December 6, 2018

PROJECT MANUAL

City of Joliet, Illinois

Eastside Wastewater Treatment Plant
Phosphorus Removal Project

IEPA Loan No. L174760
City Contract No. 2351-0219

Joliet, Illinois

Volume 3 of 3
(Division 31 to Appendix)
Bid Set

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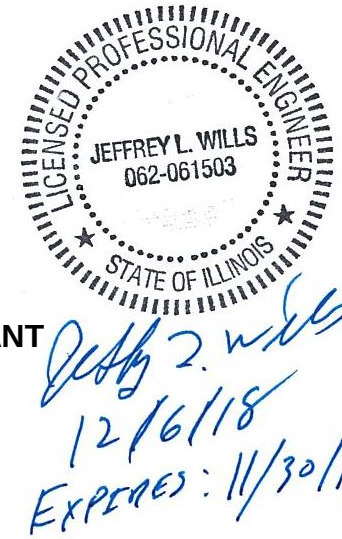
Donohue Project No.: 13320

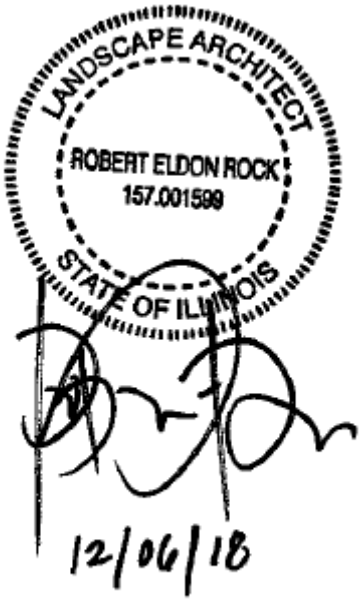
PROJECT MANUAL

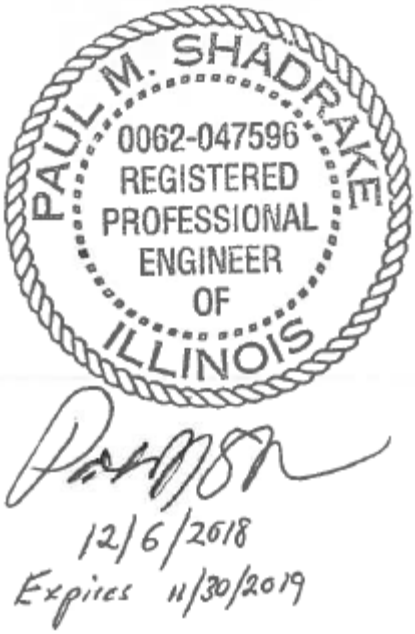
CITY OF JOLIET

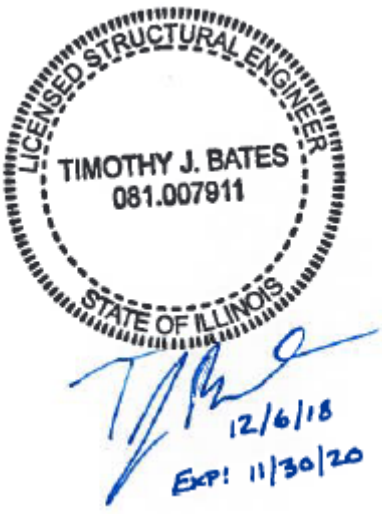
EASTSIDE WASTEWATER TREATMENT PLANT
PHOSPHORUS REMOVAL PROJECT

JOLIET, ILLINOIS









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Project No. 13320

PROJECT MANUAL
CITY OF JOLIET

EASTSIDE WWTP PHOSPHORUS REMOVAL
DESIGN AND BIDDING
IEPA LOAN NO. L174760
CITY CONTRACT NO 2351-0219

JOLIET, ILLINOIS

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DIVISION 31

EARTHWORK

SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Protection of existing surface features
2. Removal of miscellaneous surface features.
3. Clearing and grubbing of site.
4. Stripping topsoil.
5. Locating existing pipes.
6. Removal from site and disposal of stockpiled landfill material.

1.02 SUBMITTALS

A. Submit coordinates and elevation of each located underground pipe.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 PREPARATION

A. Provide a minimum of 3 working days notice, prior to construction, to owners of existing utilities and surface features.

B. Protect existing utilities and surface features indicated to remain. Restore damaged existing utilities and surface features to condition equal to condition prior to construction.

C. Protect trees, shrubs, and other land resources, where indicated to remain. Provide fencing no closer than “drip line” of trees and shrubs and of sufficient height so features will not be damaged. Comply with requirements of Section 01 57 19.

D. Do not remove or cut down trees unless identified for removal on drawings, or located within limits of excavation, proposed structures or paving as indicated on Drawings.

E. Do not trim trees unless shown on Drawings.

F. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

G. Maintain access to site.

H. Install erosion control measures prior to start of any earth-disturbing activities.

I. Do not disturb wetlands.

3.02 REMOVALS

A. Remove obstructions such as mounds of dirt, stones, or debris located within construction limits.

B. Remove surface features including pavements, curb and gutter, signs, light posts, and other miscellaneous items. Culverts, signs, mail boxes, etc. shall be replaced to original condition.

C. Full depth saw cut all pavement, sidewalk and curbing to be removed.

D. Conform to requirements of Section 01 35 16.

3.03 CLEARING AND GRUBBING

A. Clearing and grubbing shall include cutting and disposal of trees, shrubs, brush, windfalls, logs, and other vegetation, and removal and disposal of roots, stumps, stubs, grubs, logs and other timber, and other perishable or objectionable matter.

B. Clear and grub area within limits to be covered with tanks, buildings, walks, parking areas, roads, drives, and where grade is to be adjusted. Clearing and grubbing limits shall be 20 feet from building or tank lines.

C. Grub stumps and roots to a depth of at least 12 inches below existing ground surface or subgrade, whichever is lower.

D. Cut interfering tree roots and branches 1 inch or greater in diameter perpendicular to direction of growth on tree side of trench.

E. Remove cleared and grubbed material from site and dispose of in accordance with applicable regulations.

3.04 STRIPPING TOPSOIL

A. After area has been cleared of vegetation, remove existing topsoil to entire depth in areas where grade is to be adjusted and in areas to be covered by structures or paving.

B. Stripped topsoil shall be free of clay lumps, sand and gravel, stones, vegetation, and debris.

C. Stockpile on site in an area clear of new construction. Strip stockpile areas of vegetation prior to stockpiling. Provide transportation of material and sites for stockpiles if adequate areas are not available within rights-of-way shown on Drawings.

D. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage.

1. Protect from erosion.
2. Maintain stockpile free from debris and trash.
3. Immediately stabilize stockpiles and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.

E. Owner has first right to excess topsoil not used in Work. Obtain Owners approval before removing any topsoil not required for work. Remove excess topsoil not required by Owner from site.

3.05 DISPOSAL

A. Remove brush, grass, roots, trash, and other material from site preparation operations from site.

B. Do not store or permit debris to accumulate on the job site.

C. Do not burn debris at the site.

D. Dispose of materials removed by clearing and grubbing in accordance with applicable regulations.

3.06 DEMOLITION

A. Conform to Section 01 35 16.

3.07 EXPLORATORY EXCAVATION FOR EXISTING UNDERGROUND PIPING (i.e. “potholing”)

A. Prior to initiating work, Contractor shall determine exact location and elevation of underground piping and conduits at locations specified.

1. Excavate and expose top and sides of piping or conduit.
2. Locate top and outer edges of piping or conduit by surveying with equipment capable of locating each point to within 0.1 ft. accuracy.
3. Tie survey coordinate information to state plane coordinate system shown on drawings.
4. Probing to locate outer edges of piping may be permissible if exposing sides of piping would compromise the structural integrity of the piping, provided the size and invert elevation can be determined from the information available.
5. Each point to be surveyed shall consist of a set of three (3) survey points. One set of points shall consist of coordinates on each side of the pipe or conduit and the top center elevation of pipe or conduit.

B. The Contractor shall excavate the following locations. Should additional location information be needed, contact the Engineer.

1. All locations where new piping connects to existing piping.
2. All locations where new piping is shown to cross existing piping.
3. Electrical duct banks located within a 10’-0” radius of where new underground work is being performed.

C. Submit location survey information in hard copy and electronic form to Engineer. Engineer will evaluate information for its impact on proposed structures and will revise the design as required to avoid impacting the existing piping and conduits.

D. Contractor shall backfill and compact the backfill over the exposed piping and conduits in accordance with the requirements of Section 31 23 00 and/or 31 23 33 as appropriate for the location.

E. Disposal of excess soil material shall be in accordance with Section 31 22 00.

END OF SECTION

SECTION 31 22 00
GRADING

PART 1 – GENERAL

1.01 SUMMARY

A. Excavation, filling, and rough and finish grading the site to the elevations shown on the Drawings and as needed to meet the requirements of the Contract Documents.

1.02 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1-ft beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 in. below pipe or electrical duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: As defined in Section 01 22 00.

1.03 REFERENCES

A. ASTM: American Society for Testing and Materials

1.04 SUBMITTALS

A. Test Results.

1. Compaction test results.
2. Proctor test results.

B. Miscellaneous Submittals.

1. Test results to verify fill materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this section.

1.06 PROJECT / SITE CONDITIONS

A. Notify owners of above or below ground utilities encountered during grading operations.

B. Cap and remove or relocate services in accordance with instructions of owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

A. Structural Fill: Conform to requirements of Section 31 23 00.

B. Earth Fill: Natural soils free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

2.02 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than 1/2 inch, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Obtain topsoil from source stockpiled under Section 31 10 00, or provide imported topsoil obtained from sources outside the project limits, or from both sources. Stockpiled topsoil shall be screened to meet specified requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation.

B. Proof roll areas to receive fill material to detect soft or loose zones prior to placing fill. Remove and replace soft or loose zones.

C. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

D. Remove unsuitable material within influence zone under foundations, pavements, sidewalks, piping or electrical ducts.

E. Keep construction site free draining.

F. Plow, step, or bench slopes steeper than 1 vertical to 4 horizontal. Disc level surfaces.

3.03 EXCAVATION

A. Perform excavation to the lines, grades, and elevations indicated and specified herein.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Excavation of Rock:

1. Where rock, boulders, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, remove or excavate such material by means which will neither cause additional cost to the Owner and/or endanger buildings or structures on or off the site.
2. Do not use explosives without written permission from the Engineer.

D. Cut ditches and gutters accurately to the cross sections, grades, and elevations shown.

3.04 FILL USAGE

A. Structural: Within influence zone under foundations, pavements, sidewalks, piping or electrical ducts.

B. Earth: Other areas not previously specified.

3.05 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Do not operate power-operated earth moving equipment closer to foundation walls or other structures than distance equal to 1/2 height of fill above footing.

D. Place and compact fill materials in lift thickness and to densities listed.

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 3% of optimum.

Location	Maximum Lift Thickness (in.)	Modified Proctor (%)
Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Sidewalk, Crushed Aggregate Base Course, Pavement, Piping, or Electrical Duct Influence Zone	12 inches	90 minimum
Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

3.06 ROUGH GRADING

A. Grade to 4 inches below finished grade in areas to receive topsoil.

B. Grade to bottom of base course in areas to receive sidewalk or paving.

C. Rough grading, including excavated or filled sections and adjacent transition areas, shall be reasonably smooth, compacted, and free from irregular surface changes.

3.07 FINISH GRADING

A. Uniformly grade the areas within limits of grading, including adjacent transition areas, with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.

B. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8 ft, unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

C. Grade areas adjacent to buildings or structures to achieve drainage away from the structures, and to prevent ponding.

D. Maximum allowable variation from design elevation is 1 inch in 10 feet.

3.08 FIELD QUALITY CONTROL

A. Testing:

1. One field density test for each 200 cubic yards of structural fill, minimum one each lift.
2. One field density test for each 1000 cubic yards of earth fill.
3. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2922 or D2937.

3.09 ADJUSTMENT AND CLEANING

A. Remove and dispose of all unsuitable excavated material.

B. Owner has first right to excess material suitable for backfilling or site grading, not used in Work. Conform to requirements of Section 01 57 19

C. Remove excess material not required by Owner and material not suitable for backfilling or site grading from site. Excess material removed from site must be sent to landfill.

3.10 MAINTENANCE

A. Protection of Newly Graded Areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND BACKFILL

PART 1 – GENERAL

1.01 SUMMARY

A. Excavation and backfilling for structures to elevations shown on Drawings and as needed to meet requirements of Contract Documents.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1-foot beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 inches below pipe or electrical duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: As defined in Section 01 22 00.

1.04 SUBMITTALS

A. Test Results.

1. Compaction test results.

B. Miscellaneous Submittals.

1. Test results to verify fill materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1.06 PROJECT / SITE CONDITIONS

A. Notify Owners of above or below ground utilities encountered during excavation operations.

B. Cap and remove or relocate services in accordance with instructions of Owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of Owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

A. Structural Fill:

1. Well-graded sand, well-graded sand and gravel, well-graded crushed stone or gravel, or other approved material, of 2 inch maximum size, free from organic and deleterious materials.
2. Plasticity Index: ASTM D4318, 6 or less. Plasticity Index shall be performed on fraction of material that passes the No. 40 sieve.
3. Maximum Fines: ASTM D422, 10% passing No. 200 sieve.
4. Uniformity Coefficient: 5 or greater.
5. Concrete may be used as Structural Fill when approved by Engineer.

B. Flowable Fill: Lean concrete with Portland cement, fly ash, fine and coarse aggregate, foaming agent or lightweight synthetic particles, lightweight aggregate, and admixtures as required to achieve a flowable mix with a minimum compressive strength of 30 pounds per square inch and a maximum unit weight of 120 pounds per cubic foot.

C. Earth Fill: Natural soils free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

D. Free-Draining Fill:

1. ASTM C33, Size No. 67.
2. Washed crushed stone.
3. Maximum Fines: ASTM D422, 1% passing No. 200 sieve.

2.02 FILTER FABRIC

A. Porous non-woven fabric with multiple layers of randomly arranged fibers, min 4.0 ounce per square yard (typical).

B. Manufacturers:

1. Mirafi 140N by Mirafi, Inc.
2. Typar 340I by DuPont.
3. Supac 5P by Phillips Fibers Corp.
4. Propex 4545 by Amoco Fabrics Co.
5. Or Equal.

2.03 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and sole responsibility of Contractor.

2.04 SOURCE QUALITY CONTROL

A. Testing:

1. One sieve analysis, plasticity index, and uniformity coefficient for each source of structural fill.

2. One sieve analysis for each source of free-draining fill.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work, such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

B. Proof-roll and examine surfaces to receive fill and subgrades within influence zone to determine existence of soft areas, areas loosened by frost action or softened by flooding, groundwater or weather or existence of unsuitable materials.

C. Where sensitive soils are encountered, requirement for proof rolling shall be waived, and Contractor shall perform alternative field testing to determine existence of soft areas. Method of alternative testing shall be approved by Engineer.

3.02 PREPARATION

A. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation.

B. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

C. Remove unsuitable material within influence zone under foundations, pavements, sidewalks, piping or electrical ducts.

D. Remove frozen soils within influence zone.

3.03 SHEETING, SHORING, AND BRACING

A. Whenever necessary to prevent caving during excavation and to protect adjacent piping, structures, property, workers, and the public and where specifically noted herein; excavations shall be sheeted, shored, and braced.

B. When sheeting, shoring, and bracing is required, install to prevent soil from entering excavation below or through sheeting.

C. Keep sheeting, shoring, and bracing in place until structure is placed, tested, and backfilled.

D. Remove sheeting, shoring, and bracing in manner not damaging to structure or permitting voids within backfill.

E. Fill settled areas after sheeting, shoring, and bracing has been removed.

3.04 DEWATERING

A. Contractor shall dewater excavation site prior to starting excavation and shall maintain groundwater minimum of 12 inches below bottom of excavation.

B. Contractor is responsible for choosing method of groundwater control.

C. If Contractor chooses to use deep wells or well points, wells and well points shall be designed, installed, and operated to prevent removal of in-situ materials.

D. Keep construction site free-draining. Keep excavations free of water.

E. Remove soil disturbed by pressure or flow of groundwater.

F. Maintain dewatering system to prevent uplifting of or damage to structures.

G. Protect adjacent utilities, structures, and properties from damage resulting from dewatering operations.

H. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.

3.05 EXCAVATION

A. Excavate to the lines, grades, and elevations indicated and necessary to complete construction.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Over-excavate to limits noted on Drawings.

D. Protect excavated areas from freezing.

3.06 FILL USAGE

A. Structural: Within influence zone under footings and foundations, floor slabs, pavements, sidewalks, piping or electrical ducts. Provide a minimum 6 inch layer under floor slabs when subbase material is not granular in nature.

B. Flowable: Where noted.

C. Free-Draining: Where noted.

D. Earth: Other areas not previously specified.

3.07 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Place filter fabric where indicated in accordance with manufacturer’s recommendations.

D. Do not backfill until concrete is properly cured and has reached 85% of design strength, coatings approved, and required tests accepted.

E. Place fill against foundation walls enclosing interior spaces after construction such as cross-walls, beams, or slabs are in-place to brace wall and such construction has reached 85% of design strength.

F. Place fill simultaneously on both sides of free standing structures.

G. Do not operate power-operated earth moving equipment closer to foundation walls or other structures than distance equal to ½ height of fill above footing.

H. Begin compaction of each layer at structure wall to minimize lateral forces against structure due to wedging action of soil.

I. Stop backfill at specified grade to allow for placing topsoil or sidewalk or pavement subbase.

J. Place and compact fill materials in lift thickness and to densities listed.

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 3% of optimum.

Location	Maximum Lift Thickness	Modified Proctor (%)
Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Sidewalk, Pavement, Piping, or Electrical Duct Influence Zone	12 inches	90 minimum
Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

3.08 FIELD QUALITY CONTROL

A. Testing:

1. One field density test for each 25 cubic yards of structural fill, minimum one each lift.
2. One field density test for each 500 cubic yards of earth fill.
3. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2922 or D2937.

3.09 ADJUSTMENT AND CLEANING

A. Stockpile material suitable for backfill where designated by Engineer. Place no fill where trenches for sewers, water line, or other utilities will be located.

B. Remove and dispose of all unsuitable excavated material.

C. Remove excess material not required by Owner and material not suitable for backfilling or site grading from site. Excess material removed from site must be sent to landfill.

D. Conform to requirements of Section 31 22 00.

END OF SECTION

SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.01 SUMMARY

A. Trenching and backfilling to elevations shown on Drawings and as needed for installation of underground piping and utilities associated with Work and to meet requirements of Contract Documents.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: In accordance with Section 31 22 00

B. Influence Zone Under Piping or Electrical Ducts: In accordance with Section 31 22 00.

C. Unsuitable Material: As defined in Section 01 22 00.

1.04 SUBMITTALS

A. Test Results.

1. Compaction test results.
2. Proctor test results.

B. Miscellaneous Submittals.

1. Test results to verify fill materials and bedding and cover materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contactor in accordance with Section 01 45 29 and this Section.

B. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.

1.06 PROJECT / SITE CONDITIONS

A. Notify owners of above or below ground utilities encountered during trenching operations.

B. Cap and remove or relocate services in accordance with instructions of owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

F. Trenching and backfilling within influence zone of new or existing structures shall conform to the requirements of Section 31 23 00.

PART 2 – PRODUCTS

2.01 FINE AGGREGATE

A. Granular material, consisting of uniformly graded durable particles. Unwashed bank-run sand and crushed bank-run gravel may be used.

1. Gradation No. 1: IDOT Gradation FA-1 and FA-2

2. Gradation No. 2: IDOT Gradation FA-5 and FA-6

2.02 COARSE AGGREGATE

A. Hard, tough, and durable crushed stone or crushed rock.

1. Gradation No. 1: IDOT CA-11, CA-13, CA-14, CA-15 (open graded)

2. Gradation No. 2: IDOT CA-6 CA-9, CA-10 (well graded)

3. Gradation No. 3: IDOT CA-1

2.03 FILL MATERIALS

A. Structural Fill:

1. Fine Aggregate Gradation 1 or 2, Coarse Aggregate Gradation 1 or 2.

B. Excavated Trench Material:

1. Natural soils resulting from excavation of project trenches.
2. Free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

C. Flowable Fill: Lean concrete with minimum of 50 pounds of cement per cubic yard, flyash, fine and coarse aggregate, foaming agent, lightweight aggregate, and admixtures as required to achieve a flowable mix with a minimum compressive strength of 30 pounds per square inch and a maximum unit weight of 120 pounds per cubic foot.

2.04 FILTER FABRIC

A. Porous non-woven fabric with multiple layers of randomly arranged fibers, min 4.0 ounce per square yard (typical).

B. Manufacturers:

1. Mirafi 140N by Mirafi, Inc.
2. Typar 340I by DuPont.
3. Supac 5P by Phillips Fibers Corp.

4. Propex 4545 by Amoco Fabrics Co.
5. Or Equal.

2.05 DEWATERING DISCHARGE SEDIMENT CONTROL FILTER BAG

A. Any discharge from dewatering shall be discharged through a Filter Bag. The Filter Bag shall be Carthage Mills FBX 80 or approved equal.

2.06 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and sole responsibility of Contractor.

2.07 SOURCE QUALITY CONTROL

A. Testing:

1. One sieve analysis, plasticity index, and uniformity coefficient for each source and gradation of fine and coarse aggregate.
2. One sieve analysis for each source of bedding material and cover material.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

B. Remove unsuitable material from within trenches.

C. Stabilize trench bottom and replace unsuitable materials with Coarse Aggregate Gradation No. 3.

D. Where placement of coarse aggregate will not provide an adequate foundation for laying pipe due to instability of existing materials and where ordered by Engineer, place geotextile fabric on top of unstable subgrade materials prior to placing coarse aggregate. Sufficient geotextile fabric shall be used to completely enclose foundation materials and pipe.

3.03 SHEETING, SHORING, AND BRACING

A. Whenever necessary to prevent caving during excavation and to protect adjacent piping, structures, property, workers, and public, trenches shall be sheeted, shored, and braced.

B. When sheeting, shoring, and bracing is required, install to prevent soil from entering excavation below or through sheeting.

C. Remove sheeting, shoring, and bracing after backfilling, or when approved by Engineer as backfill is being placed.

D. Remove sheeting, shoring, and bracing in manner not damaging to facility or permitting voids within backfill.

E. Fill settled areas after sheeting, shoring, and bracing has been removed.

3.04 DEWATERING

A. Dewater excavation site prior to starting trenching and maintain groundwater minimum of 12 inches below bottom of trench. Dewatering system shall be of a sufficient size and capacity as required to control hydrostatic pressure on trench sides and bottom to allow material to be excavated, pipe installed and backfill placed, all in a dry condition.

B. Contactor is responsible for choosing method of groundwater control. Deep-well or wellpoint system may be required in portions of this Project. Sequence of installation of components of dewatering system shall be in accordance with the approved dewatering plan. System shall remain in continuous operation until pipe is installed and backfilled.

C. If Contactor chooses to use deep wells or well points, wells and well points shall be designed, installed, and operated to prevent removal of in-situ materials.

D. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.

E. Keep construction site free-draining. Keep trenches free of water.

F. Remove soil disturbed by pressure or flow of groundwater.

G. Maintain dewatering system to prevent uplifting of or damage to facilities.

H. Protect adjacent utilities, structures, and properties from damage resulting from dewatering operations.

I. Direct discharge of trench dewatering pumps to sediment traps before conveying to natural drainage channels or storm water drains.

3.05 EXCAVATION

A. Excavate to the lines, grades, and elevations indicated and necessary to complete construction.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Where possible, excavated materials shall be placed in areas that will not block existing vehicle and pedestrian traffic and drainageways.

D. Conduct excavating operations to carefully expose all in-place underground structures without damage. Wherever excavation extends under or approaches close to an existing structure, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Use hand excavation methods to probe for and expose such critical or hazardous installations as gas pipe and power or communication cables.

E. Trench Tolerances:

1. Maximum width of trench at top of pipe shall be outside diameter of pipe plus 24 inches. When sheeting, shoring, and bracing required, width of trench may be increased to allow for their use, provided provisions for excess width of trench are met.
2. Where trench width below top of pipe exceeds specified limit, Contactor, at his expense, shall furnish pipe with strength adequate for actual trench width.
3. Minimum trench width shall be outside diameter of pipe plus 18 inches
4. Top of concrete encasement for electrical duct or top of conduit shall be minimum of 24-inches below final grade or as shown on Drawings.
5. Trench width at ground surface shall be the minimum allowable based on OSHA standards and soil types.

F. Do not advance excavation of trenches more than 100 feet ahead of completed pipe installation.

G. Do not excavate within influence zone of existing footings or foundations without prior approval of Engineer.

H. Excavation through Rigid Pavement:

1. Remove pavement a minimum of 1 foot beyond anticipated edge of excavation.
2. Saw cut pavement to ensure straight joint.
3. Pavement replacement shall match existing.

I. Excavation, backfill, and pavement replacement of roadways shall conform to requirements of local highway authority. In no case shall the replacement pavement edges bear on less than 12 inches of undisturbed soil.

3.06 FILL USAGE

A. Bedding Material:

1. PVC, HDPE, Copper, Fiberglass or Reinforced Plastic Pipe, and Electrical Conduit or Ducts: Fine aggregate gradation No. 1.
2. Other Pipe 18-inch diameter or less: Coarse aggregate gradation No. 1.
3. Other Pipe over 18-inch diameter: Coarse aggregate gradation No. 2.

B. Bedding Material Limits:

1. Electrical Ducts:

a. Hand grade bottom of trench to established uniform grade of not less than 4 inches / 100 feet.
b. Use bedding material to bring grade to desired elevation.

2. Bedding material shall be placed over entire width of trench bottom such that after pipe has been placed thereon, imbedded to grade and aligned, there remains a 6 inch minimum depth of material below pipe barrel and a minimum of 5 inches below the bell.
3. Bell holes shall be excavated so that entire pipe barrel rests on bedding.

C. Cover Material:

1. Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: Fine aggregate gradation No.1.
2. Other Piping: Fine aggregate gradation No. 2.
3. Electrical Ducts: Structural Fill or Excavated Trench Material.
4. Bedding material may be substituted for cover material.

D. Cover Material Limits:

1. Electrical Conduit: Minimum 6 inches above and 9 inches each side.
2. Piping: Minimum of 12 inches above top of pipe and 12 inches each side.

E. Structural Fill: Within trenches under pavements and sidewalks and within piping, electrical duct or structure influence zone.

F. Excavated Trench Material: Other areas not previously specified.

G. Flowable Fill: Where noted.

3.07 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Place filter fabric where indicated in accordance with manufacturer's recommendations.

D. Do not backfill until concrete is properly cured and has reached design strength, coatings approved, and required tests accepted.

E. Place fill simultaneously on both sides of freestanding structures.

F. Where pipes leave structures, protect by backfilling pipe influence zone down to undisturbed soil with bedding material.

G. Where pipes or electrical ducts cross, protect piping or ducts at higher elevation by backfilling trench within influence zone of higher pipe or duct with structural fill.

H. Where pipes or electrical ducts leave structures, protect by backfilling within influence zone of pipe or duct with structural fill.

I. Provide mechanical compaction. Jetting, flooding, puddling, or vibroflotation methods shall not be used for compaction.

J. Place and compact bedding, cover and fill materials in lift thickness and to densities listed below:

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 3% of optimum.

Location	Maximum Lift Thickness	Modified Proctor (%)
Bedding Material or Cover Material	6 inches	90 minimum
Fill material under Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Fill material under Sidewalk, Pavement, Crushed Aggregate Base Course, Piping, or Electrical Duct Influence Zone	12 inches	90 minimum
Fill material under Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

3.08 FIELD QUALITY CONTROL

A. Testing:

1. Trench Backfill Material – Depth of Cover Less than 14 feet: Take two tests every 100 feet of trench. Test when trench has been backfilled halfway and when trench has been completely backfilled.
2. Trench Backfill Material – Depth of Cover Equal to or Greater than 14 feet: Take three tests every 100 feet of trench. Test when trench 1/3 and 2/3 backfilled and when completely backfilled.
3. Recompact and retest areas of backfill tested that did not meet minimum requirements.

3.09 ADJUSTMENT AND CLEANING

A. Stockpile material suitable for backfill where designated by Engineer. Place no fill where trenches for sewers, water line, or other utilities will be located.

B. Remove and dispose of all unsuitable excavated material.

C. Owner has first right to excess material suitable for backfilling or site grading, not used in Work. Conform to the requirements of Section 01 57 19.

D. Remove excess material not required by Owner and material not suitable for backfilling or site grading from site. Excess material removed from site must be sent to landfill.

E. Conform to requirements of Section 31 22 00.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL AND SITE STABILIZATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section describes the requirements for control of erosion on construction sites. The CONTRACTOR shall provide the necessary materials, equipment, and labor to control erosion by the methods specified herein. If no specific quantities are shown on the Plans, the CONTRACTOR shall use whatever quantities are necessary to prevent sediment transport into adjacent storm water conveyances or streams.

B. The CONTRACTOR shall submit for approval by the ENGINEER an Erosion Control Plan as required in this Section for accomplishing temporary and permanent erosion control, prior to beginning any construction on the Project.

C. The CONTRACTOR shall not begin work until after initial erosion and sediment control devices are in place and approved by the ENGINEER.

D. CONTRACTOR shall comply with erosion control procedures listed on the plans and the contents of this Section.

1.02 REGULATORY REQUIREMENTS

A. Since the project will disturb more than 1 acre of land a Stormwater NPDES Permit is needed. The CONTRACTOR shall prepare and comply with Stormwater Pollution Prevention Plan (SWPPP) described below.

B. The following laws, regulations and guidelines apply to the erosion and sedimentation control requirements described in this Section.

1. Illinois Law: 415 ILCS 5/13(b)(1)
2. Federal Code: 40 CFR 122.26
3. Federal Code: 40 CFR 122.21
4. Federal Code: 63 FR 15630-15634
5. USEPA Summary Guidance Document 833-R-92-001
6. EPA Illinois Urban Manual (1995 or most current edition)

1.03 STORMWATER POLLUTION PREVENTION PLAN SUBMITTAL

A. The Contractor shall prepare a Stormwater Pollution Prevention Plan (SWPPP) for the Project as required IEPA regulations. The Engineer has prepared erosion and sediment control plans as part of the plan set, which the Contractor may use in preparation of the SWPPP. Contractor shall comply with said plan and fully execute it in accordance with IEPA regulations, in order to minimize the discharge of pollutants in storm water. Provide Engineer and Owner with copies of inspection reports upon demand.

1.04 DEFINITIONS

A. IDOT: Illinois Department of Transportation Standard Specifications Current Edition including all addenda

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural loam surface soil, reasonable free of subsoil, clay lumps, brush, weeds, and free of roots, stumps, stones larger than two inches in any dimension, and other matter harmful to plant growth. Topsoil to supplement insufficient topsoil on the site shall originate from local sources, but not from bogs or marshes.

2.02 LIME

A. Lime used for soil amendment shall be agricultural grade limestone, ground sufficiently fine so that 80% passes a No. 8 sieve. Lime shall contain 80% calcium carbonate equivalent. Moisture shall not exceed 10%.

2.03 FERTILIZER

A. Fertilizer used in conjunction with seeding shall be dry, free-flowing granular fertilizer suitable for application by agricultural fertilizer spreaders or blower equipment, or non-volatile liquid commercial fertilizer, having an analysis of 20-10-10 (Nitrogen-Phosphoric Acid-Potash), or approved equal. Fertilizer having other analysis shall be applied at a rate to achieve at least the individual following amounts of nutrient per unit area:

Nutrient	Per Acre	Per 1,000 Square Feet
Nitrogen (N)	100 pounds	2.3 pounds
Phosphoric Acid (P_2O_5)	50 pounds	1.2 pounds
Potash (K_2O)	50 pounds	1.2 pounds

2.04 GRASS SEED

A. Grass seed shall be delivered to the site in bags, tagged, or labeled to show the percentage of purity and germination. The seed shall have been tested by a recognized seed-testing laboratory within one year prior to the date of seeding and shall conform to the latest laws of the U.S. and the State of Illinois. Upon request, the CONTRACTOR shall furnish to the ENGINEER copies of the test results. Seed mixtures shall consist of the following percentages of various varieties of grass seed, each of which shall have the designated minimum percent purity and germination.

Mixture No.	1	% Purity	% Germ.
Kentucky Bluegrass (2 types)	40%	85%	80%
Chewings Fescue	10%	97%	80%
Perennial Ryegrass	10%	95%	90%
Tall Fescue Blend (3 types)	40%	97%	85%

2.05 STRAW OR HAY MULCH

A. Unless otherwise specified mulch shall be straw or hay, reasonably free of grain, weed seed, and mold. Mulch materials shall not contain excessive moisture that might prevent feeding through a mulch blower machine. Wood cellulose fiber may be used only upon approval by the ENGINEER.

2.06 ASPHALT EMULSION

A. Asphalt emulsion used to anchor mulch shall meet the requirements of AASHTO M140, Type SS-1, emulsified asphalt.

2.07 JUTE NETTING

A. Jute netting shall be uniform, open, plain weave of undyed and unbleached single jute yarn. The yarn shall be of a loosely twisted construction, and shall not vary in thickness by more than one-half of its normal diameter. Jute netting shall be furnished in rolled strips, approximately 50 yards in length. Netting width per strip shall be 48 inches. The strip shall weigh 0.92 pounds per square yard.

2.08 NYLON SOIL REINFORCEMENT MATTING

A. Nylon soil reinforcement matting for use under seeded surfaces shall be American Enka Company "Enkamat", or equal.

2.09 FILTER FABRIC

A. Filter fabric shall be ultraviolet stabilized.

B. Manufacturers shall be Mirafi 140N (manufactured by Dominion Textile Company), Supac 5NP, or pre-approved equal.

2.10 STRAW BALE EROSION BARRIERS – NOT APPROVED

2.11 STORM INLET PROTECTION

A. Storm inlets, curb inlets, catch basins and area drains shall be provided with inlet protection to prevent intrusion of sediment and soils into the existing storm conveyance systems. Provide said protection where indicated on the Drawings. Curb inlet protection shall be SedCatch curb inlet protectors as manufactured by Erosion Runner (www.erosionrunner.com) or equivalent. Curb inlet protection shall be constructed of red and black weave polypropylene geotextile fabric, 6.2 oz per SY, and provided with a tube assembly that protects the face of the inlet from debris entry. Said material shall have UV resistance after 500 hours of exposure.

B. Place inlet protection over each inlet indicated on the Drawings to be provided with inlet protection. Where double curb inlets exist, provide the SedCatch Double Curb & Gutter Inlet protector designed specifically for that application.

2.12 SEDIMENT LOGS

A. Sediment logs shall be American Excelsior Curlex or equal. Unit length shall be 10 ft or as called out on the drawings. Density of sediment logs shall not exceed 2.6 lb/CF. Provide Type II (12” diameter) unless called out otherwise on the Drawings.

PART 3 – EXECUTION

3.01 Erosion Control Requirements

A. Water pumped from the site shall be treated by temporary sedimentation basins, grit chambers, sand filters, upslope chambers, hydro-cyclones, swirl concentrators, or other appropriate controls designed and used to remove particles of 100 microns or greater for the highest dewatering pumping rate. If the water is demonstrated to have no particles greater than 100 microns during dewatering operations, then no control is needed before discharge. Water may not be discharged in a manner that causes erosion of the site or receiving channels.

B. The CONTRACTOR shall take all possible precautions to prevent sediment from being tracked onto public or private roadways. Any sediment reaching a public or private road shall be removed by street cleaning (not flushing) before the end of each workday.

C. All storm drain or culvert inlets shall be protected with sediment control fence or equivalent barrier approved by the ENGINEER. Channelized runoff from adjacent areas passing through the site shall be diverted around disturbed areas, if practical. Otherwise, the channel shall be protected. Street flow runoff from adjacent areas greater than 10,000 square feet in area shall also be diverted around disturbed areas, unless shown to have resultant runoff velocities of less than 0.5 ft / sec across the disturbed area for one year design storms having aduration of from 0.5 to 24 hours. Diverted runoff shall be conveyed in a manner that will not erode the conveyance and receiving channels. (Note: Soil and Conservation Service Guidelines for allowable velocities in different types of channels should be followed).

D. All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at any one time.

E. All disturbed ground left inactive for seven or more days shall be stabilized by seeding or sodding (only prior to October 15) or by mulching or covering, or other equivalent control measure.

F. For sites with less than 10 acres disturbed at one time, sediment control fences or equivalent control measures shall be placed along all sideslope and downslope sides of the site. If a channel or area of concentrated runoff passes through the site, sediment control fences shall be placed along the channel edges to reduce sediment reaching the channel.

G. Any soil or dirt storage piles containing more than 10 cubic yards of material should not be located with a downslope drainage length of less than 25 feet to a roadway or drainage channel. If remaining for more than seven days, they shall be stabilized by mulching, vegetative cover, tarps, or other means. Erosion from piles which will be in existence for less than seven days shall be controlled by placing sediment control fence barriers around the pile. In-street utility repair or construction soil; or dirt storage piles located closer than 25 feet to a roadway or drainage channel must be covered with tarps or a suitable alternative control must be used if exposed for more than seven days. Storm drain culvert inlets must be protected with filter logs or other appropriate filtering barriers.

3.02 IMPLEMENTATION OF THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

A. Site Inspections: The SWPPP shall be implemented as required by this section. CONTRACTOR shall complete and document site inspections at least weekly and within 24 hours after 0.5 inch or greater rainfall.

B. SWPPP Revisions: The SWPPP shall be revised as necessary as soon as practicable following an inspection. Any plan modifications shall be implemented within 7 calendar days following discovery. That Contractor submit to the ENGINEER on an on-going basis the revised project schedules, alternate erosion control details, material data sheets, and

locations of specific erosion control measures not explicitly indicated by this Plan**,** as construction activities progress throughout the project. The Contractor's erosion control implementation submittals will be reviewed by the ENGINEER and the Owner and will be incorporated into the SWPPP as needed.

3.03 SEEDING

A. Seeding, where used for erosion control during construction prior to permanent seeding, shall be of the mixture required for the nearest permanent grass, as listed in the table below. Seed types, which would be considered weeds in such finished nearby areas, shall not be used.

B. If the CONTRACTOR intends to seed for both erosion control and restoration, he shall follow the instructions in Section 32 92 00 of these specifications, in other applicable sections, or in the Special Conditions.

C. Fertilizer shall be applied with a hydroseeder, power-drawn drill or spreader, or blower equipment either separately from, or concurrently with, the grass seed. Fertilizing shall not be done with “broadcast”-type equipment during windy weather, not at all when the ground is frozen or excessively moist. Fertilizer shall be applied at the rates specified in Part 2 of this Section of the Specifications.

D. The CONTRACTOR shall apply the seed using a hydroseeder, a power-drawn drill or spreader, or approved blower equipment with an adjustable disseminating device capable of maintaining a constant measurement rate of material discharge that will ensure an even distribution of seed and fertilizer. Seed mixture shall be applied at the following rates:

Seed Mixture	Common Usage	Application Rate
No. 1	Level residential lawns	5 lbs. / 1,000 sq. ft.

E. Seedbeds shall be maintained in a moist growing condition. When necessary, the CONTRACTOR shall soak the seedbed by sprinkling with water.

3.04 APPLICATION OF STRAW OR HAY MULCH

A. The CONTRACTOR shall furnish, haul, and evenly apply straw or hay mulch at a rate not less than 1½ tons per acre to a loose depth of one or two inches. The mulch spreading equipment shall utilize forced air to blow mulch material onto the seeded area, unless otherwise approved by the ENGINEER.

B. Unless otherwise designated, the CONTRACTOR shall anchor the straw or hay mulch by the following method:

1. Disk Crimped. Cutting into the soil with notched edges of a weighted disc so that the mulch is partially embedded in the soil.

3.05 PLACING PAPER EROSION CONTROL FABRIC AND NETTING

A. The manufacturer shall supply installation instructions. The CONTRACTOR shall install the fabric and netting in accordance with the manufacturer’s recommendations.

B. The fabric netting shall be unrolled and draped loosely, without stretching, so that continuous ground contact is maintained. In ditches, fabric shall be unrolled and applied parallel to the direction of drainage. On slopes, fabric shall be applied parallel to the slope direction.

C. In ditches and on slopes, each upslope and each downslope end of each piece of fabric netting shall be placed in a four-inch trench, stapled on 12-inch centers, backfilled and tamped. Where one roll ends and a second roll starts, the upslope piece shall be brought over the end of the downslope roll so that there is a 12-inch overlap, placed in a 4-inch trench, stapled on 12-inch centers, backfilled and tamped.

D. On slopes, where two or more widths of fabric netting are applied, the two edges shall be overlapped according to the manufacturer's installation instructions and stapled at 18- to 24-inch intervals along the exposed edge of the lap joint. The body of the fabric shall be stapled in a grid patter with staples three feet on center each way.

E. Where heavy concentrations of water or extremely erodible soil conditions exist, as noted on the Plans, erosion checks shall be installed at intervals of 50 feet or less. Such a check shall consist of a four-inch deep trench perpendicular to the flow direction across the entire width of the fabric. The fabric shall be stapled at nine-inch intervals along the bottom of the trench across the entire width of the fabric. The trench shall then be backfilled and tamped.

F. If staples become loosened, or if any fabric loosens, is torn, or undermined, repairs shall be made immediately without additional compensation.

G. Paper erosion control fabric and netting, when used in conjunction with fertilizing and seeding done for surface restoration, shall be installed immediately after fertilizing and seeding operations have been completed. Straw or hay mulch shall not be used under the fabric.

3.06 INSTALLING NYLON SOIL REINFORCEMENT MATTING

A. Nylon soil reinforcement matting shall be installed according to the manufacturer's recommendations. If this method of erosion control is to be used in conjunction with fertilizing and seeding done for surface restoration in the same area, the matting shall be placed prior to fertilizing and seeding operations. The matting shall be unrolled and draped loosely, without stretching, so that continuous ground contact is maintained. The peaked side of the matting shall be placed down, against the soil. On slopes, the matting shall be applied parallel to the slope direction. Where multiple strips of widths are used, the matting shall be lapped and stapled, as specified in Subsection 3.03 above except that the overlap width shall not be less than three inches.

B. If any staples become loosened or raised, or if any matting comes loose, is torn, or is undermined, satisfactory repairs shall be made immediately without any additional compensation.

3.07 CONSTRUCTION OF SEDIMENT CONTROL FENCE

A. Reference IDOT Specification Article 280.

B. Provide silt fence in the locations shown on the drawings and as needed to contain soils on site.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 – GENERAL

1.01 SUMMARY

A. Provide crushed aggregate base course where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 DEFINITIONS

A. IDOT Specs: Illinois Department of Transportation Standard Specification, latest edition

B. ASTM: American Society for Testing and Materials

C. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Source of Aggregates

C. Test Results of Quality Assurance Testing

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Perform the following testing:

1. Aggregate Gradation in accordance with AASHTO T 27

B. Test Aggregate Gradation during placement at or above the following frequency:

Total Daily Placement per gradation for Contract (tons)	Samples per Day
50 - 600	1
601 to 1500	2
Greater than 1501	3

PART 2 – PRODUCTS

2.01 PAVEMENT MATERIALS

A. Aggregate:

1. Furnish aggregate from local Department of Transportation approved sources.
2. Conform to IDOT CA-6 for gradation requirements.

PART 3 – EXECUTION

3.01 PREPARATION

A. Check subbase for soundness, outline, and contour. Prepare areas for base course placement on subbase by scraping down or filling irregularities. Compact subbase prior to basecourse placement.

B. Proof roll the prepared subbase. Make multiple passes to test entire area. Remove and replace areas where displacement in base (yielding, heaving, cracking or other signs of instability), in the opinion of the Engineer, is more than 1 inch under a fully-loaded tandem-axle dump truck. Excavate and backfill displaced areas with new base course material, compact, and retest. Do not begin placement of base course until deficient areas have been corrected.

C. Remove excess material not required by Owner, material not suitable for backfilling or site grading, and unsuitable materials from site. Dispose of excavated material in accordance with local, state, and federal requirements.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles such that there is no damage to existing streets, subgrade, or base course.

B. Owner has final authority to designate haul routes, procedures, and operation times

3.03 INSTALLATION

A. Construct aggregate base course in two or more layers of approximately equal thickness.

B. Maximum compacted thickness of each layer shall not exceed 6 inches. Total thickness shall be as shown on the Drawings.

C. Deposit material on foundation or previously placed layer to minimize segregation and facilitate spreading to uniform layer.

D. Compact after each layer has been placed and spread to thickness, width, and contour to 95% of maximum density (Modified Proctor), in accordance with ASTM D-1557, before succeeding layer is placed.

3.04 FIELD QUALITY CONTROL

A. Check in-place base course for surface irregularities and repair unacceptable areas.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Provide asphalt pavement where shown on Drawings, as specified herein, and as needed for a complete and proper installation.

B. Provide pavement parking striping where shown on the Drawings and as specified herein.

1.02 DEFINITIONS

A. IDOT Specifications: Illinois Department of Transportation Standard Specification, latest edition

B. ASTM: American Society for Testing and Materials

C. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Source of Aggregates showing use on previous local Department of Transportation Projects.

C. Asphalt Mix Design, including aggregate gradation, showing use on previous local Department of Transportation Projects.

D. Test Results of Quality Assurance Testing

E. Submit in accordance with Section 01 33 00.

F. Submit identification of pavement striping subcontractor and IDOT certification of approval as specified herein,

1.04 QUALITY ASSURANCE

A. Asphalt supplier shall have a minimum of 5 years of experience producing asphalt mixes for the Department of Transportation.

B. Do not commence placement of asphalt until mix design has been reviewed and approved by Engineer.

C. Epoxy pavement markings hall only be applied by Contractors who are on IDOT's list of approved Contractors maintained by IDOT's Engineer of Operations and in effect on the date of Invitation to Bid.

D. Perform the following testing during asphalt mix production and placement:

1. Aggregate Gradation in accordance with AASHTO T 27
2. Asphalt Content.
3. Air Voids by calculation in accordance with AASHTO T 269.
4. Voids in Mineral Aggregate (VMA) by calculation in accordance with AASHTO R 35.

PART 2 - PRODUCTS

2.01 PAVEMENT MATERIALS

A. Aggregate:

1. Furnish coarse aggregate from local Department of Transportation approved sources.

2. Aggregate for Bituminous Base:

a. Sound, angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings.
b. Uncrushed gravel may be used in base course mixture if required to suit local material availability.
c. Gradation: Well graded between limits specified and shall conform to IDOT Specs Article 1004.04, Type A, Gradation CA 6.

3. Aggregate for Bituminous Binder:

a. Sound, angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings.
b. Gradation: Well graded between limits specified and shall conform to IDOT Specs Article 1004.03 for HMA Binder Course, IL-19.0.

4. Aggregate for Bituminous Surface:

a. Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.
b. Sand prepared from stone, blast-furnace slag, gravel, or combinations thereof may be used if required to suit local material availability.
c. Gradation: Well graded between limits specified and shall conform to IDOT Specs Article 1004.03 for HMA Surface Course, IL-9.5.

5. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D242.

B. Bituminous Materials:

1. Asphalt Cement: Penetration Grade PG 64-22 in accordance with ASTM D946.

C. Mix Design:
1. Conform to IDOT Specs Section 1030
2. Mixture type: HMA Binder Course, IL-19.0 and HMA Surface Course, IL-9.5.

D. Tack Coat

1. Tack Coat: Emulsified asphalt meeting the one of the following Types per AASHTO M 140: AE-T, AE-PMT, SS-1h

E. Recycled Asphalt Pavement

1. Stockpile recycled asphalt pavement separately from virgin materials and list each as individual job mix formula components.

2. Conform to the following maximum allowable percent binder replacement (ratio of recovered binder to total binder):

a. Lower Layer: 35%
b. Upper layer: 25%

2.02 PAVEMENT STRIPING AND MARKINGS

A. Parking striping and pavement markings shall be epoxy pavement markings complying with Section 1095.04 of the IDOT Standard Specifications. Pavement markings and striping shall be white or yellow as approved by the Owner. Reflective glass beads are not required. The epoxy shall be applied at a minimum thickness of 20 mils.

PART 3 - EXECUTION

3.01 WEATHER LIMITATION

A. Apply tack coat when ambient temperature is above 35 degrees Fahrenheit. Do not apply when base is wet or contains standing water.

B. Place asphalt material when atmospheric temperature is above 35 degrees Fahrenheit and rising, and when base is dry.

C. Do not place asphalt material on frozen subgrade or base.

3.02 PREPARATION

A. Check base course for soundness, outline, and contour. Prepare base course for areas to be paved by scraping down or filling irregularities. Compact base course prior to paving.

B. Proof roll prepared aggregate base course to check for unstable areas and areas requiring additional compaction. Make multiple passes to test entire area to be paved. Remove and replace any area where displacement in base (yielding, heaving, cracking or other signs of stability), in opinion of Engineer, is more than 1 inch under a fully-loaded tandem-axle dump truck. Excavate and backfill displaced area with new base material, properly compacted and retested. Do not begin paving work until deficient areas have been corrected.

D. Tack Coat:

1. Apply to contact surfaces of previously paved surfaces abutting or projecting into areas to be paved.
2. Apply to surface free of loose dirt, dust or other foreign matter.
3. Apply at rate not less than 0.05 lb / ft^2
4. Apply only to areas expected to be paved in the same day.
5. Allow to dry prior to paving.

6. Avoid tracking or smearing bituminous materials onto adjoining surfaces. Remove material tracked or smeared to adjoining surfaces.

3.03 DELIVERY, STORAGE, AND HANDLING

A. Transport asphalt materials in covered trucks during rainy weather and when air temperature falls below 65 degrees F.

B. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles such that no damage results to existing streets, subgrade, or base course.

C. Owner has final authority to designate haul routes, procedures, and operation times.

3.04 PLACING ASPHALT MIX

A. Place asphalt mixture on prepared surface, spread, and strike-off. Spread mixture at a temperature within 20 degrees Fahrenheit of temperature the asphalt material supplier recommends.

B. Place using a self-propelled paver to ensure uniform spreading and strike-off of mix. Provide a smooth mixture free of tearing and segregation. Place mixture to required grade, cross-section, and compacted thickness.

C. Place inaccessible and small areas by hand. Place mixture to required grade, cross-section, and compacted thickness.

D. Joints: Place asphalt continuously to limit the number of joints. Make joints between old and new pavements and between successive days' work, to ensure continuous bond between adjoining work. Clean contact surfaces and apply tack coat. Construct joints to have same texture, density, and smoothness as other sections of asphalt pavement.

3.05 COMPACTION

A. Compact asphalt mix while still hot. Compact each layer by uniformly rolling.

B. In small areas not accessible by a roller, compact using mechanical tampers.

C. Compact until no further consolidation is visible under action of the compaction equipment.

D. Keep roller wheels moistened to avoid sticking.

3.06 FIELD QUALITY CONTROL

A. Pavement Testing:

1. General: Test in-place asphalt courses for compliance with requirements for surface smoothness and thickness. Repair or remove and replace unacceptable paving.

1. Thickness Tolerance: In-place compacted thickness will not be acceptable if actual thickness exceeds the following allowable variation from required thickness:

a. Binder Course: 1/4 inch.
b. Surface Course: 1/8 inch.

3. Surface Smoothness Tolerances: Test finished surface of each asphalt concrete course for smoothness, using 10’ straight edge applied parallel with, and at right angles to, the centerline of paved area. Surfaces will not be acceptable if deviations exceed 1/8 inch.

END OF SECTION

SECTION 32 12 18
EMULSIFIED MALTENE-BASED REJUVENATOR

PART 1 - GENERAL

1.01 SUMMARY

A. This work shall consist of furnishing all labor, material and equipment necessary to perform all operations for the application of an Emulsified Maltene-Based Asphalt Rejuvenating agent to bituminous asphaltic concrete surface courses.

B. The rejuvenation of surface courses shall be by spray application of a cationic Maltene-Based Rejuvenating Agent composed of petroleum oils and resins emulsified with water. The base used for the emulsion shall be naphthenic. All work shall be in accordance with the specifications, and any applicable drawings.

1.02 DEFINITIONS

A. IDOT Specifications: Illinois Department of Transportation Standard Specification, latest edition

B. ASTM: American Society for Testing and Materials

C. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. The CONTRACTOR shall present samples of materials, laboratory reports, calibration reports, and proof of work experience as required by these specifications prior to the start of construction.

C. Test Results of Quality Assurance Testing

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Material Performance: The rejuvenating agent shall have record of at least two years of satisfactory service as asphalt rejuvenating agent and in-depth sealer. Satisfactory service shall be based on the capability of the material to penetrate, replace lost maltene fractions, and decrease the viscosity and increase the penetration value of the in-place asphalt binder as follows; the viscosity shall be reduced by a minimum of forty-five (45) percent, the penetration value shall be increased by a minimum of twenty-five (25) percent. Testing shall be performed by an independent testing laboratory on extracted asphalt cement from pavement to a depth of three-eighths inch (3/8”). In addition, the pavement shall be in-depth sealed to prevent the intrusion of air and water.

B. The bidder must submit in shop drawings:

1. Asphalt Rejuvenator product name and descriptive literature. Literature shall be descriptive and detailed information and shall show it at least meets the material specifications.

2. The asphalt rejuvenating agent shall be applied by an experienced applicator of such material. The bidder shall have a minimum of 5 years experience in applying the product proposed for use on municipal streets. The Contractor must submit with his bid a list of five (5) projects on which he applied said rejuvenator. He shall indicate the project dates, number of square yards treated in each and the name and phone number of the manager in charge of each project.

3. A project superintendent knowledgeable and experienced in application of the asphalt rejuvenating agent must be present and in control of each day's work. The bidder shall submit in the show drawing a written experience outline of the project superintendent.

PART 2 - PRODUCTS

2.01 EMULSIFIED MALTENE-BASED REJUVENATOR

A. Product shall be:

a. "Reclamite"® produced by Tricor Refining, LLC
b. Or Engineer Approved Equal

B. The emulsion will be a naphthenic maltene-based rejuvenating agent composed of four maltene components (listed below) uniformly emulsified with water.

PART 3 – EXECUTION

3.01 APPLICATION

A. Apply emulsion per the manufacturer's recommendations
B. If pavement is new, apply a minimum of 6 months after pavement installation.

NAPHTHENIC MALTENE-BASED ASPHALT REJUVENATOR SPECIFICATIONS:

Property	Test Method ASTM	Requirements Min.	Max.
Viscosity @ 25°C, SFS	D244	15	40
Residue, w%	D244 (Mod)3	60	65
Miscibility Test	D244 (Mod.)2	Pass	
Sieve Test, w%	D244(Mod.)1	-	0.1
Particle Charge Test	D244	Positive	
Tests on Distillation Residue:			
Flash Point, COC, C	D92	196	-
Viscosity@ 60C, C	D2170	100	200
Asphaltenes, %w	D2006-70	-	1.00
Maltene Dist. Ratio (Polar Compounds) + (First Acidaffins) (Saturates) + (Second Acidaffins)	D2006-70	0.3	0.6
Polar Compounds/Saturates Ratio	D2006-70	0.5	
Asphaltenes, w%	D2006-70		1.0
Saturated Hydrocarbons, w%	D2006-70	21	28

1 - Test procedure identical with ASTM D-244 except that distilled water shall be used in place of two (2) percent sodium oleate solution.

2 - Test procedure identical with ASTM D-244 except that .02 Normal Calcium Chloride solution shall be used in place of distilled water.

3 - ASTM D-244 Modified Evaporation Test for percent of residue is made by heating 50 gram sample to 149 C (300 F) until foam ceases, then cool immediately and calculate results.

PART 3 - EXECUTION

3.01 APPLICATION TEMPERATURE AND WEATHER LIMITATIONS

A. The temperature of the asphalt rejuvenation emulsion, at the time of application shall be as recommended by the manufacturer.

B. The asphalt rejuvenating agent shall be applied only when the existing surface to be treated is thoroughly dry.

C. The asphalt rejuvenating agent shall not be applied when the ambient temperature is below 40 degrees Fahrenheit or when temperatures are forecasted to fall below 35 degrees Fahrenheit within twenty-four (24) hours of application.

D. It shall be the discretion of the Engineer to determine when weather conditions are not appropriate for the application to occur. Contractor shall halt the application process when so ordered by the Engineer.

3.02 HANDLING OF ASPHALT REJUVINATING AGENT

A. Contents in tank cars or storage tanks shall be circulated at least forty-five minutes before withdrawing any material for application.

B. When loading the distributor, the asphalt rejuvenating agent concentrate shall be loaded first and then the required amount of water shall be added. The water shall be added into the distributor with enough force to cause agitation and thorough mixing of the two (2) materials. To prevent foaming, the discharge end of the water hose or pipe shall be kept below the surface of the material in the distributor which shall be used as a spreader.

C. The distributor truck will be cleaned of all of its asphalt materials, and washed out to the extent that no discoloration of the emulsion may be perceptible. Cleanliness of the spreading equipment shall be subject to inspection and the Contractor shall halt the application process when so ordered by the Engineer.

3.03 APPLICATION EQUIPMENT

A. The distributor for spreading the emulsion shall be self- propelled, and shall have pneumatic tires. The distributor shall be designed and equipped to distribute the asphalt rejuvenating agent uniformly on variable widths of surface at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard of surface, and with an allowable variation from any specified rate not to exceed five (5) percent of the specified rate.

B. Distributor equipment shall include full circulation spray bars, pump tachometer, volume measuring device and a hand hose attachment suitable for application of the emulsion manually to cover areas inaccessible to the distributor.

C. The distributor shall be equipped to circulate and agitate the emulsion within the tank. A check of distributor equipment as well as application rate accuracy and uniformity of distribution shall be made when directed by the Engineer.

D. The truck used for sanding shall be equipped with a spreader that allows the sand to be uniformly distributed onto the pavement. The spreader shall be able to apply % pound to 3 pounds of sand per square yard in a single pass. The spreader shall be adjustable so as to not broadcast sand onto driveways or tree lawns.

E. Any wet sand shall be rejected from the job site.

F. Any equipment which is not maintained in full working order, or is proven inadequate to obtain the results prescribed, shall be repaired or replaced at the direction of the Engineer.

3.04 APPLICATION OF REJUVINATION AGENT

A. Notify Owner at least 48 hours before applying rejuvenation agent.

B. The asphalt rejuvenating agent shall be applied by a distributor truck at the temperature recommended by the manufacturer and at the pressure required for the proper distribution.

C. The emulsion shall be so applied that uniform distribution is obtained at all points of the areas to be treated.

D. Distribution shall be commenced with a running start to insure full rate of spread over the entire area to be treated.

E. Areas inadvertently missed shall receive additional treatment as may be required by a hand sprayer application.

F. Application of the asphalt rejuvenating agent shall be on one-half width of the pavement at a time. When the second half of the surface is treated, the nozzle nearest the center of the road shall overlap the previous by at least one-half the width of the nozzle spray. In any event the construction joint of the pavement shall be treated in both passes of the distributor truck.

G. Before spreading, the asphalt rejuvenating agent shall be blended with water at the rate of two (2) parts rejuvenating agent to one (1) part water, by volume or as specified by the manufacturer.

H. The combined mixture of asphalt rejuvenating agent and water shall be spread at the rate of 0.05 to 0.10 gallons per square yard, or as approved by the Engineer following field testing.

I. Where more than one application is to be made, succeeding applications shall be made as soon as penetration of the preceding application has been completed and approval is granted for additional applications by the Engineer.

J. Grades or super elevations of surfaces that may cause excessive runoff in the opinion of the Resident Engineer shall have the required amounts applied in two (2) or more applications as directed.

K. Said treatment shall be uniformly applied by a method acceptable to the Engineer. Care should be taken during all rejuvenator applications to not get excessive material on the curb and gutter. Additional cleaning may be required if this occurs at the contractor's expense.

L. After the rejuvenating emulsion has penetrated, a coating of dry sand shall be applied to the surface in sufficient amount to protect the traveling public as required by the Engineer.

M. The Contractor shall furnish a quality inspection report showing the source and manufacturer of asphalt rejuvenating agent. When directed by the Engineer, the Contractor shall take representative samples of material for testing.

3.05 STREET SWEEPING

A. The Contractor shall be responsible for sweeping and cleaning of the streets prior to and after treatment.

B. Prior to treatment, the street will be cleaned of all standing water, dirt, leaves, foreign materials, etc. This work shall be accomplished by hand brooming, power blowing or other methods approved by the Engineer.

C. If hand cleaning is not sufficient, then a self-propelled street sweeper shall be used. All sand used during the treatment must be removed no later than forty-eight (48) hours after treatment of the street. This shall be accomplished by a combination of hand and mechanical sweeping.

D. All areas must be cleaned and free of any material that would interfere with the treatment. All debris generated by sweeping shall be picked up and disposed of by the contractor. Street sweeping shall be included in the price bid per square yard for asphalt rejuvenating agent.

E. If after sand is swept and it is determined that a hazardous condition exists on the roadway, the Contractor must apply additional sand and sweep no later than twenty-four (24) hours following reapplication. No additional compensation will be allowed for reapplications and removal of sand.

3.06 TRAFFIC CONTROL AND SAFETY

A. The Contractor shall schedule his operations and carry out the work in a manner to cause the least disturbance and/or interference with the normal flow of traffic over the areas to be treated.

B. Treated portions of the pavement surfaces shall be kept closed and free from traffic until penetration has become complete and the area is suitable for traffic. Cure time shall be no longer than 90 minutes

3.07 SPREADING OF SAND

A. Sand or screenings shall be furnished by the Contractor.

B. The contractor shall furnish all equipment, tools, labor and incidentals necessary to perform the sanding operation in accordance with this contract.

C. Spreading shall consist of applying free flowing FA2 to insure even distribution of the sand or screenings to be worked into any voids in the payment surface as directed by Owner.

D. The aggregate distributor shall apply sand or screenings at a rate of two pounds to four pounds per square yard.

E. Repeated sanding may be required on some areas of pavement and contractor must be available on an as needed basis to provide the required sanding.

END OF SECTION

SECTION 32 14 13.19
PERMEABLE CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes the following:
1. Permeable Concrete Pavers
2. Permeable Joint Opening Aggregate
3. Permeable Joint Aggregate Type 1
4. Permeable Setting Bed Aggregate (Open-graded)
5. Permeable Base Aggregate (Open-graded)
6. Permeable Subbase Aggregate (Open-graded)

1.02 REFERENCES

A. ASTM International, latest edition:
1. C 29 Bulk Density and Voids in Aggregate Materials.
2. C 33, Standard Specification for Concrete Aggregates.
3. C 67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile, Section 8, Freezing and Thawing.
4. C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
5. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
6. C 144 Standard Specifications for Aggregate for Masonry Mortar.
7. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
8. C 936, Standard Specification for Solid Concrete Interlocking Paving Units.
9. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
10. D 698 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5 lb (24.4 N) Rammer and 12 in. (305 mm) drop.
11. D 1557 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (44.5 N) Rammer and 18 in. (457 mm) drop.
12. C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units
13. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
14. D 2940 Graded Aggregate Material for Bases or Subbases for Highways or Airports.
15. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

B. U.S. Green Building Council Leadership in Energy and Environmental Design (LEED)
1. Building Design + Construction, latest edition

1.03 SUBMITTALS

A. Permeable Concrete Pavers:
1. Samples for verification: Three representative full-size samples of each paver type, thickness, color and finish that indicate the range of color variation and texture expected upon project completion.
2. Accepted samples become the standard of acceptance for the product produced.
3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.

4. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

B. Permeable Joint Opening Aggregate:
   1. Provide three representative one pound samples in containers of aggregate materials that indicate the range of color variation and texture expected upon project completion.
   2. Accepted samples become the standard of acceptance for the product produced.
   3. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.
   4. Test results for void space percentage per ASTM C 29.

C. Permeable Setting Bed, Base and Subbase Aggregate:
   1. Test results from an independent testing laboratory for compliance with ASTM D 448 No. 8, No. 57 and No. 2.
   2. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.
   3. Test results for void space percentage per ASTM C 29.

D. Paving Installation Contractor:
   1. Job references from a minimum of three projects similar in size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

A. Utilize a Manufacturer having at least ten years of experience manufacturing interlocking concrete pavers on projects of similar nature or project size.

B: Source Limitations:
   1. Obtain Permeable Concrete Pavers from one source location with the resources to provide products of consistent quality in appearance and physical properties.
   2. Obtain Permeable Joint Opening Aggregate from one source with the resources to provide materials and products of consistent quality in appearance and physical properties.

C. Paving Contractor Qualifications:
   1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.

D. Mockups:
   1. Install a 10 ft x 10 ft paver area.
   2. Use this area to verify joint sizes, lines, laying pattern(s) and levelness. This area will serve as the standard by which the workmanship will be judged.
   3. Subject to acceptance by owner, mock-up may be retained as part of finished work.
   4. If mock-up is not retained, haul offsite and dispose legally.

1.05 DELIVERY, STORAGE & HANDLING

A. In accordance with Conditions of the Contract and Division 1 Product Requirement Section.

B. Deliver Permeable Concrete Pavers in manufacturer's original, unopened and undamaged container packaging with identification labels intact.
   1. Coordinate delivery and paving schedule to minimize interference with normal use of streets and sidewalks adjacent to paver installation.
   2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
   3. Unload pavers at job site in such a manner that no damage occurs to the product or adjacent surfaces.

C. Store and protect materials free from mud, dirt and other foreign materials.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Install permeable pavers only on unfrozen permeable setting bed aggregate materials.
2. Install permeable setting bed only on unfrozen permeable base and subbase aggregates.
3. Install permeable base or subbase aggregates only over unfrozen subgrade.

1.07 PERMEABLE CONCRETE PAVER OVERAGE AND ATTIC STOCK

A. Provide a minimum of 5% additional material for overage to be used during construction.

B. Furnish 100 square feet of each product and size used to owner for maintenance and repair. Furnish Permeable Concrete Pavers from the same production run as installed materials.

C. Manufacture to supply maintenance and reinstatement manuals for Permeable Concrete Paver units.

PART 2 PRODUCTS

2.01 PERMEABLE CONCRETE PAVERS

A. Basis-of-Design Product: The permeable concrete paver shapes are based on:

1. Unilock:
   a. Eco Promenade

2. As manufactured by:
   Unilock
   301 E. Sullivan Road,
   Aurora, IL 60505
   Contact: Phil Carlson 630.892.9215

3. The specified products establish minimum requirements that substitutions must meet to be considered acceptable.
   a. To obtain acceptance of unspecified products, submit written requests at least 7 days before the Bid Date.

B. Product requirements:

1. Permeable Paver: Unilock Promenade
   a. Color: Charcoal Grey
   b. Finish:
      1. Il Campo (brushed)
   c. Edge: Chamfer - 3 mm bevel
   d. Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.
      1. 3 x 12 unit paver (2.75” x 11.75” x 3.875” actual)

C. Provide pavers meeting the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units.

1. Average compressive strength 8000 psi (55MPa) with no individual unit under 7,200 psi (50 MPa).
2. Average absorption of 5% with no unit greater than 7% when tested according to ASTM C 140.
3. Resistance to 50 freeze-thaw cycles, when tested according to ASTM C1645, with no breakage greater than 1.0% loss in dry weight of any individual unit. Conduct this test method not more than 12 months prior to delivery of units.

D. Accept only pigments in concrete pavers conforming to ASTM C 979.
Note: ACI Report No. 212.3R provides guidance on the use of pigments.

E. Maximum allowable breakage of product is 5%.
F. TX Active is a Portland Cement (white) Type I, II, and III complying with ASTM C 150 with the addition of proprietary particles of titanium dioxide (TiO2) specifically engineered for use in the manufacture of concrete and concrete products.
1. TX Active - Self-cleaning and pollution reduction
- Concrete will resist most organic and inorganic pollutants that gather on the surface causing discoloration.
- Concrete will remove significant amounts of environmental pollutants deemed harmful to human health.
2. As manufactured by ESSROC Italcementi Group.
a. Unilock Chicago is an authorized producer of TX Active products.

2.02 PERMEABLE JOINT OPENING AGGREGATE
A. Provide Permeable Joint Opening Aggregate materials conforming to ASTM C 33 and gradation requirements as presented in Table 2.
1. Supplier:
a. Kafka Granite LLC, 101 S. Weber Ave, Stratford, WI 54484 – Toll Free: 800-852-7415
b. Or approved equal
2. Color: Starlight Black Granite

TABLE 1 -
PERMEABLE JOINT OPENING AGGREGATE
GRADATION REQUIREMENTS
(GRANITE CHIPS)

1/8 to 3/16 inch granite chips	
Sieve Size	Percent Passing
1/4 in (6 mm)	97 to 100
No. 4 (4.75 mm)	70 to 83
No. 8 (2.36 mm)	37 to 50
No. 16 (1.18 mm)	0 to 12
pan	

2.03 PERMEABLE SETTING BED AGGREGATE
A. Provide Permeable Setting Bed Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as presented in Table 3.

TABLE 3
PERMEABLE SETTING BED AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 8	
Sieve Size	Percent Passing
½ in (12.5 mm)	100
3/8 in (9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

2.04 PERMEABLE BASE AGGREGATE

A. Provide Permeable Base Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 57 as presented in Table 4.

TABLE 4
PERMEABLE BASE AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 57	
Sieve Size	Percent Passing
1-1/2 in (37.5 mm)	100
1 in (25 mm)	95 to 100
1/2 in (12.5 mm)	25 to 60
No. 4 (4.75 mm)	0 to 10
No. 8 (2.36 mm)	0 to 5

2.05 PERMEABLE SUBBASE AGGREGATE

A. Provide Permeable Subbase Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 2 as presented in Table 5.

TABLE 5
PERMEABLE SUBBASE AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 2	
Sieve Size	Percent Passing
3 in (75 mm)	100
2-1/2 in (63 mm)	90 to 100
2 in (50 mm)	35 to 70
1-1/2 in (37.5 mm)	0 to 15
3/4 (19 mm)	0 to 5

Note: For all aggregates, provide washed, clean, have zero plasticity, free from deleterious or foreign matter, crushed, angular rock and contain no No. 200 sieve size aggregate materials used in the construction of permeable pavement. Aggregate materials serve as the structural load bearing platform of the pavement as well as a temporary receptor for the infiltrated water that is collected through the openings in the pavement's surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance for the following items before placing the Permeable Concrete Pavers.

1. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
2. Verify that Geotextiles, if applicable, have been placed according to drawings and specifications.
3. Verify that Permeable Base and Subbase Aggregate materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.

4. Provide written density test results for soil subgrade, Permeable Base and Subbase Aggregate materials to the Owner, General Contractor and paver installation subcontractor.
5. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Beginning of bedding sand and paver installation signifies acceptance of base and edge restraints.

3.02 PREPARATION

A. Verify that the subgrade soil is free from standing water.

B. Stockpile Permeable Setting Bed, Joint, Base and Subbase Aggregate materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

C. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the Geotextile and Permeable Subbase Aggregate materials.

D. Keep area where pavement is to be constructed free from sediment during entire job. Remove and replace all Geotextile, Permeable Joint, Setting Bed, Base and Subbase Aggregate materials contaminated with sediment with clean materials.

E. Complete all subdrainage of underground services within the pavement area in conjunction with subgrade preparation and before the commencement of Permeable Subbase Aggregate construction.

F. Prevent damage to underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.

G. Compact soil subgrade uniformly to at least 90 percent of Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact soil subgrade uniformly to at least 95 percent Modified Proctor per ASTM D 1557 for vehicular areas.

3.03 INSTALLATION

A. PERMEABLE BASE AND SUBBASE AGGREGATE
1. Provide the Permeable Subbase Aggregate in uniform lifts not exceeding 6 in., (150 mm) loose thickness and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
2. Compact the Permeable Subbase Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
3. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Subbase Aggregate material more than ±3/4 in. (20 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
4. Provide the Permeable Base Aggregate material in uniform lifts not exceeding 6 in. (150 mm) over the compacted Permeable Subbase Aggregate material and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
5. Compact the Permeable Base Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the compaction device.
6. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Base Aggregate material more than ±1/2 in. (13 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
7. Grade and compact the upper surface of the Permeable Base Aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

B. PERMEABLE SETTING BED AGGREGATE

1. Provide and spread Permeable Setting Bed aggregate evenly over the Permeable Base Aggregate course and screed to a nominal thickness of 1-1/2 in. (40 mm).
    a. Protect screeded Permeable Setting Bed Aggregate from being disturbed.
    b. Screed only the area which can be covered by pavers in one day.
    c. Do not use Permeable Setting Bed Aggregate material to fill depressions in the base surface.
2. Keep moisture content constant and density loose and constant until Concrete Pavers are set and compacted.
3. Inspect the Permeable Setting Bed Aggregate course prior to commencing the placement of the permeable concrete pavers.
4. Inspect the Setting Bed Aggregate course prior to commencing the placement of the Permeable Concrete Pavers. Acceptance of the Setting Bed Aggregate occurs with the initiation of Permeable Concrete Paver placement.

C. PERMEABLE CONCRETE PAVERS

1. Replace unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.
2. Mix Concrete Pavers from a minimum of four (4) bundles simultaneously drawing the paver vertically rather than horizontally, as they are placed, to produce uniform blend of colors and textures. (Color variation occurs with all concrete products. This phenomenon is influenced by a variety of factors, e.g. moisture content, curing conditions, different aggregates and, most commonly, from different production runs. By installing from a minimum of three (3) bundles simultaneously, variation in color is dispersed and blended throughout the project).
3. Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.
4. Provide Permeable Concrete Pavers using joint pattern as indicated in the Drawings. Adjust joint pattern at pavement edges as directed in the field by the Landscape Architect. Cut all pavers exposed to vehicular tires no smaller than one-third of a whole paver.
5. Use string lines or chalk lines on Permeable Setting Bed aggregate to hold all pattern lines true.
6. Set surface elevation of pavers 1/8 in. (3 mm) above adjacent drainage inlets, concrete collars or channels.
7. Place units hand tight against spacer bars. Adjust horizontal placement of laid pavers to align straight.
    a. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
8. Provide space between paver units of 1/32 in. (1 mm) wide to achieve straight bond lines.
9. Prevent joint (bond) lines from shifting more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.
10. Fill gaps between units or at edges of the paved area that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
11. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
12. Prevent all traffic on installed pavers until Permeable Joint Aggregate has been vibrated into joints. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and Permeable Joint Aggregate material.
13. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a to 5000-lbf (22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:
    a. After edge pavers are installed and there is a completed surface.

b. Compact installed concrete pavers to within 6 feet (1,800 mm) of the laying face before ending each day's work. Cover pavers that have not been compacted and leveling course on which pavers have not been placed, with nonstaining plastic sheets to prevent Permeable Setting Bed Aggregate from becoming disturbed.

14. Protect face mix Concrete Paver surface from scuffing during compaction by utilizing a urethane pad.
15. Remove any cracked or structurally damaged pavers and replace with new units prior to installing Permeable Joint Opening Aggregate material.
16. Provide, spread and sweep Permeable Joint Opening Aggregate into joints immediately after vibrating pavers into Permeable Setting Bed course until full. Vibrate pavers and add Permeable Joint Aggregate material until joints are completely filled, then remove excess material. This will require at least 4 passes with a plate compactor.
17. Remove excess Permeable Joint Aggregate broom clean from surface when installation is complete.

3.04 FIELD QUALITY CONTROL

A. Verify final elevations for conformance to the drawings after sweeping the surface clean.
   1. Prevent final Concrete Paver finished grade elevations from deviating more than ±1/4 in. (±10 mm) under a 10 ft (3 m) straightedge or indicated slope, for finished surface of paving.

B. Lippage: No greater than 1/32 in. (0.8 mm) difference in height between Permeable Concrete Pavers and adjacent paved surfaces.

3.05 REPAIRING, CLEANING AND SEALING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Cleaning: Remove excess dirt, debris, stains, grit, etc. from exposed paver surfaces; wash and scrub clean.
   1. Clean Permeable Concrete Pavers in accordance with the manufacturer’s written recommendations.

3.06 PROTECTION

A. Protect completed work from damage due to subsequent construction activity on the site.

3.07 PERMEABLE JOINT AGGREGATE MATERIAL REFILLING

A. Remove all debris from joint and provide additional Permeable Joint Aggregate material after 120 days and before 150 days after date of Substantial Completion/Provisional Acceptance.
   1. Fill Permeable Joint Aggregate material full to the lip of the paver.

END OF SECTION

SECTION 32 16 23
SIDEWALKS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide Portland cement concrete sidewalk including form work and reinforcement, base materials with compaction, where shown on Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. CRSI: Concrete Reinforcing Steel Institute

C. NRMCA: National Ready Mixed Concrete Association

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this section.

B. Product Data:

1. Verification of concrete mix design.

C. Test Results:

1. Tests indicating compliance of reinforcement with referenced standards.
2. Concrete test results.
3. Base material test results.
4. Concrete delivery tickets: With each load of concrete delivered, provide duplicate tickets, one for Contractor, one for Engineer, with following information.

a. Serial number of ticket.
b. Date and truck number.
c. Name of supplier.
d. Class of concrete.
e. Type of cement and cement content in bags/cubic yard.
f. Admixture brand names.
g. Aggregate size.
h. Time loaded.
i. Amount of concrete in load.
j. Gallons of water added at site and slump of concrete after addition of water.
k. Temperature of concrete at delivery.
l. Time unloaded.

5. Certified reports of field tests and observations.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of NRMCA certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Do not commence placement of concrete until mix designs have been reviewed and approved by Engineer.

C. Concrete Testing: Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1. Conduct tests on sample material in accordance with methods listed below:

m. Slump: ASTM C143.
n. Air-Entrainment: ASTM C231.
o. Compressive Strength: ASTM C31 and ASTM C39.

PART 2 – PRODUCTS

2.01 BASE MATERIAL

A. Structural Backfill in accordance with Section 31 23 00, except:

1. 100 percent of material must pass a No. 4 sieve.

2.02 FORMS

A. Construct forms to exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in finished concrete. All forms must be inspected and approved by Engineer, prior to placement of concrete.

B. Forms shall be straight and of sufficient strength to resist pressure of concrete without bending, tipping, or other deformation. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

C. Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage.

D. Slip form machines may be used provided sidewalk can be constructed to the requirements of specifications.

2.03 CONCRETE

A. Conform to Section 03 30 00

1. Class A2.

2.04 OTHER MATERIALS

A. Curing Compounds:

1. AASHTO M148, Type 2.

B. Preformed Expansion Joint Material:

1. Meet requirements of ASTM D 1751.
2. 1/2 inch thick and premolded.

PART 3 – EXECUTION

3.01 PREPARATION

A. Place base material in accordance with Section 32 11 23.

B. Check base course outline, and contour. Scrape down or fill irregularities.

C. Compact base course prior to paving.

D. Set castings and frames of manholes, catch basins, etc. to required alignment and grade. Hand vibrate concrete adjacent to structures.

E. Remove foreign matter accumulated in formwork. Forms may be oiled, if necessary.

F. Dispose of excavated material as specified in Section 31 22 00.

3.02 MIXING AND DELIVERY

A. Use ready mixed concrete conforming to ASTM C94.

B. Deliver and complete discharge within 1-1/2 hours of commencing of mixing. Limitations may be waived by Engineer if concrete slump, after 1-1/2 hours, is sufficient so that concrete can be placed without addition of water. In hot weather, time criteria may be reduced by Engineer.

C. Do not use concrete that has stood for over 30 minutes after leaving the mixer.

3.03 CONVEYING CONCRETE

A. Perform concrete placement at such a rate that concrete which is being integrated with fresh concrete is still plastic.

B. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.

C. Do not use concrete which becomes non-plastic and unworkable, does not meet required quality control limits, or has been contaminated by foreign materials.

D. Remove rejected concrete from job site.

3.04 CONCRETE PLACEMENT

A. Deposit concrete in a continuous operation, within limits of construction joints, until placing of a section is complete.

B. Consolidate concrete immediately after placing by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.

C. Do not vibrate forms or reinforcement.

D. Do not use vibrators to transport concrete inside the forms.

E. Bring surfaces to correct level with straightedge, and then strike off.

F. Use bullfloats or darbies to smooth surface, leaving surface free from bumps and hollows.

3.05 CONCRETE FINISHING

A. Check sidewalk with 10-foot straight edge. For areas showing irregularities of 0.25 inches or more cut down high areas or fill depressions with freshly mixed concrete and strike off, consolidate and refinish concrete. Do not add water to correct surface deficiencies.

B. Provide a light broom finish perpendicular to direction of travel.

C. Expansion joints:

1. Extend entire width of sidewalk, at intervals not to exceed 100 feet.
2. Install full depth of sidewalk.
3. Install at all construction joints and where sidewalk abuts castings or other rigid structures.
4. Place expansion joints perpendicular to sidewalk.

D. Control Joints:

1. Spacing: Maximum intervals of 6 feet.

2. Formed control joints:

a. Depth of not less than 1/4 the sidewalk depth
b. Use 0.25 inch radius jointing tool.

A. Finish all edges with 0.25 inch radius edging tool.

B. Apply curing compound to all exposed surfaces immediately after finishing operations have been completed and surface water has disappeared.

3.06 PROTECTION FROM FREEZING

A. These provisions shall be followed when the atmospheric temperature is 35°F, or is expected to drop below 35°F during the curing period.

B. Heating of aggregates and water:

1. Concrete temperature shall be at least 50°F and not more than 80°F at the time of placing.
2. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used.
3. The equipment shall be capable of heating the materials uniformly.
4. Neither aggregates nor water used for mixing shall be heated to a temperature exceeding 150°F.
5. Materials containing frost or lumps of frozen material shall not be used.
6. When either aggregates or water are heated to 100°F, they shall be combined first in the mixer before cement is added.

C. Immediately after a pour is completed, the freshly placed concrete and forms shall be covered so as to form a protective enclosure and the air in the enclosure kept at a temperature above 50°F for at least 72 hours.

3.07 FIELD QUALITY CONTROL

A. Conform to Section 03 30 00.

B. If tests verify Work in-place is not in conformance with Specifications, Engineer will determine if Work in-place is adequate for intended use. If Work in-place is determined to be inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require. Contractor shall bear costs associated with testing, engineering analysis, remedial work, and replacement required under terms of this paragraph

C. Cracked sections of new Portland Cement Concrete sidewalk shall be removed and replaced by Contractor at no additional cost to Owner.

END OF SECTION

SECTION 32 17 43
PAVEMENT SNOW MELTING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Self-regulating heat mat and control equipment.
   a. Heat Mat Controller (002-HTP-1)
   b. HTP Remote Control Unit (900-RCU-1)

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide electric heat mat system capable of eliminating snow and ice from the surface while embedded in concrete slab.

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer's product data sheets.

B. Shop Drawings:

1. Include installation details and connection diagrams sufficient to install electric heat mat cable system.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Raychem Corporation, Division of nVent Thermal Management

2.02 CABLE DESIGN

A. Voltage: 208 volts, 60 Hertz, 1-phase as shown on Drawings for electrical connection.

B. Parallel design, current flow across cable.

C. Heat output/foot constant, independent of length.

D. Capable of overlapping without creation of hot spots.

E. Capable of being cut to any length in field.

F. Self-regulating heat output.

G. Braided metallic shield.

H. Outer plastic jacket.

I. Provide proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.

2.03 ELECTRIC MAT DESIGN

A. Capable of melting snow without salt or chemicals.

B. Voltage: 208 volts, 60 Hertz, 1-phase as shown on Drawings for electrical connection.

C. 50 Watts/ft^2

D. Embed in new concrete slab as indicated on drawings.

E. Provide manufacturers standard power connections, end seals, splice, tee kit components and expansion joint kits.

F. Provide proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.

G. Provide manufacturer's snow melting caution sign as required by NEC.

2.04 ELECTRIC MAT CONTROLS

A. Heat Mat Controller (002-HTP-1)

1. Single circuit snow/ice melting controller
2. Built-in GFPD
3. LED status display.
4. 50A switching capacity rating.
5. 208V Supply Voltage.
6. Capable of supporting up to six (6) ambient or moisture sensors.
7. Adjustable hold-on timer (0-10) hours.
8. Integrated high-limit temperature sensor.
9. Operating Temperature: -40 to 160 degrees Fahrenheit.

B. Enclosure:

1. Viewing window on enclosure front for observing digital display of controller.
2. Padlockable enclosure.
3. National Electrical Manufacturers Association (NEMA) 3R.

C. Communications:

1. Overhead snow sensor that detects precipitation or blowing snow at ambient temperatures below 38 degrees Fahrenheit.
2. Pavement-mounted sensors signals for the heating cable to turn on when the pavement temperature falls below 38 degrees Fahrenheit and precipitation in any form is present.
3. HTP Remote Control Unit (900-RCU-1) which provides LED status display, GFPD test/reset and cycle time adjustment from 2-8 hours
4. Provide dry contact closure for general alarm to plant SCADA.

D. Trigger Temperature Range: 34 degrees Fahrenheit to 44 degrees Fahrenheit

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which electric heat mat to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of Work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Install snow melting caution sign in accordance with manufacturer’s written instructions.

C. Coordinate circuit connection points and voltages with Drawings.

D. Provide Class B Ground Fault Circuit Interrupting (GFCI) protection for each heat trace line.

3.03 FIELD QUALITY CONTROL

A. Examine material for defects prior to installation.

B. Examine final installation for damage and defects in workmanship prior to startup and installation of insulation.

END OF SECTION

SECTION 32 31 19
ORNAMENTAL STEEL FENCE AND GATES

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Ornamental Steel Fence
2. Ornamental Steel Horizontal Slide Gate with Sliding Gate Operator (002-M-1301)
3. Ornamental Steel Swing Gate
4. Ornamental Steel Man Gate
5. Gate Operators including Photoeyes and Padded Sensor
6. Loop Detector (Sliding Gate Exit Loop)

1.02 DEFINITIONS

A. ASTM: American Society for Testing and Materials.

1.03 REFRENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
C. ASTM B221 – Aluminum and Aluminum Alloy Extruded Bars, Shapes and Tubes
D. ASTM D523 - Test Method for Specular Gloss.
E. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
F. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
G. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
H. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
I. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
J. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
K. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Construction details, materials descriptions and finishes for ornamental steel fence and gates:

a. Fence and gate posts
b. Rails, fittings and hardware
c. Gate Operators including Photoeyes and Padded Sensor
d. Manufacturer installation instructions for swing gate, man gate, horizontal slide gate and

loop detector.
e. Accessories.

2. Motorized gate operator materials including but not limited to motor and drive mechanism, operator housing and controls.
3. Operation and Maintenance Manual for Gate Operator

C. Shop Drawings:

1. Installation and assembly details
2. Gate Operator: Installation details showing locations of switches, loop detector and other controls.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for gate operators for inclusion in O&M Manual.

2. Submit in accordance with Section 01 78 23.

E. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Firms experienced in installing ornamental steel fences and gate operators systems that have record of successful in-service performance, at least 3 years' experience and completed at least five fence projects with similar material and scope.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials with manufacturer’s tags and labels intact and legible.

B. Store materials in clean, dry location.

1.07 RELATED WORK SPECIFIED ELSEWHERE

A. Cast in place concrete. See Section 03 30 00.

B. Electrical. See Division 26.

C. Control and functional description of Sliding Gate. See Division 40.

D. Arm gates, ground loops that specifically control arm gates, pedestal, card reader, call box intercom and CCTV’s are specified in Section 28 15 00.

E. Electric Heat Mat. See Section 32 17 43.

PART 2 – **PRODUCTS**

2.01 GENERAL

A. As specified here-in and indicated on drawings.
B. Extended picked bottom rail treatment
C. 3 Rail Style

2.02 Manufacturer

A. Ornamental Steel Fence, Swing Gate and Man Gate

1. Montage II Invincible by Ameristar Fence Products, Inc.

B. Ornamental Horizontal Slide Gate

1. TransPort II Invincible by Ameristar Fence Products, Inc.

C. Gate Operator

1. Hysecurity.

2.03 MATERIAL

A. Steel material for fence panels and posts:

1. Conform to the requirements of ASTM A653/A653M
2. Minimum yield strength of 45,000 psi (310 MPa)
3. Minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

B. Material for pickets:

1. Shall be 1" square x 14 Ga. tubing.
2. Rails shall be steel channel, 1.75" x 1. 75" x .105".
3. Picket holes in the rail shall be spaced 4.715" o.c.

C. Fence posts and gate posts shall meet the minimum size requirements of Table 1 below.

Table 1 – Minimum Sizes for Fence Posts and Gate Posts

Fence Posts	Panel Height		
2-1/2" square x 12 Ga.	Up to & Including 6' Height		
3" square x 12 Ga.	Over 6' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" sq x 12 Ga.	3" sq x 12 Ga.	3" sq x 12 Ga.
4'1" to 6'	3" sq x 12Ga.	4" sq x 11 Ga.	4" sq x 11 Ga.
6'1" to 8'	3" sq x 12 Ga.	4" sq x 11 Ga.	6" sq x 3/16"
8'1" to 10'	4" sq x 11 Ga.	6" sq x 3/16"	6" sq x 3/16"
10'1" to 12'	4" sq x 11 Ga.	6" sq x 3/16"	6" sq x 3/16"
12'1" to 14'	4" sq x 11 Ga.	6" sq x 3/16"	6" sq x 3/16"
14'1" to 16'	6" sq x 3/16"	6" sq x 3/16"	6" sq x 3/16"

2.04 FABRICATION

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by fusion welding process (virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel) completing the rigid panel assembly.

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 below (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates and man gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

F. Man gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

2.05 SWING GATE AND MAN GATE

A. Locate swing gate and man gate at locations shown on drawings.

B. Material and Fabrication shall conform to previous requirements in this specification section and as shown on Drawings.

C. Height and width

1. Height as shown on drawings.
2. Width as shown on drawings.

D. Hardware:

1. Latches shall permit operation from both sides of gate and have integral eye openings for padlocking with the padlock accessible from both sides of gate

2.06 HORIZONTAL SLIDE GATE

A. Locate horizontal slide gate at locations shown on drawings.

B. Material and Fabrication shall conform to previous requirements in this specification section and as shown Drawings.

C. Height and Width

1. Height as shown on drawings.
2. Width as shown on drawings.

D. The materials used for cantilever gate framing (uprights & diagonal bracing) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The enclosed tracks shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.

E. Material for pickets shall be 1" square x 1/8" wall aluminum pickets on gate systems greater than 24' openings, gate systems less than 24' openings shall have 1" square x 16 ga. steel pickets. Picket on center spacing shall not exceed 5". Pickets shall be securely fastened to face of top and bottom enclosed track extrusions.

F. Material for gate uprights and diagonal bracing shall be 2" square x ¼" wall aluminum. The cross-sectional shape of the enclosed-track shall confirm to the manufacturers design with as a single extrusion consisting of a 2" x 5" channeled support with integrated 2" x 2" enclosed-track raceway. Gates less than 24' openings shall be constructed as a single track system, gates greater than 24' openings shall be constructed as a dual track system.

G. Steel material for fence posts and pickets shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90. Material for gate support posts shall be 4" square x 11 Ga. tubing. Material for gate mounting posts shall be 6" square x 3/16".

H. Suspension Rollers for enclosed tracks shall be used at each support post to track connection. Each truck assembly shall be capable of being adjusted vertically via threaded rod for fine-tune adjustment. Truck assembly shall be constructed in a way so that the primary housing for the truck rollers shall pivot via ball-bearing connection to threaded rod.

I. Gate frame uprights and diagonal bracing shall be pre-fabricated and pre-punched to accept frame fasteners. Enclosed track shall be pre-punched to accept gate uprights. Pickets shall be precut to specified length and predrilled to accept picket to track fasteners. Posts shall be precut to specified lengths.

J. Top and bottom enclosed track extrusions shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Diagonal bracing shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Pickets shall be mechanically fastened to top and bottom enclosed track, as required by assembly instructions.

K. The manufactured gate components shall be subjected to coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 3.

Table 3 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

2.07 GATE OPERATORS

A. General

1. Operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads.
2. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel.
3. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms.
4. Operator shall be capable of handling gates weighing up to 4,000 pounds.
5. Gate panel velocity shall not be less than 1.0 feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly.
6. The “soft stop” feature of the gate operator shall be controlled by two adjustable hydraulic brake valves (one for each direction).

B. Standard mechanical components shall include as a minimum:

1. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2" bronze bearing surface, acting on arm pivot pins. (item 2 below).
2. Arm pivot pins: 3/4" diameter, stainless steel, with integral tabs for ease of removal.
3. Tension spring: 2-1/2" heavy duty, 800 pound capacity.
4. Tension adjustment: Finger tightened nut, not requiring the use of tools.
5. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
6. Limit switches: Fully adjustable, toggle types, with plug connection to control panel.
7. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.
8. Enclosure shall be heated for cold weather operation.
9. Chassis: 1/4" steel base plate, and 10 Ga. sides and back welded and ground smooth.
10. Cover: 16GA. galvanized sheet metal with a powder paint finish. All joints welded, filled and ground smooth. Finished corners square and true with no visible joints.
11. Finish: Fully zinc plated then finish coat of high gloss powder paint withstanding 1000-hour salt

spray test.

12. Drive wheels: 6" Dia. Metal hub with polyurethane tread.
13. Drive rail: Shall be extruded 6061 T6, not less than 1/8" thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.
14. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 p.s.i.
15. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
16. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
17. Hydraulic fluid: High performance type with a viscosity index greater than 375.
18. A zero to 2,000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
19. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.

C. Minimum standard electrical components:

1. Pump motor: Shall be a 1 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater. Three phase. 480V.
2. All components shall have overload protection.
3. Controls: Smart Touch Controller Board with 128K memory containing:

    a. Inherent entrapment sensor.
    b. Built in “warn before operate” system;
    c. Built in timer to close;
    d. Liquid crystal display for reporting of functions;
    e. 19 programmable output relay options;
    f. Anti-tailgate mode;
    g. Built-in power surge/lightening strike protection;
    h. Capable, with optional software, of event logging EEPROM for trouble shooting diagnostics;
    i. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.

4. Transformer: 75 VA, non-jumpered taps, for all common voltages.
5. Control circuit: 24VDC.

D. The controller module shall be equipped to allow operation of the gate by means of a key switch, or vehicle sensing exit loop detector, remote opener pushbutton, remote contact closure, locally by hand via a pushbutton switch on the operator if the controller module is out of service.

E. Pushbutton switch shall be externally mounted on the operator and located to prevent use by personnel located outside the fenced area.

F. Other options:

1. Snow brush and ice scrapper kit.
2. Cabinet Lock Kit.
3. Miller Edge ME123 (or equal) gate safety reverse edges for the front and rear of the gate per UL 325, yellow in color.
4. EMX IRB325 (or equal) thru-scan photoelectric eye with weather protection hoods
5. Vehicle loop detector (one exit) with controls.
6. Solenoid gate locking mechanism to work with the gate operator.

G. Operationally, the controller shall provide the following options:

1. Open and close the gate by remote dry contact by plant PLC.

2. The gate will close following an adjustable time delay.
3. When the gate is closed, an exit loop detector will trigger the gate to open when a vehicle approaches from inside the facility.
4. The gate will close following an adjustable time delay once the vehicle has cleared the gate and exit loop.
5. The gate shall open when an obstruction is detected.
6. Gate shall be programed to stay open during normal business hours.

H. Motor and Drive Mechanism shall be warranted for a minimum service life of 5 years and shall be capable of working under the following conditions without assistance:

1. Heavy frost
2. Up to ¼ inch accumulation of freezing rain or sleet on external components
3. Up to 12 inches accumulation of snowfall.

I. Equip gate operator with safety devices to prevent operation if vehicles or other obstructions are present at the start of operation or come to be located along the alignment of the closure during the gates operation. Gate operators shall also be designed to stop their operation and automatically reverse if excessive resistance or obstructions are encountered either opening or closing.

J. Gate operators shall have the capability of manual override if power or equipment failure.

2.08 LOOP DETECTOR (SLIDING GATE EXIT LOOP)

A. Provide electronic detectors capable of closing with an automatic timer with adjustable delay and a loop detector designed to open and close that gate. Electronic detector shall have adjustable detection sensitivity.

B. Sliding Gate Exit Loop shall be placed in outbound traffic lane where shown on drawings with exact location as recommend by manufacturer.

C. Loop size, number of turns, wire type, and number of strands shall be as recommended by loop manufacturer, and Gate Equipment Supplier.

2.09 CONCRETE

A. Class B2 concrete in accordance with Section 03 30 00.

2.10 GROUNDING

A. Bare Copper, solid wire No. 6 AWG and smaller with No. 30 AWG bare wire bonding jumpers.

B. 5/8 inch by 96 inch grounding rods with Exothermic welded connectors for connections below ground.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Check location of underground work to make sure fence footings clear utilities.

3.02 INSTALLATION

A. Fence Installation

1. Fence post shall be spaced at 8’ nominal span (91-1/2” Rail).
2. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.
3. Fence panels shall be attached to posts with brackets supplied by the Manufacturer.
4. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces:

    a. Remove all metal shavings from cut area.
    b. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
    c. Apply 2 coats of custom finish paint matching fence color.

B. Swing Gate and Main Gate Installation

1. Install gates in accordance with manufacturer instructions.
2. Gate posts shall be spaced according to the manufacturers’ gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
3. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles.
4. The manufacturers’ gate drawings shall identify the necessary gate hardware required for the application.
5. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer’s recommendations.

C. Horizontal Slide Gate Installation

1. Cantilever support posts shall be set in concrete footers having a minimum depth of 60”.

2. Gate to be installed per manufacturers gate installation instructions. Gate shall be installed in compliance with ASTM F2200 standards.

3. Gate posts shall be spaced according to the manufacturers’ drawings, dependent on clear opening. The manufacturers’ gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer’s recommendations.

D. Footings:

1. Dispose of excavated material as specified in Section 31 22 00.
2. Hold posts plumb, aligned and at correct height while concrete sets.
3. Rod and compact concrete around posts. Slope top of footings above level of adjacent grade and trowel finish.
4. Size:

    a. 6 inch minimum diameter, plus outside dimension of post.
    b. Set corner, end, pull, and gate posts 42 inch into concrete.
    c. Set line posts 42 inch into concrete.
    d. Total depth of concrete 6 inch greater than required for post embedment.

5. Time of Set: 48 hours before rails erected or fabric applied or stretched.

E. Gate Operators: Install gate operator, loop detectors, photo eyes, and padded sensors in accordance with manufacturer instructions.

F. Loop Detector: Bury wire loop in crushed aggregate base course in accordance with manufacturer instructions.

G. Protective Electrical Ground.

1. Ground continuous fence at intervals not exceeding 1500 feet except as follows:
   a. Within 100 feet of buildings, structures, roadways, and sidewalks, Ground at a maximum interval of 750 feet.
   b. Ground fence on each side of gates or other openings. Bond metal gates to gate posts.
   c. Bond across openings with a No. 2 AWG wire buried a minimum of 18 inches below grade.
2. Ground fence under power line by three grounds, one directly under crossing and one on each side 150 feet on each side of wire. Locate single ground directly under each telephone wire or cable crossing.
3. Ground rod shall terminate 6" below finished grade and be connected to fence with No. 6 AWG conductor. Connect each fence component to the conductor.
4. Ground gates by with bonding jumper between gate post and gate frame.
5. Make connections with clean and bare metal at points of contact.
6. Connect ground wire to fabric and ground rod by mechanical clamp of cast bronze body and bronze or stainless steel bolts and washers.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.01 SUMMARY

A. This work includes native seeding as indicated on the Drawings and in areas disturbed by the Contractor's operations. Section includes:
   1. Seed quality and provenance.
   2. Scheduling.
   3. Seedbed preparation.
   4. Seed installation.
   5. Seed protection and maintenance.

B. Related Sections:
   1. Applicable provisions of Division 1 – General Requirements shall govern work of this specification section.
   2. Applicable provisions of the project General Conditions, General Specifications sections, and Detailed Technical Specifications utilized for this project.

1.02 REFERENCES

A. Illinois Department of Transportation (IDOT):
   1. Standard Specifications for Road and Bridge Construction, Current edition, including Supplemental Specifications (Standard Specifications).

B. Illinois Seed Law, Ill. Compiled Statutes, Ch. 505, Par. 110/1 et seq., Illinois Revised Statutes, Chapter 5, par. 401 et seq.

C. Federal Seed Act: CFR, Title 7, Part 201 – Federal Seed Act Regulations

D. Plants of the Chicago Region. 1994. Swink, F. and G. Wilhelm.

1.03 DEFINITIONS

A. Weeds: Ecologically objectionable and undesirable species of vegetation in a given area.
   1. Any species identified by the Northeastern Illinois Invasive Plant Partnership, also known as NIIPP (http://www.niipp.net/natural-history-identification) shall be considered a weed.
   2. The following low quality and/or aggressive native species shall be considered weeds:
      a. *Acer negundo* – Boxelder
      b. *Amaranthus hybridus* – Green amaranth
      c. *Ambrosia artemisiifolia* – Common ragweed
      d. *Ambrosia trifida* – Giant ragweed
      e. *Brassica kaber* – Charlock
      f. *Convolvulus sepium* – Hedge bindweed
      g. *Cornus racemosa* – Gray dogwood
      h. *Cyperus esculentus* – Field nut sedge
      i. *Equisetum arvense* – Horsetail
      j. *Erigeron annuus* – Annual fleabane
      k. *Erigeron canadensis* – Horseweed
      l. *Lactuca canadensis* – Wild lettuce
      m. *Lepidium virginicum* – Common peppergrass
      n. *Oxalis europaea* – Tall wood sorrel
      o. *Oxalis stricta* – Common wood sorrel
      p. *Phragmites australis* – Common reed

q. *Plantago rugelii* – Red-stalked plantain
r. *Potentilla norvegica* – Rough cinquefoil
s. *Solanum americanum* – Black nightshade
t. *Solidago altissima* – Tall goldenrod
u. *Solidago canadensis* – Canada goldenrod
v. *Typha angustifolia* – Narrow-leaved cattail
w. *Typha x glauca* – Hybrid cattail
x. *Verbena bracteata* – Creeping vervain

B. PLS: Pure Live Seed as described in 2.1 C. of this section.

1.04 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Submit information specified in the “Quality Assurance” and “Qualifications” Articles. No work may begin prior to approval of these submittals.

C. Provide a list of not less than five successfully completed native seeding projects including name and current contact information of owners.

D. Product Data: Unless otherwise indicated, submit to the Engineer the following for each seed mix provided under work of this Section:
1. Product data for the following materials and components indicating compliance with specified requirements.
a. Seed mixes.
b. Inoculants.
c. Soil amendments.

E. For all seed mixes, submit the following:
1. Lot number for each species.
2. Year of seed production.
3. Tests results from a Certified Seed Lab showing the PLS for each seed lot. All tests must be completed within one (1) year of when seed is installed.
4. PLS weight per acre for each species on this contract.
5. Adjusted bulk seed weight for each species (lot) per acre to meet PLS weight per acre required on this contract.

1.05 QUALITY ASSURANCE

A. Refer to Division 1 Requirements.

B. Ability to Deliver:
1. Investigate sources of supply and confirm they can supply materials in quantity, variety, and quality noted and specified before submitting bid.
2. Failure to take this precaution will not relieve responsibility for furnishing and installing these materials in accordance with Contract documents without additional expense to Owner.

C. Seed shall conform to the requirements of the Illinois Seed Law and, when applicable, the Federal Seed Act, and shall be "Certified" grade or better.

D. Perform Work in accordance with the IDOT Standard Specifications, except as specifically modified herein.

E. Provide the Engineer with written compliance of all listed documentation above.

1.06 QUALIFICATIONS

A. Seed Supplier: Company specializing in producing and/or distributing seed specified in this section with minimum five (5) years experience.

B. Contractor Qualifications:
   1. Contractor shall be a company specializing in seeding installation who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
   2. Contractor shall have a minimum of five (5) years experience on comparable projects. Use experienced crews.
   3. Contractor shall be familiar with the IDOT standards and specifications.
   4. Contractor's Field Supervision: Require Installer to maintain an experienced fulltime supervisor on the Project site during times that landscape work is in progress.
   5. The work described in this section requires specialized knowledge, experience, skills, and equipment to successfully complete. The Contractor shall possess the full capability to execute the work as specified, including trained, experienced and skilled personnel and possession of or access to the required equipment. The seeding Contractor (may be a subcontractor) shall provide proof of qualifications, including a work history documenting a minimum of five (5) seeding projects completed in the last five (5) years which are comparable in scope, techniques, and size. This information shall include a complete project description, lead foreman experience history, location, client name, and contact information.

1.07 SITE CONDITIONS

A. Project Environment:
   1. Seeding shall be performed only when weather and seedbed conditions are favorable for such operations.
   2. No seeding applications shall be done during high winds or when the ground is frozen or in otherwise unworkable conditions.
   3. Operations will be suspended or delayed whenever conditions are unfavorable for such work or as approved by the Engineer.

B. Contractor Equipment:
   1. Equipment of a type, size, capacity or condition unsuited for obtaining first class work and expedition of the job shall be replaced with proper equipment.
   2. Limits of operation shall be restricted to areas approved by the Engineer.

1.08 COORDINATION

A. Section 01 31 19 – Project Meetings.

B. Coordinate the Work with installation of, including but not limited to, pavements, utilities, soils, and planting specified under other sections as the Work of this Section proceeds.

1.09 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 61 00 – Common Product Requirements.

B. All seeds shall be packaged and delivered to ensure the viability of the seed material. All seed shall be packed and covered in a manner as to ensure adequate protection against leakage, damage, and to maintain dormancy while in transit.

C. There shall be no seed delivered to the project site or received by the Engineer on Fridays,

weekends, or holidays without prior approval.

D. Deliver materials to site in original unopened packages, each bearing name and address of manufacturer, contents, and supplier's guaranteed analysis.

E. Do not use materials which become caked or otherwise damaged.

F. Do not expose materials to weather prior to delivery on site, and after delivery until used.

G. Protect materials and do not store in direct contact with ground.

H. Seeds shall be protected against leakage, damage and moisture to insure viability and dormancy.

1.11 FIELD QUALITY CONTROL

A. Grading Inspection:
   1. Finish grading in accordance with Section 32 93 00 – Planting and Fine Grading shall be inspected and approved by the Landscape Architect prior to seeding.

B. Inspections:
   1. No seed shall be sown until the Landscape Architect has inspected and approved the unopened seed mix bags.
   2. Contractor shall request a provisional inspection by the Landscape Architect upon completion of the work.
   3. Upon completion of the punch list, the Landscape Architect shall make provisional acceptance in writing.
   4. Final acceptance will be after all performance criteria have been met at the end of the specified monitoring and management period or as specified elsewhere, and after all required repairs have been made.

1.12 WARRANTY

   1. Refer to Section 32 93 00.

1.13 FINAL ACCEPTANCE

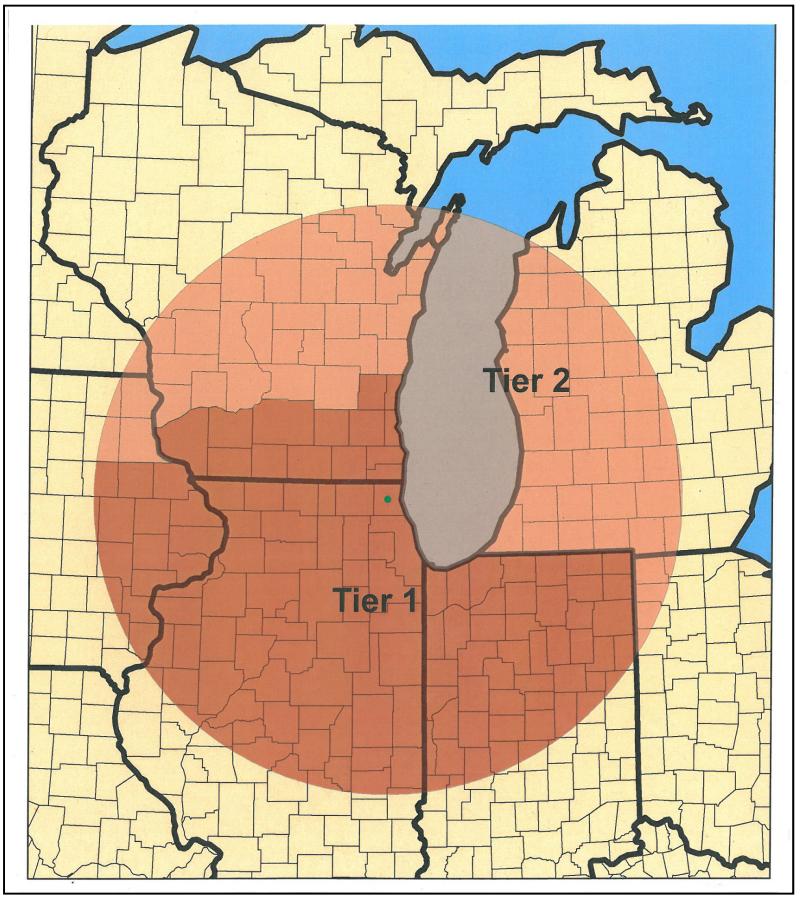
A. Native Seeding Areas:
   1. Determination of final acceptance of the seeded areas shall be made by the Landscape Architect upon the Contractor's request at the end of the warranty period unless seeding was performed and guaranteed outside of the recommended dates, in which case the inspection dates for establishment shall be as follows;
      a. Seeding performed between June 15 and July 31 will be inspected after April 15 of the following year.
      b. Seeding performed between November 2 and March 31 will be inspected after September 15 of the following year.
   2. Provide notification at least five (5) working days before requested inspection date.
      a. Seeded areas shall be accepted provided all requirements, including maintenance, have been complied with and native seed mix is well established and exhibits a vigorous growing condition.
      b. Areas failing to show satisfactory establishment shall be reseeded at the Contractor's expense.

PART 2 - PRODUCTS

2.01 SEED

A. Species mixtures shall be as designated on the plans.

B. Native seed shall preferentially have origins (provenance) from locations within Tier 1 on the attached map. If the Contractor can show that any species are not available with Tier 1 origins (provenance), they may be provided with origins (provenance) from Tier 2. Note Tier in submittals.



Plant Provenance Tier Map

1. Tier 1 provenance includes the following counties:
   a. **Illinois**: Bureau, Carroll, Cass, Champaign, Coles, Cook, De Witt, DeKalb, Douglas, DuPage, Edgar, Ford, Fulton, Henderson, Jo Daviess, Kane, Kendall, Knox, La Salle, Lake, Lee, Livingston, Logan, Macon, Marshall, McDonough, McHenry, McLean, Menard, Mercer, Moultrie, Ogle, Peoria, Piatt, Putnam, Rock Island, Sangamon, Schuyler, Stark, Stephenson, Tazewell, Vermilion, Warren, Winnebago, Whiteside, Warren, and Woodford counties.
   b. **Wisconsin**: Dane, Grant, Green, Iowa, Jefferson, Kenosha, Lafayette, Milwaukee, Ozaukee, Racine, Rock, Walworth, Waukesha, Waukesha, and Washington counties.
   c. **Indiana**: Adams, Allen, Benton, Blackford, Boone, Carroll, Cass, Clinton, De Kalb, Delaware, Elkhart, Fountain, Fulton, Grant, Hamilton, Hendricks, Howard, Huntington, Jasper, Kosciusko, Lake, LaGrange, LaPorte, Madison, Marshall, Miami, Montgomery, Newton, Noble, Parke, Porter, Pulaski, Putnam, St. Joseph, Starke, Steuben, Tippecanoe, Tipton, Vermillion, Wabash, Warren, Wells, White, and Whitley counties.
   d. **Iowa**: Buchanan, Cedar, Clinton, Delaware, Des Moines, Dubuque, Jackson, Johnson, Jones, Linn, Louisa, Muscatine, and Scott counties

C. Seed material shall conform to the following requirements:
   1. Any seed that does not meet these specifications will be rejected.
   2. The original (wild) source of seed shall be guaranteed within a 200-mile radius of Will County,

Illinois and identified by its origin tier.

3. All species shall be provided on a PLS basis. PLS shall be defined as (purity) x (total germination). Total germination is defined as (germination + hard seeds + dormant seeds). TZ can be substituted in lieu of total germination if necessary.
4. The bulk weight of any species that is less than 100% PLS must be increased in quantity to achieve the required PLS seed weight.
5. All species with dispersal appendages (e.g. *Asclepias*, *Aster*, *Liatris*, *Solidago*, etc.) and marked "DF" in species lists shall be supplied on a de-fluffed basis. Contractor must indicate in their submittal if seed is not available on a de-fluffed basis. If seed is not de-fluffed, Contractor must increase quantity of that species by 25% at no additional cost to Owner.
6. All "hulled" species (e.g. *Desmodium*, *Lespedeza*, *Dalea*, etc.) and marked "DH" in the species lists shall be supplied on a de-hulled basis. Contractor must indicate in their submittal if seed is not available on a de-hulled basis. If seed is not de-hulled, Contractor must increase quantity of that species by 25% at no additional cost to Owner.

A. Prior to installation, the Contractor shall submit any proposed species substitutions or quantity deviations to the Engineer for review. The Engineer reserves the authority to deny substitutions and deviations from the listed quantities.

B. All seed furnished shall be true to species name for each seed mix specified on the plans.

C. Packaging for all seed mixes shall clearly be labeled on the outside with all species contained in the mix, and include the following information:
   1. Scientific name of each species in the mix.
   2. PLS value, PLS weight, and bulk weight for each species in the mix.
   3. Adjusted bulk seed weight for each species per acre to meet PLS weight per acre required on this contract.
   4. Quantity, as both weight and acreage, for each species and overall mix.

D. Seed tests must be submitted and approved prior to delivery of any seed to the site. Include complete information on year of seed production and date of seed tests.
   1. Seed tests must be within one year of when the seed is sown.

E. All legume species shall be supplied with the appropriate bacterium inoculants.

F. Clearly mark seed packages that require refrigeration/freezer storage.

G. Provide a Pick Ticket with each shipment.

H. All seeds shall be packaged to ensure the viability of the seed material upon delivery to the project site.

I. All seed shall be packed and covered in such a manner as to insure adequate protection against leakage, damage, and to maintain dormancy until sown.

J. The Contractor must submit a written description of the seed materials including the following information for approval prior to delivery of any seed to the site:
   1. Origin of the various species of seed.
   2. Name and location of seed supplier, if not from Contractor's nursery.
   3. Certificate of compliance from appropriate regulatory agencies indicating approval of seeds.

K. All legume species shall have the proper inoculants supplied with them.

2.02 SOIL AMENDMENTS

A. All native seed mixes shall be combined with an appropriate endomycorrhizal inoculant, such as AM 120 Mycorrhizal Inoculum or approved equal. The inoculants shall contain a diverse mixture of

glomales fungal species (*Glomales* spp.) in pelletized form. Application rate shall be in conformance with the selected manufacturer's recommendations. All native seed shall be mixed with a granular form of endomycorrhizal inoculants prior to installation.

1. The inoculants application rate shall be a minimum of 40 pounds/acre.

2.05 WATER

A. Water shall be free from oil, acid, alkali, salts, and other harmful substances. Water may be utilized from potable or non-potable sources. Owner will not be responsible for providing supplemental water. Any available water sources located on Owner property shall not be utilized without written permission of Owner.

2.06 CARRIER AGENT

A. Carrier agent for native seeding shall be perlite, ground corn cobs, vermiculite, or similar material approved by the Landscape Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 31 19 – Project Meetings.

B. Contractor shall carefully inspect all prior work and existing conditions, and shall notify the Engineer immediately of all conditions that would impair proper execution of the work.
   1. Verify that the topsoil is ready in accordance with Section 32 93 00 to receive the Work of this section.
   2. Confirm notification with the Engineer in writing.
   3. Failure to notify at start of work constitutes acceptance of existing conditions.

3.02 SCHEDULE FOR SEEDING

A. Seeding, soil amendments, and installation of erosion control blankets and turf reinforcement mat shall be performed during the following time frames:
   1. Native seeding shall be conducted as a dormant seeding after October 15 through December 31 excluding times when the ground is frozen or covered with snow.
      a. No seeding shall be outside of the specified window without the Engineer's prior written approval.
      b. Weather conditions within season shall govern actual planting periods.
      c. Seasons may be extended upon approval by the Engineer, however, such time extensions shall not change Contractor's responsibility for establishing healthy and vigorous vegetation.
   2. Turf seeding shall be performed between April 1 and May 15 or between August 1 and September 15. The Contractor may elect to perform this seeding immediately after work progress allows; however, all responsibility for supplemental watering to stimulate germination and sustain growth shall rest with the Contractor. Guaranty and maintenance requirements as specified herein are not changed or relieved by the timing of seeding.

3.03 SEEDBED PREPARATION

A. Surface Preparation:
   1. Gullies and washout shall be filled to conform to desired shape and final grade. Entire area to be seeded shall be reasonably smooth before actual seedbed preparation begins.
   2. Stones, sticks, and stumps larger than one (1) inch in any dimension, and other debris which would interfere with seeding operations, growth or maintenance of vegetative cover shall be removed.
   3. Any existing weeds shall be treated with a non-selective non-residual herbicide prior to

seeding. Comply with directions on herbicide label including reseeding interval.

B. Seedbed Preparation:
   1. Seedbed shall be prepared with suitable tillage equipment to a three (3) inch minimum depth.
   2. Area to be seeded shall be worked until all soil particles are reduced to a size not larger than one (1) inch in the largest dimension.
   3. Prepared surface shall be free from all weeds, clods, stones, roots, sticks, rills, crusting and caking.

C. Inaccessible Areas:
   1. For areas inaccessible to machinery, a suitable seedbed shall be prepared to a minimum depth of one (1) inch, using hand tillage tools such as a rake or other suitable tillage tools.

D. Restrictions: Contractor shall suspend seeding operations when soil is too wet, too dry, frozen, untillable, or at request of the Engineer.

B. If compaction is present in graded areas (e.g. haul roads), chisel plowing the upper three (3) to six (6) inches using a construction ripper, rock rake, or similar equipment will be required in addition to seedbed preparation described above.

F. Approval:
   1. Seeding shall commence immediately after seedbed preparation, or at a later time provided seedbed remains in a friable condition suitable for seeding.
   2. If topsoil has become compacted, crusted over, glazed, or otherwise unfavorable for seeding, Contractor shall repeat seedbed preparation at no additional cost to MWRDGC.
   3. No seeds shall be sown until the seedbed has been approved by the Engineer.

G. If the long-term (i.e. permanent) seed matrix is not installed with the temporary cover crop, the permanent matrix shall be planted in the first available dormant seeding season.

3.04 FERTILIZATION (TURF SEEDING ONLY)

A. Fertilizer shall be applied at a rate of two (2) pounds of nitrogen per 1,000 square feet or 87 pounds of nitrogen per acre using a calibrated drop spreader or other mechanical method that will result in uniform coverage. Application of fertilizer by hand is not acceptable.

B. Fertilizer shall be applied prior to turf seeding. No fertilizer shall be applied until the Engineer has inspected and approved the products.

C. Use of fertilizer outside of turf seeding areas is prohibited. No fertilizer shall be applied in areas of native seeding including Wetland Terrace, Mesic Prairie, Shoreline, and Riparian.

3.05 SEED INSTALLATION

A. General:
   1. All areas of bare soil which have been graded or otherwise disturbed by construction shall be seeded, unless below normal water level or specified on the plans otherwise. Refer to the plans for locations of the specified seed mixes. No seed shall be sown during unfavorable conditions such as high winds or very wet soil.
   2. Temporary work areas, staging areas, haul roads, and all other similarly disturbed areas which require restoration shall be prepared and seeded according to the requirements of this section.
   3. Contractor shall provide the Engineer 48 hours notice of intent to perform seeding operations.
   4. Seeding operation shall be performed immediately after preparation of seedbed and approval is received from the Engineer.
   5. Ideally, seeding shall occur when the soil is moist to dry-damp and shall be timed such that rainfall occurs within 48 hours of seeding (particularly if seeding in early spring). No seed shall be sown when winds exceed a velocity of ten miles per hour or when the ground is not in proper

condition for seeding. No seed shall be sown until purity testing has been completed and approved for the seeds to be used. Only seeds meeting noxious weed requirements shall be used.

6. The last areas to be seeded/re-seeded will be site access points.
7. Seeded areas impacted by the Contractor's vehicular traffic or other such damages shall be reseeded by the Contractor without delay and at no additional cost to MWRDGC.
8. All seeded areas shall be protected from erosion and sedimentation. Erosion and sediment control measures shall be installed as detailed on the plans and in the specifications. Erosion control blankets and turf reinforcement mat shall be in accordance with the requirements of this section and in accordance with the plans.

B. Native seeding:
   1. Native seeding includes the following zones and mixtures: Wetland Terrace, Mesic Prairie, Shoreline, and Riparian
   2. The primary method for native seeding is broadcasting with a carrier agent via a mechanical spreader. Hydroseeding can be used for areas with erosion issues, or other hard to access areas, with prior approval of the Engineer. Other methods may be presented to Engineer for consideration. The Engineer will have final approval of the installation method.
      a. Prior to starting work, mechanical seeders shall be calibrated and adjusted to sow seeds at the specified rate.
      b. If a mechanical broadcast seeder (e.g. Cyclone or Seed Slinger) is used, the equipment shall be operated in a manner to ensure complete coverage of the entire area to be seeded. The seed shall be broadcast in two separate applications, with each application of seed overlapping the previous application by one-half the weight to ensure double coverage of the seeded area. For example, half the weight of seed would be installed in a north-south direction and the remaining half would be installed in an east-west direction.
      c. Where soil conditions are too wet or slopes are too steep for mechanical broadcasting, hand broadcasting or hydraulic application of the seed is acceptable on exposed soils only. Seed to be hand shall be mixed with and equal volume of carrier agent to ensure even distribution.
   3. The seed shall be mixed and planted with a granular form of endomycorrhizal inoculants at a rate of 40 pounds/acre.
   4. Roll seeded areas perpendicular to the slope within 12 hours of seeding with a cultipacker or other approved equipment.
   5. The use of rangeland-type seed drills will not be permitted without the written permission of the Engineer.

3.06 EROSION CONTROL

A. Refer to Section 31 25 00.

3.07 SEED PROTECTION AND MAINTENANCE

A. Maintain seeded areas to ensure that intended vegetation becomes well established and exhibits a vigorous growing condition.

C. Protection: Contractor shall take measures to prevent damage to areas of work as follows;
   1. Damage resulting from erosion, traffic, or any other cases shall be repaired by filling with topsoil, tamping, and seeding with the originally specified seed mixture by the Contactor.

D. Weeding:
   1. Contractor shall remove weeds, as defined in Article "Definitions" and other unintentional vegetation by least disruptive means possible. All removed weeds shall be bagged and removed from the project site. No composting of weed materials is allowed on the project site.
   2. Contractor shall provide written options for methods of removal for approval by the Engineer or Landscape Architect prior to weeding.

E. Watering of turf areas:
   1. Furnish sufficient water to apply complete coverage once each week to the seeded areas in an eight (8) hour period penetrating the soil to a minimum depth of four (4) inches until germination.
   2. Weather conditions shall dictate the need for additional watering.
   4. At no time shall a water tank truck be allowed on the seeded areas.

H. After any rainfall event, the Contractor is responsible for maintaining seeded slopes to prevent or repair erosion.

3.08 CLEANING

A. Perform cleaning of the work area during installation of the work and upon completion of the work.

B. Remove from the site excess materials, packaging, debris, and equipment associated with work of this Section upon completion of the work.

C. Contractor shall repair damage resulting from seeding operations to the satisfaction of the Engineer.

3.09 GUARANTY

A. Upon completion of seeding operations, the Contractor shall become responsible for protecting the seeded areas from any damage resulting from foot or vehicle traffic, vandalism, or weather. When possible, isolate and contain the completed areas with temporary fencing or other such means. Erosion or soil subsidence caused by rain shall be repaired to the original grade, prepared for seed, reseeded, and the specified erosion control blanket or turf reinforcement mat reapplied. Any damage which occurs before achieving the performance and guaranty criteria shall be repaired to original specifications by the Contractor at no expense to Owner.

B. Seeded areas shall have a minimum of 90% ground coverage with active growth of installed species and no bare ground greater than two square feet before initial acceptance. The minimum ground coverage shall be achieved within 90 days of the original seeding, excluding the winter months of November through March. The Contractor shall promptly remove any erosion control blankets or turf reinforcement mat and reseed the bare areas according to the specifications as necessary until the minimum coverage is achieved. When weed species interfere with proper establishment, the Contractor shall apply and appropriate herbicide to reduce competition. After each reseeding, the Contractor shall install new erosion control blankets or turf reinforcement mat as originally indicated on the plans.

C. Any erosion control blankets or turf reinforcement mat which becomes displaced for any reason shall be reinstalled to its original condition and position with additional staples. Any erosion control blankets or turf reinforcement mat which becomes damaged or otherwise ineffective shall be replaced with new product. All rills and gullies shall be repaired and the area shall be reseeded prior to reinstallation of erosion control blankets.

END OF SECTION

SECTION 32 93 00
PLANTING AND FINE GRADING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this Section and are hereby made a part of this Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.02 SCOPE OF WORK:

A. The work of this Section includes, but is not limited to, the following:
1. Trees and shrubs.
2. Groundcover, Perennial and Herbaceous plants.
3. Mulch, fertilizer and other soil amendment applications to suit plant type during and after planting.
4. Plant anchoring system.
5. Protecting and Maintaining the Completed Work.
6. Warranty and Maintenance.
7. Coordination with other Trades.
8. Clean up.
9. Post installation maintenance.
10. Warranty

B. Extent of Landscaping Work: In addition to the work indicated, Landscape work includes restoring all areas within the limit of work disturbed by work of the Contract and coordination of work with other subcontractors.

1.03 RELATED SECTIONS:

A. The following items of related work are specified and included in other Sections of the Specifications:
1. Section 01 57 19 – Temporary Environmental Controls.
2. Section 03 30 00 – Cast-In-Place Concrete.
3. Section 04 21 13 – Brick Masonry.
4. Section 31 22 00 – Grading.
5. Section 31 25 00 – Erosion Control and Site Stabilization.
6. Section 32 12 16 – Asphalt Paving.
7. Section 32 16 23 – Sidewalks.
8. Section 32 31 13 – Chain Link Fence.
9. Section 32 31 19 – Ornamental Steel Fence and Gates.

10. and Contract Documents of other separate contract(s):

1.04 REFERENCES:

A. ANLA: American Nursery & Landscape Association.

B. ANSI: American National Standards Institute.

C. AOAC: Association of Official Agricultural Chemists.

D. ASTM: American Society for Testing Materials.

1.05 STANDARDS:

A. The references listed herein shall be the standards used for performance of the Work: All standards shall include the latest and current additions and amendments.

1. American National Standards for Tree Care Operations, ANSI A300. American National Standards Institute, 11 West 42nd Street, New York, N.Y. 10036.
2. American Standard for Nursery Stock, ANSI Z60.1. American Nursery and Landscape Association, 1250 Eye Street. NW, Suite 500, Washington, D.C. 20005.
3. Horticultural Standards, American Nursery & Landscape Association.
4. Hortus Third, The Staff of the L.H. Bailey Hortorium. 1976. MacMillan Publishing Co., New York.
5. Standardized Plant Names, American Joint Committee on Horticultural Nomenclature, 1942 edition.
6. American Society for Testing Material (ASTM).
7. International Society of Arboriculture.

1.06 DEFINITIONS:

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

C. Bare Root Stock: Healthy, vigorous, plants grown without artificial root restriction devices, such as containers or fabric bags and have a well-established and branched root system. All bare root plant material shall be installed no later than the first week in May of each year. Conform to ANSI Z60.1 for storage, kind, type, and size of exterior plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Planting Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. Topsoil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

G. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil. See Section 31 22 00 & Section 31 23 00.

H. Final Acceptance: After all Punch List work has been completed and accepted, the Contractor shall request in writing for the Landscape Architect to perform a final inspection for the purpose of Final Acceptance of the work. The Landscape Architect shall not give Final Acceptance until all Punch List work has been accepted. The maintenance and warranty periods shall not commence until Final Acceptance is granted by the Landscape Architect.

1.07 SUBMITTALS:

A. Submittals shall conform to Division 1 requirements.

B. Product Data: Provide manufacturer's data for each type of product indicated showing installation and limitations in use.

C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following. Submit inspection certificates required by authorities having jurisdiction. Supply Certificates of Compliance for all materials required for fabrication and installation, certifying that each material item complies with, or exceeds, specific requirements.

1. Manufacturer's certified analysis for standard products including, but not limited to:
   a. Soil amendments.
   b. Mulch, maturity certification.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

D. Material Test Reports: Submit certified reports for tests required, including:

1. Mechanical and chemical analysis of existing surface soil and imported topsoil.
2. Miscellaneous tests listed herein. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Qualification Data: For landscape Installer's, Project Manager, Site Superintendent/Foreman, showing years of experience, certifications and licenses, education, projects worked on of a similar size, scale and complexity. For each project list client, type of project, cost of project, duration and role of personnel.

1. Provide a minimum of three project references (name, title, company, phone number and email address) for the Project Manager and Site Superintendent/Foreman. For every project provide at least one Landscape Architectural reference.

F. Samples and Submittals for Verification: Prior to ordering the below listed materials, submit representative samples and submittals to Landscape Architect for selection and approval as follows. Do not order materials until Landscape Architect's approval has been obtained. Delivered materials shall closely match the approved samples. Submit duplicate samples of each type listed below showing full range of color variation, finish and texture that can be expected in the permanent work:

1. Mulch: At least two pint-bag of partially decomposed leaf waste mulch of the type to be used on this project.
2. Staking materials, Wood Stakes and Duck-Bill System.

3. Nursery Source Plant List.
4. Hydromulch Mix (30% paper, 70% wood).
5. Root Dip Mycorrhiza Gel

G. Delivery and Storage: Prior to construction the Contractor shall submit for the Landscape Architect's review and approval a plan showing proposed routing for deliveries and access to the site as well as on site storage of bare root plant material.

H. Plant Source: The Contractor shall submit for the Landscape Architect's review and approval a list indicating the plant botanical and common name, size, quantity, form, rootball, limb height (if applicable) and source for the plants. Plant list shall clearly indicate deviations from the specified plant list and any proposed substitutions.

1. Submit a complete list of all plant material for Project with nursery source identification for each plant.
   a. Include in plant list the botanical and common names, size, quantity, form, root ball, limb height (if applicable), other requested data, and source locations for all plant materials.
   b. Include names, addresses, and phone numbers of each nursery source associated with each plant item.
   c. Plant lists shall clearly identify deviations from the specified plants and any approved substitutions. Submit substitution requests, if any, as specified in Division 1 Section 01 33 00 "Submittal Procedures". Where deviations or other changes occur in plant list, identify both the original specified plant item and the new plant item.
   d. Plants listed with submittal shall be available at the nursery for inspection and selection as specified herein. Contractor shall evaluate and verify at proposed nursery source that plant material conforms to the requirements of the Contract Documents prior to scheduling Landscape Architect's inspection and selection/tagging trip.
2. Maintain and re-submit updated Plant List and Source Identification as deviations or other changes occur until Substantial Completion. Submit as a Record Document at completion of Contract work.

I. Plant Photographs: Provide photographs of plant material as indicated herein.

J. Planting Schedule: Indicating anticipated planting dates for plants.

1.08 QUALITY ASSURANCE:

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.

B. Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

1. Employ at Contractor's expense a qualified independent testing and inspection laboratory acceptable to the Landscape Architect and Owner to perform tests and certifications indicated. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists.

C. Plant Materials: Provide quality, size, genus, species, and variety of exterior plants indicated. Provide only healthy, vigorous stock, grown in a recognized nursery acceptable to the Landscape Architect and free from disease, insects, eggs, larvae, and other defects. Provide plants in strict compliance with the recommendations of the following:

1. ANSI Z60.1, American Standard for Nursery Stock, latest edition.
2. American Association of Nurserymen, Horticultural Standards.
3. American Joint Committee on Horticultural Nomenclature, Standardized Plant Names, 1942 edition.
4. International Society of Arboriculture.

D. Labeling: Label at least one specimen of each variety and size with a securely attached, waterproof tag bearing legible designation of botanical and common name in compliance with the recommendations of the American Nursery & Landscape Association.

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Pruning: Pruning of plants is prohibited except to remove dead or broken branches and limbs. Confer with Landscape Architect and Owner before any pruning. Plants pruned without permission from the Landscape Architect and Owner is subject to rejection and replacement.

G. Inspection: Landscape Architect will inspect plant materials at place of growth before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect and Owner retains right to inspect plant materials further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work even if previously inspected and approved. Remove and replace rejected plants immediately from Project site at no change in Contract Amount.

1. Selection: All plants shall be tagged in the nursery by the Landscape Architect prior to digging of plants. The Landscape Architect and Owner shall place seals on selected plants at the nursery. Seals shall remain on plants until the acceptance of the work. At least three weeks prior to expected planting date, request, in writing, the Landscape Architect's inspection of plant material at the nursery. The Landscape Architect shall make their own travel arrangements.
2. Photographs: At the Landscape Architect's option and/ or request, the Contractor shall supply the Landscape Architect with photographs of plants for the project.
    a. The photographs shall be taken at the nursery source. Photographs shall include images showing the full range of characteristics of each plant including detailed photographs of the bark, the base of the tree (rootball crown), leaves, branching structure, form, and habit. Images shall include a scale figure or measuring device to indicate true size.
    b. Contractor shall label each photograph with the plant species botanical name, nursery name, and date of photograph.
3. Nursery Source: The Landscape Architect shall have the right to reject any nursery source if he/ she determine before, during or after inspecting or receipt of plants, any of the following:
    a. The nursery stock does not meet quality standards set forth herein.
    b. The nursery stock does not meet the intended visual characteristics of the plants as determined by the Landscape Architect.
    c. The nursery cannot supply the specified plant(s) or an acceptable substitute cultivar or species.

d. The nursery's cultural practices or maintenance procedures do not meet specified standards.
e. The nursery or plants are infested with pests or disease.

H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1.

I. Plant Sources: The Contractor shall submit to the Landscape Architect any questions regarding the source of any plant. The Landscape Architect has endeavored to locate plants at the nursery sourced below. Additional sources may be used for plants not available at the nurseries listed below provided the Landscape Architect has approved the source.

1. Trees have been located at the following sources, however makes no claim or in no way guarantees that the plants will be available at the time of installation:

a. Kaneville Tree Farms Inc.
P.O. Box 167
3S320 Harter Road
Kaneville, IL 60144
Tel: 630.557.2793

b. Kankakee Nursery
P.O. Box 288
Aroma Park, IL 60910
Tel: 815.937.9358

c. Johnsons Nursery
W180 N6275 Marcy Rd
Menomonee Falls, WI 53051
Tel: 262.252.4988

2. Other Plants including Shrubs, Perennials and Groundcover: Other sources include, but are not limited to, those listed below:

a. Hinsdale Nursery
7200 S Madison St
Willowbrook, IL 60527
Tel: 630.323.1411

b. Johnsons Nursery
W180 N6275 Marcy Rd
Menomonee Falls, WI 53051
Tel: 262.252.4988

1.09 DELIVERY, STORAGE, AND HANDLING:

A. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Plants shall be closely monitored for sufficient root moisture. Protect all materials from damage, injury and theft.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1. On-site storage space is limited and is restricted to a 24-hour period for any one material, plant or group of plants. On site storage is permissible only with written notice from the Owner.

2. Deliver materials and plants only after preparations for planting have been completed and accepted, including but not limited to: subdrainage system, irrigation, rough grading,

utilities, decompaction or remediation of soils. The Landscape Architect shall determine if the site is acceptable for planting.

C. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soils and / or topsoil.

D. Deliver plants freshly dug.

E. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery or if plants are to be stored off site set exterior plants in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, sawdust, wood chips, straw mulch, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. During the growing season, stored plant material shall be watered and the rootball kept moist with an automatic drip irrigation system to prevent drying out. Do not move trees if rootballs are saturated. Mist plants several times a day if necessary to reduce transpiration in sunny or windy locations.
4. During the dormant season, rootballs shall be insulated against freezing and cold weather damage. Plants shall be protected from cold, wind and ice damage.
5. During the storage period, inspect all plants for pests and diseases and have them evaluated by a certified arborist.
   a. Before proceeding, report issues and recommend treatment to the Landscape Architect for review and approval.
   b. Whenever possible, select and use organic treatments.
   c. Isolate trees with diseases or pests. Remove any plants from the site and replace if the Landscape Architect determines that they are unusable
6. For plants stored on-site more than 12 hours, the Contractor must keep a maintenance log. The log shall include information on the watering, misting, and protection of plants. The date, time, type of maintenance and name of maintenance personnel shall be included in the log.
7. The Contractor shall fully inspect and maintain plants for the entire duration of the storage period.
8. All stored plants shall remain the property of the Contractor and shall be replaced in kind to meet the standards defined herein for healthy plants and the character and habit defined by the Landscape Architect. The Landscape Architect shall be the sole evaluator whether replacement plants match the originally stored plants.
9. No plant shall be stored more than four weeks at any location without written acceptance by the Landscape Architect or Owner.

1.10 PROJECT CONDITIONS AND COORDINATION:

A. Utilities: Determine and stake the location of all underground utilities before project staking. All project installed utilities should be located in coordination with Illinois One-Call (JULIE) CALL 811 OR 1-800-892-0123.

B. Concealed Conditions: Notify Landscape Architect before planting when below grade conditions are detrimental to proper plant growth are encountered. Do not proceed with planting without specific written instructions from the Landscape Architect.

C. Sequence of Planting: Plant trees and shrubs after finish grades are established and before planting lawns, groundcovers and other herbaceous material, unless otherwise approved by the Landscape Architect. Complete landscaping work as quickly as possible on portions of the site as they become available for landscaping.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
2. The Contractor shall first determine that the installation of erosion control fabric is complete in all meadow areas prior to seeding. The meadows shall be hydroseeded and hydromulched on top of the installed erosion control fabric.

D. Planting Seasons: Work only within seasonal limitations for proper planting as follows:

Item	Spring Season	Fall Season
Deciduous (container)	March 15 to June 1	Sept. 1 to Nov. 15
Deciduous (balled and burlapped)	March 15 to June 1	Sept. 1 to Nov. 30
Evergreens	March 30 to June 15	Sept. 1 to Nov. 15
Groundcover	April 15 to June 15	Sept. 1 to Oct. 15
Perennials	May 15 to June 15	Sept. 1 to Oct. 15 or first frost
Bulbs	N/A	Nov. 1 to Dec. 1

E. Fall Dig Hazard: Many species of trees or shrubs are considered “Fall Transplanting Hazards” by the nursery trade. Fall Transplanting Hazards are to be transplanted only during the spring digging season, except as otherwise authorized in writing by the Landscape Architect. The Contractor shall identify Fall Transplanting Hazards from the plant schedule, and factor the proper handling of these trees into the overall sequencing of construction. The Contractor shall notify the Construction Manager and Landscape Architect of any conflicts arising from this analysis of the plant list and schedule.

1. Fall Dig Hazard species include, but are not limited too:
   a. Acer sp. (Maple)
   b. Betula sp. (Birch)
   c. Cercis canadensis
   d. Cornus sp. (Dogwood)
   e. Fagus sp. (Beech)
   f. Ilex opaca
   g. Koelreuteria paniculata
   h. Malus sp. (Crabapple)
   i. Prunus sp. (Cherry)
   j. Salix sp. (Willow)

F. Water: The Contractor shall bear the cost of supplying all water and shall reimburse applicable governing authorities for all water used for the project.

1. Water connections are available on site. Contractor shall install temporary water meter to measure water consumption. The Contractor shall immediately notify the Owner in writing if water is insufficient for work and maintenance operations.
2. Provide as needed water from sources free from impurities injurious to vegetation.
3. Provide all hoses and equipment as needed to distribute water to area of landscape work and areas needing watering. Provide water tank trucks as needed, at no additional cost, if water service is interrupted. Also refer to Division 1.

G. Painting: Do not paint vegetation for any reason.

1.11 LINES AND GRADES:

A. The Contractor shall provide his own lines and grades for the work required.

1. The Contractor shall determine where the site benchmark is located and set all grade stakes in reference to this point.

B. Grades: If present, protect and maintain grade stakes and location stakes until removal is acceptable to Landscape Architect and all parties involved in this project. If grade stakes are not present, establish grade stakes to ensure that grades shown on the Drawings are being met. See Section 31 22 00.

1.12 ACCEPTANCE AND MAINTENANCE:

A. Request for Acceptance: In writing, request Landscape Architect's inspection for acceptance at least 10 days in advance of preferred inspection date. Do not request inspection for acceptance until work is 100% complete (not including maintenance) and in compliance with the Contract requirements.

1. Partial Acceptance: Acceptance of partial areas or portions of the total work may be granted, at the Owner's option, if the area to be inspected for acceptance is large, well defined, and easily described. The Owner and Landscape Architect are not obligated to provide partial acceptance of the work.

B. Plant and Tree Maintenance: Begin maintenance immediately after planting. Provide complete maintenance and service as required to promote and maintain healthy growth including, without limitation, watering, and per the Owner’s specifications, weeding, fallen leaf removal, treating for insects and disease, resetting plants to proper grade and upright position, and other operations and maintenance work. Throughout the maintenance period, restore planting saucers and mulch, and keep mulch beds weed free. Tighten and adjust guy wires, stakes, and deadmen to keep trees in vertical position. Restore and replace damaged trunk wrappings.

1. Maintenance Period: Completely maintain plants and trees until Final Acceptance of project completion.

2. Watering: Flood all plants during the construction and maintenance periods at least twice each week. If present and operational, coordinate programming of irrigation system to meet watering needs. If irrigation system is not operational, provide hand watering as needed to maintain healthy growth. At each watering, thoroughly saturate the soil around each tree and shrub. If sufficient moisture is retained in the soil as determined by the Owner, the required watering may be reduced. Trees will require a minimum of twenty gallons of water for each watering. Shrubs will require a minimum of ten gallons of water for each watering.

3. Application of insecticides and herbicides is expressly prohibited. Confer with Owner for methods of controlling insect infestation or disease.

1.13 WARRANTY:

A. Warranty: Provide written warranty agreeing to remove and replace work that exhibits defects in materials or workmanship for the specified periods. "Defects" is defined to include, but is not limited to, death, unsatisfactory growth, disease, insect infestation, abnormal foliage density, abnormal size, abnormal color, failure to thrive, and other unsatisfactory characteristics.

1. Warranty Period for Plants: One year from end of maintenance period.
2. Replacement: Replace defective work with new material of same species, size, character, and quality of originally accepted work. With each replacement material, provide a new one year warranty for the replacement work. If a replacement is unacceptable during its one year warranty, the Contractor shall provide another replacement or, when approved by Owner, equivalent cash payment.
3. Replacement Planting Seasons: Replacement for plant warranty work shall comply with the Planting Seasons specified herein.
4. Owner's Responsibilities and Warranty Exclusions: After completion of the Contractor's maintenance responsibilities, the Owner is responsible for maintaining the work in reasonable compliance with the Contractor's maintenance instructions. The Contractor's warranty shall exclude problems due to improper or inadequate maintenance or vandalism.
    a. During the warranty period, the contractor shall visit the site at one-month intervals to review the conditions of the accepted work. The Contractor shall submit in writing to the Landscape Architect and Owner his/ her concerns regarding the Owner's maintenance practices and/ or any vandalism. The content of this notice shall include a list of specific plants involved, the presumed problem, and a method of remedy for the problem(s) cited. The Owner shall make reasonable efforts to correct the problems cited by the Contractor but the Owner shall not be held responsible for the Contractor's defects in materials or workmanship that result in decline or death to plants.
    b. Failure of the Contractor to make the required monthly review of the site during the warranty period and to submit written notice to the Owner and Landscape Architect of maintenance defects shall negate the Contractor's ability to make a claim against the Owner for negligence of maintenance.

PART 2 - PRODUCTS

2.01 PLANTING SOIL AND TOPSOIL

A. Refer to Sections 31 22 00 & Section 31 23 00.

2.02 PLANT SOURCES

A. The Contractor shall submit to the Landscape Architect any questions regarding the source of any plant.

B. Contract growing of some plants may be required. The Contractor shall identify plant species in need of contract growing within four weeks of beginning work.

2.03 DIGGING SEASON

A. Plants shall be delivered freshly dug. Plants that have been pre-dug the previous season shall not be accepted.
    a. Spring Dig: Plants shall be dug as early as possible and as determined by the nursery owner, and no later than bud break.
    b. Do not transport plants within 14 days after bud break.
2. Fall Dig: Plants shall be dug following leaf senescence.

a. Fall Dig Hazard: Many species of trees or shrubs are considered “Fall Transplanting Hazards” by the nursery trade. Fall Transplanting Hazards are to be transplanted only during the spring digging season. The Contractor shall identify Fall Transplanting Hazards from the plant schedule, and factor the proper handling of these trees into the overall sequencing of construction. The Contractor shall notify the Landscape Architect of any conflicts arising from this analysis of the plant list. Fall Dig Hazards are listed on the Drawings.

2.04 SELECTION AND INSPECTION OF PLANTS

A. The Landscape Architect will review plant materials at the nursery source and/or at the Landscape Architect’s discretion, through photographs provided by the Contractor prior to selection. All plants brought to the site will have been reviewed in this manner. Plants that do not have the Landscape Architect’s approval shall be removed from the site.

1. Tagging: At least three weeks prior to the expected planting date, request, in writing, the Landscape Architect’s inspection of plant material at the nursery. Provide photographs beforehand if requested by the Landscape Architect.
   a. The Landscape Architect will make his/her own travel arrangements to the nursery.
   b. Seals placed on the selected plants at the nursery shall remain on the plants until Final Acceptance of the work.
2. The Landscape Architect’s basis of plant selection will include:
   a. Conformance with specified genus, species, variety, size, form, rootball and quality.
   b. The visual characteristics of the plants.
   c. Plant health.
   d. Adherence of the nursery to cultural practices and maintenance procedures that are at or above industry standard.
3. On-Site Inspection:
   a. The Contractor shall permit the Landscape Architect to inspect plants upon their arrival to the project site and at any time prior to planting. The Landscape Architect will inspect the plant materials for size and condition of rootballs and/or root systems, insects, injuries, defoliation, wind burn and latent defects. The Contractor shall remove plant material that is unsatisfactory or defective and replace the plants at no additional cost to the Owner.
   b. The Landscape Architect may reject a specific nursery source and associated plants if he/she determines before, during or after receipt of plants, any of the following:
      1) The nursery stock does not meet health standards set forth herein, including disease and infestation.
      2) The nursery stock does not meet the requirements of the Landscape Architect’s basis of selection as stated herein.
      3) The nursery cannot supply the specified plant(s) or an acceptable substitute cultivar or species.

B. Substitutions

1. In the event that the Contractor is unable to obtain the plant material specified, either because of unavailability or the failure of the plant material to meet the quality requirements of this Section, the Contractor shall provide substitute plants of equal size, quality and value to the plant originally specified. The substitute plants shall conform to all requirements of this Section and shall not be considered accepted without the written consent of the Owner.

2.05 PLANT MATERIALS:

A. General: Furnish specimen nursery-grown plants of genus, species, and cultivar specified complying with ANSI Z60.1, with healthy root systems well provided with fibrous roots developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement. All parts of the plant shall be moist and show active green cambium when cut. Plants will be densely foliated when in leaf.

B. Grade: Provide plants of specified height, caliper, sizes and grades complying with ANSI Z60.1 for type of plants required.

1. Larger Stock: Plants larger than required may be used if approved by Landscape Architect, if root ball is proportionately larger, and if there is no change in Contract Price.
2. Undersize Stock: Not more than 10% of plants smaller than required may be used if approved by Landscape Architect, if equal number of oversize plants are provided to make average size equal or greater than size required, and if undersize plants are larger than the average size of the next lowest size grade.

C. Hardiness: Provide plant stock certified to have been grown within hardiness Zones 2 through 8 as established by the 2012 USDA Plant Hardiness Zone Map. Plants without this certification will be rejected.

D. Plant Character: All plants, except custom grown plants as shown on the Drawings, shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. Form and size shall comply with ANSI Z60.1.

1. Deciduous Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated.
   a. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
2. Deciduous Shrubs: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
3. Evergreen Trees and Shrubs: Well-balanced evergreen plants, of type, height, spread, and shape required, complying with ANSI Z60.1.
4. Broadleaf Evergreens: Well-balanced broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
5. Groundcover and Vines: Provide groundcover and vines of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.
6. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.
7. Bulbs: Bulbs shall be Top Size for species specified as defined by ANSI Z60.1, firm of flesh, free from decay and disease. Bulbs shall be certified as being grown for the season in which they will be installed.

E. Trunk: The height of the trees (measured from the crown of the roots to the tip of the top branch) shall be not less than the minimum size designated. The trunk of each tree shall be a single trunk growing from a single un-mutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire or other causes. No pruning wounds shall be present having a diameter exceeding one inch and such wounds must show vigorous bark on all edges. Plants shall not be pruned prior to delivery. No trees with double-leaders or twin-heads shall be acceptable. The Contractor shall reject such plants at time

of delivery by the nursery/supplier unless such plants were selected by the Landscape Architect as indicated by tags and seals.

F. Rootballs:

1. General:

a. The diameter and depth of rootballs shall be sufficient to encompass the fibrous and root feeding system necessary for the healthy development of the plant in accordance with ANSI Z60.1., or the minimum rootball diameter shown, whichever is larger.

1) If the root flare is buried 2” or more, provide a larger diameter or greater depth rootball to compensate for the buried root flare, as the soil overburden shall be removed prior to planting, which effectively reduces the size of the rootball.

b. No plant will be accepted when the ball of earth surrounding its roots has been cracked or broken prior to or during the process of planting or after the burlap, staves, ropes or platform required in connection with its transplanting have been removed. The rootballs shall remain intact during all operations.

c. Girdled Roots: Inspect root crown for girdling roots. Inspection for girdled roots shall be done at the nursery to the extent possible. If girdled roots are not visible at the nursery and are revealed before acceptance, any plant with a girdled root over 1/2” shall be rejected.

G. Balled and Burlapped: All plants to be moved balled and burlapped shall be moved with the root systems as solid units with balls of earth firmly wrapped with burlap, firmly held in place by a stout cord and drum lacing, or wire basket. Burlap for containing rootballs shall be untreated, made from biodegradable natural fibers.

H. Container Stock: Container stock shall have a full container of well developed root system. Plants loose in the container are not acceptable. The surface of the root zone shall be free of circling or kinked roots. Staked plants must be self supporting when unfastened from the stake. When removed from the container, the root ball shall be free from numerous circling roots. Large matted roots at the sides or bottom of the container will not be accepted. Container grown plants may be accepted for balled and burlapped material if approved by Landscape Architect.

I. Handling of Plants: Plants delivered by truck and plants requiring storage on site shall be properly wrapped and covered to prevent wind-drying and desiccation of branches, leaves and buds; plant balls should be firmly bound, unbroken, reasonably moist to indicate watering prior to delivery and during storage, tree trunks shall be free from fresh scars and damage in handling and all bare root material shall be heeled in if not planted within 10 hours of delivery to site. All seed mixes shall be stored in a cool, dry location.

2.06 MULCHES:

A. Well Rotted Leaf Mulch: Provide partially decomposed minimum six month aged finely shredded leaf mulch with dark brown color and free of weeds, excessive fine particles, stringy material, and chunks of wood or sticks thicker than 1/4”. Provide leaf mulch approved by Landscape Architect.

2.07 STAKING AND GUYING MATERIALS

A. Extent of staking and guying shall be reviewed with the Landscape Architect and Owner prior to installation.

B. Stakes: Provide 2” diameter un-peeled cedar staked for all balled and burlapped trees, 3 per tree. Tie shall be “ArborTie.”

1. ArborTie Manufacturers
   a. DeepRoot Green Infrastructure, 5030 Washington Street, San Fransisco, CA, Tel: 800.458.7668, www.deeproot.com
   b. Forestry Suppliers Inc., www.forestry-suppliers.com
   c. Gempler’s, www.gemplers.com
   d. Or approved equal.
2. Tree Protective Collar: Nylon of color indicated and approved by Architect.

2.08 PLANT ANCHORING SYSTEM:

A. Rootball anchoring system shall be as manufactured by Platipus Anchors, Inc., 2008 Garner Station Boulevard, Raleigh, NC 27603, Tel: 866.752.8478, or approved equal. System shall be Platipus rootball fixing system, including Plati-Mat, Model # RF2RP.

1. Work with manufacturer to confirm the correct size of anchoring system for specified trees.

2.09 ANTI-DESSICCANT:

A. Provide emulsion type, film forming agent designed to permit vapor transmission but retard excessive moisture loss. Provide “Vapor Guard” or Landscape Architect’s approved equivalent.

1. Use anti-desiccant only with the approval of the Landscape Architect.

2.10 MISCELLANEOUS MATERIALS:

A. Plywood: Provide 3/4” Grade C or better plywood for use as planking when driving vehicles or equipment over lawns or areas to be planted. The driving of vehicles over planted areas is expressly prohibited.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means installer accepts substrates, subgrades, previous work, and conditions.

3.02 PREPARATION:

A. Pre-Installation Examination Required: The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and notify Landscape Architect in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means Contractor accepts substrates, previous work, and conditions. The

Contractor shall not place any planting soil mixtures until all work in adjacent areas is complete and accepted by the Landscape Architect.

B. Concealed Conditions: Notify Landscape Architect before planting when below grade or on-structure conditions detrimental to proper plant growth are encountered. Do not proceed with planting without specific written instructions from the Landscape Architect. At the Landscape Architect's direction and at no additional expense to the Owner, plants shall be relocated to avoid the obstruction.

C. Deliver materials and plants only after preparations for planting have been completed and accepted, including but not limited to: planting soil/topsoil, rough grading, utilities, decompaction or remediation of soils. The Landscape Architect will determine when the site is acceptable for planting.

D. Layout and Approval: Layout and stake individual trees and obtain Landscape Architect's approval before starting installation. After staking is accepted, set plants in place for final review and acceptance by the Landscape Architect. Contractor shall not stake plant locations for Landscape Architects approval until proper subgrade, drainage, and topsoil preparations have been completed. Make revisions and adjustments as directed by Landscape Architect.

3.03 PLACEMENT OF PLANTING SOIL / TOPSOIL:

A. Refer to Sections 31 22 00 and 31 23 00.

3.04 HANDLING OF PLANTS

A. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape.

B. Provide a double tarp protective covering over exterior plants during transport.

C. Do not drop exterior plants during delivery.

D. Do not loosen drum-lacing nor remove container-grown stock from containers before time of planting.

E. Do not move trees if rootballs are saturated.

F. Handle planting stock by supporting the rootball or container.

3.05 TEMPORARY STORAGE OF PLANTS

A. Storage – General

1. For plants stored on or off-site for more than 24 hours, the Contractor shall keep a log that records dates of watering.
2. The Contractor shall fully inspect and maintain plants for the entire duration of the storage period.
3. All stored plants shall remain the property of the Contractor and shall be replaced in kind to meet the standards defined herein for healthy plants and the character and habit

defined herein. The Landscape Architect shall be the sole evaluator of whether replacement plants match the originally stored plants.

4. No plant shall be stored more than four weeks without written acceptance by the Landscape Architect.

B. Storage of plants less than one week:

1. If planting is delayed more than six hours after delivery of plants to the site, the Contractor shall adhere to the following practices:
   a. Set plants in shade, protect from weather and mechanical damage, and keep roots moist.
   b. Store plants upright with room between rootballs.
   c. Closely monitor plants for sufficient root moisture.
   d. Store all plant materials in a secure and clean location, free from conditions that would be harmful and/or deleterious to the immediate or long-term health of the trees.

C. Storage of plants more than one week:

1. The Contractor shall store plants at a location mutually agreed upon by the Contractor and Landscape Architect.
2. Space plants sufficiently apart to prevent damage or death to branches and leaves. During all seasons, set balled stock upright and plumb on firm ground and cover the ball with fully aged and decomposed wood mulch or other material acceptable to the Landscape Architect
3. During the growing season, stored plant material shall be watered and the rootballs kept moist with an automatic drip irrigation system to prevent drying out. Mist plants several times a day as necessary to reduce transpiration in sunny or windy locations.
4. During the dormant season, rootballs shall be insulated against freezing and cold weather damage. Plants shall be protected from wind and ice damage.
5. During the storage period, inspect all plants for pests and diseases and, if found, have them evaluated by an arborist certified in the state where the project is located.
   a. Before proceeding, report on the presence of any diseases or pests.
   b. Before proceeding, report on issues and recommended treatment to the Landscape Architect for review and approval.
   c. Whenever possible, select and use organic treatments.
   d. Isolate trees with diseases or pests and remove and replace if the Landscape Architect determines that the plants are unusable.

3.06 PLANT LAYOUT

A. Horizontal Layout: The plant locations shown on the Drawings are approximate. The Contractor shall layout the final location of individual plants by stake or flag and obtain the Landscape Architect's approval of locations before starting installation. After staking is accepted, set plants in place for final review and acceptance by the Landscape Architect. The Contractor shall make revisions and adjustments as directed by the Landscape Architect.

1. Contractor shall not stake plant locations until proper subgrade, drainage, and subsoil layers are installed.
2. Indicate the species and size of plant on the stake or flag.

B. Vertical Layout: Set the elevation of trees through the use of string lines or by instrumentation. Demonstrate to the Landscape Architect through the use of stakes and string that trees have been set at the correct elevation prior to completing planting and installing topsoil, if requested.

3.07 PLANTING WOODY PLANTS

A. General

1. Sequence of Planting: Plant trees and shrubs after the subgrade has been accepted and concurrently with the horticultural subsoil planting soil layer unless otherwise approved by the Landscape Architect. Complete landscaping work as quickly as possible on portions of the site as they become available for landscaping.
2. If plants are installed in planting pits, scarify sides of pits before placing trees.
3. Grade stakes: If present, protect and maintain grade stakes and location stakes until removal is acceptable to the Landscape Architect and all parties involved in this project. If grade stakes are not present, establish grade stakes to ensure that grades shown on the Drawings are being met.
4. Painting: Do not paint vegetation for any reason.

B. Rootball and Rootflare

1. Rootball Pedestals: Provide a rootball pedestal composed of subgrade fill immediately beneath the ball or root mass. Pedestal shall provide the relationship to finish grade described below and prevent settlement of the plant. Compact pedestal to 95% Standard Proctor.
2. Identifying and Exposing the Root Flare: Prior to setting the height of the rootball pedestal, the Contractor shall remove burlap and twine from the top of the rootball and inspect each plant to determine if the trunk flare is buried within the rootball. If buried, the Contractor shall expose the trunk flare by removing excess fill on top of rootball, taking care not to damage the bark or roots while removing the soil overburden. Adventitious roots and girdling roots shall be removed with sharp pruners. Adjust the rootball pedestal to position the trunk flare 2”-3” higher than the proposed finished grade.
3. Wire Baskets: Once set, completely remove top one-third of wire basket. For the remaining bottom two-thirds of the wire basket, cleanly cut each tier of horizontal wires making one cut centered between each set of vertical wires.
   a. Burlap: Completely remove top one-third of burlap.
4. Drum lacing and Burlap: Once set, remove top one-third of lacing and burlap.
5. Containerized plants: Completely remove container. Cut out container with a sharp blade if container does not readily separate from the rootball.
6. Scarification of Balled and Burlapped Plants: The Landscape Architect will examine the exposed rootball and determine if the Contractor shall scarify the sides of the rootball. Scarification shall result in no additional expense to the Owner.
7. Scarification of Containerized Plants: The Contractor shall scarify the rootballs of container plants with a sharp blade 2” in length. Rest the plant on its side and scarify an ‘X’ on the bottom of the root mass. Then make vertical cuts that are the full height of the rootball every 3” o.c of the full circumference.
8. Rootballs shall be kept in a moist, but not wet, condition. Protect rootballs from damage due to sun and wind. Contractor shall strictly limit the time between exposing the rootball and backfilling. Protect exposed rootballs with burlap or other shading device until backfilled.

C. Placement of Planting Soil / Topsoil at Woody Plants: Place planting soil / topsoil to finish grade as indicated in the Drawings.

1. Maintain at all times during the planting operations at least one stockpile of each approved type of plant soil or topsoil.

2. Planting soil shall be in full contact with the rootball, with no voids or air pockets. Where burlap is present, burlap shall be tightly pressed between backfill and rootball. Folded or bunched burlap will create an obstruction to backfill and rootball contact and shall be removed.
3. Backfilling of Tree Pits: Backfill with planting soil / topsoil in 6” layers. Handtamp each layer to eliminate voids and air pockets before placing subsequent layers. Continue until backfill has reached finish grade shown on the Drawings.
4. Watering Dish and Mulch: Construct a watering dish of topsoil / planting soil at the limits of excavation as shown to promote water infiltration into the root zone. Hand-tamp edges of topsoil watering dish to be firm and withstand hose pressure. Cover watering dish with mulch, leaving a 4” gap between mulch and the trunk. .

D. Watering:
1. Flood all plants with water twice within the first 24 hours after planting. Take care to avoid saturating adjacent soils where planting operations are ongoing. Monitor water pressure. Displacement of soil materials including watering dish by watering shall not be acceptable.

E. Plant Anchoring System: Install tree stakes immediately after planting to maintain trunk plumb.

3.08 PLANTING POTTED HERBACEOUS PLANTS

A. The Contractor shall scarify the rootballs of container plants. Using a sharp knife, make vertical cuts the full height of the rootball at a depth of 2” and every 3” o.c.

3.09 PLANTING HERBACEOUS PLUGS

A. Install the plug so the stem base is at or slightly above finish grade. Plant plugs fully into planting soil, not mulch.

B. Install plugs to their full depth. A “J-Root” installation shall not be acceptable.

C. Tamp each plug in place so that it is firmly seated in the soil, with no air pockets.

D. In areas that receive periodic inundation, installation to be performed with a crossed sod staple. Extent of this installation is to be reviewed with the Landscape Architect in the field during planting layout.

3.10 SOIL DIAGNOSTICS DURING THE MAINTENANCE PERIOD

A. If plants exhibit unsatisfactory growth during the maintenance period, perform soil testing for chemical properties, compaction and infiltration rates. Adhere to Landscape Architect’s recommend remediation. Remediation may include, but are not limited to, soil amendments, Liquid Biological Amendment treatment, or soil decompaction.

3.11 PLACEMENT OF MISCELLANEOUS MATERIALS:

A. Fertilizer: Apply organic fertilizer as required by soil analysis and approved by Landscape Architect. Refer to Section 31 25 00.

3.12 FINE GRADING:

A. Prior to fine grading, Contractor shall verify that the rough grading, under drainage system, and planting soil / topsoil have been accepted.

B. Fine Grading: Set sufficient grade stakes for checking the finished grades. Stakes must be set at the bottom and top of slopes and the centers of plant beds. Grades shall be established which are accurate to 1/10th of a foot either way. Connect contours and spot elevations with an even slope. All grading will insure drainage away from structures.

1. After topsoil mix has been spread, it shall be carefully prepared by scarifying and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over one inch in diameter shall be removed from the topsoil. Topsoil shall also be free of smaller stones in excessive quantities as determined by the Landscape Architect.
2. Fine grade planted areas to smooth, free draining, even surfaces with fine texture. Roll, rake and drag areas to flatten ridges and fill depressions, except as select areas shown on drawings. Control moisture content to maintain optimum conditions, but do not create a muddy condition.
3. Rolling - Typical: Roll the entire area with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional topsoil and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade or to the shapes and configurations as shown on the details.
4. Maintenance and Restoration: Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to lawn planting.

3.13 TRAFFIC ACCESS:

A. The Contractor is strictly prohibited from tracking or driving over newly planted areas.

B. Restore area disturbed by planting to achieve full healthy growth as approved by Landscape Architect. Vehicular traffic routes must conform to pre-approved routing of construction operations.

3.14 TEMPORARY EROSION CONTROL

A. Refer to Section 31 25 00.

3.15 CLEANING, PROTECTION AND EXCESS MATERIALS:

A. Clean pavements and keep work areas clean and neat during landscape work. Remove all debris from site.

B. Provide temporary protection, as specified and as needed to protect drainage system, restrict traffic, to permit growth to develop, to protect completed work, and to ensure work is without damage or deterioration at time of final acceptance. Remove and replace damaged landscape work prior to acceptance.

1. Protection of Drainage System: Protect existing drainage protection system at all drain inlets to prevent silt, materials or debris caused by planting operations from entering the

drainage system. If drainage protection system is not present, establish erosion control measures. Refer to Section 31 25 00.

2. Excess Planting Soil / Topsoil and Materials: remove the excess planting soil / topsoil and materials from the site at no additional cost to the Owner.

C. Tags: Remove all nursery identification labels, seals and tags at final acceptance of the project.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 05 10
SITE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes Site Piping for:

1. Water piping (W1, W2 and W3)
2. Sanitary sewer
3. Plumbing piping
4. Storm sewer
5. Process mechanical piping
6. Facility Natural Gas Piping
7. Alum casing piping

1.02 REFERENCES

A. AWWA: American Waterworks Association

1.03 SYSTEM DESCRIPTION

A. Systems include yard piping between buildings or structures.

B. Systems are further described and specified in:

1. Water Distribution System: Section 33 11 16
2. Sewer Pipe Systems: Section: 33 31 13
3. Process-Mechanical Piping Systems: 40 05 05
4. Plumbing Systems: Section 22 00 05
5. Facility Natural Gas Piping: Section 23 11 23

1.04 SUBMITTALS

A. Manufacturer's specifications, data sheets, and installation instructions for piping, equipment, and accessories.

B. Include other data as necessary to show compliance with these Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 - PRODUCTS

2.01 WATER PIPE AND FITTINGS:

A. Comply with Section 33 11 16.

B. Tapping Service Connections:

1. Tapping sleeve shall be Ductile Iron meeting ASTM A536. Side flange seals shall be of the O-Ring type of either round, oval, or rectangular cross sectional shape. All sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe. Sleeve shall be coated with asphaltic varnish in compliance with NSF-61.
2. City of Joliet shall perform tapping of all water mains for potable water services. Call 815-724-4220 to schedule appointment.

C. Buried valves for water piping:

1. Resilient wedge gate valves in conformance with AWWA C509 with mechanical joints, cast iron body, bronze-mounted with bronze nonrising stems and O-ring seals. Mechanical joint bolts shall be A-304 stainless steel with nuts and washers of series 300 stainless steel per ASTM A194.
2. Operating nut 2 in., opening left.
3. Internal and external surfaces of valve body shall be epoxy coated in accordance with AWWA C550.
4. Manufacturers:
    a. American Flow Control.
    b. Clow.
    c. East Jordan.

2.02 VALVE BOXES

A. Provide for buried valves.

B. Three-piece screw type, cast iron box and cover with “WATER” cast into lit

C. Valve box diameter 5-1/4 inch, length as required for installation.

D. Provide stainless steel extension stems for water mains deeper than 6’.

E. Manufacturers: EJ Series 8550, Tyler 6850

2.03 FIRE HYDRANTS

A. Manufacturer:

1. EJ 5BR250
2. Clow Medallion
3. Mueller Centurion A423.

B. Compliant with AWWA C502 (Dry Barrel). Self-draining, non-freezing, compression type hydrant.

C. Provide compression type with a 5¼-inch minimum size main valve assembly, O-ring seals, two 2½-inch hose nozzles, and a 4½-inch pumper nozzle with National Standard threads, a National Standard operating nut, and an above ground break flange.

D. Interior parts shall be of brass construction and removable without excavating the hydrant.

E. Tamper-proof removable handwheel option.

2.04 SANITARY SEWER (DRAIN)

A. Comply with Section 33 31 13.

2.05 STORM SEWER

A. Comply with Section 33 31 13.

2.06 PROCESS MECHANICAL PIPING

A. Piping: comply with Sections 40 05 05.
B. Valves: comply with Section 40 05 53

2.07 Facility Natural Gas Piping

A. Comply with Section 23 11 23

2.08 BACKFILL, COVER AND BEDDING MATERIALS

A. Comply with Section 31 23 33.

2.09 CONNECTING DISSIMILAR PIPE MATERIALS

A. Provide factory fabricated connecting piece meeting same structural and joint testing standards as adjacent new piping.

2.10 BURIED INSULATION

A. Manufacturers:

1. Dow Chemical Company, Styrofoam HI 60.
2. U.C. Industries, Inc., Foamular 600.
3. Or equal.

B. Rigid, closed-cell extruded polystyrene insulation, moisture-resistant and suitable for buried installations.

2.11 UNDERGROUND PIPE TRACE WIRE

A. Tracer wire shall be NEPTCO Tracesafe.

B. All tracing wire splices shall be spliced with Direct Bury Splice Kit as manufactured by 3M, or equal.

2.12 CASING PIPE FOR ALUM TUBING - SOLID WALL POLYVINYL CHLORIDE (PVC)

A. Schedule 80 PVC pipe and fittings: comply with Sections 40 05 05 and 40 05 31.13.

B. Provide special shapes and fittings. Use long-radius type bends. Provide solvent weld joints. Butted ends or slip-on joints not acceptable. Provide solvent as recommended by pipe manufacturer.

2.13 FITTINGS FOR DUCTILE IRON OR PVC PIPE

A. Mechanical joint, except mechanical joint required where tie rods used.

B. Mechanical joints and Meg-a-lug retainer glands shall be provided where restrained joints are required to resist thrust and deflection.

C. Compact style in accordance with AWWA C153.

D. Cement Lined: AWWA C104.

PART 3 - EXECUTION

3.01 BURIED PIPING INSTALLATION

A. Comply with Section 31 23 33 and material and system specifications for piping being installed.

B. When new pipe is to be connected to existing pipe not terminating in manhole, uncover end of existing pipe to allow adjustments in line and grade before any pipe is laid.

C. Lay pipe to line and grade shown on Drawings.

D. For gravity piping, begin laying pipe from lowest point in proposed pipe line.

E. For pressure piping, lay pipe at continuous slope between invert elevations shown at building faces, unless otherwise noted.

F. Lay pipe with bell end of bell and spigot pipe pointing upgrade.

G. Lay gravity pipe uniformly to line and grade so finished pipe presents uniform bore.

H. Noticeable variations from true alignment and grade shall be considered sufficient cause for rejection of Work.

I. Record North, Easting and Elevation of all bends and fittings. Provide data to Owner and Engineer as work progresses.

J. Take precautions to prevent foreign material from entering pipe during or after laying operations. If foreign material enters pipe, remove it completely before continuing.

K. Provide watertight plugs for open ends of pipe when laying not in progress.

L. Laying of Pipe in Cold Weather:

1. Heat pipe and jointing materials to prevent freezing of joints.
2. Do not lay pipe on frozen ground.
3. Pipes with rubber gaskets or resilient type joints: Warm gasket or joint material to facilitate making proper joint.
4. With solvent cemented joint: Remove ice and snow from jointed area prior to applying of solvent cement.

M. Wrap buried ductile iron pipe with polyethylene wrap as specified in Section 33 11 16.

N. Lay water main and process mechanical pressure pipe to line and grade so horizontal and vertical joint deflection will not be more than 50% maximum deflection as recommended by manufacturer. Where greater deflections are necessary, proper fittings shall be used.

O. Connect dissimilar pipe materials using factory fabricated connecting pieces.

P. Plug lines and provide necessary thrust restraint until connections to internal and building systems are made.

3.02 VALVE BOX INSTALLATION

A. Center valve boxes on the valves, setting plumb.

B. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.

C. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.

3.03 TRACER WIRE INSTALLATION

A. Install for all pipe except ductile iron.

B. Secure tracer wire to pipe, including stubs and dead ends, at top of pipe and tape at 10 ft intervals.

C. Positively electrically connect wire to valve boxes, hydrants, or terminate at structure. Termination at structures shall be in accordance with details shown in drawings.

D. Where pipe terminates at a structure, bring tracer wire to surface per Detail C490 in the drawings.

3.04 MANHOLE AND INLET INSTALLATION

A. Comply with Sections 33 39 00 and 31 23 33.

B. Construct at locations and elevations shown on Drawings.

3.05 INSULATION INSTALLATION

A. Place at locations of water or drain (sanitary) and process piping where less than 5 feet of cover exists.

1. Prior to placement of horizontal insulation, place bedding material 6 inches deep over top of pipe, level, and compact. Lightly scarify surface of cover material to depth of 1/2 inch.
2. Place horizontal insulation boards on scarified material with long side parallel to centerline of pipe.
3. Place boards in staggered arrangement to eliminate continuous joints. If 2 or more layers of insulation board are used to meet required thickness, place each layer to cover joints of layer immediately below.

B. Backfill First Lift:

1. Backfill with 6 inches of bedding material. End or side dump onto insulation board and spread so construction equipment does not operate directly on insulation.
2. Compact layer with equipment exerting contact stress of 70 to 80 pounds per square inch.

C. After first lift, compact to specified density.

3.06 FIELD QUALITY CONTROL

A. Disinfection:

1. Disinfect potable water lines (W1) in accordance Section 33 13 00.

B. Testing:

1. Test piping systems in accordance with Section 40 05 10 and requirements of applicable systems specifications.
2. Electrical Continuity: Test tracer wire for electrical continuity prior to acceptance of piping.

END OF SECTION

SECTION 33 11 16
SITE WATER DISTRIBUTION PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Potable Water main (indicated as W1 piping on the site plan)
2. Non-potable water (indicated as W2 and W3 piping on the site plan)
3. Tracer wire

1.02 DEFINITIONS

A. American Society of Testing Materials (ASTM).

B. American Waterworks Association (AWWA).

C. The work, materials, and methods of construction under this Section shall be in accordance with the "Standard Specifications for Water and Sewer Main Construction in Illinois", 2009 edition, as jointly published by the Illinois Society of Professional Engineers, The Consulting Engineers Council of Illinois, The Illinois Chapter of the American Public Works Association, the Illinois Municipal League, and the Associated General Contractors of Illinois, and hereinafter referred to as the "Standard Specifications".

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Manufacturer's specifications, data sheets, and installation instructions for piping, equipment, and accessories.
2. Include other data as necessary to show compliance with these Specifications.

C. Submit thrust restraint calculations showing lengths, locations and methods of restraining pipe.

D. Test Results:

1. Results of plant tests shall be included with shipment of materials, with two additional copies of each test results to be furnished to Engineer.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: pipe manufacturer shall have minimum of five (5) years experience

manufacturing pipe in accordance with ASTM or AWWA Standard Specifications.

B. Plant testing for Ductile Iron Pipe:

1. Hydrostatic testing of each pipe to 150 psi per AWWA C-151.
2. Tensile strength testing (60,000 psi minimum).
3. Impact strength testing (7ft-lb minimum).

C. Plant Testing for PVC Pipe:

1. Testing shall be performed on pipe manufactured for this project for:

a. Flattening test per AWWA
b. Sustained pressure test per AWWA
c. Burst Pressure per AWWA
d. Extrusion quality per AWWA
e. Pipe diameter, wall thickness and other dimensions shall be verified as per ASTM D2122.
f. PVC cell classification meets requirements for 12454 in accordance with ASTM D-1784

D. For all pipes

1. For pipe testing frequency, pipe lot shall be defined as pipe of same diameter and class manufactured by same process in one plant, over period not to exceed approximately 2 weeks.

2. Engineer or Engineer's representative may randomly select test pipe from each lot as follows:

a. For lots of 100 or more pipe, 1% of number of pipe in lot with a minimum of 2 pipes selected.
b. For lots less than 100 pipe, 1 pipe will be selected.
c. For lots less than 10 pipes, testing may be waived by Engineer if manufacturing plant has satisfactory specification compliance on other pipe lots.

E. Fusion technician shall be fully qualified by the pipe supplier to install fusible polyvinylchloride pipe of the type and size being used. Qualification shall be current as of the actual date of fusion performance on the project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store in a manner that will exclude dirt and moisture from entering pipe and prevent damage from construction operations.

B. Store pipe and materials in accordance with Manufacturer's recommendations.

PART 2 – PRODUCTS

2.01 DUCTILE IRON PIPE – Potable (W1) and Non-Potable (W2, W3) Water Main 4" Diameter or Larger

A. Pipe: Thickness Class 52 in accordance with AWWA C151.

B. Lining: Cement mortar lining complying with ANSI A-21.4 or AWWA C104, standard thickness.

C. Outside Coating: Zinc coating in accordance with ISO 8179-1 with 1 mil thick asphaltic exterior.

D. Joints: mechanical joints, AWWA C110
1. All joints shall be fully restrained

a. Restraints shall be Meg-a-Lug by EBAA Iron, or equal.
b. All buried nuts and bolts shall be Corten.

E. Fittings: Provide restrained mechanical joints on plugs, caps, tees, and bends deflecting 11 ¼ degrees or more either vertically or horizontally.
a. Restraints shall be Meg-a-Lug by EBAA Iron, or equal.
b. All buried nuts and bolts shall be Corten.

2.02 TYPE "K" COPPER – Potable Water Mains (W1) and Non-Potable Water Mains (W2, W3) of 3" diameter and smaller.

A. See Section 22 00 05.

2.03 TRACER WIRE

A. See Section 33 05 10

2.05 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement ("Polywrap") shall conform to AWWA Standard C105. Encasement shall be three layers of co-extruded linear low-density polyethylene (LLDPE) film fused into one. The polyethylene film supplied shall be distinctly marked (at minimum 2 foot intervals) with the following information or equivalent:
1. manufacturer's name (or trademark),
2. year manufactured,
3. minimum film thickness and material type (LLDPE),
4. range of nominal pipe diameter size
5. ANSI/AWWA C105/A21.5 (compliance)
6. A warning "WARNING–CORROSION PROTECTION-REPAIR ANY DAMAGE"
7. labeled "WATER"

B. Tape shall be polyethylene compatible adhesive and a minimum of 1.5" wide. Shall be Scotchwrap #50, Fulton #355, or Polyken #900.

C. Store all polyethylene encasement out of the sunlight. Exposure of wrapped pipe should be kept to a minimum.

D. Approved suppliers of polyethylene encasement:

1. American Pipe, V-Bio
2. Or equal.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

B. Comply with Section 31 23 33, appropriate paragraphs of this section and pipe manufacturer's recommendations.

3.02 FIELD MEASUREMENT

A. Make necessary measurements in the field to assure precise fit of items in accordance with approved design.

3.03 HANDLING

A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:

1. Carry pipe into position; do not drag.
2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.

B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved.

C. Before installation, inspect each piece of pipe and each fitting for defects.

D. Replace material found to be defective at no additional cost to Owner.

E. Store rubber gaskets in a cool dark place until just prior to time of installation.

3.04 PIPE CUTTING

A. Cut pipe neatly and without damage to pipe.

B. Unless otherwise recommended by pipe manufacturer, cut pipe with mechanical cutter.

C. Cut plastic pipe square, and remove all burrs.

3.05 LOCATING

A. Locate water pipe at least 10 feet away, horizontally, from sanitary or storm sewer pipes.

B. A deviation may be allowed on a case by case basis if bottom of water main is at least 18" above top of sewer pipe and minimum horizontal separation is 3 feet.

C. Where water lines cross under gravity-flow sewer lines, fully encase sewer pipe in concrete for a distance of at least ten feet each side of crossing, or provide pressure pipe with no joint located within 10 feet of crossing.

D. Where water mains cross over sewers, water main shall be at least 18 inches above top of sewer.

3.06 JOINT DEFLECTION

A. Maximum allowable deflection will be one–half (1/2) of amount given in AWWA C600 or the manufacturers recommendation whichever is less.

B. If alignment requires deflection exceeding one-half the limits shown in AWWA C600 or from the manufacturer, furnish bends to provide angular deflections within the limits shown.

3.07 PLACING AND LAYING

A. General:

1. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment. Do not dump or drop materials into trench.

2. Except where necessary in making connections to other lines or in unique circumstances where no options exist, lay pipe with bells facing in direction of normal flow (bell section on upstream end).
3. Rest full length of each pipe section solidly on pipe bedding, with recesses excavated to accommodate bells, couplings, and joints.
4. Relay pipe that has the grade or joints disturbed after laying.
5. Do not lay pipe in water, or when trench conditions are unsuitable for work; keep water out of the trench until jointing is completed.
6. Securely close open ends of pipe, fittings, and valves when work is not in progress.
7. Where any part of coating or lining is damaged, repair in accordance with manufacturers recommendations at no additional cost to Owner.

B. Place and spread pipe bedding material in trench bottom to depth shown on drawings and in accordance with Section 31 23 33.

C. Pipe laying

1. Position pipe and fittings in trench in a manner that identifying markings will be readily visible for inspection.

2. Cutting and joining:

a. Protect against abrasion from serrated holding devices.
b. Remove burrs from surfaces to be jointed and dirt, dust, and moisture by wiping clean with chemical cleaner or dry cloth.
c. Using a pure bristle paint brush, apply an even coat of the specified lubricant on the rubber gasket joint.

3. Insert pipe into bottom of the fitting socket; and push home
4. Align pipe system components without strain and within allowable deflection limits.
5. Provide tracer wire as specified in 33 05 10.
6. Wrap buried ductile iron pipe with polyethylene wrap as specified in AWWA C105.

D. At connections to existing pipe or where different pipe materials connect with each other, use factory-manufactured fittings approved by utility having jurisdiction.

E. Sleeves:

1. Where pipe passes through walls of valve pits or structures, provide cast iron wall sleeves.

2. Fill annular space between walls and sleeves with rich cement mortar.
3. Fill annular space between pipe and sleeves with mastic.

3.08 TESTING AND INSPECTION

A. Closing un-observed work: Do not allow or cause any work of this Section to be covered until after it has been observed and tested.

B. Hydrostatic Pressure Test:

1. Where any section of a water line is provided with concrete thrust blocking for fittings, do not make hydrostatic tests until at least five days after installation of the concrete thrust blocking.
2. Devise a method for disposal of water used for hydrostatic tests.

3. Pressure: 150 pounds per square inch
4. Perform in accordance with section 40 05 10.
5. Replace or remake joints showing visible leakage.
6. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings, and valves. Replace with sound material and repeat the test until results are satisfactory.
7. Make repair and replacement without additional cost to the Owner

C. Disinfection – Disinfect according to 33 13 00. **Not Applicable to W2 and W3 mains**

END OF SECTION

SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

A. Disinfection of new water mains and existing water mains which have been relocated or contaminated by construction operations.

1.02 SUBMITTALS

A. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.

B. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Conform to requirements of this section and regulatory agencies. If requirements of this section are in conflict with requirements of regulatory agencies, the most stringent shall apply.

B. Disinfection shall be acceptable to Owner.

PART 2 – PRODUCTS

2.01 CHLORINE

A. Chlorine gas-water solution or direct chlorine feed is preferred for disinfection.

B. Use of high test calcium hypochlorite or tablet method of disinfection shall be approved by Engineer and in accordance with AWWA procedures.

C. Tablet form calcium hypochlorite may be used only for water mains up to 12 in. dia and less than 2,500 ft in length.

PART 3 – EXECUTION

3.01 GENERAL

A. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651.

B. Contractor liable for damages arising from direct contact of granular calcium hypochlorite with solvent welding materials used to join PVC pipe.

3.02 CHLORINE PREPARATION

A. Liquid Chlorine:

1. Apply chlorine gas-water solution by means of solution feed chlorinating device or, if approved by Engineer, dry gas may be fed directly through proper devices for regulating rate of flow and providing effective diffusion of gas into water within unit.

2. Provide chlorinating devices for feeding solutions of chlorine gas that prevent backflow of water into chlorine cylinder.

B. Calcium Hypochlorite:

1. Prepare granular calcium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1% chlorine solution.
2. To prepare chlorine solution, add 1 lb of calcium hypochlorite (65% to 70% available Cl_2) to 7-1/2 gal water.

3.03 PIPELINE PREPARATION

A. After pressure and leakage tests complete, flush units thoroughly to remove foreign material.

B. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.

C. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.04 APPLICATION OF DISINFECTANT

A. Point of Application:

1. Apply chlorinating agent at supply end of unit.
2. For pipes, apply disinfectant through corporation cock installed in top of pipe.
3. Place tablets in accordance with AWWA C651.

B. Rate of Application:

1. Introduce water at controlled rate in order to regulate chlorine dosage.
2. Proportion rate of chlorine mixture flow to rate of water entering unit so chlorine dose applied produces at least 25mg/l chlorine residual after period of 24 hrs.
3. Method of determining rate of flow of water into unit shall be approved by Engineer.

C. Keep chlorine gas-water disinfecting solution and contaminated water from flowing into units previously disinfected and flushed.

D. Retain chlorinated water in unit long enough to destroy nonspore-forming bacteria. Minimum retention period shall be 24hrs. Minimum chlorine residual shall not be less than 25 mg/l.

E. Operate valves and appurtenances while line or unit is being disinfected to ensure surfaces of valves are disinfected.

F. When approved by Engineer, flush and swab pipe, fittings or valves that must be placed in service immediately with 5% solution of calcium hypochlorite immediately prior to assembly.

3.05 FINAL FLUSHING AND TEST

A. Following chlorination, flush unit or system until replacement water in system is proven to be comparable in quality to water which will enter unit or system.

B. The Owner shall take the water samples and provide testing at their lab at no cost to Contractor. Contractor shall notify Owner when main is ready for sampling and testing. There must be two consecutive days of satisfactory results before service connections can be made.

C. Condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples.

D. If initial treatment results in unsatisfactory bacterial test, repeat disinfection until satisfactory results obtained.

E. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/l.

F. Prevent entry of contaminated water into previously disinfected units or systems.

END OF SECTION

SECTION 33 31 13
SEWERAGE PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide underground sewer pipe materials and installation as shown on Drawings, specified herein, and as needed for a complete and proper installation of Storm and Sanitary systems.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. AASHTO: American Association of State Highway and Transportation Officials

C. The work, materials, and methods of construction under this Section shall be in accordance with the “Standard Specifications for Water and Sewer Main Construction in Illinois”, 2009 edition, as jointly published by the Illinois Society of Professional Engineers, The Consulting Engineers Council of Illinois, The Illinois Chapter of the American Public Works Association, the Illinois Municipal League, and the Associated General Contractors of Illinois, and hereinafter referred to as the “Standard Specifications”.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product data:

2. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
3. Manufacturers recommended installation procedures.

C. Provide certification reports attesting that materials supplied meet referenced specifications

D. Calculations verifying pipe class, ASTM C76, or pipe D-Load, ASTM C655, and pipe floatation (for depths less than 6 feet), shall be furnished to Engineer prior to pipe manufacture.

E. Lining certification and installation guide.

F. Pipe layout/installation guide from manhole to manhole by pipe diameter and pipe class or D-Load, or pipe stiffness rating.

G. Pipe joint certification indicating compliance with 50 ft hydrostatic head rating.

H. Submit in accordance with Section 01 33 00.

I. Results of plant tests shall be included with shipment of materials, with two additional copies of each test result to be furnished to Engineer.

J. Documentation demonstrating compliance with Spec. Section 00 30 80 regarding the use of American iron and steel in the products being furnished under this Section.

1.04 QUALITY ASSURANCE

A. Pipe manufacturer shall have minimum of five (5) years experience manufacturing pipe in accordance with ASTM and AWWA Standard Specifications.

1.05 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-4 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 - PRODUCTS

2.01 GRAVITY SEWER PIPE STRENGTH DESIGN

A. All sewer pipe materials provided shall be designed in accordance with the following criteria:

1. Traffic Loading = HS-20 per AASHTO, Traffic impact = 30% for depths less than 5 feet.
2. Soil loading based upon depth and unit weight of 125 pounds per cubic feet.
3. Trenching and Bedding as per details shown in plans for pipe types and per Section 31 23 33.
4. Ground water table assumed to be at the surface.
5. Saturated soil weight for bouyancy calculations = 62.5 pounds per cubic feet.
6. Safety factor for pipe buoyancy calculations =1.3.

2.02 4-INCHES AND LESS THAN 24-INCHES (STORM, DRAIN, AND SANITARY)

A. Pipe: ASTM D3034, SDR 26. Use elastomeric gasket type (ASTM F477 and ASTM D3212). Gaskets for fittings and joints: provide minimum cross-sectional area of 0.20 square inches (ASTM F477).
B. Branch fittings shall be factor fabricated type, SDR 26.
C. Risers and service pipe and fittings: SDR 26, solid wall type (ASTM 3034)

2.03 SANITARY SERVICE PIPING

A. 4-inches and Smaller: See Section 22 00 05.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with approved design.

3.03 INSTALLATION

A. Trenching and backfill for Work of this Section shall conform to Section 31 23 33 and pipe manufacturer's recommendations.

B. Location with respect to water supply piping:

1. Locate sewer at least 10 feet away, horizontally, from water supply main or service line, as measured from outside edges of pipe.
2. Where water lines cross under gravity sewer lines, a minimum vertical separation of 18 inches shall be maintained between top of water main and bottom of sewer. Water lines shall not cross under sewer lines.
3. Where water lines cross over gravity sewer lines, water main shall be at least 18 inches above sewer.
4. When these conditions are not met, contractor shall:

    a. Fully encase sewer pipe for a distance of ten feet on each side of crossing; or whenever sewer and water main are within eight feet horizontally.
    b. Use acceptable pressure rated pipe for sewer with no joint closer horizontally than five feet from crossing.
    c. Where concrete encasement is used, provide not less than 4 inch thickness around pipe and 6 inches at pipe joints.

C. Pipe laying:

1. Protect pipe during handling against shocks and free fall. Remove extraneous material from pipe interior.
2. Between manholes all gravity pipe shall be of same strength class and as shown on layout/installation guide.
3. Lay pipe by proceeding upgrade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
4. Lay each pipe accurately to indicated line and grade, aligning so sewer has a uniform invert. Noticeable variations from true alignment and grade shall be considered sufficient cause for rejection of Work.
5. Continually maintain interior of pipe free from foreign material. Provide watertight plugs for open ends of pipe when laying not in progress.
6. Before making pipe joints, clean and dry all surfaces of pipe to be joined.
7. Use lubricants recommended by pipe manufacturer.
8. Place, fit, join, and adjust joints to obtain water tight seal.
9. Laying of Pipe in Cold Weather:

    a. Heat pipe and jointing material to prevent freezing of joints, as recommended by manufacturer.
    b. Do not lay pipe on frozen ground.

c. Pipes with rubber gaskets or resilient type joints: Warm gasket or joint material to facilitate making proper joint.

3.04 TESTING AND INSPECTING

A. Do not allow or cause any work of this Section to be covered until after it has been inspected.

B. Test and inspect sewer installation in accordance with Section 40 05 10.

1. Leakage Test

a. Low Pressure Air Test, or
b. Infiltration Test, if top surface of ground water is at least 2 feet above top of pipe for entire test length

2. Deflection Test (Flexible Pipe Only)

a. Perform not sooner than 30 days following installation.

END OF SECTION

SECTION 33 39 00
MANHOLES AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete manholes, risers, and inlets.

1.02 DEFINITIONS

A. American Society of Testing Materials (ASTM)

B. American Association of State Highway Transportation officials (AASHTO)

C. Illinois Department of Transportation Standard Specifications (IDOT) Current Edition including all addenda.

D. Illinois Recommended Standards for Sewage Works (Illinois Standards).

1.03 REFERENCES

A. The work, materials, and methods of construction under this Section shall be in accordance with the “Standard Specifications for Water and Sewer Main Construction in Illinois”, 2009 edition, as jointly published by the Illinois Society of Professional Engineers, The Consulting Engineers Council of Illinois, The Illinois Chapter of the American Public Works Association, the Illinois Municipal League, and the Associated General Contractors of Illinois, and hereinafter referred to as the “Standard Specifications”.

1.04 SUBMITTALS

A. Product data:

1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
2. Manufacturer's recommended installation procedures.

B. Provide certification reports attesting that the materials supplied meet the referenced specifications.

C. Shop drawings for concrete manholes showing all components to be installed.

D. Buoyancy calculations for each manhole documenting that buoyancy is not a problem for each structure. Where buoyancy calculations indicate less than the required safety factor, the CONTRACTOR shall indicate how he will overcome the uplift forces for the completed condition. The criteria for the buoyancy calculations are as follows:

1. Minimum safety factor 1.1.
2. Surface friction with backfill materials shall not be included.
3. Submerged soil weight of 55 pounds per cubic foot where soil weight is used to help hold down the manhole. Only soil directly above manhole or any anti-flotation devices may be included.
4. Water table to grade.

5. No water weight to be included inside structure.
6. Weights of castings, all precast components may be included.

E. Documentation demonstrating compliance with Spec. Section 00 30 80 regarding the use of American iron and steel in the products being furnished under this Section, including reinforcing steel in concrete, manhole castings, frames and lids.

F. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

1.06 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A. Precast sections:

1. Provide reinforced precast reinforced concrete manhole components complying with ASTM C478.

2. Manholes shall be precast for the inside nominal diameter as noted on the Plans.

3. Lift Holes

a. No “see through” lift holes shall be allowed on precast concrete manholes and risers 48 inches in diameter or less.
b. All lift holes on structures greater than 48 inches in diameter shall be thoroughly wetted and completely filled with non-shrink mortar or epoxy grout; then smoothed and covered on the outside, with a trowelable grade butyl rubber base backplaster material to minimize leakage.

4. Adjustment

a. Adjust castings to grade with reinforced concrete rings.

5. Barrel Section Wall Thickness: as per ASTM C478 and IDOT Standard Specs.

6. Integral anti-flotation collars shall be installed around bottom of all manholes that calculations indicate have buoyancy factors of less than 1:1.

B. Joints:

1. Sanitary Structures shall be sealed and watertight. Provide joints meeting requirements of ASTM C443.
2. Joints for precast manhole riser sections shall be made with rubber o-rings or a continuous ring of butyl rubber sealant (EZ-Stik or Kent Seal in trowelable grade, rope form or approved equal). The butyl sealant (rope form) shall be 1-inch diameter equivalent or as recommended by the manhole manufacturer. Provide exterior joint protection. MacWrap or equal.
3. Provide external frame seal conforming to ASTM C923. Infi-Shield Uni-Band or equal.
4. Adjusting rings and manhole frames shall be set with butyl rubber sealant (EZ-Stik or Kent Seal butyl base sealant) troweled into a 1/4 inch thick layer over the entire surface areas of the top of cone and all adjusting rings.
5. For manholes installed in pavement, one rubber composite adjustment shall be provided. EJ Infra-riser or equal.

C. Gravity sewer to Manhole Connections: All connections shall provide for a watertight seal between the pipe and manhole. Incorporate cast-in adapters, boots, to accommodate connection of pipe, provide for grade differential across manhole

1. To connect a sewer to a manhole, a flexible boot. Flexible connectors shall be in accordance with ASTM C923.

a. KOR-N-SEAL flexible boot
b. Or equal.

D. Source Quality Control:

1. Test risers and tops in accordance with ASTM C497 for compressive strength compliance by compression tests on cores drilled from 5% of lot.
2. Number of compression tests may be reduced to 1% of lot, with minimum of two cores per lot, for manhole sections fabricated on sewer pipe machine.
3. Manufacturer's core drilling machine shall conform to ASTM C497. Operator shall take test cores as directed by testing laboratory.
4. Stamp base sections, risers and tops, meeting strength requirements, with appropriate monogram.

2.02 STEPS

A. Manufacturer shall install steps as specified and shown on the drawings. Embed steps into risers or conical top section wall minimum of 3 in.

B. Step design shall comply with ASTM C497, with horizontal pullout load of 400 lb and vertical load rating of 800 lb.

2.03 CONCRETE

A. Provide cast-in-place concrete in accordance with pertinent provisions of Section 03 30 00.

2.04 MORTAR

A. Comply with ASTM C270, type M.

2.05 FRAMES and COVERS

A. ASTM A48, Class 30-B minimum.

B. Provide covers as specified on drawings

C. Provide all frames, gratings and covers from the same manufacturer unless approved by ENGINEER.

D. For Storm water manholes with Closed Cover: Provide standard finish, supplied as a total unit, sized in accordance with the information below with the wording "STORM" and “CITY OF JOLIET” as appropriate in 2 inch high letters cast into the cover.

1. Self-sealing, watertight, having machined bearing surfaces, resilient gaskets and two recessed or concealed lid lifting slots. Lids shall be non-rocking.
2. Manufacturers: Neenah R-1710 or East Jordan Iron Works equivalent 1050Z1.

E. For Storm water manholes with Open Grated Cover: Provide standard finish, supplied as a total unit, sized in accordance with the information below with the wording "STORM" and “CITY OF JOLIET” as appropriate in 2 inch high letters cast into the cover.

1. Neenah R-4040-24 G type grate
2. East Jordan Iron Works equivalent

F. For sanitary or process manholes, including manholes on drain lines or recycle lines, provide solid lid, standard finish, supplied as a total unit, sized in accordance with the information below with the wording “Sewer” and “City of Joliet” cast into the cover.

3. Self-sealing, watertight, having machined bearing surfaces, resilient gaskets and two recessed or concealed lid lifting slots. Lids shall be non-rocking.
4. Manufacturers: East Jordan Iron Works 1050Z1.

E. Castings shall be free from cracks, holes, swells, and cold shuts.

2.06 SEALING CHIMNEYS

A. External Chimney Seals:

1. Manhole chimneys (upper precast section and adjustment rings) on all manholes, including storm inlets and catch basins shall be provided with an external manhole chimney seal.
2. Furnish manholes to minimize the chimney height required, so that chimney seal extensions will not be required. Note that a standard 9 inch seal covers a 6-1/2 inch chimney height.
3. External Chimney Seals shall be Infi-Shield Uni-Band or equal.

2.07 DROP CONNECTIONS

A. Where sewer mains enter the manhole 24” or more above the effluent sewer, a drop connection shall be provided. All drop connections shall be external drop connections constructed as shown in the details on the Drawings.

3.08 EXTERIOR COATING

A. The exterior, below-grade surfaces of all manholes, valve vaults, meter vaults, and pump station wetwells shall be field coated with ConSeal CS-55 or equal as per manufacturer’s instructions.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 INSTALLATION

A. Trench, backfill, and compact for the work of this Section in strict accordance with pertinent provisions of Section 31 23 33.

B. Standard Pre-cast Integral Base:

1. Excavate so structure base rests on a minimum of 6 inches bedding material.

C. Adjustments:

1. Contractor shall adjust all manholes to final grade as shown on the plans or as staked in the field prior to placement of pavement surfaces.

3.04 BACKFILL

A. Backfill with pipe bedding and cover material in accordance with Section 31 23 33.

B. Compaction: Layers shall not exceed 12 inches loose measure and shall be mechanically tamped to 95% Standard Proctor Density to top of manhole.

3.05 MANHOLE TO PIPE CONNECTIONS

A. All field tapped holes for connecting pipe to manholes shall be made by coring. Provide flexible rubber boot connector in accordance with ASTM C-923 around the pipe penetration.

3.06 STRUCTURE BENCHES / FLOWLINES

A. Manhole bench and flow lines shall be neatly finished smooth with hydraulic grout or cement.

B. Shape the invert channels to be smooth and semicircular, conforming to the inside of the adjacent sewer sections.

3.07 SETTING FRAMES AND CASTINGS

A. Set castings to finish grade elevation as identified on plan drawings.

B. Adjust castings to grade with reinforced concrete rings, 2 to 4 inches thick. Do not use more than 6 inches of casting rings.

C. Sealing: Seal interior and exterior of adjusting rings and castings with trowelable mastic sealing material prior to installation of external chimney seal.

3.08 TESTING AND INSPECTING

A. Do not allow or cause any of the work of this Section to be backfilled, covered or otherwise enclosed until after it has been inspected.

B. Manhole Infiltration Inspection. The CONTRACTOR, accompanied by the ENGINEER, shall re-inspect all manholes before the dates of substantial and final completion, to check for manhole infiltration and to observe the general condition of the manhole. All active or flowing leaks and any other necessary repairs shall be corrected prior to final acceptance of the work.

C. Test structures in accordance with ASTM C1244-93 "Standard Test Method for Concrete Sewer Manholes by the Negative Pressure (Vacuum) Test" as required by the Standard Specification for Water and Sewer Main Construction in Illinois, 2009 edition.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

SECTION 40 05 05
PROCESS PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. This section identifies process-mechanical piping systems to be provided, specifies unique requirements for each system identified, and references other sections where detailed requirements of piping components are specified.

B. Process-mechanical piping systems are shown on Process-Mechanical Drawings and on Civil Site Piping Drawings. Civil Site Piping Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems that are specified in other sections.

C. Process-Mechanical Piping Schedule included with this section identifies process-mechanical piping systems to be provided. Schedule includes application information and specifies unique system requirements.

1.02 SUBMITTALS

A. Shop Drawings:

1. Layout drawings for each process-mechanical piping system drawn to scale. Identify each piping system with same flow stream identifier as shown on Drawings.

a. Double-line layout for each piping system 3-inch pipe size and larger. Minimum scale of ¼-inch = 1 foot.
b. Single-line or double-line layout for each piping system smaller than 3-inch pipe size. Minimum scale of ¼-inch = 1 foot.
c. For each piping system include:

1) Size for each pipe and fitting.
2) Material, lining type, and system number for coating to be provided for each pipe and fitting.
3) Pipe class, thickness or schedule for each pipe and fitting.
4) Pipe end connections (joint type) and couplings.
5) Location and type of supports, hangers, anchors, and expansion joints.
6) Pipe couplings, saddles, sleeves, clamps, adapters, and other piping products.
7) Pipe mounted equipment and instrumentation identified by tag number assigned on Drawings.
8) Insulation to be provided.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

A. Provide pipe and fittings as shown on Drawings and as specified in sections identified in Process-Mechanical Piping Schedule presented at end of this section.

B. Provide polypropylene tubing for conveying alum as shown on drawings. Polypropylene tubing to withstand 100 psi.

2.02 PRODUCTS FOR PIPING SUPPORT, FLEXIBILITY, THERMAL EXPANSION, ANCHORAGE, AND VIBRATION ISOLATION

A. Provide support system for each non-buried process-mechanical piping system in accordance with Section 40 05 07.

B. Provide anchors, restraints, and concrete blocks as required to resist hydraulic thrust and forces due to thermal expansion.

C. Piping system, including support and anchorage system, shall allow for thermal expansion and contraction due to differences in operating temperature and temperature piping is exposed to during construction. Provide piping system products to allow for and control movement of piping due to thermal expansion and contraction.

D. No attempt has been made to show all pipe supports, hangers, anchors, expansion joints, and other piping products required for piping support, thermal expansion, and anchorage. Absence of these products on Drawings does not relieve Contractor of his responsibility for providing them in accordance with these Specifications.

E. Provide joints, couplings, and expansion joints as shown on Drawings and as required for piping flexibility and vibration isolation. No attempt has been made to show all joints, couplings, expansion joints, and other piping products required for piping flexibility and vibration isolation.

2.03 OTHER PIPING PRODUCTS

A. For buried piping, furnish fill material and install piping in accordance with Section 31 23 33.

B. Provide insulation for piping systems identified to be insulated in REMARKS column of Process-Mechanical Piping Schedule. Provide piping insulation in accordance with Section 40 42 13.

C. Provide products for pipe penetrations in accordance with Section 40 05 09.

D. Provide couplings, flanged coupling adapters, and service saddles in accordance with Section 40 05 06.

E. Provide rubber expansion joints in accordance with Section 40 05 15.19.

2.04 COATINGS

A. Coat exterior surfaces of non-insulated piping products with coating system numbers specified in Specifications sections identified in Part 3 of this section and in accordance with Section 09 96 00.

PART 3 – EXECUTION

3.01 PREPARATION

A. Use implements, tools, and facilities for handling and protection of piping products to avoid damage prior to installation.

B. Inspect piping products before installation. Provide new or repair or recondition damaged piping products. Repair or reconditioning is subject to Engineer's approval. Patch damaged interior linings and exterior coatings or replace damaged product with new product. Patching is subject to Engineer's approval.

C. Clean ends of piping products before installation. Remove foreign matter and dirt from inside of piping products and keep products clean until Work has been accepted.

3.02 INSTALLATION

A. Location:

1. Install piping parallel to structure lines unless shown otherwise on Drawings.
2. Do not install piping through beams, columns, or other structural members unless shown on Drawings.
3. Locate valves in piping system in accordance with manufacturer's instructions. In horizontal piping runs, do not orient valves so operating stem is below horizontal centerline.

B. Assembly:

1. Install piping without springing or forcing in manner which would cause stress in piping, valves, or connected equipment.
2. Set pipe flanges level, plumb, and aligned. Set flanged fittings so flange is true and perpendicular to pipe axis. Set flanges so bolt holes straddle vertical centerline of pipes.
3. For flanged connections, match bolt holes and obtain uniform contact over entire flange area prior to installation of flange bolts. Tighten bolts to uniformly compress gaskets and minimize flange stress. Tighten bolts to torque recommended by gasket manufacturer. Coat nuts and bolts with anti-seize thread compound.
4. Machine off raised-face of steel flange when mating with flat-faced flange.

C. Pump, Blower and Equipment Connections:

1. Align pipe, equipment, pumps, and blowers so stresses are not transmitted to connections. Support piping independently from pumps, blowers, and equipment. Do not support piping from equipment, blowers, and pumps. Anchor piping to prevent transmission of hydraulic thrust load to pumps, blowers, and equipment.
2. Install couplings, adapters, expansion joints, flanges, and unions so pumps, equipment, valves, and in-line instruments can be removed from service without disruption to other portions of piping system.
3. Install couplings, expansion joints and other vibration isolation components to isolate piping from pump, blower, and equipment vibration.
4. For welded nozzle connections, allow for shrinkage during welding to prevent excessive stresses on pumps and equipment.
5. Provide drain piping from pump and equipment drains and overflows to floor drain system.
6. Provide control lines such as air and bubbler level system piping necessary for operation of pumps, equipment, valves, and in-line instruments.

D. Install insulating flange, insulating coupling or dielectric union at each connection between ferrous and non-ferrous metal piping.

3.03 FIELD QUALITY CONTROL

A. Inspect installed piping products for dents, kinks, abrupt changes of curvature, damage to lining, and other damage. Repair or recondition damaged products as approved by Engineer or replace damaged products with new products.

B. Inspect installed, unlined piping products for corrosion and scale on interior surfaces. Clean products to remove corrosion and scale or replace with new products.

C. Test system in accordance with Section 40 05 10 and as specified in Process-Mechanical Piping Schedule.

3.04 CLEANING

A. After installation and before testing, remove dirt, rocks, debris and other foreign matter from interior of each piping system.
B. Water flush each hydrostatically tested piping system unless specified otherwise.

1. Flushing velocities of 2.5 feet per second shall be maintained until accumulated debris has been removed.
2. Insert cone strainers at equipment connections prior to flushing. Remove cone strainers after flushing is complete.
3. Remove accumulated debris through drains not less than 2 inch in diameter or by temporarily removing pipe spools, fittings, or valves.
4. Drain piping after flushing and immediately dry piping with compressed air.

C. Blow clean each pneumatically tested piping system with compressed air unless specified otherwise.

3.05 PROCESS-MECHANICAL PIPING SCHEDULE

A. **SERVICE** column: Presents Flow Stream Identifiers for process-mechanical piping systems shown on Process-Mechanical Drawings and on Civil Drawings.

1. Civil Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems which are not included in Process-Mechanical Piping Schedule. Site utility, plumbing, fire protection, and HVAC piping systems are specified in other sections.

B. **SIZE** column: Presents nominal pipe diameter(s) for each piping system shown on Process-Mechanical Drawings and continuation of piping system on Civil Drawings.

C. **PIPE MATL** column: Identifies material type to be provided for piping system. Piping material shall conform to requirements of referenced sections:

Pipe Material	Section	Abbreviation in Piping Schedule
Cement Lined Ductile Iron Piping	40 05 19	CLDI
Unlined Ductile Iron Piping	40 05 19	ULDI
304L Stainless Steel Piping	40 05 23	304SS
Polyvinyl Chloride Piping	40 05 31.13	PVC
Polypropylene Tubing	40 05 05	PPL
Chlorinated Polyvinyl Chloride Piping	40 05 31.23	CPVC

D. **LOCATION** Column: Identifies installation location of piping system. Piping system components shall be suitable for condition specified.

E. **MIN/MAX TEMP** column: Presents minimum and maximum operating temperature of piping system. Piping system components shall be suitable for operating temperatures shown.

F. **MAX PRESSURE** column: Presents maximum operating pressure of piping system and type of test to be provided. Piping system components shall be suitable for maximum operating pressure shown and test pressure specified.

1. Provide hydrostatic testing in accordance with Section 40 05 10 where maximum operating pressure value is followed by "-H".
2. Provide high pressure air testing in accordance with Section 40 05 10 where maximum operating pressure value is followed by "-P".
3. Provide low pressure air testing in accordance with Section 40 05 10 where "-A" is specified.
4. Test pressure for hydrostatic and high pressure air testing shall be 1.5 times maximum operating pressure, minimum, unless specified otherwise in REMARKS column. Test pressure for low pressure air testing shall be as specified in Section 40 05 10.

G. **COLOR** column: Specifies color coding and banding to be provided for non-buried piping systems. Provide color coding, banding, and labeling in accordance with Section 40 05 97.

H. **REMARKS** column: Provides further description of piping system and specifies additional requirements.

PROCESS-MECHANICAL PIPING SCHEDULE

Service	Size (in.)	Pipe Matl	Location	Min/Max Temp (°F)	Max Press (psig)	Color	Remarks
125 – CHEMICAL BUILDING							
ALUM	1/2, 1, 2, 3	PVC	Inside Exposed, Buried	40/95	75-H	Yellow	
Alum Tube	3/8	PPL	Inside Exposed	40/95	N/A	None	Install inside casing pipe. Do not pressure test alum tube.
Alum Casing	6	PVC	Inside Exposed, Embedded	40/95	5-H	Yellow	Casing pipe for Alum Tube. Heat Trace, Insulate and Jacket per 40 41 00 and 40 42 13 where indicated on drawings.
OF	3	PVC	Inside Exposed	40/95	5-H	Black	
V	6	PVC	Inside Exposed, Embedded, Outside Exposed	-20/110	5-A	Black	
V	See Section 22 00 05 for all vent piping not called out on Drawings 125-M-2, 125-M-3 and 125-M-4						
W3	1/2, 1	PVC	Inside Exposed, Embedded	40/95	90-H	Light Gray	No threaded connections.
130 – PRELIMINARY TREATMENT BUILDING							
Alum Tube	3/8	PPL	Outside Exposed, Inside Exposed, Buried	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Outside Exposed, Inside Exposed, Embedded	-20/110	5-H	Yellow	Casing pipe for Alum Tube. Heat Trace, Insulate and Jacket per 40 41 00 and 40 42 13 where indicated on drawings.
150 – SOUTH AERATION BASIN							
ALP	6, 12, 16	304SS	Outside Exposed, Embedded, Submerged	-20/110	30-A	None	
ALP	See Remark	See Remark	Outside Exposed, Submerged	-20/110	30-A	None	For diffusers and diffuser piping see Section 46 51 33.

PROCESS-MECHANICAL PIPING SCHEDULE							
Service	**Size (in.)**	**Pipe Matl**	**Location**	**Min/Max Temp (°F)**	**Max Press (psig)**	**Color**	**Remarks**
Alum Tube	3/8	PPL	Outside Exposed, Inside Exposed, Submerged	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Outside Exposed, Inside Exposed, Submerged, Buried	-20/110	5-H	Yellow	Casing pipe for Alum Tube. Heat Trace, Insulate and Jacket per 26 44 00 and 40 42 13 where indicated on drawings.
160 – NORTH AERATION BASIN							
ALP	6, 12, 16	304SS	Outside Exposed, Submerged	-20/110	30-A	None	
ALP	See Remark	See Remark	Outside Exposed, Submerged	-20/110	30-A	None	For diffusers and diffuser piping see Section 46 51 33.
Alum Tube	3/8	PPL	Outside Exposed, Submerged	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Outside Exposed, Submerged, Buried	-20/110	5-H	Yellow	Casing pipe for Alum Tube. Heat Trace, Insulate and Jacket per 40 41 00 and 40 42 13 where indicated on drawings.
195 – EFFLUENT PUMP STATION							
D	SEE REMARK	PVC OR PPL	Inside Exposed	40/95	10-P	Light Gray	Coordinate with Ortho Phosphate Analyzer equipment manufacturer.
SA	SEE REMARK	PVC OR PPL	Inside Exposed	40/95	100-P	Light Gray	Coordinate with Ortho Phosphate Analyzer equipment manufacturer.
600 – SOLIDS PROCESSING BUILDING							
Alum Tube	3/8	PPL	Outside Exposed, Inside Exposed, Submerged	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Outside Exposed, Inside Exposed, Submerged	-20/110	5-H	Yellow	Casing pipe for Alum Tube.
D	2	PVC	Inside Exposed, Embedded	40/95	10- H	Light Gray	
D	4	CLDI	Inside Exposed, Embedded, Buried, Submerged	-20/110	10- H	Light Gray	
DSD	4, 6	CLDI	Inside Exposed	40/95	100- H	Light Brown	
OF	4	304SS	Inside Exposed	40/95	5-H	Light Gray	
PO	1-1/2	PVC	Inside Exposed, Embedded	40/95	50- H	Orange w/ Green Band	
PSD	4, 6	CLDI	Inside Exposed	40/95	100- H	Light Brown	
TWAS/ TPSD	6	CLDI	Inside Exposed	40/95	225- H	Light Brown	
TDSD	6	CLDI	Inside Exposed	40/95	225- H	Light Brown	

PROCESS-MECHANICAL PIPING SCHEDULE							
Service	**Size (in.)**	**Pipe Matl**	**Location**	**Min/Max Temp (°F)**	**Max Press (psig)**	**Color**	**Remarks**
WAS	6	CLDI	Inside Exposed	40/95	100-H	Light Brown	
W2	2-1/2, 2, 1-1/2, 1, 3/4	304SS	Inside Exposed, Embedded	40/95	90-H		
W3	4, 6, 8	CLDI	Inside Exposed, Embedded, Submerged	40/95	90-H		
W3	3/4, 1, 1-1/2, 2	PVC	Inside Exposed, Embedded	40/95	90-H		Provide 304SS where noted on drawings including at W3 Pump.
605 – PROCESS DRAIN PUMP STATION							
Alum Tube	3/8	PPL	Outside Exposed, Inside Exposed,	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Embedded ,Submerged, Buried	-20/110	5-H	Yellow	Casing pipe for Alum Tube.
D	3/4	PVC	Inside Exposed, Embedded, Buried, Submerged	-20/110	10- H	Light Gray	
D	4	CLDI	Inside Exposed, Embedded, Buried, Submerged	-20/110	10- H	Light Gray	
PD	4, 6	CLDI	Inside Exposed, Embedded, Buried, Submerged	-20/110	45- H	Light Brown	
610 – Odorous Air System							
W2	1/2, 1, 1-1/2, 2	CPVC	Outside Exposed	-20/110	80-H		Heat Trace, Insulate and Jacket per 40 41 00 and 40 42 13 where indicated on drawings.
700 – DIGESTER CONTROL BUILDING							
TDSD	6	CLDI	Inside Exposed	40/95	200- H	None	
DSP, DSD	6	CLDI	Buried	-20/110	200- H	None	For buried pipe installation comply with Division 33.
705 – TUNNEL							
PSD	6	CLDI	Buried, Embedded, Inside Exposed	-20/110	200- H	Light Brown	
TDSD	6	CLDI	Buried	-20/110	200- H	None	For buried pipe installation comply with Division 33.
YARD PIPING							
Alum Tube	3/8	PPL	Outside Exposed, Inside Exposed	-20/110	N/A	None	Install inside casing pipe.
Alum Casing	6	PVC	Buried, Embedded	-20/110	5-H	None	Casing pipe for Alum Tube. Heat Trace, Insulate and Jacket per 26 44 00 and 40 42 13 where indicated on drawings.

PROCESS-MECHANICAL PIPING SCHEDULE							
Service	**Size (in.)**	**Pipe Matl**	**Location**	**Min/Max Temp (°F)**	**Max Press (psig)**	**Color**	**Remarks**
							For buried pipe installation comply with Division 33.
D	4	CLDI	Embedded, Buried	-20/110	10- H	None	For buried pipe installation comply with Division 33.
DSP, DSD	6	CLDI	Buried	-20/110	200- H	None	For buried pipe installation comply with Division 33.
TDSD	6	CLDI	Inside Exposed	-20/110	200- H	None	For buried pipe installation comply with Division 33.

END SECTION

SECTION 40 05 06
COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Couplings, flanged coupling adapters, and service saddles required for piping connections. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 REFERENCES

A. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for couplings and service saddles specified.
2. Catalog cuts and product specifications for couplings, flanged coupling adapters, and service saddles.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain couplings and service saddles from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 COUPLINGS

A. Couplings for connecting plain-end steel or ductile iron pipe of same outside diameter:

1. Dresser Style 38.
2. Smith-Blair Product No. 411.

B. Transition couplings for connecting plain-end steel or ductile iron pipe of different outside diameter:

1. Dresser Style 162.
2. Smith-Blair Product No. 413.

C. Insulating couplings for connecting plain-end steel or ductile iron pipe and stopping flow of electrical current:

1. Dresser Style 39.
2. Smith-Blair Product No. 416.

D. Pressure rating shall be greater than test pressure of piping system.

E. Materials:

1. Middle Ring and Gaskets: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
2. Followers: Ductile iron or steel.
3. Bolts and Nuts: Manufacturer's standard.

2.02 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters for connecting plain-end steel or ductile iron pipe to flanged pipe, fitting, valve, instrument, or equipment item:

1. Dresser Style 128.
2. Smith-Blair Product No. 913.

B. Pressure rating shall be greater than test pressure of piping system.

C. Materials:

1. Flange: Steel, faced and drilled to 150-pound class in conformance with ANSI B16.5.
2. Body: Steel.
3. Follower: Ductile iron or steel.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
5. Bolts and Nuts: Manufacturer's standard.

2.03 DISMANTLING JOINTS

A. Dismantling joint for valve, pump, meter, or other fitting installations with heavy duty joint restraint:

1. Style 975, by Smith Blair, Inc.
2. Or equal.

B. Pressure and Service: Same as connected piping.

C. Body: ASTM A53, ASTM A283 Gr C or carbon steel with a minimum yield of 30,000 psi.

D. Follower Flange: Ductile iron per ASTM A536, Steel section per ASTM A576GR1020HR, or carbon steel having a minimum yield stress of 30,000 psi.

E. Gasket: Recommended by the manufacturer.

F. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.

G. Type 316 stainless steel anchor studs installed in pressure-tight anchor boss for restraint. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer.

2.04 SERVICE SADDLES

A. Service saddles for tapping pipe sizes 18 inches and smaller shall be double strap design.

1. Dresser Style 91.
2. Smith-Blair Product No. 313.

B. Service saddles for tapping pipe sizes larger than 18 inches shall be triple strap design.

1. Smith-Blair Product No. 366.

C. Materials:

1. Body: Malleable iron or ductile iron.
2. Straps: Steel.
3. Nuts and Washers: Manufacturer's standard.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.

2.05 ANCHORS

A. Provide anchors including, but not limited to, tie rods, lugs, harness assemblies, flanged spool pieces, friction collars and hardware for each coupling, and flanged coupling adapter. Anchors shall restrain pipe to prevent movement out of each coupling and flanged coupling adapter.

B. Design each anchor to sustain force developed by test pressure of piping system.

C. Anchor studs placed perpendicular to longitudinal axis of pipe is unacceptable.

D. Anchorage with welded attachments to ductile iron piping is unacceptable.

2.06 COATINGS

A. Coatings for couplings, flanged coupling adapters, and service saddles shall be same material as coatings for connected pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install couplings and service saddles in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 40 05 07
PIPE HANGERS AND SUPPORTS

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. System of pipe supports and anchors with necessary inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, and other accessories.

1.02 DEFINITIONS

A. Submerged: At or below point 1 foot 6 inches above peak (maximum) water surface elevations in water holding structure.

1.03 REFERENCES

A. MSS: Manufacturers Standardization Society

B. ASTM: American Society for Testing and Materials

C. ANSI: American National Standards Institute

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design, detail, and installation of pipe support system shall be responsibility of Contractor.
2. Pipe support system components shall withstand dead loads imposed by weight of pipes filled with water plus insulation, plus live loads due to thermal expansion, vibration, internal test pressures, and have minimum safety factor of 5.
3. Absence of pipe supports and details on Drawings shall not relieve Contractor of responsibility for providing them throughout plant.
4. Supply design loading criteria to precast concrete manufacturer for piping supported from precast members.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for pipe hangers, supports, and anchors specified.

C. Shop Drawings:

1. Pipe supporting system, including manufacturer's product data, dimensions, sizes, types, location, maximum loadings, thrust anchorage, and installation instructions.
2. Shop Drawing shall be stamped by a Structural Engineer registered in the State of Illinois.
3. Provide one reproducible and one print.

D. Submit in accordance with Section 01 33 00.

E. Provide AIS certification.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain pipe hangers, supports, and anchor components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipe hangers, supports, and anchors to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store pipe hangers, supports, and anchors in clean, dry location.

1.08 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. B-Line.

B. Grinnell.

C. Carpenter-Patterson.

D. Unistrut.

E. Superstrut.

2.02 GENERAL

A. MSS types indicated are typical of types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover locations where standard catalog supports are inapplicable.

B. Provide factory fabricated piping hangers and supports, clamps, hanger rod attachments, building attachments, saddles, shields, thrust anchorage, and other miscellaneous products of MSS SP69

type indicated or shop fabricated supports; comply with MSS SP58 and manufacturer's published product information. Where MSS type not indicated, provide proper selection for installation requirements and comply with MSS SP69, MSS SP89 and manufacturer's published product information.

2.03 MATERIALS

A. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories shall be hot dipped galvanized or of stainless steel construction unless otherwise noted.

B. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories in submerged or non-submerged location in wet wells, tanks, channels, or tank covers shall be Type 316 stainless steel.

C. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories with Exposure: “Corrosive” shall be Fiberglass Reinforced Plastic (FRP) and/or non-metallic materials including fasteners and anchorments.

2.04 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General:

1. Unless otherwise shown or specified, hangers for 2 1/2 inches and smaller pipe shall be split-ring, adjustable swivel, clevis or roller type, hangers for 3 inch pipe or greater shall be clevis or roller type.
2. Hangers for use with spring supports shall be split-ring or clamp type.
3. Hangers for fiberglass reinforced pipe shall be saddle type.
4. Each hanger shall be designed to permit at least 1/2 inch vertical adjustment after installation.

B. Adjustable Swivel Split Ring Hanger: MSS Type 6.

C. Adjustable Clevis Hanger: MSS Type 1, fabricated from steel.

D. Adjustable Band Hanger: MSS Type 7, fabricated from steel.

E. Adjustable Swivel-Band Hanger: MSS Type 10.

F. Clamp: MSS Type 4.

G. Single Roll Support: MSS Type 41, including axle roller and threaded sockets.

H. Adjustable Roller Hanger: MSS Type 43, including axle roller and clevis.

I. Roll/Stand: MSS Type 44, including roller, stand, and axle.

J. Adjustable Roller/Base: MSS Type 46, including roller, adjustable base, and stand.

K. Steel Brackets: Welded structural steel shapes complying with following:

1. Light Duty: MSS Type 31.
2. Medium Duty: MSS Type 32.
3. Heavy Duty: MSS Type 33.

L. Adjustable Saddle Support:

1. MSS Type 38, including saddle, pipe and reducer.
2. Fabricate base support from steel pipe and include cast iron flange or welded steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

M. Stanchion Saddle Support:

1. MSS Type 37, including saddle and U-bolt.
2. Fabricate base support from steel pipe and include cast iron flange or welded steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

N. Strap or wire hangers not acceptable.

2.05 VERTICAL PIPING CLAMPS

A. 2-Bolt Riser Clamp: MSS Type 8, galvanized or plastic coated.

B. 4-Bolt Riser Clamp: MSS Type 42, include pipe spacers at inner bolt holes, galvanized or plastic coated.

2.06 HANGER RODS AND ATTACHMENTS

A. Hanger Rods:

1. ASTM A36, threaded both ends or continuous thread.
2. Rods shall conform to following sizes.

Pipe Size (inches)	Minimum Rod Diameter (inches)
Up to 2	3/8
2 1/2 and 3	1/2
4	5/8
6	3/4
8 to 12	7/8
14 and Up	1
Trapeze Hangers	As Required

B. Turnbuckles: MSS Type 13.

C. Weldless Eye Nut: MSS Type 17.

D. Eye Socket: MSS Type 16.

E. Clevis: MSS Type 14.

2.07 BUILDING ATTACHMENTS

A. Individual Concrete Inserts:

1. MSS Type 18, malleable iron.
2. MSS Type 19, steel.
3. Minimum Safe Load: 1,100 pounds.

B. Continuous Concrete Inserts:

1. Unistrut, P-3200 Series.
2. B-Line.

3. Grinnel.
4. Superstrut.
5. Or equal.

C. Top Beam C-Clamp: MSS Type 19.

D. C-Clamps: MSS Type 23, steel.

E. Single-Side Clamp: MSS Type 25.

F. Top I-Beam Clamp: MSS Type 25.

G. Side Beam Clamp: MSS Type 20.

H. Concrete Anchors:

1. Provide in accordance with Section 05 50 00.
2. Minimum Safety Factor: 5.

2.08 SADDLES AND SHIELDS

A. Protection Saddles: MSS Type 39.

B. Protection Shields: MSS Type 40.

C. Wood Insulation Saddle:

1. Elcen Metal Products Company.
2. Or approved equal.

2.09 MISCELLANEOUS MATERIALS

A. Metal Framing Systems:

1. Unistrut, galvanized.
2. B-Line, galvanized.
3. Grinnell, galvanized.
4. Or approved equal.

B. Shop-Fabricated Anchors and Supports:

1. Steel Plates, Shapes, and Bars: ASTM A36.
2. Restraining Rods: ASTM A307.

C. Concrete: Minimum 28 day compressive strength of concrete – 3,000 pounds per square inch.

PART 3 – EXECUTION

3.01 GENERAL

A. Proceed with installation of hangers, supports, and anchors after required building structural work is complete and concrete support structure has reached 28-day compressive strength as 3,000 pounds per square inch.

B. Install hangers, supports, clamps, and attachments from building structure. Comply with MSS SP-69. Group parallel runs of horizontal piping to be supported together on trapeze type hangers

where possible.

C. Install supports to provide indicated pipe slopes and maximum pipe deflections allowed by ANSI B31.1 are not exceeded.

D. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

E. Do not support piping from other piping.

F. Prevent contact between dissimilar metals. Where concrete or metal pipe support is used, place 1/8 inch thick Teflon, neoprene rubber or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and support.

G. Prevent electrolysis in support of copper tubing by use of hangers and supports where are copper plated, plastic coated or by other recognized industry methods. Electrician's tape not acceptable isolation method.

H. Apply anti-seize compound to nuts and bolts.

3.02 INSTALLATION OF BUILDING ATTACHMENTS

A. Support piping from structural framing, unless otherwise noted.

B. Concrete Inserts:

1. Locate inserts so total load on insert does not exceed manufacturer's recommended maximum load. Location of inserts shall be approved by Engineer.
2. Where necessary to anchor supports to hardened concrete or completed masonry, use concrete anchors.

C. Attach to structural steel with beam clamps.

3.03 THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

1. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and be sufficiently rigid to force expansion and contraction movement to take place at expansion joints or elbows and preclude separation of joints.
2. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead ending pipe lines. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.

B. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with recommendations of National Association of Expansion Joint Manufacturers.

3.04 PIPE SUPPORT

A. Spacing:

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
Steel	
10 and larger	22

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
8	19
6	17
5	16
4	14
3 1/2	13
3	12
2 1/2	11
2	10
1 1/2	9
1	7
3/4	6
1/2	5
Copper	
4	12
3 1/2	11
3	10
2 1/2	9
2	8
1 1/2	8
1 1/4	7
1	5
3/4	5
1/2	5
Plastic (Schedule 80 at 100 degrees Fahrenheit, F)	
8	9-1/2
6	9
4	7-1/2
3	7
2	6
1 1/2	5-1/2
1	5
3/4	4-1/2
1/2	4-1/2
(For plumbing or chemical applications, plastic piping shall be supported at maximum of 4 ft-0 in. spacing.)	
Stainless Steel	
1 and smaller	6
1 1/2 through 4	8
6	8
8 and 10	10
12	10
14	12
16	12
18 and larger	14
Cast Iron and Ductile Iron	
1 and smaller	6
1 1/4 through 2 1/2	8
3 and 4	10
6	12
8	12
10 and 12	14
14	16

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
16 and 18	16
20	18
24 and larger	18
(For cast iron soil pipe plumbing applications, support as 5 ft-0 in. spacing.)	

B. Where piping of various sizes is to be supported together, space supports for smallest pipe size or install intermediate supports for smaller diameter pipe.

C. Provide minimum of 2 pipe supports for each pipe run.

D. Where piping connects to equipment, support by pipe support and not by equipment, unless approved by equipment manufacturer.

E. Unless otherwise shown or authorized by Engineer, place piping running parallel to walls approximately 1 1/2 inches out from face of wall and at least 3 inches below ceiling.

F. Pedestal pipe supports shall be adjustable with stanchion, saddle, and anchoring flange. Use of threaded rod for pedestal support stanchions is not acceptable.

G. Piping supports for vertical piping passing through floor sleeves shall be galvanized steel riser clamps.

H. Piping passing through sleeves or openings in interior wall sleeves shall be carried by supports or hangers. Do not rest on wall.

I. Support piping in manner preventing undue strain on valve, fitting or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise shown. Do not install pipe supports and hangers in equipment access areas.

J. Install supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Piping shall be free to move when expands or contracts, except where fixed anchors are indicated. Where specified hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch per 100 feet for each 100 degrees F change in temperature exceed 1/2 inch, provide approved roller supports.

L. Piping 6 inches and larger supported by trapeze hangers shall be supported with rollers.

M. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

N. Coat hangers, clamps, protective shields, metal framing support components, and hanger accessories in accordance with Section 09 96 00.

3.05 GALLERY AND TUNNEL PIPING

A. Support piping by metal framing system. Where possible, extend each insert channel continuously over gallery or tunnel ceiling and down both walls to floor.

3.06 INSULATED PIPING

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8 inches and larger, install wood insulation saddles.

C. Where insulation without vapor barrier is indicated, install protection saddles on piping 2 inches and larger.

3.07 BURIED PIPING

A. Provide unlugged bell and spigot or bell tees, Y-branches, and bends deflecting 11 1/4 degrees or more and plugs with reaction blocking, anchors, joint harness or other acceptable means for preventing movement of pipe and joints caused by internal pressure.

B. Concrete Blocking:

1. Extend from fitting to solid undisturbed earth and installed so joints accessible for repair.
2. Bearing area of concrete reaction blocking shall be as shown on Drawings.
3. If adequate support against undisturbed ground cannot be obtained, install metal harness anchorages consisting of steel rods across joint and securely anchored to pipe and fitting or other adequate anchorage facilities to provide necessary support.
4. Should lack of solid vertical excavation face be due to improper trench excavation, cost of furnishing and installing metal harness anchorage in excess of Contract value of concrete blocking replaced by such anchorages shall be borne by Contractor.

C. Provide reaction blocking, anchorages or other supports for fittings installed in fills or other unstable ground or above grade as shown on Drawings.

END OF SECTION

SECTION 40 05 09
WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modular mechanical seals.
2. High density polyethylene (HDPE) sleeves.
3. Fire Barriers.

1.02 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for sleeves and seals specified.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Single-Source Responsibility: Obtain sleeve and seals from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Thunderline LINK-SEAL.

2.02 MODULAR MECHANICAL SEALS

A. Modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill annular space between pipe and opening.

B. Seal Element: Ethylene propylene diene monomer (EPDM).

C. Pressure Plates: Composite.

D. Bolts and Nuts: 316 stainless steel.

2.03 HDPE SLEEVES

A. Material: HDPE.

B. Integrally molded water stop / anchor at least 4-inches larger than outside diameter of sleeve.

C. Textured surface to increase concrete bond strength.

D. Designed for use with modular mechanical seals.

2.04 FIRE BARRIERS

A. Manufacturer:

1. 3M – Fire Barrier – Ultra PPD Plastic Pipe Device.
2. Or Equal.

B. Metal collar with heat expanding intumescent material designed to expand to fill the void of failed plastic piping.

C. UL classified for 2-hour fire wall penetrations.

D. For floor or wall assembly.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install sleeves and seals in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 40 05 10
TESTING PIPING SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Hydrostatic pressure testing, low pressure air testing, and high pressure air testing of piping systems.

B. Systems to be tested, type of test to be performed, and test pressure shall be as specified in other sections of Specifications.

1.02 SUBMITTALS

A. Test report for each piping system tested. Include following:

1. Date of test.
2. Description and identification of piping system tested.
3. Type of test performed.
4. Test fluid.
5. Test pressure.
6. Type and location of leaks detected.
7. Corrective action taken to repair leaks.
8. Results of retesting.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Test in presence of Engineer.

B. Owner will provide on-site source of water for testing specified herein.

1. Groundwater or final effluent water from existing plant may be used for testing except for testing of W1 Potable City Water and W2 Non-potable City water.

C. Provide pumps and piping required to bring water to point of use.

D. Provide air supply.

E. Provide test pressure equipment, meters, pressure gauges, and other equipment, materials, and facilities necessary to perform specified tests.

F. Provide bulkheads, flanges, valves, bracing, blocking, or other temporary sectionalizing devices that may be required.

G. Remove temporary devices after tests complete.

H. Perform tests on exposed piping after completely installed, including supports, hangers, and anchors.

I. Perform tests on piping before insulation installed.

J. Perform tests on piping that is clean and free of dirt, sand or other foreign material.

K. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts.

L. Add test fluid slowly.

M. Include regulator set to avoid overpressurizing and damaging piping.

N. Perform pressure testing in accordance with local, state, and federal requirements.

O. Correct leaks or defects and retest at no additional cost to Owner.

3.02 HYDROSTATIC PRESSURE TESTING

A. Perform hydrostatic pressure testing for piping systems identified in other sections. Test pressure shall be as specified in other sections.

B. Open vents at high points to purge air pockets while piping system is filling. Venting may also be provided by loosening flanges or with equipment vents.

C. Testing:

1. After section of piping to be tested has been filled with water, apply test pressure by means of force pump of such design and capacity that required pressure can be applied and maintained without interruption for duration of test.
2. Measure test pressure by means of tested and properly calibrated pressure gauge acceptable to Engineer.
3. Maintain test pressure for sufficient length of time to permit Engineer to observe piping under test but not less than 2 hours.

D. With exception of buried piping with mechanical joints or push-on joints, piping systems shall show no visual evidence of weeping or leaking. If leakage is evident, make appropriate repairs and retest.

E. Maximum allowable leakage for buried piping with mechanical joints or push-on joints is as follows. If leakage is excessive, make appropriate repairs and retest.

$$L = \frac{NDP^{1/2}}{7{,}400}$$

Where:
L = Leakage, gallons per hr
N = Number of joints under test
D = Nominal diameter of piping, in.
P = Average pressure during test, lbs per sq in.

3.03 LOW PRESSURE AIR TESTING

A. General:

1. Perform low pressure air testing for gravity sewer and drainage piping systems identified in other sections.

2. Test pipes between adjacent manholes. Test time for air pressure to drop 1.0 psi.

    a. For pipes 4 in. through 36 in. dia comply with Table 40 05 10.
    b. Pipe over 36 in. dia shall not be tested by the low pressure air method.
    c. Ignore length of laterals.

B. Preparation:

1. Isolate pipe section to be tested by plugging each end with air tight plugs. Plug ends of branches, laterals and wyes which are to be included in test section.
2. Brace plugs to prevent slippage and blowout due to internal pressure.
3. One plug shall have inlet tap or other provision for connecting air supply.
4. Air control equipment shall consist of valves and pressure gauges to control rate at which air flows into test section and gauges to monitor air pressure inside pipe.

C. Testing:

1. If pipe to be tested is submerged in water, determine height of water above spring line of pipe at each end of test section and compute average. For each foot of water above pipe's spring line, increase test pressure by 0.43 psi.
2. Add air slowly to test section until pressure inside pipe is raised to 4.0 psi greater than average back pressure of water that may be over pipe
3. After pressure of 4.0 psi obtained, control supply of air so internal pressure maintained between 3.5 and 4.0 psi (above average water back pressure) for minimum of 2 minutes to allow temperature of air to come into equilibrium with temperature of pipe.
4. Determine rate of air lost by time pressure drop method.

    a. After temperature stabilized for 2 minute period, disconnect air supply. Allow pressure to decrease to 3.6 psi. At this pressure, start stopwatch to determine time required for pressure to drop 1.0 psi. Time required for loss of 1.0 psi is then compared to Table 01815.
    b. If time is equal to or greater than time indicated in table, test shall be acceptable.
    c. If time is less than time indicated in table, make appropriate repairs and retest.

3.04 HIGH PRESSURE AIR TESTING

A. Perform high pressure air testing for piping systems as specified in other sections. Test pressure shall be as specified in other sections.

B. Perform preliminary test at not greater than 25 psi. Examine for leakage at joints with soap solution and visual detection of soap bubbles. Correct visible leaks.

C. Perform final test at test pressure specified. Pressure in system shall be gradually increased in small increments until test pressure reached. Test pressure shall be maintained for minimum of 10 minutes and additional time necessary to conduct soap bubble test examination of each joint for leakage.

D. Piping system shall show no evidence of leakage. If leakage is evident, make appropriate repairs and retest.

TABLE 40 05 10
LOW PRESSURE AIR TEST

Test time required for loss of air pressure of
1.0 psi for size and length of pipe indicated.

A	B	C	D	E	F
Pipe Dia (in.)	**Time/Ft Up To Length In Column C (sec)**	**Length Time In Column B Applies (ft)**	**Test Time For Length Between Columns C & E (min:sec)**	**Length Time In Column F Applies (ft)**	**Time/Ft Over Length In Column E (sec)**
4	0.18	636	1:54	1,432	0.08
6	0.40	424	2:50	955	0.18
8	0.71	318	3:47	716	0.32
10	1.11	255	4:43	573	0.49
12	1.60	212	5:40	477	0.71
15	2.50	170	7:05	382	1.11
18	3.62	141	8:30	318	1.61
21	4.92	121	9:55	273	2.19
24	6.42	106	11:20	239	2.85
27	8.14	94	12:45	212	3.62
30	10.00	85	14:10	191	4.44
33	12.14	77	15:35	174	5.40
36	14.37	71	17:00	159	6.39

END OF SECTION

SECTION 40 05 15.19
RUBBER EXPANSION JOINTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rubber expansion joints with control units.

1.02 SUBMITTALS

A. General:

1. Not required for products identical to those specified herein by name of manufacturer.
2. For products other than those specified herein by name of manufacturer, submit information in accordance with Requests for Substitutes or "Or Equal" items in Section 01 33 00.
3. Submit information for products that vary from specified requirements regardless of manufacturer name.
4. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. AIS Certification.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain expansion joint components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.04 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. General Rubber.

B. Garlock.

C. Mercer.

D. Or equal.

2.02 JOINTS

A. Cover, body, seamless tube, and integral full-faced flanges. Standard 125-pound flange drilling.

B. Materials and construction shall be suitable for fluid service, maximum operating temperature, maximum operating pressure and test pressure of piping system.

C. Single arch.

1. Filled for wastewater, sludge and other fluids with suspended solids.
2. Unfilled for air, clean water and other fluids without suspended solids.

D. Split metal retaining rings coated in accordance with Section 09 96 00.

E. Provide control unit for each expansion joint.

1. Gusset plates, washers, bolts, and elastomeric bushings.
2. No metal-to-metal contact to eliminate transmission of noise and vibration.
3. Size control units for maximum operating pressure and test pressure of piping system.

F. Minimum movement capability for single, unfilled arch joints:

Joint Size (inch)	Axial Compression (inch)	Axial Extension (inch)	Lateral Deflection (inch)
≤ 6	7/16	1/4	1/2
8 to 18	11/16	3/8	1/2
20 to 24	13/16	7/16	1/2
26 to 40	15/16	1/2	1/2
≥ 42	1-1/16	9/16	1/2

G. Minimum movement capability for single, filled arch joints shall be at least 50 percent of movement specified above for unfilled arch joints.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install expansion joint components in accordance with manufacturer's written instructions.

B. Install rubber expansion joints where indicated on Drawings and elsewhere as determined by Contractor for adequate expansion compensation and vibration isolation of piping systems

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various ductile iron piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular ductile iron piping products to be provided under this Contract.

1.02 REFERENCES

A. AWWA: American Water Works Association

B. ANSI: American National Standards Institute

C. ASTM: American Society for Testing and Materials

D. AWS: American Welding Society

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for ductile iron piping specified.
2. Manufacturer's specifications, catalog cuts, and literature for the following:

a. Pipe.
b. Inside linings.
c. Restrained push-on joints.
d. Mechanical joints.
e. Flange joints.
f. Grooved joints.
g. Standard fittings.
h. Special fittings.
i. Wall pipe and floor pipe.
j. Polyethylene encasement.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for ductile iron piping.
2. Submit outside coating system for buried, interior, exterior, and submerged piping locations. Include submittal information in accordance with Section 09 96 00.
3. Submit all product data and coating system information specified above in one complete submittal.

4. Shop drawings showing layout for ductile iron piping systems shall be submitted in accordance with and transmitted under appropriate piping system Specification section.
5. Submit in accordance with Section 01 33 00.

D. Lining Reports:

1. Submit layout drawing showing location of each pipe spool and fitting identification number.
2. Submit notarized certification report for each pipe spool and fitting for approval prior to shipment.

E. Provide AIS Certification.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing materials of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain ductile iron piping from single supplier with responsibility for entire system.

1.05 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. American Cast Iron Pipe Company.

B. U.S. Pipe and Foundry Company.

C. McWane Ductile - Clow Water Systems Co. (Less than 48-inch pipe)

2.02 PIPE

A. Liquid and air service pipe: AWWA C151, ductile iron.

B. Minimum Thickness/Pressure Class:

1. Buried Piping Restrained push on joint pipe and mechanical joint pipe, Thickness Class 53.
2. Flanged joint pipe: Special Thickness Class 53.

2.03 INSIDE LINING

A. Pipe and fittings shall be provided unlined or with inside lining as specified in Section 40 05 05.

B. Cement lining shall be in accordance with AWWA C104.

C. Glass Lining:

1. Glass-lined products shall be furnished to Contractor by glass lining manufacturer. Glass lining manufacturer shall supply pipe, fittings, fabrication, glass lining and outside coating.

2. Glass lining shall be in accordance with ASTM B 1000-15.

3. Manufacturers:

   a. Fast Fabricators; Remington, VA.
   b. C&B Piping; Leeds, AL.
   c. U.S. Pipe Fabrication.

4. Special glasses and inorganic materials applied in minimum of two coats. Apply base coat and fire to temperature above 1,400 degrees Fahrenheit (F) to fuse glass to metal. Process subsequent coats in similar manner to form integral molecular bond with base coat. Finished lining shall be as follows:

   a. Thickness: 0.008 to 0.012 inches.
   b. Hardness: 5 to 6 on Mohs Scale.
   c. Density: 2.5 to 3.0 grams per cubic centimeter.
   d. Sufficiently bonded to metal surface to withstand strain of 0.001 inch per inch without damage to glass lining.
   e. Resistant to corrosion by solutions of between pH-3 and pH-10 at 125 degrees F.
   f. Withstand thermal shock of 350 degrees F without crazing, blistering or spalling.
   g. No visible loss of surface glass after immersion in 8 percent sulfuric acid solution at 148 degrees F for 10 minutes.
   h. Weight loss not more than 3 milligrams per square inch when tested according to ASTM C283.
   i. Visually free of pinholes, crazing, or fish scales that expose metal.

5. Fabrication of glass lined pipe shall be performed by glass lining manufacturer. Fabrication or cutting of pipe outside of glass lining manufacturer's shop is unacceptable.
6. In Factory Glass Lining Testing:

   a. Each pipe spool and fitting shall be marked, inspected, and certified that glass lining meets specified requirements.
   b. For each pipe spool and fitting, perform low voltage, wet sponge, non-destructive holiday detection testing in accordance with ASTM D 5162-01 and manufacturer’s recommendations.

      1) Acceptable fittings pinhole criteria:

Pipe Size (in.)	Number of Pinholes per Fitting
3 - 8	5
10 - 18	8
20 and larger	10

      2) Acceptable pipe spool pinhole criteria:

Pipe Size (in.)	Number of Pinholes per 20' Length of Pipe
3 - 8	12
10 - 18	20
20 and larger	28

c. Provide certification report including, but is not be limited to, the following information:

1) Pipe or fitting identification name/number
2) Date of manufacturer
3) Date of inspection
4) Name of inspector
5) Inspection performed

Holiday detection for pinholes, crazing, scaling, any exposed metal, or end damage
Glass thickness
Other (as recorded)

d. Upon delivery, each pipe and fitting may be inspected by Engineer in presence of Contractor. If, in the opinion of Engineer, pipe does not meet Contract Specifications, pipe or fitting will be retested on by a mutually-agreed upon by a third party company. If the third party company verifies that the pipe does not meet contract Specifications, pipe or fitting will be rejected and the Contractor shall pay for the third-party testing. New pipe or fitting shall be provided to replace rejected product at no additional cost to Owner.

2.04 JOINTS

A. Joint Type:

1. Liquid and air services in buried locations shall be mechanical or push-on joint unless otherwise noted or specified in system Specification section.

a. Provide restrained mechanical joints or restrained push-on joints for piping systems with a maximum operating pressure greater than 5 pounds per square inch.

2. Liquid and air service in locations other than buried shall be flanged or grooved end joint. As noted on Drawings or as specified in system Specification section if different than specified above for services and locations.

B. Mechanical and Push-On Joints:

1. AWWA C111.
2. Gasket material:

a. Suitable for service and maximum operating temperature of piping system as specified in Section 40 05 05.
b. Selected by pipe manufacturer.

3. Restrained Mechanical Joints:

a. Incorporate restraint into follower gland with individually actuated wedges.
b. Full mechanical joint deflection during assembly and after burial.
c. Ductile iron components.

d. Series 1100 Megalug as manufactured by EBBA Iron, Inc., no substitutes permitted.

4. Restrained Push-On Joints:

a. Retainer Ring Type:

1) American Cast Iron Pipe Company, Flex-Ring and Lok-Ring.
2) U.S. Pipe and Foundry Company, TR-Flex.
3) Clow, TR-Flex.

5. Restrained joints shall be mechanical locking type to provide positive restraint from joint separation without use of restraining rods, straps, or clamps.
6. Minimum pressure rating of restrained joints: 250 pounds per square inch.
7. For all buried applications use Cor-Blue T-bolts or equal, which have a ceramic filled, baked on fluorocarbon resin developed to handle highly corrosive conditions. Cor-Blue or equal T-Bolts and nuts shall comply with current version of ANSI/AWWA C111/A21.11.

C. Flanged Joints:

1. Flanged pipe for liquid and air service shall be in accordance with AWWA C115.
2. Fabrication of flanged pipe, including assembly of flange on pipe shall be performed by pipe manufacturer in accordance with AWWA C115. Assembly of flange on pipe outside of manufacturer's shop is unacceptable.
3. Flange material for flanged pipe shall be ductile iron. Flanged pipe with gray iron flanges is not acceptable.
4. Gasket material shall be suitable for service and maximum operating temperature of piping system as specified in Section 40 05 05. Torque requirement of gaskets shall be less than torque rating of flange, bolt, and nuts.
5. Gaskets shall be ring or full face, 1/8-inch thick, and conform to dimensions shown in Appendices to AWWA C110 and AWWA C115.
6. Bolts:

a. Size, length, and number as shown in AWWA C110 and AWWA C115.
b. Material:
c. Carbon steel, ASTM A307, Grade B.
1) Carbon steel, ASTM A307, Grade B for all locations unless otherwise noted.
2) Type 316 stainless steel for all locations submerged, within wetwells, tanks, channels or tank covers. Provide bolt insulating sleeves to protect against dissimilar materials.
d. Dimensions: ANSI B18.2.1, heavy hex.

7. Nuts:

a. Size, length, and number as shown in AWWA C110 and AWWA C115.
b. Material:

1) Carbon steel, ASTM A307, Grade B for all locations unless otherwise noted.
2) Type 316 stainless steel for all locations submerged, within wetwells, tanks, channels or tank covers. Provide bolt insulation sleeves for to protect against dissimilar materials.

c. Dimensions: ANSI B18.2.2, heavy hex.

2.05 FITTINGS

A. Pressure rating shall be 250 pounds per square inch, minimum.

B. Standard fittings for liquid and air service:

1. Restrained push-on and restrained mechanical joint fittings:

a. Ductile iron.
b. AWWA C110 or AWWA C153.

2. Flanged joint fittings:

a. Ductile iron.
b. AWWA C110.
c. Flange dimensions in accordance with AWWA C115.

3. Grooved joint fittings:

a. Ductile iron.
b. AWWA C110 except end preparation.
c. End preparation in accordance with AWWA C606, rigid radius groove.
d. Minimum wall thickness in accordance with AWWA C110/ANSI A21.10 and AWWA C153.

C. Special fittings for liquid and air service, not included in AWWA standards, shall be manufacturer's standard, based on AWWA design principles, and in compliance with applicable requirements of AWWA standards.

D. Wall Pipe and Floor Pipe:

1. Ductile iron.
2. Wall thickness of body equal to or greater than wall thickness of connecting pipe.
3. Flanges set flush with face of concrete shall be tapped for stud bolts.
4. Collar dimensions as shown on Drawings.
5. Collar cast integral with pipe or fabricated by welded attachment of collar to pipe.
6. Fabricated wall pipe and floor pipe shall be as follows:

a. Rated for dead end thrust due to 250 pounds per square inch internal pressure.
b. Steel collar welded continuously around pipe on both sides of collar.
c. Weld in pipe manufacturer's shop by qualified welder.
d. Electrodes: AWS A5.15, Class ENiFe-CI or AWS 5.6, Class ECuAl-2.

E. Miscellaneous Fittings:

1. Provide miscellaneous fittings, such as cutting in sleeves, tapping sleeves, caps, plugs, and other fittings, as required for a complete system.
2. Manufacturer of miscellaneous fittings shall be same manufacturer as pipe.
3. Miscellaneous fittings shall be suitable for service.

2.06 COATINGS

A. Provide buried piping with 1 mil thick asphaltic coating in accordance with applicable AWWA and ANSI standards.

B. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 96 00.

C. Finish color for interior and exterior piping shall be as specified in Section 40 05 05.

D. Coating for piping embedded in concrete is not required.

2.07 POLYETHYLENE ENCASEMENT

A. Provide polyethylene encasement for buried piping in accordance with AWWA C105.

PART 3 – EXECUTION

3.01 INSTALLATION

A. In accordance with Section 40 05 05.

B. Buried Piping: In accordance with Section 33 05 10.

C. Pipes to be cut in the field shall be gauged and within acceptable tolerances to ensure fit of connections.

3.02 JOINT ASSEMBLY

A. Restrained push-on, mechanical, and grooved joint in accordance with manufacturer's written instructions.

B. Flanged joint in accordance with Section 40 05 05, flanged pipe manufacturer's written instructions, and gasket manufacturer's written instructions.

3.03 WALL PIPE

A. Support by formwork to prevent contact with reinforcing steel.

B. Install in accordance with Section 03 30 00.

3.04 POLYETHYLENE ENCASEMENT

A. Install in accordance with AWWA C105.

3.05 TAPPING

A. Do not tap polyethylene-lined and glass-lined pipe.

B. Taps for cement-lined and unlined pipe shall be in accordance with pipe manufacturer's instructions.

C. Provide service saddles for tap sizes greater than 1-inch. Service saddles are not required for tap sizes 1-inch and smaller.

3.06 TESTING

A. Test pipe and pipe products in accordance with Section 40 05 10.

3.07 IDENTIFICATION

A. Provide pipe identification in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 23
STAINLESS STEEL PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various 304L Stainless Steel Products. Some products specified in this Section may not be required for this Project. Refer to piping system Specification section(s) and Drawings to determine 304L stainless steel piping products to be provided under this Contract.

1.02 REFERENCES

A. ASME: American Society of Mechanical Engineers.

B. ASTM: American Society of Testing and Materials.

C. ANSI: American National Standards Institute.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for piping system specified.
2. Submit for pipe, fittings, flanges, face rings, and bolting.
3. Submit proposed gasket material for each service. Submit documentation confirming gasket material selection is appropriate for fluid carried in system.
4. Coating system for carbon steel surfaces. Include coating system submittal information specified in Section 09 96 00.

C. Shop Drawings:

1. Shop Drawings showing layout for 304L stainless steel piping shall be submitted in accordance with and transmitted under appropriate piping system specification sections.

D. Submit in accordance with Section 01 33 00.

E. Provide AIS Certification.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Welding Qualifications:

1. Contractor shall be responsible for qualifying welders as required by ANSI B31.3 and ASME

Boiler and Pressure Vessel Code, Section IX.

C. Contractor shall maintain record of welding procedures used and welders or welding operators assigned to this Project and their symbols. Records shall show date and results of procedure and performance qualifications. Records shall be certified by Contractor and kept at job site and shall be available to Owner or Engineer on request for duration of Project.

D. Single-Source Responsibility: Obtain 316L stainless steel products from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Shipping:

1. Sections with field welded ends shall have wooden plug securely installed at each end to prevent pipes from being bent out of round.
2. Flanged connections shall have plywood blind wired over end and through bolt holes to hold flange against face ring or clip-on type flange protectors.
3. Ship protected from damage and contact with carbon steel.
4. Tarp sections during shipment to avoid contact with road dust and salt spray.

C. Storage:

1. 304L stainless steel products in clean, dry location.
2. Store protected from damage and contact with carbon steel.

1.06 IEPA LOAN REQUIRED DOCUMENTATION – AMERICAN IRON & STEEL

A. Pursuant to the IEPA loan being used to finance the project, the CONTRACTOR and his/her suppliers shall comply with Section 436 of federal H.R. 3547, which are requirements regarding the use of American iron and steel products. These requirements apply to and are binding to the manufacturer of the products specified in this Section.

B. The manufacturer shall provide with the shop drawing submittal one (1) signed and dated original of the AIS Certification Letter (a blank copy of which is provided on page A-00 30 80-3 of this manual). Said letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Felker Brothers Corporation

B. Or equal.

2.02 GENERAL

A. Grade of stainless steel (304 or 316) shall be as indicated in Section 15200 or elsewhere.

B. At Contractor’s option, 316 stainless steel will be accepted in lieu of 304 stainless steel.

C. All piping, fittings and miscellaneous components installed on welded piping systems shall be provided in low carbon (L) variant of specified stainless steel alloy.

D. When cast materials are used, systems specified for:

1. 304 stainless steel shall be cast from CF-8 materials.
2. 304L stainless steel shall be cast from CF-3 materials.
3. 316 stainless steel shall be cast from CF-8M materials.
4. 316L stainless steel shall be cast from CF-3M materials.

E. At Contractor's option, thicker materials than specified are acceptable.

2.03 PIPE

A. Unless indicated otherwise, provide piping as follows:

1. 1/2-inch to 3/4-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for socket welded piping, Schedule 80 for threaded.
d. Fittings:

1) 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2) Threaded end connections conforming to ASME B1.20.1.
3) Dimensions: Conform to MSS-SP-114.
4) ASTM A351, cast stainless steel.

2. 1-inch to 2-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for socket welded piping, Schedule 40 for threaded.
d. Fittings:

1) 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2) Threaded end connections conforming to ASME B1.20.1.
3) Dimensions: Conform to MSS-SP-114.
4) ASTM A351, cast stainless steel.

3. 2-1/2-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for butt welded piping.
d. Butt Weld Fittings:

1) ASTM A403, Class WP, Grade 304L.
2) Dimensions: Conform to ANSI B16.9, Buttwelded.
3) Elbows shall be long radius unless otherwise indicated on Drawings.
4) Wall Thickness: match connecting pipe.

4. 3-inch to 24-inch:

a. ASTM A312 or ASTM A778.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for butt welded piping.
d. Butt Weld Fittings:

1) ASTM A403 or ASTM A774, Class WP.
2) Dimensions: Conform to ANSI B16.9, Buttwelded.
3) Elbows shall be long radius unless otherwise indicated on Drawings.

2.04 FITTINGS

A. Class 150 Cast - socket welded:

1. Meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP).
2. Socket welded end connections shall be bored to match mating pipe Outside Diameter.
3. Dimensions: Conform to MSS-SP-114. ASTM A351, cast stainless steel.

B. Butt Weld Fittings:

1. ASTM A403, Class WP when ASTM A312 pipe materials provided.
2. ASTM A774, Class WP when ASTM A778 pipe materials provided.
3. Dimensions: Conform to ANSI B16.9, Buttwelded.
4. Elbows shall be long radius unless otherwise indicated on Drawings.
5. Wall Thickness: match connecting pipe.

C. Threaded Fittings:

1. Fittings shall be 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2. Threaded end connections conforming to ASME B1.20.1.
3. Dimensions: Conform to MSS-SP-114.
4. ASTM A351, cast stainless steel.

2.05 JOINTS

A. Threaded Joints:

1. Size: ½-inch to 2-inch.
2. Non-flanged equipment connections and valves shall be threaded, all other connections are Contractors choice of threaded or socket welded.
3. Thread Sealant: Teflon tape or Teflon paste.

B. Socket Welded Joints:

1. Size: ½-inch to 2-inch.
2. Socket welded joints shall be performed in the shop in accordance with 2.06 or in the field in accordance with 3.03.

C. Butt Welded Joints:

1. Size: 2-1/2-inch and Larger.
2. Butt welded joints shall be performed in the shop in accordance with 2.06 or in the field in accordance with 3.03.

D. Flanged Joints:

1. Unless indicated otherwise, provide flanges as follows:
2. Size: 1-1/2-inch to 24-inch
3. Flange:

    a. 304L back-up type.
    b. Faced and drilled to 150 pound class in conformance with ANSI B16.5.

4. Face Ring: Stainless steel angle ring or flat plate to match pipe material. Flat plate thickness to suit pipe wall thickness and welding procedure to avoid warpage.
5. Bolting: ASTM F593-02 Type 304 stainless steel bolts, nuts and washers.
6. Gaskets: Ring-type, PTFE composition, non-asbestos, recommended as suitable for service by gasket manufacturer, similar to Garlock “Gylon” style.

2.06 SHOP FABRICATION

A. Dimensions:

1. Piping dimensions of fabricated sections shall conform to dimensions for manufactured pipe in ANSI B36.19.
2. For purpose of shop fabrication, dimensions shown on Drawings shall be considered approximate only. Field verification is responsibility of Contractor. Where possible, use field welds in each direction with adequate allowance for trim and fit, but not less than 2-inch in each direction. Loose flanged shall be provided for fit up at equipment connections.

B. Branch Connections:

1. Nozzle welds may be used in lieu of buttwelded reducing tees when permitted by ANSI B31.3. Buttwelded tees shall be used when branch is same size or one pipe size smaller than header. Nozzle welds shall be reinforced in conformance with ANSI B31.3.
2. Threaded full couplings may be used for branch connections of 1-inch or smaller pipe size. Coupling shall comply with Paragraph 2.03A of this section.

C. Shop Welded Joints:

1. Preparation: Equipment used in welding preparation shall be covered or faced to prevent mild steel contamination of stainless steel. Items shall be marked “STAINLESS STEEL”, and shall be used for no other purpose.
2. Cleaning: Clean metal to be fused of lubricants, grease, paint, filings, and cuttings. Cleaning with alcohol or acetone. Do not use chlorinated solvents.
3. MIG and TIG Welding: Metal Inert Gas (MIG) welding may be used with automatic or semi-automatic machine welding. Tungsten Inert Gas (TIG) welding shall be used for manual welding of pressure joints. Apply shielding gas protection to underside of weld. Filler metal rods shall be AWS A5.9 Type ER308L or ER316L.
4. SMA Welding: Shielded Metal Arc (SMA) welding may be used at noncritical non-pressure connections and for joining stainless to carbon steel. Welding electrodes shall be stored in dry atmosphere to avoid moisture pick-up. Filler metal rods shall be AWS A5.4 Type E308L or E316L.
5. Dissimilar Metals: Do not weld carbon steel directly to stainless steel piping. Weld “poison pads” of equal thickness and same material of pipe to pipe and attach carbon steel to poison pad. SMA welding may be used to attach carbon steel to stainless pad. Filler metal rods shall be AWS A5.4 Type E309, or ASW A5.9 Type ER309 if TIG welding is used.
6. Shielding Gas: Use welding grade argon or helium-argon mixture.
7. Penetration: Buttweld joints shall have 100 percent penetration.

8. Tack Welding: Make tack welds with same grade of filler metal as finished weld. Tack welds shall be small enough to be absorbed into following weld beads and have slag and oxides removed prior to finishing weld or shall be completely removed.
9. Weld Finish: Inside of weld shall be smooth and free from projections and depressions. Grind with iron free grinding wheels labeled “STAINLESS STEEL” used for nothing else. Use 160 grit grinding wheels. Remove scale, oxides, and discolorations from pipes and welds. Products and procedures shall be as recommended by manufacturer.

2.07 COATING

A. Surface preparation, priming, and finish coating of carbon steel surfaces shall be compatible and in accordance with Section 09 96 00.

B. Stainless steel components shall not be coated.

C. Surface Treatment of Stainless Steel Components:

1. Electro-chemically clean or acid passivate all welds in stainless steel subassemblies.
2. After passivation, thoroughly rinse weldments with clean water and allow to air dry.
3. Heat tint or carbon steel contamination shall not be evident. If contamination is evident, clean by method specified above, rinse and recheck.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install piping systems in accordance with manufacturer's written instructions.

B. Install in accordance with appropriate piping system Specification section.

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

3.03 FIELD WELDED JOINTS

A. Branched connections:

1. Nozzle welds may be used in lieu of buttwelded reducing tees when permitted by ANSI B31.3. Use buttwelded tees when branch is same size or one pipe size smaller than header. Reinforced nozzle welds in conformance with ANSI B31.3.
2. Threaded full couplings may be used for branch connections of 1-inch or smaller pipe size. Couplings shall comply with Paragraph 2.03.A.

B. Joint Preparation:

1. Equipment used in welding preparation shall be covered or faced to prevent mild steel contamination of stainless steel.
2. Prepare buttwelded joints in conformance ANSI A16.25.
3. Cleaning: Clean metal to be fused of lubricants, grease, paint, filings, and cuttings. Cleaning with alcohol or acetone. Do not use chlorinated solvents.

C. Welding:

1. Protect weld area from wind or draft while welding with gas back-up.
2. Preheat weld area if work piece temperature is less than 60 degrees Fahrenheit (F).

3. TIG Welding: Use Tungsten Inert Gas (TIG) welding for welding of critical pressure pipe joints. Apply shielding gas protection to underside of weld. Filler metal rods shall be AWS A5.9 Type ER316L.
4. SMA Welding: Shielded Metal Arc (SMA) welding may be used at noncritical pressure pipe joints and for joining stainless steel to carbon steel. Welding electrodes shall be stored in dry atmosphere to avoid moisture pick-up. Filler metal rods shall be AWS A5.4 Type E316L.
5. Dissimilar Metals: Carbon steel shall not be welded directly to stainless steel piping. Weld "poison pads" of equal thickness and same material of pipe to pipe and attach carbon steel to poison pad. SMA welding may be used to attach carbon steel to stainless pad. Filler metal rods shall be AWS A5.4 Type E309, or ASW A5.9 Type ER309 if TIG welding is used.
6. Shielding Gas: Use welding grade argon or helium-argon mixture.
7. Penetration: Buttweld joints shall have 100 percent penetration.
8. Tack Welding: Make tack welds with same grade of filler metal as finished weld. Tack welds shall be small enough to be absorbed into following weld beads and have slag and oxides removed prior to finishing weld or be completely removed.
9. Weld Finish: Inside of weld shall be smooth and free from projections and depressions. Grind with iron free grinding wheels labeled "STAINLESS STEEL" used for nothing else. Use 160 grit grinding wheels. Remove scale, oxides, and discolorations from pipes and welds. Products and procedures shall be as recommended by manufacturer.

D. Field welding of joints shall not be performed in the Digester Control Building (Structure 700), Tunnel (Structure 705), Secondary Digester Building (Structure 710), Lower Level of Chemical Building (Structure 125). These areas are Class I, Division 1, Group D Hazardous Classified Locations.

3.01 WALL PIPES, WALL SLEEVES, AND SEALS FOR WALL PENETRATIONS

A. Support wall pipe by form work to prevent contact with reinforcing steel.

B. Install wall pipe in accordance with Section 03 30 00.

END OF SECTION

SECTION 40 05 31.13
POLYVINYL CHLORIDE PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various PVC piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular PVC piping products to be provided under this Contract.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for PVC components specified.
2. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
3. Submit proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for PVC components.
2. Submit layout for PVC piping systems in accordance with and transmitted under appropriate piping system Specification section.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain PVC components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 PVC MATERIAL

A. Type 1, Grade 1 conforming to ASTM D1784.

2.02 PIPE

A. Schedule 80 PVC conforming to ASTM D1785.

2.03 PERFORATIONS

A. Provide perforations where perforated pipe called for on Drawings or in other Specification section(s).

B. Perforation requirements: 5/8-inch diameter holes on 5-inch centers 120 degrees apart.

2.04 FITTINGS

A. Schedule 80 PVC.

1. ASTM D2464 for threaded joint type.
2. ASTM D2467 for socket joint type.

2.05 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.06 FLANGES

A. PVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 150-pound bolt-hole drilling pattern.

2.07 GASKETS

A. Full-face, 1/8-inch thick flat type.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

C. Material compatible with fluid carried in system.

2.08 BOLTING

A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

B. Bolts shall conform to ANSI B.1.20.1.

C. Provide washers same material as bolts.

2.09 SOLVENT CEMENT

A. Join socket connections with PVC solvent cement conforming to ASTM D2564.

B. As recommended by pipe and fitting manufacturer to assure compatibility.

2.10 THREAD LUBRICANT

A. Teflon tape.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install PVC components in accordance with manufacturer's written instructions.

B. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 31.23
CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPING

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various CPVC piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular CPVC piping products to be provided under this Contract.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

B. ASTM: American Society of Tessting and Materials.

1.03 SYSTEM DESCRIPTION

A. Provide CPVC piping systems and components where specified on Drawings and/or specification Section 40 05 05 – Exposed Piping Installation.

B. Materials shall be compatible for exposure to hydrogen sulfide fumes at a concentration of up to 300 pppm and sulfuric acid at a pH of 5-8.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for CPVC piping systems specified.
2. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
3. Submit proposed gasket material for each service. Submit documentation confirming gasket material selection is appropriate for fluid carried in system.
4. Submit product data for solvent cement. Submit documentation confirming solvent cement material selection is appropriate for fluid carried in system.

C. Shop Drawings:

1. Submit layout for CPVC piping systems in accordance with and transmitted under appropriate piping system Specification(s) section.

D. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain CPVC piping systems components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver CPVC piping systems components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Ship protected from damage. Tarp sections during shipment to avoid contact with road dust and salt spray.

C. Store CPVC piping systems in clean, dry location.

D. Tarp sections during storage to avoid sunlight and UV light.

PART 2 – PRODUCTS

2.01 CPVC MATERIAL

A. Class 23447.B conforming to ASTM D1784.

B. Pipe and fitting materials shall be specially formulated with sufficient UV screeners to provide for long-term outdoor exposure with no deleterious effects.

2.02 PIPE

A. Schedule 80 CPVC conforming to ASTM F441.

B. Pipe shall be rated for 150-pounds per square inch at 73 degrees Fahrenheit (F).

2.03 FITTINGS

A. Schedule 80 CPVC.

1. ASTM F437 for threaded joint type.
2. ASTM F439 for socket joint type.

B. Fittings shall be rated for 150-pounds per square inch at 73 degrees Fahrenheit (F).

2.04 UNIONS

A. Unions shall be O-ring seal type having interchangeable components with two union valves for maximum system versatility.

B. Unions intended for joining dissimilar materials shall be the transition type, which utilize components of the two dissimilar materials, joined with an elastomeric seal to absorb the thermal expansion coefficient differential. Seal material shall be compatible with fluid carried in system.

2.05 FLANGES

A. CPVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 150-pound bolt-hole drilling pattern.

2.06 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches or for buried piping. If permitted by Engineer, threaded joints may be used in lieu of solvent welded joints in exposed interior locations where required to facilitate assembly. Use of threaded joints shall be held to a minimum.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.07 GASKETS

A. Full-face, 1/8-inch thick flat type.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

C. Material compatible with fluid carried in system.

2.08 BOLTING

A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

B. Bolts shall conform to ANSI B.1.20.1.

C. Provide washers same material as bolts.

2.09 SOLVENT CEMENT

A. Join socket connections with CPVC solvent cement conforming to ASTM F493.

B. Provide solvents as recommended by pipe and fitting manufacturer to assure compatibility with media in pipe system.

2.10 THREAD LUBRICANT

A. Teflon tape.

2.11 BASKET STRAINERS

A. Manufacturer:

1. Spears.
2. Or equal.

B. CPVC Type IV Cell Classification 23447 material.

C. EPDM O-rings.

D. Minimum 6:1 open area ratio through basket to the corresponding pipe size.

E. 20-mesh stainless steel strainer basket.

F. Quick release clamp retained bonnet with safety nut, ¼-inch ball type CPVC pressure release valve, and safety pressure gauge.

G. O-ring sealed, threaded drain plug on lower end of unit.

H. Pressure rated to 150-pounds per square inch at 73 degrees Fahrenheit (F).

I. Suitable for service temperatures up to 200 degrees F.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install CPVC piping systems in accordance with manufacturer's written instructions.

B. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 53
PROCESS VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plug Valves.
2. Butterfly Valves.
3. Check Valves.
4. Ball Valves.
5. Solenoid Valves.
6. Globe Valves.
7. Needle Valves.
8. Mechanical Regulating Valves.
9. Valve Accessories.
10. Actuators

B. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 DEFINITIONS

A. psi – pounds per square inch

B. w.c. – water column

C. FOG – fats-oils-grease

D. Deg F – Degree Fahrenheit

E. CWP – cold working pressure

F. SWP – steam working pressure

G. NPT – National Pipe Thread

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. AIS: American Iron & Steel

C. ASTM: American Society for Testing and Materials

D. ASME: American Society of Mechanical Engineers

E. AWWA: American Water Works Association

F. ISO: International Organization for Standardization

G. MSS: Manufacturers Standardization Society

H. NEMA: National Electrical Manufacture's Association

I. NSF: National Sanitation Foundation

1.04 SUBMITTALS

A. Product Data and Shop Drawings:

1. Submit in accordance with Section 01 33 00 in sufficient detail to confirm compliance with the Drawings and this Section.
2. Submittal shall, at a minimum, include the items listed below.

a. Manufacturer's product data for each type of valve.
b. Motor data. Submit in accordance with Section 26 05 84.
c. Coating systems. Submit in accordance with Section 09 96 00.
d. Valve schedule. Identify all valves by type number, pipeline, location, joint type, manufacturer, and model or catalog number.

B. Instructional Services Documentation:

1. Submit in accordance with Section 01 61 00.

C. Operation and Maintenance (O&M) Data:

1. Submit in accordance with Section 01 78 23.

D. Provide AIS certification.

1.05 QUALITY ASSURANCE

A. Manufacturer shall be responsible for all components identified for each valve type, accessory, and actuator specified in this Section.

1.06 WARRANTY

A. Manufacturer shall furnish one year standard warranty from date of substantial completion to guarantee there shall be no defects in workmanship in any item supplied.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

PART 2 – PRODUCTS

2.01 GENERAL

A. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for proper completion of Work included under this section.

B. Valves installed in insulated piping systems shall be furnished with extended stem as required to allow operation of valve without damage to, or interference with, insulation system.

C. Unless otherwise shown, valves shall be same size as adjoining pipe.

D. All units shall have name of manufacturer and size of valve cast on body or bonnet or shown on permanently attached plate in raised letters.

E. Service for all items specified herein are shown on Drawings or in Specifications. Note, this is a general specification; some types listed herein may not be part of the Work.

2.02 PLUG VALVES

A. Type V005: Eccentric Plug Valve

1. Manufacturers:

a. DeZurik.
b. Val-Matic.

2. Non-lubricated, resilient seated eccentric plug valve in compliance with AWWA C517-09.
3. Drip-tight shut-off up to full pressure rating of valve with pressure in either direction.
4. Provide grease zerk fittings in upper bonnet and lower body bearing for sludge applications.
5. Provide 100 percent Full Port valve, shall have a port area of 100 percent of the connection pipe area.
6. Pressure rating for valves 12-inch and smaller: 175-psig.
7. Pressure rating for valves 14-inch and larger: 150-psig.
8. Cast iron body, ASTM A126, Grade B.
9. Bonnet shall be ASTM A126 Grade B cast iron or nickel aluminum bronze alloy C95500.
10. Buna-N, V packing, U-cup, or O-ring seals.
11. Nickel seats.
12. Balanced plug coated with Hycar. Valves for digester gas service shall be provided with 316 stainless steel plugs.
13. Flanged ends, 125-pound ANSI Standards.
14. Mechanical joint ends for buried piping.
15. Stainless steel bearings.
16. Valves 4-inch and smaller, maximum operating pressure 25 psig and less: lever actuator.
17. Valves 4-inch and smaller, maximum operating pressure greater than 25 psig: gear actuator.
18. Valves 6-inch and larger: gear actuator.

2.03 BUTTERFLY VALVES

A. Type V130: Stainless Steel Butterfly Valve

1. Manufacturers:

a. DeZurik, Series BHP.

b. Henry Pratt HP Series
c. Or Equal.

2. 2-1/2-inch and larger.
3. 316 stainless steel body, 316 or 17-4 stainless steel shaft, and 316 stainless steel gland.
4. 316 stainless steel disc.
5. Virgin PTFE packing and seat.
6. Class 150, lugged body.
7. Lever Actuator.

2.04 CHECK VALVES

A. Type V205: Air Cushioned Swing Check Valve

1. Manufacturers:

a. Valve & Primer Corporation, APCO. Series 6000.
b. Val-Matic.

2. 2-1/2-in through 12-inch
3. Swing check with outside lever, weight, and air cushion chamber.
4. Suitable for flow direction horizontal or vertical up.
5. External adjustable counterweight to initiate valve closure.
6. External air cushion chamber to dampen valve closure. Closing speed adjustable.
7. Cast or ductile iron body, disc, and cover.
8. Stainless steel hinge shafts.
9. Flanged ends meeting 125-lb ANSI standards.
10. Rated 200-lb water-oil-gas (WOG).
11. Stainless steel body seat, resilient field replaceable seat ring on disc.

B. Type V206: Flanged Swing Flex Check Valve

1. Manufacturers:

a. Val Matic Surgebuster Swing Check Valve
b. Henry Pratt, RD Series

2. Design:

a. Valve body shall be full-flow equal to nominal pipe diameter at all points through valve. Exception is 4-inch valve shall be capable of passing a 3-inch solid.
b. Seating surface shall be 45-degree angle to reduce travel of disc to full open position.
c. Provide threaded port with plug on bottom of valve.
d. Top access port shall be full-size, allowing removal of disc without removing valve from line. Access cover shall be domed in shape to provide flushing action over disc for operating in lines containing high solids content.
e. Provide threaded port in access cover with mechanical indicator to provide disc position indication. Indicator shall have continuous contact with disc under all operating conditions to assure accurate disc position indication. Position of indicator shall allow reading from the east side of the valve when installed, not from the side adjacent to the structural beam.
f. Disc shall be one-piece construction, molded with integral O-ring type sealing surface and reinforced with alloy steel. Flex portion of disc shall contain nylon reinforcement and shall be warranted for 25-yrs.

g. Non-slam closing characteristics shall be provided through short 35-degree disc stroke and memory disc return action to provide cracking pressure of 0.25-psig.
h. The disc accelerator shall be of one piece construction and provide rapid closure of the valve in high head applications. The disc accelerator shall be enclosed within the valve and shall be field adjustable and replaceable without removal of the valve from the line. The disc accelerator shall be securely held in place captured between the cover and disc. It shall be formed with a large radius to allow smooth movement over the disc surface.
i. Valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking or distortion to valve disc or seat, and shall remain drip tight at both high and low pressures.

3. Materials:

a. Valve body and cover: ASTM A546 Grade 65-45-12 ductile iron.
b. Disc shall be molded Buna-N (NBR), ASTM D2000-BG.
c. Disc accelerator shall be Type 302 stainless steel.

C. Type V255: PVC Ball Check Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Hayward Industrial Products, Inc.
c. Chemtrol
d. Or equal.

2. Ball check valve.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Viton seats and seals.
8. O-rings shall be EPDM.
9. All valve unions and nuts shall have Buttress threads.
10. Valve shall be suitable for installation in the vertical or horizontal position.
11. Rated for 150-psi at 73 deg F.

D. Type V256: Stainless Steel Ball Check Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Hayward Industrial Products, Inc.
c. Chemtrol
d. Or equal.

2. A spring-loaded non-slam type check valve.
3. Provide sizes as indicated on Drawings.
4. Wafer style type fitted between two flanges.
5. Stainless steel spring with EPDM.
6. Body material of stainless steel with an EPDM seat.
7. Spring material shall be stainless steel.
8. Disk shall be of stainless steel.

2.05 BALL VALVES

A. Type V355: PVC, Socket-Weld Ball Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Nibco.
c. Hayward Industrial Products, Inc.
d. Chemtrol
e. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Full-port.
8. PTFE ball seats.
9. O-rings shall be EPDM.
10. All valve unions and nuts shall have Buttress threads.
11. Rated for 150-psi at 73 deg F.
12. Unless indicated otherwise, provide with double-stop polypropylene handle operator.

B. Type V335: Stainless Steel, Threaded Water Service Ball Valve

1. Manufacturers:

a. Apollo, Figure 86R-100.
b. Or Equal.

2. 1-inch and smaller for water service on stainless steel piping systems.
3. Comply with MSS-SP-110.
4. Full port, three-piece stainless body.
5. Threaded or socket welded ends as dictated by piping specification.
6. Stainless steel ball and stem.
7. Reinforced TFE Seats.
8. 1,000 psi CWP.

2.06 SOLENOID VALVES

A. Type V530: SST, Threaded Solenoid Valves for Water Service

1. Manufacturers:

a. Magnatrol Valve Corp. Type K.
b. Or Equal.

2. Provide in sizes indicated on Drawings.
3. 304 stainless steel body the threaded NPT ends.
4. 303 stainless steel piston and pilot valve.
5. Malleable or cast iron coil enclosure.

6. 430 stainless steel plunger.
7. 304 stainless steel bonnet tube.
8. Inconel spring and stem pin.
9. Glass filled Teflon orifice seal.
10. Silver AC shading coil.
11. Normally/fail closed design.
12. Rated at 110-psi differential pressure.
13. 120 Volt /1-phase/60-Hertz power supply.
14. NEMA 4X enclosure.
15. Provide with manual over-ride.

2.07 GLOBE VALVES

A. Type V601: Globe Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Nibco.
c. Hayward Industrial Products, Inc.
d. Chemtrol
e. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. EPDM Seal.
8. Rated for 150-psi at 73 deg F.

2.08 NEEDLE VALVES

A. Type V901: Needle Valve

1. Manufacturers:

a. Apollo 60A Series
b. Or Equal.

2. Valve Body: Stainless Steel
3. Packing Washer: EPDM
4. Working Pressure: up to 100 psi

2.09 MECHANICAL REGULATING VALVES

A. Type V740: Stainless Steel Pressure Reducing Valve for Water Service

1. Manufacturers:

a. Fisher Regulator, Series 95H.
b. Or Equal.

2. Provide in sizes indicated on Drawings.
3. Self operating pressure reducing valve.
4. Stainless steel body and trim.

5. Nitrile elastomers.
6. Rated for 300-psig inlet and outlet pressure.
7. 25-70 psi adjustable outlet pressure spring range.

2.10 MISCELLANEOUS VALVES

A. Type V735: Float Valve

1. Manufacturers:

a. CLA-VAL, Model 124-01, angle pattern or globe pattern float valve. If provided with globe pattern, provide downturning elbow on valve discharge.

2. Modulating hydraulically operated diaphragm float valve.
3. Valve shall be self regulating without the need on an external power supply.
4. Valve shall fully open when the liquid level reaches a preset low point and close drip tight when the level reaches the preset high point.
5. Valve body shall be cast steel, size as shown on Plans.
6. Threaded end connections
7. Bronze or stainless steel trim.
8. Nylon reinforced Bura-N Diaphragm.
9. Stainless steel stem, nut and spring.
10. Stainless steel float and rod.
11. Contractor shall coordinate float rod length with break tank dimensions.
12. Accessories:

a. Pilot system strainer.
b. Pilot system isolation valves.

2.11 ACCESSORIES

A. Valve Actuators:

1. Open by turning counter-clockwise.
2. Valves with centerline 5-feet 6-inch or less above operating floor: Handwheel for gear-actuated valves, lever for lever-actuated valves. Shall require no more than 40-pound effort to unseat valve.
3. Valves 4-inch and larger, unless otherwise noted on drawings, with centerline greater than 5-feet 6-inch above operating floor: Chainwheel.
4. Valves 4-inch and smaller, maximum operating pressure 25 psig and less: Lever.
5. Valves 4-inch and smaller, maximum operating pressure greater than 25 psig: Gear.
6. Valves 6-inch and larger: Gear.

B. Tee Wrenches:

1. Provide for buried and submerged valves.
2. Coordinate location of tee wrench wall brackets with Owner.
3. Provide wrench compatible with connection to 2-inch nut.

C. Chain Wheels and Chain Levers:

1. Provide chain wheels with guides and chain having coil proof design.
2. Provide chain levers with chain having coil proof design.
3. Galvanized or cadmium plate chain wheels, chain levers, guides, and chain.
4. Chain size as recommended by valve manufacturer.

5. Extend chains to within 4-feet of operating floor.
6. Provide chain hooks and tieback anchors for chains. Install so chain does not interfere with personnel traffic.

D. Buried and Submerged Valves:

1. Provide seals on shafts and gaskets on valve and actuator covers to prevent water entry.
2. Provide totally enclosed actuator mounting brackets with gasket seals.

E. Valve Boxes:

1. Provide for buried valves.
2. Three-piece screw type, cast iron box and cover.
3. Valve box diameter 5 ¼-inch, length as required for installation.
4. Provide extension stem as required for installation and 2-inch operating nut located within 6-inches from top of cover.

F. Floor Boxes:

1. Provide for valves as shown on Drawings.
2. Cast iron box and cover.
3. Provide valves with extension stems, complete with operating nuts, as required to locate top of operating nuts 2-inches below top of floor box cover.
4. Provide floor box cover wrench.

G. Extension Stems for Submerged Valves or Valves Below Operating Floor or Walkway:

1. Provide for valves as shown on Drawings.
2. Provide with intermediate stem guides with maximum spacing not exceeding 10 feet or L/R not exceeding 200.
3. Stem guides, stem, and couplings: Type 316 stainless steel.
4. Provide stem ends with transition pieces to connect to valve actuator and operator above.

H. Operator (Floor) Stand:

1. Ductile iron or Type 316 stainless steel floor mounted operator stand to operate extended stem valves with handwheel or handcrank actuator as noted on Drawings.
2. Provide bevel gear operator with clear plastic stem cover.
3. Floorstand and handwheel shall be cast iron.
4. Provide valve position indicator.
5. Provide rising stem, unless otherwise noted on Drawings.

I. Locking Devices:

1. Provide for valves as shown on Drawings.
2. Locking device shall be integral to the valve/operator and shall accept a normal padlock. Locking devices using chains and cables are not acceptable.
3. Provide two padlocks (one duty and one spare) for each pad-lockable valve.
4. Provide one key for each pad-lockable valve.
5. All padlocks provided shall be compatible with all keys provided. Different keys for each padlock are not acceptable.

J. Worm and Gear Actuators:

1. Totally enclosed design.

2. Sized for valve operation under valve rated pressure with pull of 40-pounds on handwheel or chain wheel.
3. Self-locking to prevent valve position creep.
4. Hardened alloy steel worm.
5. Reduction gearing runs in lubricant.
6. Orient operators to avoid interference with adjacent piping, equipment, and structures.
7. Include valve position indication.

2.12 ELECTRIC ACTUATORS

A. General:

1. Actuators shall be furnished and sized by valve manufacturer.

B. Type EA-1N:

1. Manufacturers:

a. Rotork
b. No Substitutions Permitted

2. Design Requirements:

a. Furnished and sized by valve manufacturer.
b. Self-contained, packaged-unit designed for modulating service of valve requiring multi-turn actuation.
c. Electric motor double-reduction gear type consisting of motor controls, gearbox, geared limit switches, torque switches, and manual override with de-clutching level.
d. Torque output no less than 1.5 times the required operating torque.
e. Self-locking.
f. Removable from valve without taking valve out of service.
g. Designed for mounting and running in any position.
h. Suitable for indoor or outdoor service with ambient temperature above 150 deg F.
i. Modulating service actuators shall be rated for a minimum 1,200 starts per hour.
j. Where noted on Drawings, provide Explosion Proof actuators suitable for Class I, Division 1 Group C and D Hazardous.

3. Construction:

a. Motor speed reduction shall be by means of gear train.
b. Gearbox totally enclosed and sealed, constructed of Ductile Iron. No other materials of construction will be acceptable.
c. Gearbox shall have oil or grease lubricated hardened steel spur gears and self-locking worm and worm gear set. Worm shall be heat treated alloy steel and have worm threaded surface rolled or ground. Worm gear shall be bronze. Non-metallic gears in power train are not acceptable.
d. Shafts shall be heat-treated alloy steel supported throughout by anti-friction ball or roller bearings and permanently lubricated at the factory.
e. All thrust components shall be supported by use of tapered roller bearings.
f. Electrical components factory wired, except devices located remote from actuator.
g. Integral terminal strips for field wiring connections.
h. Separately sealed terminal compartment for remote control connections.
i. Heater and thermostat for humid and low temperature environments.
j. NEMA 4X enclosure for motor, gearing, switches, and wiring terminals unless located in a hazardous area as noted on Drawings and in Valve schedule. Actuators in

hazardous areas shall be NEMA 7 rated.
k. Enclosure shall have a bonded O-ring seal and a hinged cover.
l. Aluminum Electrical Compartment Cover with Stainless Steel hinges and captivated hex head screws.

4. Manual Operation:

a. Engageable manual override.
b. Padlockable in manual or motor mode.
c. Safety interlock feature to prevent motor operating when manual override engaged.
d. Handwheel rim pull at 40 pound maximum.
e. Failure of the motorized gearing shall not prevent manual operation.

5. Motor:

a. 460 Volt, 3-phase, 60 Hertz
b. Unless approved by Engineer, maximum horsepower 1.
c. Constant speed.
d. Reversing.
e. Continuous duty cycle for modulating electric actuators.
f. Standard duty cycle for Open-Close electric actuators.
g. Permanently lubricated ball bearings.
h. Entirely enclosed and nonventilated

6. Control:

a. Reversing motor controller (solid-state for continuous modulation).
b. Control power transformer.
c. Automatic reset thermal overload relay.
d. Current-sensing motor overload relay or automatic phase correction single phase protection.
e. OPEN/STOP/CLOSE local control operation.
f. Remote position control for modulating actuators.
g. Timer to Inhibit/Limit the Motion/Duty Cycle for modulating actuators.
h. Deadband adjustment of Process/Feedback signal deviation for modulating actuators.
i. OPEN/CLOSE position indicating lights or LEDs.
j. Pad-lockable LOCAL/OFF/REMOTE switch.
k. Automatic double acting limit switches.
l. Limit switches are independently adjustable, and capable of being adjusted to trip at any point between full open and full closed.
m. Adjustable travel limit switches factory set to full open and full closed positions.
n. Programmable torque-fault indicator switches.
o. Torque switches or torque sensing operate during the complete gate cycle to protect the valve from excessive loads in either travel direction.
p. Network transmission of REMOTE, FAIL, OPEN and CLOSED status.
q. Internally supplied 120Vac control power for local OPEN/STOP/CLOSE commands.

7. Network Control System

a. Shall consist of a redundant master station and field devices networked on a single 2-wire twisted pair fault tolerant digital network.
b. Master Station of microprocessor type, suitable for indoor mounting
c. Capable of operating with up to 240 field units using a two-wire screened twisted pair data highway up to 12.5 miles long.

d. The digital network shall be current based and require no internal or external signal repeaters or amplifiers to achieve the maximum distance or device count. There shall be NO limitations on distance between field devices up to the maximum distance of the network. The network shall be constructed in a “ring” configuration originating at the master station, daisy chained to each field device and returning to the master station.
e. The master station shall be available as “hot standby” as necessary for the application providing complete redundancy of the hardware which will automatically assume control on failure of the primary unit.
f. Lightning and surge protection: the master station and field units shall be protected against lightning by the provision of transient suppression devices on all two-wire connection ports rated at 1.5k V for one millisecond. Optical isolation shall be used within the field units and master station for enhanced noise protection.
g. Hand-held test equipment shall be available to facilitate the testing of installed field units and the setting of field unit parameters. Field unit testers shall be able to emulate master station communication on the two-wire network terminals.

h. Master Station

    i. Operates utilizing 90 to 264 VAC, 60Hz, 1 amp.
    ii. 316 Stainless Steel hinged door enclosure with Sola Industrial UPS convenience outlet, EtherNet/IP gateway, circuit breakers, terminal blocks, and panel LED light.
    iii. Color icon based display and keypad to enable complete system configuration and monitoring as well as monitoring and control of every connected field device unit. A security system shall be included to prevent unauthorized users access to control and setting of parameters.

i. Host Communications

    i. The master station shall include (2) independent host serial communications ports for integration into the facility process control and monitoring system.
    ii. The host communication ports can be RS232 or RS485 as necessary for the application in any combination.
    iii. RS232 and RS485 ports shall support Modbus RTU for communication with supervisory control and monitoring equipment.
    iv. The system shall also include 2 Ethernet ports for connection into the facility Local Area Network. The Ethernet ports shall support Modbus TCP for communication with supervisory control and monitoring equipment.
    v. A gateway converter to EtherNet/IP shall be included for host communications. A Data table mapping shall be included with shop submittal.
    vi. An additional Ethernet service port shall be provided on the front of the master station for setup, configuration and diagnostics.
    vii. Ethernet port shall include an embedded web server for system monitoring and control using a standard PC web browser.
    viii. Standard Web pages shall be included for:
        - Master station configuration
        - Master station monitoring and control
        - Field Network diagnostics with indication of location and fault type if present.
        - Individual field device screens for monitoring and control including user defined tag names.
        - Individual Field device configuration screens indicating configuration of system related parameters for each connected field device.
        - Open and closed Torque profiles consisting of 8 values in each

direction, from actuator types that are capable of providing this information.

ix. A last event logger shall be included for the field devices to date and time stamp the last occurrence of status and alarm information. The event logger shall also record date and time stamped the origination of the last command to each field device.

x. An automatic email notification facility should be included to automatically notify user defined recipients of alarm conditions.

xi. The web pages will be multi-lingual and displayed in the correct language of the user as defined in their user account.

xii. Multiple user name, password and security levels shall be included to restrict access.

xiii. IP address filtering and HTTPS support shall also be included to further enhance security.

j. Field Communications

i. The field network shall use 20mA current for data transmission with a maximum applied voltage of 15V.

ii. The system shall continuously poll each connected field device and report any changes in status or communication failure. A report by exception protocol shall be used to minimize response time. Commands shall take precedence over the data collection, command shall be immediately transferred to the field device.

iii. Failure or loss of power to any one or more connected field units in the network shall not cause loss of control or communication with the remaining devices. On restoration of power to a field unit, it shall be resume communications with the master station automatically.

iv. The system shall be capable of maintaining communications with all field devices in the presences of a single open, short, or ground fault in the network. A “loop back” facility will be used to isolate faulty segments of the digital network.

v. In addition, the system shall be capable of automatically producing an “as wired” network map, indicating the physical order of device connection. In the event of a network fault, the location and type of fault shall be indicated. Multiple faults shall result in the loss of communication only with those devices isolated between the faults and not the entire system. This cable security feature shall be inherent in the system and achieved by using only a single cable without secondary networks or additional hardware.

k. Valve Actuator Field Units:

i. Actuators shall be connected to the network via plug-in modules mounted internally of the actuator double sealed enclosure.

ii. The following information shall be available for each actuator via the network:

- Valve Opening,
- Valve Closing,
- Valve Open,
- Valve Closed,
- Valve Stationary in Mid-Position,
- Cable Fault.
- Continuous Valve Position,
- Unavailable for control
- Motor Thermostat Trip,
- Local Stop Selected,

- Local Control Selected,
- Valve Obstructed (motor turned off during travel due to high valve torque requirement),
- Valve Jammed (valve stuck in seat)

iii. Remote control functions: Open, Close, Stop at Any Time, Assume an Intermediate Position, Assume Emergency Shut-Down Position.

l. General Purpose Field Units (includes gate actuators):

i. General I/O modules shall also be available to enable monitoring and control of non-actuator devices as required by the facility, and shall include 8 digital inputs, 2 analog inputs, 1 analog output (0-5 vcd) and 4 digital outputs.
ii. Shall be available in a variety of enclosures suitable for location in the field or control room environment.

m. Parameter Settings

i. There shall be settings for the loop baud rate and unique address (up to 240) for each field device. These settings shall be made non-intrusively without the need to remove covers or gain access directly to the field unit itself.

n. Supplier must have at least three (3) years of commercial operating experience and be able to provide at least ten (10) trouble free site references.

C. Type EA-1:

1. Manufacturers:

a. Rotork
b. No Substitutions Permitted

2. Design Requirements:

a. Furnished and sized by valve manufacturer.
b. Self-contained, packaged-unit designed for modulating service of valve requiring multi-turn actuation.
c. Electric motor double-reduction gear type consisting of motor controls, gearbox, geared limit switches, torque switches, and manual override with de-clutching level.
d. Torque output no less than 1.5 times the required operating torque.
e. Self-locking.
f. Removable from valve without taking valve out of service.
g. Designed for mounting and running in any position.
h. Suitable for indoor or outdoor service with ambient temperature above 150 deg F.
i. Modulating service actuators shall be rated for a minimum 1,200 starts per hour.
j. Where noted on Drawings, provide Explosion Proof actuators suitable for Class I, Division 1 Group C and D Hazardous.

3. Construction:

a. Motor speed reduction shall be by means of gear train.
b. Gearbox totally enclosed and sealed, constructed of Ductile Iron. No other materials of construction will be acceptable.
c. Gearbox shall have oil or grease lubricated hardened steel spur gears and self-locking worm and worm gear set. Worm shall be heat treated alloy steel and have worm threaded surface rolled or ground. Worm gear shall be bronze. Non-metallic

gears in power train are not acceptable.
   d. Shafts shall be heat-treated alloy steel supported throughout by anti-friction ball or roller bearings and permanently lubricated at the factory.
   e. All thrust components shall be supported by use of tapered roller bearings.
   f. Electrical components factory wired, except devices located remote from actuator.
   g. Integral terminal strips for field wiring connections.
   h. Separately sealed terminal compartment for remote control connections.
   i. Heater and thermostat for humid and low temperature environments.
   j. NEMA 4X enclosure for motor, gearing, switches, and wiring terminals unless located in a hazardous area as noted on Drawings and in Valve schedule. Actuators in hazardous areas shall be NEMA 7 rated.
   k. Enclosure shall have a bonded O-ring seal and a hinged cover.
   l. Aluminum Electrical Compartment Cover with Stainless Steel hinges and captivated hex head screws.

4. Manual Operation:

   a. Engageable manual override.
   b. Padlockable in manual or motor mode.
   c. Safety interlock feature to prevent motor operating when manual override engaged.
   d. Handwheel rim pull at 40 pound maximum.
   e. Failure of the motorized gearing shall not prevent manual operation.

5. Motor:

   a. 460 Volt, 3-phase, 60 Hertz
   b. Unless approved by Engineer, maximum horsepower 1.
   c. Constant speed.
   d. Reversing.
   e. Continuous duty cycle for modulating electric actuators.
   f. Standard duty cycle for Open-Close electric actuators.
   g. Permanently lubricated ball bearings.
   h. Entirely enclosed and non-ventilated

6. Control:

   a. Reversing motor controller (solid-state for continuous modulation).
   b. Control power transformer.
   c. Automatic reset thermal overload relay.
   d. Current-sensing motor overload relay or automatic phase correction single phase protection.
   e. OPEN/STOP/CLOSE local control operation.
   f. Remote 4-20mAdc position control for modulating actuators.
   g. Timer to Inhibit/Limit the Motion/Duty Cycle for modulating actuators.
   h. Deadband adjustment of Process/Feedback signal deviation for modulating actuators.
   i. OPEN/CLOSE position indicating lights or LEDs.
   j. Pad-lockable STOP/LOCAL/REMOTE switch.
   k. Automatic double acting limit switches.
   l. Limit switches are independently adjustable, and capable of being adjusted to trip at any point between full open and full closed.
   m. Adjustable travel limit switches factory set to full open and full closed positions.
   n. Programmable torque-fault indicator switches.
   o. Torque switches or torque sensing operate during the complete gate cycle to protect the valve from excessive loads in either travel direction.

p. Unpowered contacts for indication of REMOTE, FAIL, OPEN and CLOSED status, rated at 5 amps at 120 vac.
q. Internally supplied 120 vac control power for OPEN/STOP/CLOSE commands.

7. Remote Position Indication (see P&ID for requirements):

a. Integral position transmitter, internally powered, producing a 4-20 mA output in direct proportion to valve position for connection to an external instrument loop. Position transmitter shall use a multi-turn, conductive plastic potentiometer rated for 10-20 million cycles.
b. Full closed position shall correspond to 4 mA.
c. Capable of driving a minimum external load impedance of 350 ohms.

2.13 SOLENOID ACTUATORS

A. General:

1. Actuators shall be furnished and sized by valve manufacturer.

B. Type SA-1:

1. Manufacturers:

a. Asco.
b. Or equal.

2. Cast aluminum or brass body, soft seated, 120 vac solenoid coil.
3. Minimum operating pressure differential capability of 100-psig.
4. Solenoid operator:

a. Molded coil in NEMA 4 enclosure.
b. Removable from valve body while valve body remains in piping.

5. Mounted on actuator by valve manufacturer.
6. Piped to valve actuator by valve manufacturer.
7. Provide 2-way type solenoid valves for solenoid operated valves specified fail closed.

2.14 COATINGS

A. Manufacturer is responsible for surface preparation and application of first coat (prime coat) of equipment prior to shipment. Coatings shall comply with Section 09 96 00.

B. Contractor shall provide finish coats at Project Site. Finish coat products shall be manufactured by same manufacturer of first coat (prime coat).

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install valves in accordance with manufacturer's written recommendations and approved submittals.

B. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flanged faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints.

C. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Pressure test valves at same time connected piping is tested.
2. Repair leaking joints.
3. Protect parts of valves and actuators that could be damaged by test.

Schedule 1: Actuated Valve Schedule

Tag No.	Valve Type	Valve Size (inch)	Service	Actuator Type	Operating Mode	Failure Mode	Control	NEMA Rating	Comments
600-SV-0611 600-SV-0612	Solenoid	1/2	W2	SA-1	O/C	LAST POSITION	See 009-N-6 for details	4X	120 Volt
BF-6-15 BF-6-16	Existing Butterfly	24	ML	EA-1N	O/C	LAST POSITION	For actuator control see 009-N-11 Detail 3	4X	480 Volt Actuators for existing butterfly valves
BF-6-17 BF-6-18 BF-6-19 BF-6-20	Existing Butterfly	36	ML	EA-1N	O/C	LAST POSITION	For actuator control see 009-N-11 Detail 3	7	480 Volt Actuators for existing butterfly valves. Provide connection to existing stem.
BFV-6-29 BFV-6-30 BFV-6-31 BFV-6-32 BFV-6-33 BFV-6-34	Existing Butterfly	24	ML	EA-1N	O/C	LAST POSITION	For actuator control see 009-N-11 Detail 3	4X	480 Volt Actuators for existing butterfly valves. Provide connection to existing stem.
600-FCV-0521	V005	6	DSS	EA-1	Modulating	LAST POSITION	See Detail 1- Modulating Valve on Drawing 009-N-5	4X	
600-FCV-0531	V005	6	WAS	EA-1	Modulating	LAST POSITION		4X	
600-FCV-0532	V005	6	WAS	EA-1	Modulating	LAST POSITION		4X	
600-FCV-0541	V005	6	PSD	EA-1	Modulating	LAST POSITION		4X	
600-FCV-0542	V005	6	PSD	EA-1	Modulating	LAST POSITION		4X	
600-CV-0631	V005	4	D	EA-1	O/C	LAST POSITION	See Detail 1- Drain Valve on Drawing 009-N-6	4X	
600-CV-0632	V005	4	D	EA-1	O/C	LAST POSITION		4X	
600-CV-0621	V005	4	W3	EA-1	O/C	LAST POSITION	See Detail 1- Drain Valve on Drawing 009-N-6	4X	
600-CV-0622	V005	4	W3	EA-1	O/C	LAST POSITION		4X	

END OF SECTION

SECTION 40 05 59
STAINLESS STEEL GATES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Stainless Steel Gates
2. Gate Operators
3. Gate Accessories.

B. Provide gates as specified in Stainless Steel Gate Schedule.

1.02 DEFINITIONS

A. EPDM: Ethylene Propylene Diene Monomer

B. GPM: Gallons per Minute

C. UHMWPE: Ultra High Molecular Weight Polyethylene

D. VIF: Verify in Field

1.03 REFERENCES

A. ASTM: American Society of Testing and Materials

B. AWWA: American Water Works Association

1.04 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Conform to AWWA C561 as modified herein.
2. Proportion for stresses occurring during continuous operation and for additional stresses occurring during fabrication or installation.

B. Field Leakage Criteria:

1. Seating Head: Leakage shall not exceed 0.05 gallon per minute per foot of periphery under design head conditions.
2. Unseating Head: Leakage shall not exceed 0.05 gallon per minute per foot of periphery under design head condition.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for gates specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for gates. General arrangement drawings and catalog cuts are not considered acceptable installation and assembly drawings.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.
3. Stainless Steel Gate Schedule. Identify all gates by type number, pipeline, location, joint type, manufacturer, and model or catalog number.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of gates with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of gates in service.
3. Submit in accordance with Section 01 78 23.
4. Contractor advised that the AIS requirements do not apply to gates.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain gate components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 WARRANTY

A. Manufacturer shall furnish written one year standard warranty from date of substantial completion to guarantee there shall be no defects in material or workmanship in any item supplied.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver gates and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.09 MAINTENANCE

A. Provide spare parts necessary to maintain the equipment in service for a period of two years.

B. Provide special tools required for checking, testing, parts replacement, and maintenance.

C. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Fontaine Aquanox

B. Rodney Hunt

C. Whipps, Inc.

D. No Substitutions Permitted

2.02 STAINLESS STEEL GATES

A. General:

1. This Section includes design, materials of construction, fabrication, and supply of stainless steel gates as shown on Drawings and as indicated in the Stainless Steel Gate Schedule.
2. Gates shall be either self-contained or non self-contained of the rising stem configuration as shown on Drawings and as indicated in the Stainless Steel Gate Schedule.
3. Downward opening weir type gates shall be self-contained or non self-contained weir type with disc arranged to lower to open with guides designed to mount on face of concrete wall as shown on Drawings and as indicated in the Stainless Steel Gate Schedule. All downward opening gates shall be provided with self-adjusting type seals, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord.
4. Gates shall be provided with three-sided seal system as shown on Drawings and as indicated in the Stainless Steel Gate Schedule. All seals shall be the self-adjusting type, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord.
5. Except as modified or supplemented herein, all gates and operators shall conform to applicable requirements of AWWA C561, latest edition.

B. Materials:

1.	Disc Skin Plate:	ASTM A240, Type 316L Stainless Steel
2.	Frame and Guides:	ASTM A240, Type 316L Stainless Steel
3.	Seals:	UHMWPE ASTM D4020
4.	Invert seal	EPDM or Buna-N ASTM D-2000
5.	Seats:	UHMWPE ASTM D4020
6.	Retainer Bars and Fasteners:	ASTM A276, Type 316L Stainless Steel
7.	Stems:	ASTM A276, Type 316L Stainless Steel
8.	Stem Couplings:	ASTM A276, Type 316L Stainless Steel
9.	Stem Guides:	ASTM A240, Type 316L Stainless Steel
10.	Frame, Yoke, Stem Guides, Pedestal, Wall Brackets, Slide:	ASTM A240 and A276, Type 316L Stainless Steel
11.	Guides, Side & Bottom Seals, Stem Guide Liner:	UHMWPE ASTM D-4020
12.	Compression Cord or Pad:	Silicon or Nitrile, ASTM D2000 or EPDM ASTM D 1056

13. Gasket: EPDM ASTM D 1056
14. Stem Cover: Opaque-UV protected/enhanced Lexan or Butyrate ASTM D-707
15. Lift Nut: Manganese bronze ASTM B584 UNS-C86500
16. Anchor bolts: minimum diameter of 1/2-inch

C. Performance:

1. Design Head: Gates shall be designed to withstand design head (maximum design head shall be taken as height of slide unless otherwise shown in Stainless Steel Gate Schedule).
2. Seal Performance Test: Gate's sealing system shall be tested through a cycle test in an abrasive environment and shall show leakage requirements are still obtained after 25,000 cycles with minimum deterioration.

D. Disc / Slide:

1. Flat plate reinforced with structural or formed members welded to plate.
2. Limit deflection of gate to 1/720 of span or 1/16-inch, whichever is less.
3. Working design stresses shall not exceed lesser of 40 percent yield strength or 25 percent ultimate strength of material.
4. Disc components shall have minimum material thickness of 1/4-inch.
5. Slide shall consist of flat plate reinforced with formed plates or structural members to limit its deflection.

E. Guides and Frame:

1. Frame shall be Flange Back Design, constructed of 316L stainless steel plate, with the guide section formed into "C" or "Z" channel shaped channel to house the seal, and shall be reinforced to withstand the specified operation conditions.
2. Frame shall be a rigid, one-piece assembly with a flanged frame arrangement.
3. Flat frames shall only be provided on gates with frames that will be embedded or mounted in existing channels or openings.
4. Guides shall have a minimum weight of 13 lbs/ft. Guide extensions shall have a minimum weight of 6.5 lbs/ft. Angles are not acceptable for guide extensions.
5. Lifting lugs shall be provided on all frame styles.
6. On self-contained gates, the side frame shall extend above the operating floor and the operating mechanism shall be mounted to the yoke. When shown, the frame may extend to the operating floor and a floorstand may be mounted to the yoke.
7. Yoke members shall be designed for output of gate hoist and shall be arranged to permit removing disc from frame.
8. Guide slot shall engage disc plate a minimum of 1-inch on each side.
9. Guides extending above operating floor shall be sufficiently strong so further reinforcing not required.

F. Seals:

1. The seal system shall consist of self-adjusting UHMWPE seals with a rubber compression cord.
2. The UHMWPE seals shall be arranged to ensure that there is no metal-to-metal contact between the slide and the frame.
3. Continuous compression cord shall ensure contact between UHMWPE guide and gate in all positions.
4. Sealing system shall maintain efficient sealing in any position of slide and let water flow only in open part of gate. Vertical face of seal shall contact seating surface of guides to properly seal corners. Shape seal to produce seating surface ¾-in. wide, minimum.

5. All seals shall be secured with assembly bolts. All seals shall be field removable and field replaceable without the need to remove the gate frame from the wall or to remove concrete or grout to access the attachment bolts.
6. The compression cord shall be contained by the UHMWPE seal so that it shall not be in contact with the slide.
7. Seal system shall be self-adjusting for the life of the gate. Adjustable wedging devices such as wedges, wedge bars and pressure pads are not acceptable.
8. Rubber J-type seals or similar are not acceptable.

G. Stems:

1. Stem threads shall be of the machine cut or machine rolled, full depth Acme type polished to a 16 microinch finish or better. Stems shall be designed to transmit in compression a minimum of 2 times the rated output of hoist at 40 pounds effort on crank or handwheel.
2. Stems shall have a minimum diameter of 1½-inches and shall be constructed of solid round bar.
3. Stem shall have slenderness ration (L/r) less than 200.
4. Stem guides, where required to limit unsupported stem length, shall be 316 stainless steel with bronze or UHMWPE bushings. Stem guides shall be a one piece design with four anchor bolts and shall be constructed of minimum 3/8-inch 316L stainless steel plate.
5. Dual Operators: Gates having widths in excess of 48 inches and equal to or greater than 2 times their height shall be provided with two gear boxes connected by a tandem shaft for simultaneous operation. All gates with gate openings of 84 inches wide or wider and with widths twice the height shall be provided with two gearboxes and a tandem shaft. Tandem shaft shall be of 316L stainless steel.
6. Operating stem shall be of 316L stainless steel designed to transmit in compression at least two times rated output of operating manual mechanism with 40 pounds effort on crank or handwheel.
7. Where electric operator is used, stem design force shall not be less than 1.25 times output thrust of hydraulic or pneumatic cylinder, with pressure equal to maximum working pressure of supply or 1.25 times output thrust of electric motor in stalled condition.
8. For stems in more than one piece and with diameter or 2-inches and larger, different sections shall be joined together by 316L stainless steel or solid bronze couplings.
9. Couplings shall be internally threaded and keyed or bored and bolted and shall be of greater strength than the stem.
10. Guides shall be adjustable and shall be spaced in accordance with manufacturer's recommendation.

H. Stem Covers:

1. Transparent, lexan or butyrate plastic, vented pipe stem cover and cap to provide indication of gate position, permit inspection of stem threads, and protect stem from contamination.
2. Clear mylar indicating tape shall be provided for field application after the gate has been installed and positioned.

I. Operator:

1. Benchstand hoists shall be sized to permit operation of gate under full operating head with maximum effort of 40 pounds on crank or handwheel.
2. Hoist nut shall be manganese bronze conforming to ASTM B584 C86500.
3. Hoist nut shall be supported on ball or roller bearings.
4. Suitable seals shall be provided to prevent entry of foreign matter.
5. Direction of handwheel or crank rotation to open gate shall be clearly and permanently marked on hoist.

6. All bearings and gears shall be totally enclosed in weather tight housing. Pinion shaft of crank-operated mechanisms shall be constructed of 316L stainless steel and supported by ball, roller, or needle bearings.
7. Each manual operator shall be designed to operate gate under maximum specified seating and unseating heads by using maximum effort of 40 pounds on crank or handwheel, and shall be able to withstand, without damage, an effort of 80 pounds.
8. Pedestals shall be fabricated from 316L stainless steel and shall have a minimum 4-inch diameter tube and 1/2-inch minimum thick base plate and operator mounting plate.
9. Install pedestals using max. 1-in thick leveling grout pad.
10. Crank shall be removable and fitted with corrosion resistant rotating handle.
11. Maximum crank radius shall be 15 inches and maximum handwheel diameter shall be 24 inches.

2.03 ELECTRIC ACTUATOR

A. Manufacturers:

1. Rotork
2. No Substitutions Permitted.

B. General:

1. Provide in accordance with Section 40 05 53 paragraph 2.10.B.

C. Spare Parts:

1. Provide one (1) bronze operating nut of each size stem and each type of operator (manual and electric).
2. Provide one (1) stop collar of each size stem.

2.04 GATE ACCESSORIES

A. Manually Operated Floor Stands

1. Maximum effort of 40 pounds shall be required to operate gate at design head.
2. Enclosed gear type with crank capable of manual operation or by means of portable electric operator.
3. Provide single or double gear reduction, depending upon lifting capacity required.
4. Steel or cast iron gears with machine cut teeth designed for smooth operation.
5. Mount gearing and lift nut in ductile iron housing and support with fabricated 316L stainless steel pedestal to place 316L stainless steel input shaft approximately 36 inches above floor.
6. Provide lubrication fittings in gear housing to permit lubrication of gears and bearings.
7. Removable cast aluminum crank arm with revolving brass or nylon grip.
8. Handwheel shall be provided with face of handwheel in vertical orientation.
9. Provide rising stem gates with Butyrate or lexan cover, unless noted otherwise.

B. LIFTING MECHANISM

1. Provide gates for manual or hoisting mechanism operation as indicated in Stainless Steel Gate Schedule.

   a. Provisions for manual operation shall be, reinforced lifting clevis hole, single lift or lifting lug as indicated in Stainless Steel Gate Schedule. Reinforced lifting clevis hole shall consist of 1” dia lifting hole with extra thickness welded to gate before drilling hole in order to provide additional surface area clevis pin will contact.
   b. Hoisting Mechanism: Handcrank or handwheel.

1) Handcrank: Capable of operation by crank or portable electric operator.
2) Provide 2 adjustable bronze or stainless steel stop collars on stems of manually operated gates to set open and closing settings. Stop collars shall be internally threaded and outfitted with a stainless steel set screw. In lieu of one of the stop collars, positive stops can be provided on the frame and slide.
3) Bottom of gate in full open position to be at or above top of gate elevation when fully closed.
4) Hoist shall be sized to permit operation of gate under full operating load with a maximum effort of 40 pounds on the crank or handwheel.
5) Handwheel or handcrank operator centerline shall be no more than 3 feet-6 inches above operating floor, unless otherwise noted. Provide remote drive on self-contained gates as indicated in Stainless Steel Gate Schedule.

c. When in closed position, gates shall seat flush with bottom and be provided with compressible resilient seal mounted on disc or frame. Specially mold and design seal to produce wide sealing surface.

d. Provide 316L stainless steel operating stem attached to disc with stainless steel stem connector. Stem shall have minimum diameter of 1½-inches.

e. Where gate width is in excess of 48 inches and equal to or greater than twice gate height, provide multiple operating stems. Mechanically interconnect multiple operating stems to provide uniform gate operation with 316L stainless steel shafts. Where electrically actuated, provide actuator installation bracket. Coordinate position of actuator, handwheel, and controls with Engineer.

1) For Dual Stem application, provide bevel gearboxes with electric actuator mounted to one of the gearboxes or mount the electric actuator and intermediate gearbox to drive bevel gearboxes. Actuator installed where any part of actuator extends beyond outside width of gate frame into walkway area is not acceptable.
2) Provide flexible couplings and Type 316L stainless steel shaft or tubing with stainless steel connecting bolts.
3) Provide removable corrosion resistant guard to prevent contact with rotating shaft assembly when interconnected gearboxes are driven by an electric actuator.
4) All fasteners shall be Type 316 stainless steel.

2.05 COATINGS

A. Manufacturer is responsible for surface preparation and priming of the manual gearbox housing in the plant. Contractor is responsible for finish coating the gearboxes after installation of the equipment.

B. Prior to substantial completion, examine coated surfaces and retouch or refinish surfaces (with same coating material) to leave in condition acceptable to Engineer.

C. Coatings shall comply with Section 09 96 00.

D. Stainless steel surfaces shall not be coated. All weld burn and slag shall be mechanically passivated in accordance with ASTM A380 to provide a uniform finish. If bead blasting is utilized, the entire slide and entire frame shall be bead blasted to provide a uniform finish.

E. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install gates in accordance with manufacturer's written instructions.

B. Installation of all parts shall be done by Contractor in a workmanlike manner and in accordance with detailed technical installation procedures supplied by gate manufacturer. It shall be Contractor's responsibility to handle, store, and install gate operating mechanism and accessories in strict accordance with manufacturer's drawings and recommendations.

C. Equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions and recommendations of equipment manufacturer unless exceptions are noted by Engineer.

D. Gates and operators shall be supplied with all necessary parts and accessories indicated on Drawings, specified or otherwise required for a complete, properly operating installation.

E. Gates shall be shop inspected for operation before shipping.

F. Install gates in accordance with manufacturer's written recommendations and approved submittals.

G. Electric actuator orientation and positioning, or rotation of various component heads on actuator may be required to be adjusted in the field after, or during, installation. Contractor shall coordinate with Engineer in positioning actuator to allow best access to controls and allow handwheel to be in lowest position possible and accessible with portable actuator.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 10. Coordinate field location with Engineer

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom for a minimum of two separate trips, designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

    a. 3 man-days for Installation Services.
    b. 1 man-day for Instructional Services.
    c. 1 man-day for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier's or Manufacturer's field

services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. After installation has been completed, test sluice gates under normal operating conditions in presence of Engineer.

C. Repair leaks or other imperfections found upon testing.

STAINLESS STEEL GATE SCHEDULE							
Tag Number	Opening Size (inches by inches)	Material	Design Head from Centerline (feet)	Operator	Installation	Max HP	Notes
SG-6-3 SG-6-4 SG-6-5 SG-6-6 SG-6-7 SG-6-8	6' x 2'-3"	Type 316L Stainless Steel	Unseating Head: 3.3'	Gate-Mounted (48" above Operating Floor) Open – Close Electric Actuator (Remote Controllable) Dual Stems	Surface Mounted	1	Opening Invert: 524.6±, VIF Weir Elevation: 525.25±, VIF Operating Floor: 527.00±, VIF three-sided seal system Rising Stem Over existing Stop Gate Frame 6' wide opening, 2.5" thick embedded frame on 3 sides Downward Opening Weir Gate
SG-6-18 SG-6-19 SG-6-20 SG-6-21 SG-6-22 SG-6-23	6' x 3'-3"	Type 316L Stainless Steel	Unseating Head: 3.3'	Gate-Mounted (48" above Operating Floor) Open – Close Electric Actuator (Remote Controllable) Dual Stems	Surface Mounted	1	Opening Invert: 524.6±, VIF Weir Elevation: 525.25±, VIF Operating Floor: 528.00±, VIF three-sided seal system Rising Stem Over existing Stop Gate Frame 6' wide opening, 2.5" thick embedded frame on 3 sides Downward Opening Weir Gate

END OF SECTION

SECTION 40 05 97
PIPING AND EQUIPMENT IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic pipe markers.
2. Underground type plastic line marker.
3. Engraved plastic laminate signs.
4. Plastic equipment markers.
5. Piping system color coding schedule.

B. Identification furnished as part of equipment is specified as part of equipment assembly in other sections and shall comply with requirements of this section.

C. Refer to Division 26 for identification requirements of electrical and instrumentation work, not Work of this Section.

D. Refer to Division 10 for identification and signage requirements of architectural work, not work of this Section.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for piping and equipment identification specified.

C. Shop Drawings:

1. Submit piping system color coding schedule indicating flow stream identifier and proposed color. Submittal shall include color chart for reference. Schedule shall include all piping systems from Sections 40 05 05 and 22 00 05.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Regulatory Requirements:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Single-Source Responsibility: Obtain piping and equipment identification from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and equipment identification to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store piping and equipment identification in clean, dry location.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. Furnish minimum 5 percent extra stock of each mechanical identification material required for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Allen Systems, Inc.

B. Brady (W.H.) Company, Signmark Division.

C. Marking Services, Inc.

D. Industrial Safety Supply Company, Inc.

E. Seton Name Plate Corporation.

2.02 MECHANICAL IDENTIFICATION MATERIALS

A. Provide manufacturer’s recommended products as specified for each application.

B. Where more than single type is specified for application, selection is installer’s option, provide single selection for each product category.

C. Bands, markers, and identification materials used in mechanical rooms and process locations shall be rated for exterior application and suitable for withstanding occasional washdown.

2.03 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or if not indicated, as recommended by manufacturers or required for proper identification and operation and maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown or specified, provide identification indicating individual system number as well as service (i.e., Boiler No. 3, Air Supply Unit No. 10-ASU-2).

2.04 PLASTIC PIPE MARKERS

A. Snap-on Type: Provide preprinted, semi-rigid snap-on, color coded pipe markers complying with ANSI A13.1.

B. Pressure Sensitive Type: Provide preprinted, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI A13.1. Dot matrix printing is not acceptable.

C. Small Pipes: For external diameters less than 6 inch (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of following methods:

1. Snap-on application of pretensioned, semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color coded plastic adhesive tape not less than 4 inch wide, full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
4. For plastic chemical tubing use only snap-on type.

D. Large Pipes: For external diameter 6 inch and larger (including insulation, if any), provide either full band or strip type pipe markers not narrower than 3 times letter height (and of required length), fastened by one of following methods:

1. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 4 inch wide, full circle at both ends of pipe marker, tape lapped 3 inch.
2. Strapped to pipe (or insulation) application of semi-rigid type with manufacturer's standard stainless steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled or shown and abbreviate only as necessary for each application length, and only with approval of Engineer. Lettering height shall be as follows:

Outside Pipe Diameter (inches)	Minimum Letter Height (inches)	Minimum Length of Marker (inches)
¾ to 1-1/4	½	8
1-1/2 to 2	¾	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	32

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

G. Label and band colors in accordance with ANSI A13.1-2007, Process-Mechanical Piping Schedule Section 40 05 05 and following:

1. Lettering and arrows:

    a. Black on yellow background for flammable fluids.
    b. White on green background for potable, cooling, boiler feed, and other waters.
    c. White on blue background for compressed air.
    d. White on red background for fire quenching fluids.
    e. Black on orange background for toxic and corrosive fluids, including biogas.
    f. White on brown background for combustible fluids.
    g. White on purple background for other.
    h. Black on white background for wastewater.
    i. White on gray background for sludge service.
    j. White on black background for other.

2. Banding: Colors and band spacing as scheduled or as shown on Drawings.

2.05 UNDERGROUND TYPE PLASTIC LINE MARKERS

A. Permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 inch wide by 4 mils thick. Provide tape with printing most accurately indicating type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.

2.06 ENGRAVED PLASTIC LAMINATE SIGNS

A. Engraving stock melamine plastic laminate complying with FS L-P-387A(1) in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting necessary because of substrate.

B. Thickness: 1/16-inch for units up to 20 square inches or 8-inch length, 1/8-inch for larger units.

C. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.07 PLASTIC EQUIPMENT MARKERS

A. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on white background.

B. Nomenclature: Marker shall use terminology in Contract Documents as closely as possible:

1. Equipment Name (e.g., Chilled Water Pump No. 1).
2. Equipment Tag No. (e.g., 30-P-1).

C. Size: Provide approximate 3-inch by 6-inch (minimum) for equipment.

1. 1-inch high letters for equipment tag number.
2. ½-inch high letters for descriptive equipment name.

2.08 FLOW CONTROL AND MEASUREMENT DEVICE TAGS

A. Provide tags for all flow control devices (e.g., valves) and flow measurement devices (e.g., flowmeters) installed in piping of 4-inch diameter or larger.

B. Provide tags for all flow control devices (e.g., gates) that control flow from/in basins or channels.

C. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on yellow background.

D. Size: Adequate to accommodate letter height below.

1. 1/2-inch high letters for nomenclature.

E. Fastening: Fasten to device using nylon zip tie through metal eyelet in tag.

F. Nomenclature:

1. For devices that are named and tagged (e.g., electrically-actuated devices) in the Contract Documents, use the nomenclature in the Contract Documents.

a. Equipment Name (e.g., Chilled Water Pump No. 1)
b. Equipment Tag No. (e.g., 30-P-1)

2. For devices that are not named or tagged in the Contract Documents, use the nomenclature below.

a. YYY-ZZZ where YYY = Device Type, ZZZ = Tag Number (e.g, PV-001 represents plug valve 001).
b. Device Types, YYY shall be defined as follows: G = gate, PV = plug valve, BFV = butterfly valve, CV = check valve, GV = gate valve, ARV = air release valve, BV = ball valve, KV = knife valve, PRV = pressure regulating valve, PIV = pinch valve, MV = mud valve, SPV = specialty valve.

G. Submittal:

1. Submit device inventory in format shown below. Notes: [1] – example shows device that is not tagged in Contract Documents, [2] – example shows device that is named and tagged in Contract Documents.

Description	Tag Nomenclature
Butterfly Valve[1]	V130-001
Ball Valve[1]	V335-001
Ball Valve[1]	V335-002
WAS Diverter Valve No. 2[2]	FV-0652
MHS Flushing Valve[2]	FCV-0941

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install piping and equipment identification in accordance with manufacturer's written instructions.

B. Coordination: Where identification is to be applied to surfaces requiring insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after

completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 IDENTIFICATION

A. Locate pipe markers with arrows and color bands as follows wherever piping exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exterior non-concealed locations.

1. Near each valve and control device.
2. Near locations where pipes pass through walls or floors, ceilings or enter non-accessible enclosures.
3. At access doors, manholes, and similar access points permitting view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 30 feet along each piping run, except reduce spacing to 20 feet in congested area of piping and equipment.
6. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Locate color bands at each marker and at intermediate spacing not to exceed 10 feet between bands, and at lesser spacing as indicated or as required by local codes.

C. Locate directional arrows at each marker. Provide 3 arrows at each tee or branch fitting.

D. Where piping is normally visible from more than 1 side, provide 2 or 3 labels and arrows spaced at 120 degree intervals around pipe in accordance with ANSI A13.1.

E. Painting or Coating:

1. Painting of piping, ductwork, and equipment is work of Section 09 96 00.
2. Colors listed are general. Colors shall match existing piping system color coding.
3. For piping scheduled to be color-coded, but not scheduled for complete painting (such as some plastic piping or aluminum jacked insulation) provide additional banding to represent background color. At each banding location provide following sequence:

a. 8-inch wide tape of scheduled pipe color.
b. 4-inch wide tape of scheduled band color.
c. 8-inch wide tape of scheduled pipe color.

F. Underground Piping Identification:

1. During backfilling/top soil placement of each exterior underground piping system, install continuous underground type plastic line marker located directly over buried line at 6 to 8 inch below finished grade. Where multiple small lines buried in common trench and do not exceed overall width of 16 inch, install single line marker.

G. Process Valve Identification:

1. Install engraved plastic marker at each process valve, gate, or flow control device as identified by P&ID tag numbers on Drawings.

H. Mechanical Equipment Identification:

1. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, if not otherwise specified for each item

or device. Provide signs for each unit having equipment tag number on Drawings or in Specifications.

3.03 FIELD QUALITY CONTROL

A. Final Survey and Repairs:

1. 1-year after date of substantial completion, Contractor shall perform walk-through survey of mechanical identification systems and shall remove and replace any bands, labels, tags or markers that are loose, discolored, or defective.
2. Replacement materials shall be provided by Contractor, not drawn from Owner's extra material.

3.04 ADJUSTMENT AND CLEANING

A. Adjusting: Relocate any mechanical identification device visually blocked.

B. Cleaning: Clean face of identification devices.

END OF SECTION

SECTION 40 41 00
PROCESS PIPING AND EQUIPMENT HEAT TRACING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Self-regulating heat tapes and control equipment.
2. Provide electrical heat trace system as part of piping and insulation system furnished under other sections.

a. South Aeration Tank (150-HTU-0182)
b. North Aeration Tank (160-HTU-0181)
c. Preliminary Treatment Building (130-HTU-0183)
d. Chemical Building (125-HTP-1)
e. Solids Processing Building (600-HTP-1)

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide pipe tracing cable system capable of maintaining pipe contents at a temperature of 40ºF, when outside ambient temperature is -20ºF with 20 miles per hour wind.

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer's product data sheets.

B. Shop Drawings:

1. Show isometric layout of pipe tracing cables over piping layout.
2. Include installation details and connection diagrams sufficient to install pipe tracing cable system.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Raychem Corporation, Division of nVent Thermal Management

2.02 CABLE DESIGN

A. Voltage: 120 volts, 60 Hertz, 1-phase as shown on Drawings for electrical connection.

B. Parallel design, current flow across cable.

C. Heat output/foot constant, independent of length.

D. Capable of overlapping without creation of hot spots.

E. Capable of being cut to any length in field.

F. Self-regulating heat output.

G. Braided metallic shield.

H. Outer plastic jacket.

I. Provide manufacturers standard power connections, end seals, splice and tee kit components.

J. Provide lighted end seal on each individual heat trace line.

K. Provide proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.

2.03 SOLID STATE HEAT TRACE CONTROL AND MONITORING SYSTEM (125-HTP-1 & 600-HTP-1)

A. Control and Monitoring System

1. Programmable keypad with password lockout feature to prevent unauthorized programming changes.

a. Memory: Nonvolatile, restored after power loss.
b. Temperature: degrees Fahrenheit or degrees Celsius.
c. Operating ambient temperature: -40 to +140 ^{o}F.

2. Stored parameters:

a. Minimum and maximum temperature.
b. Maximum ground fault current.
c. Maximum heater current.
d. Power accumulator.
e. Relay cycle count.
f. Time in use.

3. Solid state relays with proportional control and have the ability to monitor the following

a. Current.
b. Resistance.
c. Temperature.
d. Voltage.
e. Ground Fault: 30 milliamp trip level and 20 milliamp alarm level.
f. Dedicated solid state relay for each heat trace line.

4. Alarm conditions:

    a. Low/high temperature.
    b. Low/high current.
    c. Low/high voltage.
    d. Low/high resistance.
    e. Ground fault alarm and trip.
    f. Remote Temperature Detection (RTD) failure.
    g. Loss of programmed values.
    h. Solid state relay failure.

5. Digital display with the following:

    a. Actual temperature.
    b. Control temperature.
    c. Heat trace current.
    d. Heat trace voltage.
    e. Heat trace resistance.
    f. Heat trace ground faults.
    g. Programming parameter values.
    h. Alarm values.

6. Light Emitting Diode (LED) status lights:

    a. Current mode.
    b. Heater on.
    c. Alarm condition.
    d. Receive/transmit data.

7. Automatic diagnostic cycle to check heat trace lines for faults.

B. Thermostatic sensing control:

1. Provide ambient sensing thermostat to operate pipe heating systems when ambient temperature drops to 40 degrees Fahrenheit.
2. Provide alarm thermostat on each heat trace line to monitor pipe temperature. Initiate alarm when pipe drops below 35 degrees Fahrenheit.

C. Enclosure:

1. Viewing window on enclosure front for observing digital display of controller.
2. Padlockable enclosure.
3. National Electrical Manufacturers Association (NEMA) 4X Fiberglass Reinforced Plastic (FRP).

D. Communications:

1. Cable: 3 conductor resistance temperature detector (RTD) wire to heat trace control and monitoring units.
2. Each heat trace control and monitoring unit shall have a unique address.
3. Provide dry contact closure for general alarm condition to plant SCADA.

2.04 SOLID STATE HEAT TRACE CONTROL AND MONITORING SYSTEM (160-HTU-0181, 150-HTU-0182 & 130-HTU-0183)

A. Thermostatic sensing control:

1. Provide ambient sensing thermostat to operate pipe heating systems when ambient temperature drops to 40 degrees Fahrenheit.
2. Provide alarm thermostat on each heat trace line to monitor pipe temperature. Initiate alarm when pipe drops below 35 degrees Fahrenheit.
3. Provide alarm contact and initiate alarm when RTD fails.

B. Enclosure:

1. Viewing window on controller front for observing digital display.
2. National Electrical Manufacturers Association (NEMA) 4X Fiberglass Reinforced Plastic (FRP).

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which pipe tracing cables to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of Work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Coordinate circuit connection points and voltages with Drawings.

C. Apply "electrical traced" signs to outside of thermal insulation.

D. Provide Class B Ground Fault Circuit Interrupting (GFCI) protection for each heat trace line.

3.03 FIELD QUALITY CONTROL

A. Examine material for defects prior to installation.

B. Examine final installation for damage and defects in workmanship prior to startup and installation of insulation.

C. Prior to and after installation of insulation, each pipe tracing system shall be megger tested. Minimum insulation resistance shall be 20 megohms regardless of circuit length. Both bus wires shall be tested to verify the connection of all splices and tees. Megger test pipe tracing system in accordance with manufacturers written instructions.

END OF SECTION

SECTION 40 42 13
MECHANICAL INSULATION AND JACKET

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Drawings and General Requirements of contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this Section.

B. Extent of mechanical insulation specified in this section includes Piping and Ductwork Systems (where indicated).

1.02 QUALITY ASSURANCE

A. Installation shall meet the requirements local plumbing, mechanical, and energy codes.

B. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiberglass
4. Manville Corp.
5. Owens-Corning Fiberglass Corp.
6. Pittsburg Corning Corp.
7. Rubatex Corp.

C. Installer - A firm with at least 3 years successful installation experience on projects with mechanical insulation similar to that required for this project.

D. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data - Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each mechanical system requiring insulation in accordance with Section 01 33 00.

B. Maintenance Data - Submit maintenance data and replacement material lists for each type of mechanical insulation in accordance with Section 01 78 23.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or level, affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.01 POLYISOCYANURATE INSULATION MATERIALS

A. Manufacturers:

1. Trymer.
2. Dyplast Products.
3. Or equal.

B. Polyisocyanurate Insulation: Product meets the requirements of ASTM C591, type IV.

C. Thermal conductivity of 0.19 btu-inch/hr-ft2-°F or lower at 75°F mean temperature.

D. Minimum 4 lb/ft3 density for buried and minimum 2 lb/ft3 density for exposed insulation.

E. Flame spread/smoke developed performance tested via method ASTM E-84, UL 723, or NFPA 255 of 25/50 or better at thicknesses of 1.0 inches or less.

F. Heat traced piping systems shall be provided oversized as required for installation of heat tracing.

G. Buried system jacketing:

1. Flexible polyvinyldene chloride (PVDC), Saran 560 CX or equal.
2. 6.0-mils thickness.
3. 0.01-perms permeance rating.

2.02 JACKETING MATERIALS

A. Aluminum Piping Jacket Materials:

1. JRA, 0.016-inch. aluminum, ASTM B209, with Pittsburgh seam, butt joint strips, matching fitting covers, stucco embossed finish and weather mastic.

PART 3 - EXECUTION

3.01 SYSTEM INSULATION

A. For all Exterior and Buried Piping systems identified on Drawings, Section 40 05 05, or herein, to be heat traced and/or insulated and jacketed:

1. Insulate exterior above grade heat traced piping system with the following types and thicknesses of insulation:

a. Insulation: Polyisocyanurate, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
b. Jacketing: Aluminum, stucco embossed.

2. Insulate exterior below grade heat traced piping system with the following types and thicknesses of insulation:

a. Polyisocyanurate, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes. Jacketing: Saran 560 CX, or equal.

3.02 INSTALLATION OF INSULATION

A. Install insulation products in accordance with manufacturer's written instructions.

B. Carbon steel piping systems insulated with Polyisocyanurate shall be provided with a 5-mil prime coat of epoxy primer.

C. Install insulation on pipe systems subsequent to testing and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

F. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

H. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

I. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

3.03 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 40 61 13
PROCESS CONTROL SYSTEM (PCS) GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section covers general provisions and requirements for all work necessary for Engineering, furnishing, installing, adjusting, testing, documenting, programming, and starting-up the Process Control System, complete.

B. Unless otherwise noted, the System Integrator shall assume responsibility for specification sections 40 61 13 through 40 79 00 as listed in sub-section 2.04.B within this Specification.

C. The Contract Documents including drawings and specifications are complementary parts and what is called for by one part shall be as binding as if called for by all parts.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. IEEE: Institute of Electrical and Electronics Engineers

C. ISA: Instrumentation, Systems and Automation Society

D. NEMA: National Electrical Manufacturers Association

E. NFPA: National Fire Protection Agency

F. UL: Underwriters Laboratory

1.03 ABBREVIATIONS

A. HMI: Human/Machine Interface

B. I&C : instrumentation and Controls

C. I/O: Input / Output

D. LOS: Line of Sight

E. NEC: National Electrical Code

F. PC: Personal Computer

G. PCN: Process Control Network

H. PCS: Process Control System

I. PLC: Programmable Logic Controller

J. OIU: Operator Interface Unit

K. SACSS: Security Access Control System Supplier

L. SCADA : Supervisory Control and Data Acquisition

M. UPS: Uninterruptible Power Supply

1.04 DEFINITIONS

A. Process Control System: a complete, integrated system of PLC's, PC's, Windows-based servers, instruments, devices, wireless and wired process control networks, software, application Engineering, and ancillary equipment for monitoring and control of wastewater collection and treatment facilities.

B. Process Control Network: a complete, integrated and secured communication network consisting of equipment and cabling that provides communications between components of the Process Control System.

C. System Integrator: Organization, whose principle function is design, program, configure, manufacture, install and service of PCS. An organization, under the direction of the Contractor, who shall assume complete responsibility for: detailed design, manufacture, installation, configuration, technically advising on and certifying correctness of installation, testing and adjusting, documenting and starting-up, and training of the complete PCS.

D. Plant Access Control System: Networked system of security cameras, card/FOB readers, entrance gate actuators, controllers, master stations, and software used to limit physical site and building access to authorized personnel.

E. Security Access Control System Supplier (SACSS): Organization, whose principle function is design, configuration, programming, manufacture, installation and service of Plant Security System. An organization, under direction of the Contractor who shall assume complete responsibility for: engineering, manufacture, installation, configuration, technically advising on and certifying correctness of installation, securing, testing and adjusting, documenting and starting-up, of complete Plant Access Control System (Reference Specification Section: 28 15 00).

1.05 SUBMITTALS

A. In addition to the requirements of Section 01 33 00, the following information shall be provided in tabbed, booklet format covering all Project work.

B. Shop Drawings:

1. General:

a. Drawings shall include ancillary devices such as terminal strips, relays, fuses, utility lights and receptacles, fans, heaters, etc.
b. Typical drawings for multiple circuits or systems are not acceptable.

2. Panel Layout Drawings - Drawings shall show all panel mounted devices to scale and dimensioned and shall include legend.

a. Include cross reference to a bill of material for components used.
b. Component designations shall match those used on elementary schematic diagrams and physical component labeling required per Section 40 67 00.
c. Prepare in general accordance with NFPA 79, Annex D.

3. Elementary Schematic Diagrams – Ladder type circuit diagrams prepared to facilitate the understanding of the system function and maintenance and fault detection.

a. Control devices shall be shown between vertical lines that represent control power wiring, with the left line representing control circuits common and right representing operating coils common except where permitted by Clause 9 of NFPA 79.
b. Control devices shall be shown on numbered horizontal lines (rungs) between the vertical lines.
c. Drawings shall include a cross referencing scheme used in conjunction with each relay, output device, limit switch, and other devices so that any contact related to a device can be readily located on the drawing.
d. Component designations shall be included for all devices, with the same designations used on Panel Layout Drawings.
e. Each panel terminal within a terminal strip shall be numbered; when multiple terminal strips exist each shall be given a unique identification. Terminal strip identification shall be included on Panel Layout Drawings.
f. All wires shall be numbered; wire numbers shall be applied to labels in accordance with Section 40 67 00. Wiring and devices external to panel shall be clearly identified.
g. Control devices shall utilize the symbology depicted in NFPA 79 and IEEE315.
h. Switch symbols shall be shown with utilities turned off and devices in their normal starting condition. Include control settings on the diagrams when available.

4. Panel Interconnection Diagrams – Wiring interconnection diagrams prepared to show all signal and power wiring for external connections to control panels provided for Project. Wire and cable tags information shall be provided to Contractor in an electronic format for in physical wire and cable tagging.

    a. Drawings prepared on a per control panel basis.
    b. Show interconnecting wiring, field device, control panel, and provision for 2 field located termination cabinets.
    c. Interconnecting wiring shall include wire and cable tag numbers.
    d. Field device information shall include device tag and description, signal description, signal electrical characteristics, and range.
    e. Control panel information shall include terminal strip identification and terminal number.
    f. Drawings shall indicate source of control signal power.
    g. Prepare drawings in accordance with requirements of NFPA 79.

5. PLC Equipment Layout Drawing including processing equipment, I/O components, power supplies, and peripheral devices.
6. PLC data base list with I/O module cross reference identification for each PLC processor.
7. PLC documentation describing memory type, size and structure; listing of I/O; data table memory and size of memory available for all programs.
8. PCS Equipment Layout Drawings including detailed enclosure layouts for servers, switches and communications systems with overall dimensions and equipment bill of materials.
9. CCTV installation locations to include connections to the PCN.
10. FOC installation locations and connections to the PCN.
11. SCADA software programs for all applications, describing programming methods and procedures, utilities, diagnostics, documentation, and system support functions. Documentation covering all custom software or programming proposed or required for this Project.
12. Network information including detailed block diagram showing system hardware and components; operating systems and software with revision numbers indicated; format, protocol and procedures for Process Control Network communications; on-line and off-line capabilities for programming, system utilities and diagnostics; recommended test

equipment.

13. Process Control Network Drawings - Drawings shall show connections between connected Process Control System devices including workstations, HMI's/OIU's, PLCs, and network devices. Drawings shall indicate network domain and device addresses, subnet masks, gateways, and other pertinent network address information.
14. Detailed fiber optic system layout drawings including patch panel connections, cable ID and color code.
15. Electrical power, UPS, Grounding, and DC Power Schematics for all equipment.
16. Heat rejection calculations for all enclosures.
17. UPS sizing calculations.
18. Test reports.

C. List of special tools (including software) required for instrument calibration, startup, checking, testing, parts replacement, troubleshooting, and maintenance of all components of the Process Control System. Identify any special tools specially designed or adapted for use on parts of this system.

D. Product Data:

1. Catalog Information - Provide catalog information and descriptive literature on all equipment associated with the PCS.
2. Product Data (Specification) Sheets – Provide product data sheets for each component provided under this Section. The purpose of the data sheets is to supplement the generalized catalog information provided by citing all specific features for each specific component (e.g.: scale range, materials of construction, special options included). Product Data Sheets shall follow General ISA S20 format.

E. Test Outline and Procedure Submittal

1. A detailed description of each specified test procedure and demonstration shall be submitted for approval. The decision of Engineer upon the acceptability of the procedure shall be final.
2. It is required that this be a two-step submittal: outlines first followed, upon receipt of Engineer's approval, by specific test descriptions.
3. Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with these Specifications.
4. Provide detailed step-by-step in-factory and field test procedure in accordance with Section 40 61 21. Include proposed test documentation and sign-off sheets and punch list forms.
5. Identify complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.

F. Spare and Expendable Items Submittal

1. Contractor shall provide a list of recommended spares and expendable items as recommended by System Integrator in sufficient quantities to sustain the Process Control System for a period of 3 year after acceptance.
2. A total purchase cost for the recommended list shall be provided in addition to the unit cost for each item. The cost of obtaining spare and expendable items selected by Owner will be addressed as a Change Order at the Owner's discretion..
3. In addition to the Spares and Expendables List, Contractor shall provide a Component Part List as recommended by Systems Integrator. The Component Part List shall be a complete parts list for the entire Process Control System, and shall have the following features:

    a. All components shall be grouped by component type, with the component types

identified in a similar manner to the component identification code used in these Specifications.
b. All components shall be listed with their exact and complete manufacturer's part number, including all options or accessories.
c. All components shall be identified with their complete tag number as shown in these Specifications, or as modified or assigned by Contractor and approved by Engineer.
d. All components without tag numbers shall be grouped within component types by manufacturer's part number. Exact quantities shall be listed for each part number.

G. Operation and Maintenance (O&M) Data:

1. Process Control System - Submit in accordance with Section 40 61 30.
2. Fully document copy of all application programs including PLC, PC and Server-based applications. See Section 40 61 30 for requirements

H. Record Drawings: Submit in accordance with Section 40 61 30.

1.06 QUALITY ASSURANCE

A. Contractor shall engage the services of a qualified System Integrator for the purposes of furnishing the Process Control System, providing technical assistance on the installation of System and certifying the correctness of said installation.

B. Equipment shall be latest and most modern design at time of Notice to Proceed.

C. All software and firmware used in this Project shall be latest version that is compatible with each other, as of the Notice to Proceed.

D. Like items of Equipment shall be end products of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

E. PCS components shall be grounded in accordance with NEC requirements.

F. Coordination - In order to insure timely performance of the Contract and the System's conformance with Specifications, coordination meeting(s) shall be held during the course of the project.

1. Within 30 days of date of Contract Time commencement, submit Progress Meeting schedule for final coordination by Owner/Engineer, Contractor and Systems Integrator. Submit also the Submittal Schedule and Project Activity Schedule for final review.
2. Progress Meetings shall be held at the project site and designated by Owner with Owner/Engineer’s, Contractor’s and System Integrator's representatives in attendance.
3. Purpose of Progress Meetings is to obtain Owner/Engineer’s clarification on intent of Contract Documents during Submittal preparation and prior to HMI and PLC software configuration at no additional cost to Owner. Progress Meeting(s) shall cover following:

a. Review of functional descriptions describing equipment operation.
b. Owner/Engineer selection of options.
c. Owner/Engineer review documentation

4. Prepare and submit Startup Schedule, coordinated with overall Construction Schedule including the following:

a. Factory Acceptance Test(s).
b. Review of Wiring Sign-Off forms by Owner/Engineer.
c. I/O checkout by System Integrator.

d. Plant startup.
e. Training.
f. Post startup services.

1.07 SYSTEM INTEGRATOR RESPONSIBILITY

A. System Integrator shall inspect Equipment provided under this Section prior to shipment to Project sites.

B. System Integrator shall coordinate work with Contactor and City IT to insure that:

1. All components provided under this Section are properly installed in accordance with all applicable standards, regulations, laws, and accepted codes applying to the Plant site.
2. All components provided under this Section are properly configured.
3. All relocated components as described on Drawings are re-calibrated for new installation.
4. The proper type, size, and number of control wires with conduits are provided.
5. Proper electric power circuits are provided for all components and systems.

C. System Integrator shall be responsible for coordination of voltage levels and signal types for signals connected to Process Control System. Provide relays, signal isolators, termination or pull-up resistors, signal conditioners or other devices only as required for proper interfacing and operation of non-compatible devices.

D. System Integrator shall supply all HMI, OIT, and PLC software fully configured specific to the process functions described herein.

E. System Integrator shall be responsible for coordinate work with the SACSS for work described in Sections 28 15 00. The System Integrator is also responsible for coordinating with the SACSS and City IT to insure that the configuration meets the operational needs of the Process Control System.

F. System Integrator shall be responsible for establishing proper communication of all control system equipment as shown on drawings and specified. System Integrator shall test and document communications as part of testing specified in Section 40 61 21.

G. System Integrator shall be responsible for the operational testing of the HMI, OIT, and PLC software programs.

H. Systems Integrator shall be responsible for configuration and setup of Variable Frequency Drive parameters. The setup shall include data access via the Process Control Network.

1. VFD’s shall be programmed for auto-restart enabled.
2. VFD’s shall be programmed such that a voltage dip is not considered a fault.
3. VFD’s shall be programmed so that loss of communications is not considered a fault.

I. Systems Integrator shall be responsible for the configuration and setup of the Power Monitoring Devices provided as part of the process control system. The setup shall include data access via the Process Control Network.

J. Systems Integrator shall be responsible for the configuration of network communications with vendor LCP’s and equipment including; analytical sensor networks, W2 and W3 Booster Pumps, Polymer systems, GBT’s, Odorous Air system, Aeration Basin Mixers, Actuator Master Station, Security Access Systems, Gate Operator, and other miscellaneous equipment.

K. Systems Integrator shall be responsible for providing all SCADA software licenses as

required for Project.

L. System Integrator shall coordinate Process Control Network addressing schemes with Owner and incorporate agreed upon scheme for all equipment on the PCS including vendor supplied equipment.

M. All field located conduits, wiring and cables shall be provided in accordance with Division 26 – Electrical. Exceptions to this are; copper Ethernet cable, and fiber optic cable which shall be provided in accordance with Division 40.

N. Modifications to existing control equipment.

1. Provide equipment necessary to affect changes to existing control equipment as shown on drawings and specified.
2. Provide interposing relays and current-to-current isolation relays only as required to affect signal interfacing with non-compatible devices.
3. Modify documents of existing control equipment to reflect new as-built conditions.

O. Contactor shall furnish Owner with copy of all configured PLC application programs after On-Site Acceptance Test.

P. Application Engineering shall be done by the System Integrator.

Q. Application Engineering is defined in Sections 40 61 20 and 40 61 96.

1.08 WORK FOR HIRE

A. Any and all configuration, programming, setup or other software functions (Software) performed on all intelligent devices provided as part of this Project is to be considered “Work for Hire” under the 1976 Copyright Act as amended (Title 17 of the United States Code). The Software shall be owned by Owner and shall be turned over to Owner fully documented as the work is completed.

B. Owner intends only to obtain the Software for its own use.

C. Owner will not prevent the Software supplier from reuse of the Software concepts and ideas for other projects. Any reuse of the Software concepts and ideas generated under this Project is solely the responsibility of the Software supplier. The Software supplier shall defend, indemnify and hold harmless Owner from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of Software concepts and ideas.

1.09 WARRANTY

A. Provide warranty in accordance with General Conditions.

B. Furnish a copy of the warranty together with the operating instructions and maintenance data for the complete system.

C. System defects and deficiencies shall be corrected by Contractor within 24 hours of notification if Owner does not have necessary replacement parts in stock and within 4 hours of notification if Owner has necessary replacement parts in stock. Failure to correct these items per these requirements may result in Contractor losing Maintenance Bond.

PART 2 – PRODUCTS

2.01 SYSTEM INTEGRATOR

A. Wunderlich-Malec.
B. No Substitutes permitted.

2.02 SYSTEM INTEGRATOR EXPERIENCE REQUIREMENT

A. The Contractor shall utilize a System Integrator having the experience and knowledge, as defined herein, to undertake the work specified in this Section. The System Integrator shall be an organization having the following organizational and individual experience, knowledge, and capability:

1. System Integrator shall be regularly engaged in the design, installation, and servicing of wastewater treatment PCS.
2. System Integrator shall demonstrate the ability to produce electrical and control logic diagrams in the level of detail required by this specification.
3. System Integrator shall have previously executed a minimum of five (5) wastewater treatment PCS projects of similar size and complexity to this Project and incorporating PLCs and HMI platforms included in this Project.
4. Systems Integrator shall have previously successfully executed Ethernet wireless and wired networked projects of comparable size and complexity to this Project.
5. The person(s) performing the field I&C work as required by the Contact Documents shall have a minimum of five (5) years experience on PLC-based systems.
6. System Integrator shall provide, on-site, a Control Systems Engineer to commission the functional testing, start-up and training as required by the Contract Documents. The individual shall have authored and commissioned control logic for no fewer then three (3) projects of similar or greater complexity, and shall have a demonstrated proficiency in authoring logic in PLC Function Block Language.
7. Upon request of Owner and in addition to other specified requirements, Contractor shall provide a minimum of five (5) System Integrator references to confirm compliance with these requirements.

2.03 EQUIPMENT, SYSTEMS AND SERVICES

A. Equipment, Systems and Services provided under this Section shall conform to the following requirements.

1. UL 508 - Standards for Safety, Industrial Control Equipment.
2. NEMA ICS 1 - General Standards for Industrial Control and Systems.
3. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
4. NEMA ICS 3 - Industrial Systems.
5. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
6. NEMA ICS 250 - Enclosures for Electrical Equipment.
7. NFPA 79 - Electrical Standard for Industrial Machinery
8. UL 698A Intrinsic Safe Circuits.

B. Equipment, Systems and Services provided under this section include the following.

1. Process Control System – Configuration Services	Section 40 61 20.
2. Process Control System – Testing	Section 40 61 21.
3. Process Control System – Training	Section 40 61 26.
4. Process Control System – O&M Data	Section 40 61 30.
5. Process Control System – Input/Output List	Section 40 61 93.

6.	Process Control Descriptions	Section 40 61 96.
7.	Computer System Hardware and Ancillaries	Section 40 62 00.
8.	Programmable Logic Controllers	Section 40 63 43.
9.	Network and Communication Equipment	Section 40 66 00.
10.	Control Panels	Section 40 67 00.
11.	Uninterruptible Power Supply (UPS)	Section 40 67 63.
12.	Instrumentation of Process Systems	Section 40 70 00.
13.	Flow Measurement	Section 40 71 00.
14.	Level Measurement	Section 40 72 00.
15.	Pressure, Strain, and Force Measurement	Section 40 73 00.
16.	Temperature Measurement	Section 40 74 00.
17.	Process Liquid Analytical Measurement	Section 40 75 00.
18.	Process Gas Analytical Measurement	Section 40 76 00.
19.	Panel Mounted Instruments	Section 40 78 00.
20.	Miscellaneous Control System Field Devices	Section 40 79 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Contractor shall install and wire Process Control System equipment in accordance with System Integrator's and Instrument Manufacturer's written instructions and approved submittals.

3.02 PLC INPUT/OUTPUT SIGNAL POWER SOURCE

A. Except for 4-wire instruments, all analog loops shall be powered from respective process control panel.

B. 120 volts alternating and direct current for Process Control System inputs shall be sourced from respective process control panel.

C. 120 volts alternating and direct current for Process Control System outputs shall be sourced from respective location receiving control signal.

D. See Section 40 67 00 for additional signal interface requirements.

3.03 FIELD QUALITY CONTROL

A. Protection During Construction.

1. Throughout Contract, Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the Engineer-reviewed System Integrator's recommendations.

B. Cleaning and Touch-up Painting.

1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

C. Panels and Panel-Mounted Equipment.

1. Panels and panel-mounted devices shall be assembled as completely as possible at the System Integrator's factory. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the job site.

D. Inspections.

1. System Integrator shall provide services of qualified service Engineer to supervise and inspect equipment installation to ensure system is installed in accordance with System Integrator's recommendations.
2. All materials, equipment, and workmanship shall be subject to observation at any time by Engineer's representatives. Correct any work, materials or equipment not in accordance with these Contract Documents or found to be deficient or defective. Make corrections in a manner satisfactory to Engineer at no additional cost to Owner.
3. The System Integrator shall supervise final power and signal connections by Contractor to all equipment provided under this Section. For all equipment provided under this Section and all other equipment interfaced by the system, the System Integrator shall verify and certify by written notice to Engineer, correctness of final signal connections and correctness of adjustment.
4. System Integrator shall field calibrate equipment at time of complete startup on loop-by-loop basis. Submit calibration certification to Engineer for each piece of equipment. Make adjustments necessary to place equipment in satisfactory operation.
5. During this startup period, Contractor's personnel are to thoroughly check all of the equipment and perform the on-site tests specified above.

3.04 SUBSTANTIAL COMPLETION

A. In addition to requirements identified in other parts of the Contract Documents, Substantial Completion shall require the following process instrumentation and control work is successfully completed:

1. Owner's receipt of required site documentation including required O&M material.
2. Completion of specified training associated with equipment provided.
3. Successful completion of the specified demonstration period.
4. Owner's receipt of required tools.

END OF SECTION

SECTION 40 61 20
PROCESS CONTROL SYSTEM (PCS) – CONFIGURATION SERVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Configuration of Process Control System (PCS) in conjunction with following sections:

1. Section 40 61 93.
2. Section 40 61 96.

PART 2 – SERVICES

2.01 SUMMARY

A. Provide configuration services for Process Control System HMI computers, VFD's, Control Panel PLC's, VFD's, SCADA Workstations, multifunction process displays, Pump monitoring devices, and network equipment/communications.

B. Graphic displays (screens) shall be formatted as schematic or symbolic representations of equipment shown on drawings and shall be consistent with Owner's existing software platforms.

C. Provide, as a minimum, one graphic display per major piece of process equipment.

D. Shall work with Owner for creative input enhancements during HMI graphic display generation.

E. Shall modify Owner's existing iFIX SCADA software maintaining consistency with respect to fit, form, and functionality of existing screens.

F. Shall modify Owner's existing Historian software adding points associated with project.

G. Shall modify Owner's existing Alarm software adding critical alarms associated with project.

H. PanelView (600-PV-1) shall be configured to duplicate SCADA HMI functionality for the entire Plant.

2.02 RESPONSIBILITIES

A. Configuration Services for Process Control System shall be provided by System Integrator.

1. PLC programming shall utilize Studio 5000 Logix Designer (latest version compatible with hardware).
2. HMI programming shall utilize existing iFIX software.
3. PanelView programming shall utilize FactoryTalk View Studio and FactoryTalk View Point software.

2.03 PLC PROGRAMMING GUIDELINES

A. PLC programming shall be consistent with (and expand upon) Owner's existing PLC logic.

B. Set-points, alarm values, timer values, control loop tuning parameters, and other numeric values used within PLC and HMI programs shall be part of continuous common data table within program. Parameter changes shall not require modification to instructions within program. Parameter

changes shall be adjustable by changing data table through operator input via HMI.

C. Unless specified otherwise, procedure for control power fail Restart for equipment shall be as follows:

1. Equipment shall shut down on loss of control power.
2. Upon restoration of power, previously running equipment shall be restarted using same sequence of startup used for “Remote” control.
3. Prior to Restart, Auxiliary equipment shall be placed in “Off” position.
4. Equipment Restart shall be sequenced through use of timer functions to prevent simultaneous restart.

D. PLC shall not be enabled to control equipment unless respective field Local/Remote, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch is in “Remote” or “Remote” position. Equipment status monitoring/ displaying and process parameter logging/ trending shall continue in all modes of control.

E. Determination of high (low) Off-Normal conditions shall be by comparing an analog input value to Operator entered set-point values. Off-Normal status bit shall be set when rising (falling) input value is equal or greater (less) than entered set-point value. Off-Normal status bit shall be reset when falling (rising) input value is equal or less (greater) than entered set-point value minus (plus) entered deadband value. Operator entered high (low) set-point values are absolute values and deadband values are relative values. All values are entered through HMI.

F. Setting of Off-Normal status bits shall cause status conditions to be displayed and/or alarmed at HMI.

G. Resetting Off-Normal status bits shall cause status conditions displayed and/or alarmed at HMI to be cleared.

H. Adjustable delay timers on alarm points shall prevent nuisance alarming or nuisance clearing of alarms. Timer values shall be ranged 0-30 seconds. Initial setting, unless otherwise specified in functional descriptions of Section 40 61 96, shall be 5 sec.

I. All status conditions alarmed at HMI shall also be logged to data table.

J. Motor Running status shall be monitored and displayed at HMI continuously.

K. Setting of Motor Failed status bits:

1. If motor is required to run via PLC control (control station Hand/Off/Auto selector switch in “Auto”),
2. And If absence of Motor Running status causes Motor Fail watchdog timer to time out,
3. Then Motor Failed status bit shall be set.

L. Setting a Motor Failed status bit shall cause motor command output to be inhibited and shall cause Motor Failed status to be displayed and alarmed at HMI.

M. Resetting of Motor Failed status bits:

1. If control station Hand/Off/Auto selector switch in “Auto” position,
2. And if HMI On/Off/Auto control function is cycled to “Off” position from either “On” or “Auto” positions,
3. Then Motor Failed status bit shall be reset.

N. Resetting a Motor Failed status bit shall cause motor command output to be re-enabled and shall

cause Motor Failed status displayed and alarmed at HMI to be cleared.

O. Unless specified in functional descriptions in Section 40 61 96, the following watchdog timer values shall cause equipment fail status bits to be Set:

1. Valve fail to open: 30 sec.
2. Valve fail to close: 30 sec.
3. Equipment fail to start: 30 sec.

P. Adjustable filtering of analog inputs shall eliminate process upsets due to noise. Filtering shall be by running-average method.

Q. Integration algorithm shall be included for “Totalizing” analog flow signals.

R. Integration algorithm shall be included for “Totalizing” Equipment Run times (Elapsed Time Meter).

S. Proportional/Integral/Derivative (PID) control outputs shall utilize sample and hold algorithm. Intent is to allow slow reacting processes to stabilize before additional control output changes are made by maintaining constant output from PID control for adjustable time period. PID control shall utilize deviation set-points to reactivate controller in event deviation is exceeded during controller off time. Unless specified otherwise in functional descriptions in Section 40 61 96, off time shall have an adjustable range of 0-30 minutes.

T. Equipment Sequencer:

1. When more than one piece of similar equipment controls a process, then a sequencing strategy shall be employed regarding the operational sequence for the equipment, when the equipment is in “Remote” mode.

    a. Lead: shall be the first called to run based on process demand.
    b. Lag: shall be the second called to run (when more than one Lag exists, then Lag1, Lag2, Lag3, etc. shall be used).
    c. Standby: shall be equipment not normally called to run during the sequence of operation. Note: not every sequencer will have a Standby position.

2. Lead/Lag/Standby equipment is rotated within the sequencer based on: runtime hours, on-off cycles, day of the week, or manual selection as Owner preference dictates (see Section 40 61 96 Functional Descriptions for details).
3. When a piece of equipment fails (as determined elsewhere in this section), it is placed in the Standby position of the sequencer. Equipment previously in the Standby position, is moved into the Lag position of the sequencer.

U. PLC input coils shall be configured as non-latched unless specified otherwise.

V. PLC output contacts shall be configured as maintained unless specified otherwise.

W. PLC CPU fault or failure shall be considered a critical alarm and alert the Operator.

2.04 HMI COMPUTERS (AND PANELVIEW OIT) PROGRAMMING GUIDELINES

A. Screens:

1. Existing Owner HMI application shall be used as a basis for programming guidelines.
2. New and/or modified screens shall be consistent with Owner’s existing standards with regards to fit, form, function, and appearance.
3. Graphic screens for HMI shall be formatted to resemble P&IDs. As a minimum, one graphic

display per process loop shall be provided.

4. Screens shall be simplified representation of process flow stream and associated equipment as shown on Drawings. Only major devices shall be shown. Non-reporting equipment (isolation valves, check valves, indicators) shall not be shown.
5. In addition to process related display screens, the following shall be provided (or modified):

    a. Main Screen: Director for all other screens. Selection of any other screens shall be by cursor pick of description for that screen or function key identifier for that screen.
    b. Utility Screen: Equipment status, Motor Run totalizer (hours).
    c. Alarm Screens: Screen for points in alarm as selected by alarm selection matrix and screen for equipment in off-normal state (ie. Out of Service).
    d. Data Screens: Listing of all Operator and Engineering entered values.
    e. Trend Screen: Operator selected points for trending.
    f. Report Screen: Operator initiated report generator.

6. Operator and Engineering screens shall be segregated to allow password protection of engineering-entered values.
7. There shall be pick-fields on all screens that will allow for return to main menu or to adjacent process flow screen (continuation of all process flow paths, either entering or existing).
8. Pick-fields shall be activated by placing mouse cursor on object or text and clicking left mouse button, or by selection of associated function key (F1-F12).

B. External I/O Poll Times:

1. External I/O poll times shall be set initially as specified in Section 40 61 93.

C. Equipment not in Auto:

1. If equipment is not in “auto” at local control station for a period greater than 30 minutes, it shall generate an alarm at the HMI.
2. A separate alarm screen for all equipment not in auto shall be generated for the Operator to quickly review.

D. External Data Input:

1. Data entry areas shall be provided at HMI for adjustment of process and alarm set-points. Data entry areas shall be password protected.
2. Upper and lower limits shall be provided for all data entry values. Entry of values outside of limits shall not be accepted and shall generate appropriate error message on screen. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
3. Upper and lower limits shall be provided for all logged analog input values. Logged values outside of limits shall generate appropriate alarm. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
4. Upper and lower limits shall determine range of analog input value. Value shall be scaled in standard Engineering Units.
5. Password protection shall consist of alpha-numeric sequence and shall be intended for Plant Supervisor and Head Operator entry only.
6. Unless otherwise specified in Functional Descriptions, process points shall be scanned as follows:

    a. Critical Alarm points and analog input process points shall be scanned continuously.
    b. General Alarm points shall be scanned only on change of state into alarm condition.
    c. All other points scanned only when required for display at HMI.

7. All dynamic screen displays shall be updated every 2 seconds, minimum.

E. Equipment sequencer:

1. When more than one piece of similar equipment controls a process, then a sequencing strategy shall be employed regarding the operational sequence for the equipment, when the equipment is in an “Remote” mode.

    a. A spreadsheet-style matrix shall be used for equipment sequencing whereby equipment position within the sequencer is selected by the Operator using Lead/Lag/Standby verbiage. Note: not every sequencer will have a Standby position.
    b. Additional information, such as pressure, level or flow requirements may be included as a guide to the selection process.
    c. Equipment Sequencer shall allow Lead/Lag/Standby selection based on: runtime hours, on-off cycles, day of the week, or manual selection as Owner preference dictates.
    d. Equipment Sequencer shall indicate when a piece of equipment has been moved to Standby position as a result of equipment failure.

F. Display Objects – General

1. Process piping and pumps/fans/mixers may be animated with color to show active/non-active status.
2. Tankage shall be rendered in 3D.
3. Use graphic symbology for rendering of objects.

G. Display Objects – Process Lines and Inline Device Symbology

1. Where inline devices are dynamic in nature, their equipment symbols shall be formatted as Display Objects to change color based upon feedback. Coordinate color use with Owner’s existing HMI configuration. Recommended color use:

    a. Off – Gray.
    b. On – Green.
    c. Warning – Red, Solid.
    d. Fail/Alarm – Red, Flashing.
    e. Status – Amber.

2. Inline devices shall have alphanumeric tag identified near them, adjacent to associated symbol.
3. Arrow heads shall be used as pointers for flow direction at all points of entrance to equipment, at all points where process lines change direction and at points of merger.
4. Process lines entering or leaving screen shall have points of continuation identified by boxed text, indicating From/To screen. One end of box shall form arrow to show direction of flow and act as pick-field for selection of screen of continuation. Color shall be same as associated process line.
5. Process lines shall be identified with flow stream abbreviation as listed in standard symbolic table and as shown on P&IDs, where convenient.

H. Display Objects – Large Equipment Symbology

1. Symbol shape shall be simple reflection of true shape of equipment being depicted.
2. Outline color shall be white.
3. Equipment tag and description name shall be located within shape. If not practical, locate near shape. Text shall be white and enclosed in white border box. For example:

    a. Tank levels shall be displayed within tank symbol as vertical bar, with bar color representative of fluid within tank.
    b. Tank level bar height shall be proportional to analog input value scaled from 0 to 100%.

100% shall be equal to full vertical height of symbol.

I. Display Objects – Data Fields

1. Analog process data not conducive to graphic symbology shall be formatted as rectangular Data Fields:
2. Process values (i.e. Flow, ORP, DO, Elapsed Time) shall be displayed as Data Fields near associated device symbol and shall consist of: alphanumeric tag, green in color; data value, white in color, right justified; engineering unit, green in color. Entire field shall be grouped as one block.
3. Data Fields shall be configured with high and low limits as described above.

J. Display Objects – Status Displays

1. Status Displays shall be similar to Data Fields but shall be linked to discrete data points or status bits:
2. Discrete equipment parameters (i.e. Run, Fail, On/Off, Open/Close) shall be indicated as rectangular Status Displays and shall consist of: alphanumeric tag, green in color; single or dual-state equipment value, white in color, center justified. Entire field shall be grouped as one block.
3. Displays shall be classified as Alarms or Events (see below).

K. Control Objects

1. Control Objects shall reside on graphic screens as either visible objects or as pop-up objects.
2. Visible Control Objects shall be restricted to simple functions. For example:

    a. Single-State Pushbutton (i.e. Reset, Silence, Acknowledge, GoTo):

        1) Display alphanumeric tag of equipment or function to be manipulated. Function shall be independent of equipment control mode. There shall be graphic representation of one pushbutton, black in color with white or green text, center justified. Button shall act as pick-field and when selected by cursor and activated by clicking left mouse button, shall generate programmed output. Output shall not latch. Button, when activated, shall highlight with white border.

    b. Dual-State Pushbutton (i.e. Open/Close, On/Off, Start/Stop):

        1) Display alphanumeric tag of equipment or function to be manipulated. Function shall be dependent upon equipment control mode. There shall be graphic representation of one pushbutton, black in color with white or green text, center justified. Button shall act as pick-field and when selected by cursor and activated by clicking left mouse button, shall generate programmed output. Pick-field shall indicate change of state by changing text within object and/or changing color. Output shall latch, requiring mouse click to toggle back to original state. Button, when activated, shall highlight with white border.

    c. Data Entry Field:

        1) Similar to Data Display Field described above. Allows operator entry of process values such as set-points.

3. Pop-up activation for dynamic control of equipment shall be by pick-fields associated with symbol of device to be controlled. Pop-up shall be small window or graphic overlay on current screen in location that will not interfere with current operation. Pop-up will contain necessary symbolism for dynamic control and worded prompts as necessary. Examples of pop-up

Control Objects:

a. PID Controller Faceplate:

1) Display alphanumeric tag of final element being controlled. Mode of field Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch shall be displayed. If in Remote, word "Remote" shall be displayed next to controller. If not in Remote, word "Local" shall be displayed – depending on field condition. Set-point, Process Variable, and Control Variable shall be displayed in vertical bargraph and digital formats. Bargraph shall be graduated scale equal to range of final element. Display bar shall be equal in length to graduated scale. Set-point and Process Variables shall be scaled in engineering units. Control Variable shall be scaled in percent of output. There shall be a graphic representation of a two-position pushbutton set (see below) labeled as “Auto-Manual” and shall act as pick-field. When selected by cursor and activated by clicking left mouse button, selector shall toggle between “Remote” and “Manual” modes of control. When selector is in “Remote”, PID controller calculates Control Variable. When selector is in “Manual”, Control Variable output shall follow setting by Operator. Control shall be available only when selector switch is in “Remote”.

b. Flow Controller Faceplate:

1) Display alphanumeric tag of valve being controlled. Mode of field Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch shall be displayed. If in Remote, word "Remote" shall be displayed next to controller. If not in Remote, word "Local" shall be displayed – depending on field condition. Set-point, Process Variable, and Control Variable shall be displayed in horizontal bargraph and digital formats. Bargraph shall be graduated scale equal to range of associated flow. Display bar shall be equal in length to graduated scale. Setpoint and Process Variables shall be scaled in engineering units. Control Variable shall be scaled in percent of valve position. There shall be a graphic representation of a two-position selector (see below) labeled as “Auto-Manual” and shall act as pick-field. When selected by cursor and activated by clicking left mouse button, selector shall toggle between “Remote” and “Manual” modes of control. When selector is in “Remote”, Flow Controller calculates Control Variable. When selector is in “Manual”, Control Variable output shall follow setting by operator. Control shall be available only when selector switch is in “Remote”.

c. 2-Position Pushbutton Set (i.e. Manual/Auto, Start/Stop, Open/Close):

1) Operationally the same as Dual-state Pushbutton described above. Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch shall be displayed. If in Remote, word "Remote" shall be displayed next to controller. If not in Remote, word "Local" or “Off” shall be displayed – depending on field condition. There shall be graphic representation of two pushbuttons, one red in color, other green in color. Buttons shall act as pick-fields and when selected by cursor and activated by clicking left mouse button, shall indicate and generate programmed output. Output shall remain latched until other button is activated. Button activated shall highlight with black border. Pick-fields shall be available only when selector switch is in “Remote”.

d. 3-Position Switch Set (i.e. Local/Off/Remote, Local/Remote, Open/Stop/Close):

1) Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto, Local/Off/Remote, On/Off/Remote or Open/Close/Remote selector switch shall be

displayed. If in Remote, word "Remote" shall be displayed next to controller. If not in Remote, the word "Local" or “Off” shall be displayed – depending on field condition. There shall be graphic representation of three pushbuttons, one red in color, one green in color, other white (amber) in color. Buttons shall act as pick-fields and when selected by cursor and activated by clicking left mouse button, shall indicate and generate programmed output. Output shall remain latched until another button is activated. Button activated shall highlight with black border. Pick-fields shall be available only when selector switch is in “Remote”.

e. Analog Output Control (i.e. “Speed-Pot”, Process Set-point Control):

1) Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch shall be displayed. If in Remote, word "Remote" shall be displayed next to controller. If not in Remote, word "Local" shall be displayed. Analog Output Control shall be displayed in vertical (horizontal) bargraph and digital formats. Bargraph shall be graduated scale equal to range of output. Display bar shall be equal in length to graduated scale. Process Variable units shall be scaled in engineering units. Speed or Valve Position units shall be scaled in percent of output. Control shall be available only when selector switch is in “Remote”.

4. Pop-up Control Objects shall not be continually visible. Functions become complex depending upon numbers and types of smaller objects grouped together to create them. For example, a valve control object might be created by grouping a 2-Position Pushbutton Set (Local/Remote), a 3-Position Position Pushbutton Set (Open/Stop/Close) and Status Display Objects (Open, Closed) together.

L. Alarming Requirements

1. Alarms and Events shall be logged in similar fashion as Owner’s current configuration.
1. Provide (modify) alarm summary screen(s) at HMI and OIT.
2. Display only current alarms. Acknowledged alarms which are no longer active shall not be displayed.
3. Allow operator to acknowledge alarms using single keystroke or cursor pick at alarm summary screen.
4. Alarm Display shall include following information:

a. Time and date alarm initially occurred.
b. Alarm point identification.
c. Alarm value and engineering units for alarms generated from analog process points.
d. Description of alarm (up to 40 characters).

5. Events shall be logged to separate data file. Events shall not be displayed unless evoked and shall not be annunciated.

M. Data Logging requirements – Analog and Discrete

1. All input process points shall be logged to the hard disk of the HMI computer.
2. Procedure for data collection and storage shall be as follows:

a. HMI I/O driver shall poll process points as specified on I/O list and transfer data to image table.
b. HMI shall scan image table for analog process points once every second, and log value to data base.
c. HMI shall calculate minimum, maximum and average for each analog process point and log to data base.

d. HMI shall scan image table for discrete process points on status change only, and log value to data base.

N. Trend Display Requirements

1. Configure HMI computer to display logged data in graphical trend format.
2. Trend Display Requirements:

a. Identification of process point being displayed. Use same nomenclature as used on HMI screens.
b. Start and end time of data being displayed.
c. Display shall incorporate movable vertical cursor along time axis. Parameter values at cursor date and time shall be displayed digitally.
d. Initial configuration of displays shall display data from present time back to 72 hrs prior to present time. Provide capability for operator to enter new start time for data being displayed to view parameter trend more than 72 hrs old.
e. Displays shall include y-axis range identification, including values and engineering units.
f. Configure trend displays to use maximum of computer screen area possible for purpose of increased resolution.
g. Trend displays shall be accessible, via single keystroke, from graphic screen displaying trended point.

3. Organize graphics screens for trend displays into categories by process:

a. Provide separate graphic screen within each category to display each process point trend. Provide different color for each process point.
b. Provide separate category for manually entered data from HMI computer.

PART 3 – EXECUTION

3.01 PERFORMANCE

A. Configure PLC's, OIT, and HMI computers consistent with Drawings, Specifications, and existing equipment on site.

B. Refer to Section 40 61 93 for information on ranges, signal functions, set-points, initial values and activation points.

C. Provide two, 1-day HMI workshops with Owner covering HMI and OIT screen navigation, set-up, alarming, trending, historian, and reporting that shall provide Owner the opportunity for input to the creative process of screen development. Owner-directed changes shall be incorporated without additional cost to the Owner.

D. Provide one 1-day PLC workshop with Owner covering PLC programming with respect to functionality of processes and equipment that shall provide Owner the opportunity for input to the creative process of PLC programming of the process systems. Owner-directed changes shall be incorporated without additional cost to the Owner.

1. Coordinate any changes effecting wiring and/or equipment with Contractor and Engineer.

E. Provide one 1-day Solids Processing Equipment (Structure 600) Operation Workshop with Owner, Contractor, and equipment venders covering process and equipment operation with respect to communications of signals for proper equipment integration. Include supporting equipment in the discussion such as DSS Pumps, WAS Pumps, and PSD Pumps.

1. Coordinate any changes effecting wiring and/or equipment with Contractor and Engineer.

F. Each Workshop shall include written notes distributed to all in attendance, and to include Engineer.

END OF SECTION

SECTION 40 61 21
PROCESS CONTROL SYSTEM (PCS) – TESTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes in-factory and field testing requirements.

B. Testing of Process Control System (PCS) in conjunction with following sections.

1. Section 40 61 93.
2. Section 40 61 96.

1.02 SUBMITTALS

A. In addition to submittal requirements of Section 40 61 13, provide the following:

1. Test Results:

a. Pass/fail status of all digital I/O.
b. Results of analog I/O testing.

2. Miscellaneous:

a. Detailed step-by-step in-factory and field test procedure at least 6 wks in advance of scheduled test date. Include sign-off sheets and punch list forms and description of configurations to be tested.
b. Complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.
c. Preventive maintenance schedule.

3. Submit in accordance with Section 01 33 00.

PART 2 – SERVICES

2.01 PREPARATION

A. In-Factory Testing Aids and Equipment:

1. Provide following documents.

a. One copy of submittals applicable to equipment to be tested.
b. One copy of Drawings and Specifications, with Addenda and Change Orders.
c. One master copy of test procedure.
d. Complete inventory of equipment to be tested including make, model, and serial number.

B. Meet following criteria prior to start of test.

1. Complete submittals and resolve disputes, if any.
2. Engineer review of test procedure.
3. Include PLC processor, PLC network interface, and PanelView (when required) in testing.
4. Coordinate test date agreeable to each party.

C. Schedule:

1. At end of test, meet to review list of deficiencies. Engineer will indicate those items which must be corrected prior to shipment.
2. Confirm, in writing, times and dates 2 weeks before tests.

2.02 IN-FACTORY INSPECTION AND PLC I/O TESTING

A. In-Factory inspection and testing shall be performed at site of panel fabrication.

B. In-Factory inspection and testing may be witnessed by Engineer and Owner. Coordinate schedules.

C. Process Control System PLC shall pass in-factory inspection and testing prior to shipment to job site.

D. In-Factory Inspection.

1. In-Factory inspection will verify following in accordance with approved submittals:

a. Panel dimensions.
b. Equipment layout.
c. Wiring.
d. Wire and terminal identification.

2. Verify proper access to equipment for maintenance.
3. Verify proper access to field wire termination points.
4. Inspect for neatness of wiring and wire harness construction.

E. In-Factory Testing and Demonstration.

1. Install PLC programming software, furnished as part of the project, to permit following:

a. Diagnostic test of PLC processor to assure proper run mode operation.
b. Diagnostic test of remote I/O to assure proper operation.
c. Inspection of PLC data table to allow viewing of discrete input on/off status.
d. Inspection of PLC data table to view register contents when inputs are tested at 0, 4, 12, and 20 mAdc.
e. Forcing of all digital outputs.
f. Generation of 4, 12, and 20 mAdc signals for all analog outputs.

2. Test as follows:

a. Verify equipment and manuals against inventory lists.
b. Run hardware diagnostics.
c. Testing of all input and output (I/O) signals at terminal strip used for field terminations.

1) Test change of state for all discrete inputs.
2) Test analog inputs at 0, 4, 12, and 20 mAdc.
3) Manipulate PLC data table or use forces to test response of all discrete output signals.
4) Manipulate PLC data table to test response of all analog output signals at 4, 12, and 20 mAdc.

3. Correct any deficiencies discovered prior to shipment to job-site.

F. Documentation

1. Prepare in-factory inspection and testing sign-off document. Document shall include following as a minimum.

    a. Project description and number.
    b. Company name for PLC supplier, Owner, and Engineer.
    c. Section labeled “In-Factory Inspection”, with listing of items to be inspected as described above.

        1) For each item, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection.
        2) Include area for handwritten notes of any corrections required.

    d. Section labeled “In-Factory Testing”, with listing of items to be tested as described above.

        1) For each item, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection. Include separate line for I/O point to be tested.
        2) Include area for handwritten notes of any corrections required.

2.03 FIELD I/O AND SOFTWARE TESTING

A. General:

1. Field testing is intended to check installation of the Process Control System PLC’s in addition to providing a diagnostic check of field equipment and wiring.
2. Field testing shall make use of operator workstations provided in Section 40 62 00. Provide configuration required to establish Ethernet communications with the Process Control System PLC.
3. Testing shall begin after Process Control System PLC has been installed and all terminations are complete.
4. Field testing may be witnessed by Engineer and Owner. Coordinate schedules.
5. Use PLC configuration utilized for In-Factory Testing.
6. Test as follows:

    a. Run hardware diagnostics.
    b. Testing of all input and output (I/O) signals by activation or injection of signal at field device.

        1) Digital input signals:

            a) For all equipment run signals, test by on/off operation of equipment. If operation of equipment is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of motor starter auxiliary contact or other source of run signal.
            b) For all alarm or status signals, test by activation of device generating alarm. If generation of alarm is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of alarm contact at nearest accessible location to generating device.
            c) For signals designated as spare, test by jumpering of signal at Process Control System PLC panel field termination point.
            d) Demonstrate change of state in PLC data table.
            e) Demonstrate change of state at HMI.

        2) Analog input signals:

a) Verify impedance capabilities of transmitting device has not been exceeded by installation of Process Control System PLC.
b) Disconnect transmitting device and inject 0, 4, 12, and 20 mAdc into loop.
c) Demonstrate proper response to various signals in PLC data table.
d) Demonstrate proper response to various signals at HMI.
e) Verify proper response of other devices in analog loop to various signals.
f) For signals designated as spare, test by injection of signal at Process Control System PLC panel field termination point.

3) Digital output signals:

a) Manipulate PLC data table or use forces to test response of all discrete output signals.
b) Demonstrate change of state at HMI.
c) Verify proper response of other devices in loop to signals.
d) For signals designated as spare, test by checking signal at Process Control System PLC panel field termination point.

4) Analog output signals:

a) Verify impedance capabilities of analog outputs are not exceeded.
b) Generate 4, 12, and 20 mAdc signals for all analog outputs through PLC data table.
c) Verify proper response of other devices in analog loop to various signals. Verify proper loop current through measurement.
d) Demonstrate proper response to various signals at HMI.
e) For signals designated as spare, test by measuring of signal at Process Control System PLC panel field termination point.

7. Documentation

a. Prepare field testing sign-off document. Document shall include following as a minimum:

1) Project description and number.
2) Company name for Owner, PLC supplier, and Engineer.
3) For each I/O point, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection. Include separate line for I/O point to be tested.
4) Include area for handwritten notes of any corrections required.

8. Problem field devices or wiring.

a. Provide written documentation of any problems encountered with Owner's existing field devices or wiring during testing.

PART 3 – EXECUTION

3.01 PERFORMANCE

A. Test PLC's, OIT, and HMI workstations consistent with Drawings and Specifications.

B. Refer to Section 40 61 93 for information on ranges, signal functions, set-points, initial values and activation points.

END OF SECTION

SECTION 40 61 26
PROCESS CONTROL SYSTEM (PCS) – TRAINING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Training requirements.

B. Include training on the following subjects:

1. Overview of equipment and how it interacts with equipment and processes.
2. Operation and use of control programs residing at each PLC and HMI.
3. Overview of equipment areas and how they interact with field panels and instruments and other area equipment.
4. Care-taking procedures for PLC's.
5. Overview of plant communications hardware and equipment.
6. PLC programming additions and modifications.
7. SCADA software additions and modifications.
8. PanelView OIU software additions and modifications.

C. Comply with requirements of Section 01 79 30

1.02 ABBREVIATIONS AND REFERENCES

A. HMI Human Machine Interface

B. OIU Operator Interface Unit

C. PLC Programmable Logic Controller

D. SCADA Supervisory Control And Data Acquisition

1.03 SUBMITTALS

A. General:

1. Two weeks prior to training provide to Engineer a copy of the training documents to be presented to participants.
2. Material shall be arranged in a Tabed 3 ring binder seperated by primary subjects as defined below.
3. Material shall be comprensive, yet arranged in a manner easy to find or reference key information.
4. Partial submittals are not acceptable.

PART 2 – PRODUCTS – Not Applicable

PART 3 – EXECUTION

3.01 MAINTENANCE TRAINING

A. Cover following areas as a minimum:

1. Testing programs which can isolate faults to functional area.
2. Theory, logic flow, physical hardware awareness, and interface connections and assembly of

each equipment item.

3. Diagnostic procedures using special and general purpose test equipment. Theory, testing, and troubleshooting procedures given for special test equipment.
4. Operation of computers and peripherals.
5. Programming routines and procedures to enable students to take advantage of on-line and standby equipment for maintenance and performance verification.
6. Present short operator's course to ensure students understand operator functions and man/machine interfaces. Explain displays and printouts so students understand how information is derived, when it is presented incorrectly, and use of guidelines to differentiate between software and hardware problems.

3.02 INSTRUMENT TRAINING

A. Cover following areas as a minimum:

1. General principle of operation.
2. Calibration schedule.
3. Calibration procedure.
4. Calibration equipment required (if needed).
5. Recommended spare parts.
6. Consumable part – recommended replacement schedule (e.g. Reagents, filters, probe tips) and procedure.
7. General care and maintenance with special consideration to all instruments that may require cleaning such as pressure and level elements, etc.

3.03 HMI TRAINING

A. HMI functionality.
B. How key components work; shall include, but not be limited to:

1. Entering of set points.
2. Using alarm matrix.
3. Acknowledging and clearing alarms.

END OF SECTION

SECTION 40 61 30
PROCESS CONTROL SYSTEM (PCS) – O&M DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements for Operations and Maintenance (O&M) data for Process Control System.

B. Comply with requirements of:

1. Section 01 33 00.
2. Section 01 78 23.

PART 2 – SERVICES

2.01 HARDWARE MANUALS

A. General:

1. Include equipment comprising system. Provide instructions for O&M of installed system and for individual equipment units comprising system.
2. Provide level of comprehension so experienced electronics technician can understand them. Convey understanding of how system operates and provide sufficient procedures for O&M. Use abbreviated tabular data such as charts, tables, checklists, and diagrams whenever practical, in lieu of written text. Make Drawings and tables integral part of manuals.
3. Standard hardware manuals are acceptable, if errata sheets are included to reflect specific equipment provided.

B. Organization and Content:

1. Introduction Section: Brief explanation of function of equipment covered. Be concise and do not include detailed descriptions. Provide quick orientation to use and purpose of manual and its relationship to system and equipment.
2. Safety Precautions: Major hazards to personnel and equipment peculiar to equipment or jobs covered. Intersperse specific hazard information, cautions or warning notes at appropriate points throughout other sections of manual.
3. Physical Description: Physical description (size, dimension, weight, special attachments, and physical orientation or clearances) for installation and operation. Identify special environmental (cooling, exhausting or noise) constraints.
4. Functional Description: How various functions operate together to cause desired results. Include block diagrams and flow diagrams for clarification and understanding. Provide text and diagrams which mutually support each other.
5. Operating procedures: Include maintenance-oriented operating procedures for individual equipment so maintenance personnel will be able to verify proper operation.

    a. Describe each equipment, unit, and assembly in detail with regard to technical or theoretical operation. Include information to component level. Describe each circuit and mechanical mechanism. Cross-reference descriptions so functions of each piece of equipment are covered. Use schematic diagrams, sketches, equivalent diagrams, tables, and graphs to supplement text.
    b. Applicable checkout, troubleshooting, servicing, removal and replacement, and in-place repair procedures which are performed on system basis. Provide written procedures for every adjustment point of equipment.

6. Checkout Procedures: Verify satisfactory operation of system, subsystem or unit as applicable. If checkout requires detailed step-by-step procedure include such procedures. Indicate why checkout is performed and what conditions are to be satisfied.
7. Troubleshooting Procedures: Isolate faulty components. Sequence troubleshooting procedures in logical progression from malfunction indication to location of faulty component(s). Indicate special connections or test equipment required for troubleshooting.
8. Servicing Requirements: Cleaning, lubricating, replenishing, and other housekeeping and preventive maintenance procedures applying to particular equipment. Make reference to applicable manuals which describe various servicing procedures.
9. Removal and Replacement Procedures: Step-by-step instructions for removal and replacement of items subject to frequent replacement. If special tools are required, identify by name and part number.
10. Diagrams: Schematic diagrams, logic diagrams, and associated data necessary for maintenance personnel to trace circuits, make continuity checks, and accomplish general and specific troubleshooting on inoperative or malfunctioning circuits. Provide pin wiring diagrams and cabling and plug tables showing to-and-from wiring information. Provide symbol chart where necessary to explain graphic symbols appearing on diagrams.
11. Tabular Listing: Special tools, equipment, and test equipment applicable to test, adjustment, and fault isolation procedures. Write systems maintenance instructions to enable correct use of test equipment.
12. Parts Lists: Provide clear traceability from equipment to replaceable component. Identify each component part with original manufacturer's name and part number. Identify component parts or assemblies modified for Project by part number. Parts lists may be tabulated or supplied in form of engineering or manufacturing drawings.

2.02 SYSTEM CONFIGURATION DRAWING AND MANUALS

A. System configuration drawing showing Process Control System Equipment including, but not limited to PLC, HMI's, OIUs, remote I/O controllers, and local area network hardware. Show cabling and interconnection between system components.

B. Configuration data manual describing how final system configured. Describe unique data and system parameters.

2.03 DRAWINGS

A. Provide following for process control system elements.

1. Block Diagram: Diagram showing major Process Control System components. Identify components by manufacturer and model number. Show interconnecting cables diagrammatically.
2. Network diagrams including existing equipment, fiber, and copper connections.
3. Power and Grounding Interconnection Diagrams:

    a. Power diagrams shall detail interconnections from power source through power conditioning equipment, to process control system equipment.
    b. Grounding diagram shall illustrate grounding philosophy and implementation.

4. Interconnecting Wiring Diagrams: Show Process Control System elements, interconnecting cables and wiring terminations, and terminations to interacting elements and subsystems. Number terminations. Label terminations for circuits extending outside PLC assemblies.

    a. Coordinate external circuit portion of diagram with Work specified under Division 26 and bear Contractor's mark showing Work is complete.
    b. Nomenclature for external connections shall be in accordance with I/O lists in these Contract Documents and on Drawings.

5. Shop Drawings for specifically assembled process control system equipment such as panels, consoles, and cabinets. Drawings shall include, but not be limited to, following.

    a. Complete connection diagram.
    b. Bill of materials listing each major item of assembly. Provide data sheets for each item, annotated as necessary to describe specific items/options furnished.
    c. Layout and fabrication drawings showing locations of components.
    d. Installation and mounting detail drawings.
    e. Anchor bolt size and location.
    f. Equipment weights.
    g. Cabinet details and location.

        1) Exterior dimensions.
        2) Cable ingress and egress areas.
        3) Cable routing.
        4) Power termination location.
        5) Ground lug location.
        6) Cable termination points.
        7) Nameplate schedules.

END OF SECTION

SECTION 40 61 93
PROCESS CONTROL SYSTEM – INPUT/OUTPUT LIST

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes Process Control System hard-wired PLC I/O and programming parameters. Section to be used in conjunction with the following sections:

1. Section 40 61 20
2. Section 40 61 96.

C. This section includes:

1. Schedule 1 to Section 40 61 93, Input/Output List.

D. I/O LIST as shown in Schedule 1 of this Section contains information to configure I/O subsystem hardware and to indicate range conversion or signal function.

1.02 ABBREVIATIONS AND REFERENCES

A. I/O Inputs/Outputs

B. PLC Programmable Logic Controller

PART 2 – SERVICES

2.01 I/O LIST DEFINITIONS

A. LOCATION is the tag number for the PLC the I/O point is interfaced to.

B. DRAWING is the Drawing number of Process and Instrumentation Diagram (P&ID) in which the I/O point is located.

C. TAG is the field tagname given to the I/O point as designated on the Drawings.

1. This list is not to be considered a comprehensive list of PLC tagnames.

D. EQUIPMENT describes associated equipment.

1. Equipment in Schedule 1 table may be truncated and/or abbreviated due to space considerations.
2. Shop Submittals for PLC Drawings shall have Equipment tagnames as described on Process and Instrumentation Diagram (P&ID) Drawings.

E. FUNCTION describes associated process parameter or programmable controller action.

F. I/O TYPE is defined as one of following:

1. AI Designates Analog Input.
2. DI Designates Discrete Input.
3. AO Designates Analog Output.
4. RO Designates Relay Output; momentary, maintained or latched relay contact output.

G. SIGNAL TYPE Description:

1. Analog Input (AI):

a. DATA 1: Process parameter range.
b. DATA 2: Process parameter engineering units.
c. POLL TIME: 0.25 second.

2. Digital Input (DI):

a. DATA 1: Condition existing when field contact open.
b. DATA 2: Condition existing when field contact closed.
c. POLL TIME: Change-of-State, exception-based.

3. Analog Output (AO):

a. DATA 1: Process parameter range.
b. DATA 2: Process parameter engineering units.

4. Relay Output (RO):

a. Relay outputs, using dry contact-closure type outputs, can be momentary, maintained or latched.
b. DATA 1: Contact open function.
c. DATA 2: Contact closed function.

H. DATA_1 and DATA_2 describe function or signal characteristics. These are further defined under SIGNAL TYPE above.

1. I/O point data fields are subject to review and modification by Engineer during Shop Drawing review phase. Incorporate modifications into entire system.

PART 3 – EXECUTION

3.01 I/O CONFIGURATION

A. In addition to the PLC Configuration Standards included in Section 40 61 20, I/O shall be configured such that any single I/O module failure shall not shut down all the process equipment for a given process.

B. The objective of this configuration is to avoid a strategy failure because of a single I/O module failure.

1. For example, if a treatment system includes 4 pumps, the I/O for each pump should be placed such that the failure of an I/O point or module will only affect one of the four pumps, with the remaining pumps operating normally.

C. I/O Point Spares Utilization

1. Provide 25% prewired spare points per panel. Incorporate spare points into active point data base. Include changing point names, descriptions, ranges, or status from spare to new point. Include related documentation changes. Spares utilization will be subject to following limitations:

a. Incorporation shall not significantly alter control software functions. Minor change is

addition of device alarm input. Significant change is addition of control device.

b. Incorporation shall not significantly alter local area panels or field wiring to device. Minor alterations include additions of signals to terminations. Significant alterations include addition of major equipment.
c. Additions shall not increase size of reports beyond that specified elsewhere.
d. Changes shall not be made subsequent to submittal approval for a given panel or process area loop drawings.
e. Treat changing of active points to spare points in same manner as incorporation of spares.

(See following pages for Schedule 1 of this Section)

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-900	009-N-13	002-OBSTR-1311	GATE OPERATOR	OBSTRUCTION	DI	120Vac	NORMAL	ALARM
SCC-900	009-N-13	002-ALR-1311	GATE OPERATOR	RUN ALARM	DI	120Vac	NORMAL	ALARM
SCC-900	009-N-13	900-ACS-1	FACILITY SECURE ACCESS	GRANTED	DI	120Vac	NOT GRANTED	GRANTED
SCC-900	009-N-15	SCC-900-POWER	SCC-A LINE FILTER	FAILURE	DI	120Vac	NORMAL	POWER FAILURE
SCC-900	009-N-15	900-UPS-LOW	900 UPS	LOW BATTERY	DI	120Vac	NORMAL	LOW BATTERY
SCC-900	009-N-15	900-UPS-FAIL	900 UPS	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-900	009-N-15	900-FACP-FAIL	900 FIRE ALARM CP	TROUBLE	DI	120Vac	NORMAL	TROUBLE
SCC-900	009-N-15	900-FACP-ALRM	900 FIRE ALARM CP	ALARM	DI	120Vac	NORMAL	ALARM
SCC-900	009-N-15	600-VENT-FAIL	900 VENTILATION SYSTEM	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-900	009-N-15	900-SPD-1	SURGE PROTECTOR	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-900	009-N-13	002-CTO-1311	GATE OPERATOR	REMOTE OPEN	RO	120Vac	NOT OPEN	OPEN
SCC-900	009-N-13	002-CTC-1311	GATE OPERATOR	REMOTE CLOSE	RO	120Vac	NOT CLOSE	CLOSE
SCC-900	009-N-15	900-LITE-1501	MAIN GATE	LIGHTING	RO	120Vac	LIGHTS OFF	LIGHTS ON
SCC-900	009-N-15	900-LITE-1502	ADMIN BUILDING	POLE LIGHTING	RO	120Vac	LIGHTS OFF	LIGHTS ON
SCC-900	009-N-15	900-LITE-1503	ADMIN BUILDING	WALL LIGHTING	RO	120Vac	LIGHTS OFF	LIGHTS ON
SCC-A	009-N-2	600-FLT-0221	W2 BOOSTER PUMP 1	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-2	600-FLT-0222	W2 BOOSTER PUMP 2	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-2	600-FLT-0231	W3 BOOSTER PUMP 1	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-2	600-FLT-0232	W3 BOOSTER PUMP 2	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-3	600-FSH-0371	600 EYEWASH STATION	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
SCC-A	009-N-3	600-ESTOP-0300	POLYMER PREP SYSTEM	EMERGENCY STOP	DI	120Vac	NORMAL	ESTOP
SCC-A	009-N-4	600-MS-0401	POLYMER FEED PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-4	600-LR-0401	POLYMER FEED PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-4	600-ALM-0401	POLYMER FEED PUMP 1	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-4	600-TSH-0401	POLYMER FEED PUMP 1	HIGH STATOR TEMP	DI	120Vac	NORMAL	HIGH TEMP
SCC-A	009-N-4	600-MS-0402	POLYMER FEED PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-4	600-LR-0402	POLYMER FEED PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-4	600-ALM-0402	POLYMER FEED PUMP 2	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-4	600-TSH-0402	POLYMER FEED PUMP 2	HIGH STATOR TEMP	DI	120Vac	NORMAL	HIGH TEMP
SCC-A	009-N-5	600-ZS-0591	DOOR SWITCH	GBT ROOM INTRUSION	DI	120Vac	NORMAL	INTRUSION
SCC-A	009-N-5	600-ZS-0592	DOOR SWITCH	GBT ROOM INTRUSION	DI	120Vac	NORMAL	INTRUSION
SCC-A	009-N-5	600-ZS-0593	DOOR SWITCH	GBT ROOM INTRUSION	DI	120Vac	NORMAL	INTRUSION
SCC-A	009-N-5	600-ZS-0594	DOOR SWITCH	GBT ROOM INTRUSION	DI	120Vac	NORMAL	INTRUSION
SCC-A	009-N-5	600-ZS-0595	DOOR SWITCH	GBT ROOM INTRUSION	DI	120Vac	NORMAL	INTRUSION
SCC-A	009-N-5	600-LR-0521	DSS FCV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-5	600-FLT-0521	DSS FCV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-5	600-ZSO-0521	DSS FCV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-5	600-ZSC-0521	DSS FCV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-5	600-LR-0531	GBT 1 WAS FCV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-5	600-FLT-0531	GBT 1 WAS FCV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-5	600-ZSO-0531	GBT 1 WAS FCV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-A	009-N-5	600-ZSC-0531	GBT 1 WAS FCV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-5	600-LR-0532	GBT 2 WAS FCV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-5	600-FLT-0532	GBT 2 WAS FCV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-5	600-ZSO-0532	GBT 2 WAS FCV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-5	600-ZSC-0532	GBT 2 WAS FCV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-5	600-LR-0541	GBT 1 PSD FCV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-5	600-FLT-0541	GBT 1 PSD FCV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-5	600-ZSO-0541	GBT 1 PSD FCV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-5	600-ZSC-0541	GBT 1 PSD FCV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-5	600-LR-0542	GBT 2 PSD FCV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-5	600-FLT-0542	GBT 2 PSD FCV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-5	600-ZSO-0542	GBT 2 PSD FCV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-5	600-ZSC-0542	GBT 2 PSD FCV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-6	600-LE-0621	LEVEL INSTRUMENT	LOSS OF ECHO	DI	120Vac	NORMAL	LOSS
SCC-A	009-N-6	600-LE-0622	LEVEL INSTRUMENT	LOSS OF ECHO	DI	120Vac	NORMAL	LOSS
SCC-A	009-N-6	600-TSH-0601	THICKENED SLUDGE PUMP 1	MOTOR OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
SCC-A	009-N-6	600-PSL-0611	THICKENED SLUDGE PUMP 1	SEAL WATER LOW PRESS	DI	120Vac	NORMAL	LOW PRESSURE
SCC-A	009-N-6	600-PSH-0601H	THICKENED SLUDGE PUMP 1	HIGH DISCH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-A	009-N-6	600-PSL-0601L	THICKENED SLUDGE PUMP 1	LOW DISCH PRESSURE	DI	120Vac	NORMAL	LOW PRESSURE
SCC-A	009-N-6	600-AUTO-0601	THICKENED SLUDGE PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-6	600-HAND-0601	THICKENED SLUDGE PUMP 1	IN HAND	DI	120Vac	NOT IN HAND	IN HAND
SCC-A	009-N-6	600-ESTOP-0601	THICKENED SLUDGE PUMP 1	ESTOP	DI	120Vac	ESTOP	NORMAL
SCC-A	009-N-6	600-MS-0601	THICKENED SLUDGE PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-6	600-TSH-0602	THICKENED SLUDGE PUMP 2	MOTOR OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
SCC-A	009-N-6	600-PSL-0622	THICKENED SLUDGE PUMP 2	SEAL WATER LOW PRESS	DI	120Vac	NORMAL	LOW PRESSURE
SCC-A	009-N-6	600-PSH-0602H	THICKENED SLUDGE PUMP 2	HIGH DISCH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-A	009-N-6	600-PSL-0602L	THICKENED SLUDGE PUMP 2	LOW DISCH PRESSURE	DI	120Vac	NORMAL	LOW PRESSURE
SCC-A	009-N-6	600-AUTO-0602	THICKENED SLUDGE PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-6	600-HAND-0602	THICKENED SLUDGE PUMP 2	IN HAND	DI	120Vac	NOT IN HAND	IN HAND
SCC-A	009-N-6	600-ESTOP-0602	THICKENED SLUDGE PUMP 2	ESTOP	DI	120Vac	ESTOP	NORMAL
SCC-A	009-N-6	600-MS-0602	THICKENED SLUDGE PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-6	600-LR-0621	GBT DISCH CHUTE 1 FLUSH VLV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-6	600-FLT-0621	GBT DISCH CHUTE 1 FLUSH VLV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-6	600-ZSO-0621	GBT DISCH CHUTE 1 FLUSH VLV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-6	600-ZSC-0621	GBT DISCH CHUTE 1 FLUSH VLV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-6	600-LR-0622	GBT DISCH CHUTE 2 FLUSH VLV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-6	600-FLT-0622	GBT DISCH CHUTE 2 FLUSH VLV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-6	600-ZSO-0622	GBT DISCH CHUTE 2 FLUSH VLV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-6	600-ZSC-0622	GBT DISCH CHUTE 2 FLUSH VLV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-6	600-LR-0631	GBT DISCH CHUTE 1 DRAIN VLV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-6	600-FLT-0631	GBT DISCH CHUTE 1 DRAIN VLV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-6	600-ZSO-0631	GBT DISCH CHUTE 1 DRAIN VLV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-A	009-N-6	600-ZSC-0631	GBT DISCH CHUTE 1 DRAIN VLV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-6	600-LR-0632	GBT DISCH CHUTE 2 DRAIN VLV	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
SCC-A	009-N-6	600-FLT-0632	GBT DISCH CHUTE 2 DRAIN VLV	FAULT	DI	120Vac	NORMAL	FAULT
SCC-A	009-N-6	600-ZSO-0632	GBT DISCH CHUTE 2 DRAIN VLV	CONFIRMED OPEN	DI	120Vac	NOT CO	CONF OPEN
SCC-A	009-N-6	600-ZSC-0632	GBT DISCH CHUTE 2 DRAIN VLV	CONFIRMED CLOSED	DI	120Vac	NOT CC	CONF CLOSED
SCC-A	009-N-7	605-LSHH-0722	PROCESS DRAIN PUMP STATION	HIGH HIGH LEVEL	DI	120Vac	NORMAL	HIGH HIGH
SCC-A	009-N-7	605-LSL-0721	PROCESS DRAIN PUMP STATION	LOW LEVEL CUTOUT	DI	120Vac	NORMAL	CUTOUT
SCC-A	009-N-7	605-LSH-0741	PROCESS DRAIN VALVE VAULT	FLOOD	DI	120Vac	NORMAL	FLOOD
SCC-A	009-N-7	605-SF-0701	PROCESS DRAIN PUMP 1	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
SCC-A	009-N-7	605-OT-0701	PROCESS DRAIN PUMP 1	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
SCC-A	009-N-7	605-AUTO-0701	PROCESS DRAIN PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-7	605-HAND-0701	PROCESS DRAIN PUMP 1	IN HAND	DI	120Vac	NOT IN HAND	IN HAND
SCC-A	009-N-7	605-MS-0701	PROCESS DRAIN PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-7	605-SF-0702	PROCESS DRAIN PUMP 2	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
SCC-A	009-N-7	605-OT-0702	PROCESS DRAIN PUMP 2	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
SCC-A	009-N-7	605-AUTO-0702	PROCESS DRAIN PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-A	009-N-7	605-HAND-0702	PROCESS DRAIN PUMP 2	IN HAND	DI	120Vac	NOT IN HAND	IN HAND
SCC-A	009-N-7	605-MS-0702	PROCESS DRAIN PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-8	610-MS-0801	ODOROUS AIR FAN	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-8	610-MS-0811	RECIRCULATION PUMP	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-A	009-N-8	610-LCP-0800	ODOROUS AIR SYSTEM	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-12	195-ALM-1201	ORTHO-PHOSPHATE	ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-12	195-SPU-1201	SAMPLE PREP UNIT	ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-12	195-SPU-MAIN	SAMPLE PREP UNIT	MAINTENANCE	DI	120Vac	NORMAL	MAINTENANCE
SCC-A	009-N-14	SCC-MAIN-POWER	SCC-A LINE FILTER	FAILURE	DI	120Vac	NORMAL	POWER FAILURE
SCC-A	009-N-14	600-UPS-LOW	600 UPS	LOW BATTERY	DI	120Vac	NORMAL	LOW BATTERY
SCC-A	009-N-14	600-UPS-FAIL	600 UPS	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-SPD-1	SURGE PROTECTOR	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-FACP-FAIL	600 FIRE ALARM CP	TROUBLE	DI	120Vac	NORMAL	TROUBLE
SCC-A	009-N-14	600-FACP-ALRM	600 FIRE ALARM CP	ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-14	600-HTP-1	HEAT TRACE PANEL	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-SP1-FAIL	SUMP PUMP 1	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-SP2-FAIL	SUMP PUMP 2	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-LSHH-1414	600 BASEMENT SUMP	HIGH HIGH LEVEL	DI	120Vac	NORMAL	HIGH HIGH
SCC-A	009-N-14	600-TCP-VENT	HVAC SYSTEM	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-TCP-ODOR	HVAC SYSTEM	ODOROUS AIR FAN REQ'D	DI	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-14	600-FLT-1420	GBT ROOM GAS MONITOR	FAULT	DI	120Vac	NORMAL	FAILURE
SCC-A	009-N-14	600-ALM-1420	GBT ROOM GAS MONITOR	ALARM	DI	120Vac	NORMAL	ALARM
SCC-A	009-N-2	600-EN-0221	W2 BOOSTER PUMP 1	ENABLE	RO	120Vac	DISABLE	ENABLE
SCC-A	009-N-2	600-EN-0222	W2 BOOSTER PUMP 2	ENABLE	RO	120Vac	DISABLE	ENABLE
SCC-A	009-N-2	600-EN-0231	W3 BOOSTER PUMP 1	ENABLE	RO	120Vac	DISABLE	ENABLE
SCC-A	009-N-2	600-EN-0232	W3 BOOSTER PUMP 2	ENABLE	RO	120Vac	DISABLE	ENABLE

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-A	009-N-4	600-MC-0401	POLYMER FEED PUMP 1	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-4	600-MC-0402	POLYMER FEED PUMP 2	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-5	600-RTZ-0521	DSS FLOWMETER	RETURN TO ZERO	RO	120Vac	NORMAL	RTZ
SCC-A	009-N-5	600-RTZ-0531	GBT 1 WAS FLOWMETER	RETURN TO ZERO	RO	120Vac	NORMAL	RTZ
SCC-A	009-N-5	600-RTZ-0532	GBT 2 WAS FLOWMETER	RETURN TO ZERO	RO	120Vac	NORMAL	RTZ
SCC-A	009-N-5	600-RTZ-0541	GBT 1 PSD FLOWMETER	RETURN TO ZERO	RO	120Vac	NORMAL	RTZ
SCC-A	009-N-5	600-RTZ-0542	GBT 2 PSD FLOWMETER	RETURN TO ZERO	RO	120Vac	NORMAL	RTZ
SCC-A	009-N-6	600-CTO-0621	GBT DISCH CHUTE 1 FLUSH VLV	CALL TO OPEN	RO	120Vac	NORMAL	CTO
SCC-A	009-N-6	600-CTC-0621	GBT DISCH CHUTE 1 FLUSH VLV	CALL TO CLOSE	RO	120Vac	NORMAL	CTC
SCC-A	009-N-6	600-CTO-0622	GBT DISCH CHUTE 2 FLUSH VLV	CALL TO OPEN	RO	120Vac	NORMAL	CTO
SCC-A	009-N-6	600-CTC-0622	GBT DISCH CHUTE 2 FLUSH VLV	CALL TO CLOSE	RO	120Vac	NORMAL	CTC
SCC-A	009-N-6	600-CTO-0631	GBT DISCH CHUTE 1 DRAIN VLV	CALL TO OPEN	RO	120Vac	NORMAL	CTO
SCC-A	009-N-6	600-CTC-0631	GBT DISCH CHUTE 1 DRAIN VLV	CALL TO CLOSE	RO	120Vac	NORMAL	CTC
SCC-A	009-N-6	600-CTO-0632	GBT DISCH CHUTE 2 DRAIN VLV	CALL TO OPEN	RO	120Vac	NORMAL	CTO
SCC-A	009-N-6	600-CTC-0632	GBT DISCH CHUTE 2 DRAIN VLV	CALL TO CLOSE	RO	120Vac	NORMAL	CTC
SCC-A	009-N-6	600-MC-0601	THICKENED SLUDGE PUMP 1	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-6	600-MC-0602	THICKENED SLUDGE PUMP 2	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-6	600-SV-0611	TWAS PUMP 1 SEAL WATER SOL	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-6	600-SV-0612	TWAS PUMP 2 SEAL WATER SOL	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-7	605-MC-0701	PROCESS DRAIN PUMP 1	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-7	605-MC-0702	PROCESS DRAIN PUMP 2	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-8	610-MC-0801	ODOROUS AIR FAN	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-A	009-N-14	600-YA-1421	STRUCTURE 600	GAS ALARM BEACON	RO	120Vac	NORMAL	ALARM
SCC-A	009-N-14	600-YA-1431	STRUCTURE 600	LOSS OF VENTILATION	RO	120Vac	NORMAL	ALARM
SCC-A	009-N-2	600-PIT-0221	W2 BOOSTER PUMP 1	PRESSURE	AI	4-20mA	0-160	PSI
SCC-A	009-N-2	600-PIT-0222	W2 BOOSTER PUMP 2	PRESSURE	AI	4-20mA	0-160	PSI
SCC-A	009-N-2	600-PIT-0231	W3 BOOSTER PUMP 1	PRESSURE	AI	4-20mA	0-160	PSI
SCC-A	009-N-2	600-PIT-0232	W3 BOOSTER PUMP 2	PRESSURE	AI	4-20mA	0-160	PSI
SCC-A	009-N-4	600-FDB-0401	POLYMER FEED PUMP 1	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-A	009-N-4	600-FDB-0402	POLYMER FEED PUMP 2	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-A	009-N-5	600-FIT-0521	DSS	FLOW	AI	4-20mA	0-200	GPM
SCC-A	009-N-5	600-FIT-0531	GBT 1 WAS	FLOW	AI	4-20mA	0-400	GPM
SCC-A	009-N-5	600-FIT-0532	GBT 2 WAS	FLOW	AI	4-20mA	0-400	GPM
SCC-A	009-N-5	600-FIT-0541	GBT 1 PSD	FLOW	AI	4-20mA	0-200	GPM
SCC-A	009-N-5	600-FIT-0542	GBT 2 PSD	FLOW	AI	4-20mA	0-200	GPM
SCC-A	009-N-5	600-FDB-0521	DSS FCV	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-FDB-0531	GBT 1 WAS FCV	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-FDB-0532	GBT 2 WAS FCV	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-FDB-0541	GBT 1 PSD FCV	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-FDB-0542	GBT 2 PSD FCV	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
SCC-A	009-N-6	600-LIT-0621	GBT DISCH CHUTE 1	LEVEL	AI	4-20mA	0-12	FEET
SCC-A	009-N-6	600-LIT-0622	GBT DISCH CHUTE 2	LEVEL	AI	4-20mA	0-12	FEET

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-A	009-N-6	600-TIT-0601	THICKENED SLUDGE PUMP 1	CASING TEMPERATURE	AI	4-20mA	0-200	°F
SCC-A	009-N-6	600-TIT-0602	THICKENED SLUDGE PUMP 2	CASING TEMPERATURE	AI	4-20mA	0-200	°F
SCC-A	009-N-7	605-LIT-0711	PROCESS DRAIN PUMP STATION	LEVEL	AI	4-20mA	0-15	FEET
SCC-A	009-N-8	600-FIT-0801	ODOROUS AIR	FLOW	AI	4-20mA	0-5000	SCFM
SCC-A	009-N-8	600-FITT-0801	ODOROUS AIR	TEMPERATURE	AI	4-20mA	30-100	°F
SCC-A	009-N-14	600-AIT-1420	GBT ROOM	H2S CONCENTRATION	AI	4-20mA	0-50	PPM
SCC-A	009-N-4	600-CMD-0401	POLYMER FEED PUMP 1	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-4	600-CMD-0402	POLYMER FEED PUMP 2	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-5	600-CMD-0521	DSS FCV	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-CMD-0531	GBT 1 WAS FCV	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-CMD-0532	GBT 2 WAS FCV	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-CMD-0541	GBT 1 PSD FCV	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
SCC-A	009-N-5	600-CMD-0542	GBT 2 PSD FCV	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
SCC-A	009-N-6	600-CMD-0601	THICKENED SLUDGE PUMP 1	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-6	600-CMD-0602	THICKENED SLUDGE PUMP 2	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-7	605-CMD-0701	PROCESS DRAIN PUMP 1	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-7	605-CMD-0702	PROCESS DRAIN PUMP 2	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
SCC-A	009-N-8	610-CMD-0801	ODOROUS AIR FAN	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
SCC-D/F	009-N-15	170-SPD-1	SURGE PROTECTOR	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-D/F	009-N-15	160-HTU-0181	HEAT TRACE	FAULT	DI	120Vac	NORMAL	FAULT
SCC-D/F	009-N-15	150-HTU-0182	HEAT TRACE	FAULT	DI	120Vac	NORMAL	FAULT
SCC-MAIN	009-N-1	125-TFCP-SILENCE	ALUM TANKS TRUCK FILL CP	HORN SILENCE	DI	120Vac	NOT SILENCE	SILENCE
SCC-MAIN	009-N-1	125-MS-0111	ALUM FEED PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0111	ALUM FEED PUMP 1	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0111	ALUM FEED PUMP 1	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE
SCC-MAIN	009-N-1	125-LR-0111	ALUM FEED PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0111	ALUM FEED PUMP 1	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-MS-0112	ALUM FEED PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0112	ALUM FEED PUMP 2	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0112	ALUM FEED PUMP 2	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE
SCC-MAIN	009-N-1	125-LR-0112	ALUM FEED PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0112	ALUM FEED PUMP 2	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-MS-0123	ALUM FEED PUMP 3	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0123	ALUM FEED PUMP 3	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0123	ALUM FEED PUMP 3	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE
SCC-MAIN	009-N-1	125-LR-0123	ALUM FEED PUMP 3	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0123	ALUM FEED PUMP 3	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-MS-0124	ALUM FEED PUMP 4	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0124	ALUM FEED PUMP 4	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0124	ALUM FEED PUMP 4	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-MAIN	009-N-1	125-LR-0124	ALUM FEED PUMP 4	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0124	ALUM FEED PUMP 4	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-MS-0135	ALUM FEED PUMP 5	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0135	ALUM FEED PUMP 5	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0135	ALUM FEED PUMP 5	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE
SCC-MAIN	009-N-1	125-LR-0135	ALUM FEED PUMP 5	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0135	ALUM FEED PUMP 5	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-MS-0136	ALUM FEED PUMP 6	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
SCC-MAIN	009-N-1	125-ALM-0136	ALUM FEED PUMP 6	COMMON ALARM	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-LEAK-0136	ALUM FEED PUMP 6	LEAKAGE	DI	120Vac	NORMAL	LEAKAGE
SCC-MAIN	009-N-1	125-LR-0136	ALUM FEED PUMP 6	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
SCC-MAIN	009-N-1	125-PSH-0136	ALUM FEED PUMP 6	HIGH PRESSURE	DI	120Vac	NORMAL	HIGH PRESSURE
SCC-MAIN	009-N-1	125-FSH-0171	120/125 EYEWASH STATIONS	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
SCC-MAIN	009-N-1	130-HTU-0183	HEAT TRACE	FAULT	DI	120Vac	NORMAL	FAULT
SCC-MAIN	009-N-14	SCC-MAIN-POWER	SCC-MAIN LINE FILTER	FAILURE	DI	120Vac	NORMAL	POWER FAILURE
SCC-MAIN	009-N-14	120-UPS-LOW	120 UPS	LOW BATTERY	DI	120Vac	NORMAL	LOW BATTERY
SCC-MAIN	009-N-14	120-UPS-FAIL	120 UPS	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-MAIN	009-N-14	120-VENT-FAIL	120 VENTILATION SYSTEM	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-MAIN	009-N-14	125-VENT-FAIL	125 VENTILATION SYSTEM	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-MAIN	009-N-14	125-HTP-1	HEAT TRACE PANEL (ALUM)	FAILURE	DI	120Vac	NORMAL	FAILURE
SCC-MAIN	009-N-14	125-FSH-1501	CHEMICAL ROOM	SPRINKLER ACTIVATION	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-14	125-ZS-1511	CHEMICAL ROOM	SPRINKLER TAMPER	DI	120Vac	NORMAL	ALARM
SCC-MAIN	009-N-1	125-TFCP-HORN	ALUM TANKS TRUCK FILL CP	HORN ANNUNCIATE	RO	120Vac	NOT HORN	HORN
SCC-MAIN	009-N-1	125-TFCP-T1-FULL	ALUM TANKS TRUCK FILL CP	TANK 1 FULL LIGHT	RO	120Vac	NOT FULL	TANK 1 FULL
SCC-MAIN	009-N-1	125-TFCP-T2-FULL	ALUM TANKS TRUCK FILL CP	TANK 2 FULL LIGHT	RO	120Vac	NOT FULL	TANK 2 FULL
SCC-MAIN	009-N-1	125-TFCP-T3-FULL	ALUM TANKS TRUCK FILL CP	TANK 3 FULL LIGHT	RO	120Vac	NOT FULL	TANK 3 FULL
SCC-MAIN	009-N-1	125-CTR-0111	ALUM FEED PUMP 1	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-CTR-0112	ALUM FEED PUMP 2	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-CTR-0123	ALUM FEED PUMP 3	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-CTR-0124	ALUM FEED PUMP 4	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-CTR-0135	ALUM FEED PUMP 5	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-CTR-0136	ALUM FEED PUMP 6	REQUIRED	RO	120Vac	NOT REQUIRED	REQUIRED
SCC-MAIN	009-N-1	125-PIT-0101	ALUM TANK 1	LEVEL	AI	4-20mA	0-18	FEET
SCC-MAIN	009-N-1	125-PIT-0102	ALUM TANK 2	LEVEL	AI	4-20mA	0-18	FEET
SCC-MAIN	009-N-1	125-PIT-0103	ALUM TANK 3	LEVEL	AI	4-20mA	0-18	FEET
SCC-MAIN	009-N-1	125-FBK-0111	ALUM FEED PUMP 1	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-FBK-0112	ALUM FEED PUMP 2	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-FBK-0123	ALUM FEED PUMP 3	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-FBK-0124	ALUM FEED PUMP 4	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-FBK-0135	ALUM FEED PUMP 5	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-FBK-0136	ALUM FEED PUMP 6	FLOW FEEDBACK	AI	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-CMD-0111	ALUM FEED PUMP 1	FLOW PACE	AO	4-20mA	0-100	% SPEED

LOCATION	DRAWING	TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
SCC-MAIN	009-N-1	125-CMD-0112	ALUM FEED PUMP 2	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-CMD-0123	ALUM FEED PUMP 3	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-CMD-0124	ALUM FEED PUMP 4	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-CMD-0135	ALUM FEED PUMP 5	FLOW PACE	AO	4-20mA	0-100	% SPEED
SCC-MAIN	009-N-1	125-CMD-0136	ALUM FEED PUMP 6	FLOW PACE	AO	4-20mA	0-100	% SPEED
I/O list does not include existing PLC signals that may or may not be shown on Drawings. I/O list does not include soft signals communicated over networks.								

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Process Control System in conjunction with P&IDs.

B. Items specified in this section shall conform to general requirements of Section 40 61 13.

C. See Section 40 61 20 for PCS Configuration Requirements.

1.02 REFERENCES

A. NEMA: National Electrical Manufacturer Association

1.03 ABBREVATIONS

A. HMI: Human/Machine Interface

B. I/O: Input / Output

C. OIU : Operator Interface Unit

D. LOS: Line of Sight

E. NEC: National Electrical Code

F. PC: Personal Computer

G. PCS: Process Control System

H. PLC: Programmable Logic Controller

I. SCADA : Supervisory Control and Data Acquisition

J. UPS: Uninterruptible Power Supply

K. I&C : Instrumentation and Controls

1.04 DEFINTIONS

A. Plant-Wide Process Network

1. A virtual network created by the Ethernet Switches. The Process Network shall primarily handle data communication between HMI Server and the PLCs in the system. This traffic shall contain collected data and control commands.

B. Plant-Wide Information Network

1. A virtual network created by the Ethernet Switches. The Information Network shall primarily handle data communications between the HMI Server and users of that information including the HMI Clients, the Portal Server and the Historian Server.

1.05 SYSTEM DESCRIPTION

A. For general requirements for PCS, see Section 40 61 13.

B. Design requirements:

1. System modifications include one HMI (PanelView) programmed for entire plant monitoring and control, relocating SCADA Computers and Workstations working in conjunction with multiple new Programmable Logic Controllers and control panels.
2. Software licensing as required.
3. All System components shall be housed within control panels.
4. System shall use PLC form factor I/O subsystems to connect local and remote Equipment.
5. System shall provide separate 24 volts direct current regulated power supplies to power I/O subsystem and to power analog instrumentation loops as required.
6. Data highway components shall be provided to interconnect PLC to data highway-enabled field devices, and PLC to existing Process Control System (PCS).
7. System shall provide peer-to-peer communication between PLC, HMI computers and other devices connected to System.
8. Isolation and surge protection shall be provided for all incoming and out-going power and signal lines.
9. System shall be provided with quantity and type of I/O as specified in Section 40 61 93 and as shown on the Drawings.
10. System shall have a minimum of 20% prewired spare points of each type of I/O point used.
11. System shall be expandable, at future date, to accommodate additional I/O.

C. Performance requirements:

1. HMI shall serve only as operator interface to PLC and shall not contain automatic control functions. Automatic control functions shall be programmed into the PLC.
2. PLCs shall be programmed to be autonomous; a loss of the Process Control Network (PCN) shall not cause any PLC to lose the ability to maintain control of its respective processes.
3. System shall perform process monitoring and supervisory control using PLC and HMI computer.
4. PLC shall send/receive process data to/from field Equipment and be capable of following when configured:

    a. Receive analog data from primary control elements; convert to engineering units, process for alarms and responsibility checks, and store.
    b. Receive digital data from primary control elements, check for alarm and status change, and store.
    c. Perform control and arithmetic calculations, including software PID and other regulatory control functions, based on system parameters and real-time data and output the properly conditioned control commands to final control elements.
    d. Perform sequential control functions.
    e. Ascertain off-normal conditions of process parameters and generate alarms for monitoring at the HMI. The HMI shall not be the source of alarm generation.
    f. Communicate with HMI computer over Ethernet data highway.
    g. Respond to operator requests for data and to control commands from HMI.
    h. Respond to inhibit, enable and interlock signals from other sources.
    i. Respond to supervisory requests for data, to control commands and to process parameter setting changes from plant PCS.

5. HMI computer shall receive/send process data from/to PLC, maintain database and be capable of following when configured.

    a. Real-time data collection. Receive and store process data from PLC.

b. Receive and store manually entered data from keyboard or pointing device such as operator changes and process parameter setting changes.
c. Send operator and process parameter setting changes to PLC.
d. Display plant activity with alphanumeric and color graphic displays of I/O associated with PLC.
e. Data collection for maintenance management. Provide operating information from which to generate reports and logs.
f. Real-time data collection.
g. Historical data storage and reporting.
h. Provide overall plant alarm and status monitoring with visual and audible alarming.
i. Record alarms and events on screen and store to file.
j. Allow operator input of data not collected by System.

6. "Hand" mode of field mounted Hand/Off/Auto selector switches shall enable field control of equipment. PLC control shall be inhibited in "Hand" mode. "Auto" mode shall enable PLC based Manual or Automatic control. Field control shall be inhibited in "Auto" mode.
7. Control logic for "Automatic" mode shall be programmed functions of the PLC.
8. Field mounted Hand/Off/Auto selector switches shall be provided with extra contact blocks for monitoring of "Auto" mode at the PLC.

D. Control Panel Requirements:

1. Unless otherwise specified, "running" signals shall be derived from equipment motor starter normally open auxiliary contacts.
2. Electrical wiring and controls shall conform to Division 26 – ELECTRICAL.
3. Equipment on panels shall be identified as follows:

a. Indicating Light Off: Equipment Not Running.
b. Indicating Light Green: Equipment in Operation.
c. Indicating Light Red: Equipment in Alarm Condition.
d. Indicating Light White: Power Supply Energized.

4. Fail Logic: Failure of equipment, after having been "called to run", shall generate a Fail alarm. Typical points of failure are motor overload (overcurrent), motor undercurrent (blower surge), motor under voltage, fail-to-start and power fail. Power fail shall include, in addition to loss of control power, the tripping of equipment circuit breakers while equipment is called to run. Provide necessary logic to sense discrepancy between "called to run" and "running" signals and activate Fail Alarm signal after adjustable time delay.
5. References to "selector switch" refer to maintained contact type functions. Loss and return of control power to circuit does not change control mode or requirement as dictated by switch position.
6. References to "pushbutton" refer to momentary contact type functions. Loss and return of control power to circuit reverts control mode or requirement to default condition. Initiating pushbutton is required to re-establish control mode or requirement.

E. Instrumentation & Control

1. I&C design is based upon the concept of facilities with automatic and semi-automatic control of specific plant functions. With this in mind, the following Instrumentation and Control design parameters were developed:

a. Use of custom fabricated, PLC – based control panels. Panels shall act as area controllers, located in several of the process areas.
b. Operator access to the PLC panels shall be through a system of distributed panel mounted and desktop type computers running as thin clients to the application. Wherever possible, these units shall be located in proximity to the PLC panels.

c. Use of Vendor furnished control panels with appropriate operator interface for individually packaged systems with above normal inter-system coordination requirements.
d. Selection of automated control for processes dramatically affected by plant flow variations, loading variations, or where operating efficiencies are paramount.
e. Use of a distributed HMI computer system to monitor critical and non-critical alarms, equipment run times, status conditions, plant flows and levels, and to act as input terminals for supervisory set-point and timer function changes.
f. PLC based control panels and central HMI shall be linked through the use of Ethernet for transmission of data. Data transmission shall be Ethernet protocol and shall run on fiber optic media.
g. Use of locally mounted OIT's to provide local control of specific local systems along with operational status, critical, non-critical, and dial-out alarm conditions.
h. Where appropriate, Vendor furnished panels shall be specified with PLC's or communications modules for data link interface for Ethernet system. Remainder of Vendor furnished panels shall be hard-wired to nearest PLC based control panel to pick up monitoring and control signals, and subsequent relaying of data to the HMI.

2. I&C design is based upon the following additional considerations.

a. Alarms shall be provided for conditions which shall cause safety or health risk, environmental damage, property or equipment damage, or process failure. Alarms are considered critical, non-critical or dial-out in nature and are defined as follows.

1) Critical Alarms are defined as those which shall cause safety or health risk, environmental damage, significant property or equipment damage, or failure of process operations critical to meeting effluent limitations if not attended to and corrected immediately.
2) Non-critical Alarms are defined as those which, if not attended to and corrected within a specific timeframe, may eventually cause safety or health risk, environmental or property damage, or process failure.
3) Dial-out Alarms are defined as all critical alarms and those non-critical alarms which plant management wishes to be notified of immediately.

b. Critical Alarms shall be annunciated at a location where personnel responsible for operation of the facilities are expected to be stationed or on call at all times.
c. Non-critical Alarms shall be indicated at a location where the presence of an operator is expected periodically.
d. Panels shall conform to NEMA standards as defined in Section 40 67 00.
e. Timers, time clocks, and repeat cycle timers shall be a function of the PLC.

1.06 QUALITY ASSURANCE

A. PCS hardware and software shall be provided and integrated by single Systems Integrator.

B. Provide process control system hardware required to meet function of specifications. Configure Ethernet Network to maximize process control system availability. Provide fully operational process control system.

C. Label hardware revision levels on equipment and spares installed.

1.07 PLC INPUT/OUTPUT MODULE CONNECTION

A. Input and output signals for similar process equipment shall be assigned to I/O Modules so that failure of any one module does not affect all process equipment.

B. Inputs and outputs shall be configured in accordance with Sections 40 61 20 and 40 61 93.

PART 2 – PRODUCTS

2.01 VFD's – GENERAL

A. VFD's shall be programmed with the following operational features:

1. During functional testing, if any frequencies throughout the speed range of the VFD's exhibit pump/motor/equipment vibration characteristics above normal running conditions, then the VFD shall be programmed to skip these frequencies with an associated bandwidth above and below the skip frequency. Adjustable to 0.1Hz.
2. VFD's shall be programmed to not fault on loss of communications.
3. VFD's shall be programmed for auto-restart enabled.
4. VFD's shall be programmed with minimum and maximum speed clamps to protect equipment and processes from damage or disruption.

2.02 PLC-BASED CONTROL PANELS – GENERAL

A. PLC-Based Control Panel Functional Descriptions - General:

1. Functional Descriptions for PLC-based control panels that follow pertain to "Auto" modes requiring supervisory control with interactive logic.
2. PLC control of equipment shall require "Hand/Off/Auto" selector switches to be in the "Auto" position. Equipment not in "Auto" shall be considered to be in "Hand" mode and shall be controlled manually at the equipment. "Hand" mode shall be for maintenance purposes and may inhibit Pump safeguards such as seal fail or overtemp conditions.
3. Stop or emergency stops shall work as designed for all modes of operation.
4. All fail signals shall be alert the Operator, alarm the equipment, and remove from equipment sequencer.

2.03 PROCESS CONTROL BUILDING NETWORK RACK 120-NET-1

A. Rack

1. 48U Network Rack Enclosure.
2. For mounting of standard 19" rack equipment.
3. Free Standing – with casters and leveling feet.
4. Cooling fans as required.

B. Rack Mounted Equipment

1. UPS in accordance with Section 40 67 63.
2. Copper Patch Panels in accordance with Section 40 66 00.
3. Fiber Patch Panels in accordance with Section 40 66 00.
4. Network Switch in accordance with Section 40 66 00.
5. IT equipment supplied and installed by the Owner.

2.04 PROCESS CONTROL BUILDING PLC PANEL SCC-MAIN

A. Panel

1. Indoor Enclosure.
2. NEMA 12.
3. Free Standing or Wall Mount as determined by the System Integrator based on space requirements.

4. 120Vac Power Supply.

B. Front of Panel Mounted Devices

1. Data outlet.
2. 120Vac Power Light.

C. Rear of Panel Mounted Devices

1. PLC in accordance with Section 40 63 43.
2. Line Filter.
3. 24Vdc Power Supply.
4. Cooling fan with thermostat.
5. Circuit breakers and fuses as required.
6. Relocated Network switches as shown on Drawings.
7. Relocated Fiber Optic Patch Panels.

D. Signals and Wiring

1. Re-terminate existing field wiring as required.
2. Duplicate existing I/O and signals in new PLC and programming.
3. Provide in accordance with Section 40 61 93 and as shown on Drawings.
4. Provide Ethernet connections for equipment as shown on Drawings.

E. Functional Description – Alum Delivery (009-N-1)

1. Alum is delivered to the site by truck and will be unloaded at the unloading area at the front of Building 125.
2. Alum connections are located just inside the door, where each Alum Tank has its own connection.
3. The Alum delivery area includes an Alum Tanks Truck Fill Control Panel (125-TFCP-1) which acts as the interface for delivery personnel. The panel includes an LCD readout of the level of the each Alum Tank (in feet), and a Tank Full light that illuminates when tank full (high level) has been reached in the respective Tank. Tank head pressure is measured by a pressure transmitter (125-PIT-0101, 125-PIT-0102, and 125-PIT-0103) whereby pressure is converted to tank level. The Alum Truck Fill Control Panel also includes an audible annunciator (horn) that will sound when tank overflow level has been reached in any of the three Tanks (as determined by operator adjustable set-point). The Horn Silence pushbutton located on the panel shall inhibit the horn. The horn circuit is reset in the PLC when respective tank level recedes below tank full alarm level for 15 minutes.
4. Each Alum Tank shall be declared “in service” or “out of service” by the Operator at the HMI so level set-point alarms may be displayed or inhibited.
5. Each Alum Tank shall include HMI level set-points for Tank full, Tank overflow, Alum Re-order (Tank Low), and Tank Low-Low.

F. Functional Description – ALUM Feed System (009-N-1)

1. The purpose of the Alum Feed System is to remove phosphorous from the wastewater by feeding a liquid alum solution. This system will provide full phosphorus removal or polishing if the biological phosphorus removal processes are not achieving sufficient phosphorus removal.
2. The Alum can be fed upstream of the primary tanks or into the aeration tank effluent channels (upstream of the final clarifiers). For sidestream phosphorus management, alum can be fed to the Gravity Belt Thickener (GBT) filtrate at the Process Drain Pump Station (Structure 605) on the north side of the Solids Processing Building (Structure 600), to the Digester Liquor line which returns to the manhole between Structure 120 and Structure 130

or to the TWAS/TPSD line in Solids Processing Building upstream of split to Digesters No. 1, 2 and 3.

3. Dosing for the aeration tank effluent channel location will typically be operated in Flow Pace Trim Mode (see below) based on influent flow and the measurement of orthophosphate by an online orthophosphate analyzer (195-OPA-1201) located upstream of the UV system. Dosing for Primary Tanks upstream of grit removal will typically be operated in Flow Pace Mode (see below) based on influent flow. Dosing at all other locations will typically be operated as a manual dosing rate set-point.
4. The Alum Feed System consists of three storage tanks (125-T-0101, 125-T-0102, and 125-T-0103) and six chemical feed pumps (125-P-0111, 125-P-0112, 125-P-0123, 125-P-0124, 125-P-0135, and 125-P-0136). Pump Number 1 will normally be dedicated to the effluent channel of the North Aeration Basin. Pump Number 2 will normally be dedicated to the effluent channel of the South Aeration Basin. Pump Number 3 will normally be dedicated to the Primary Influent and dosed upstream of grit removal. Pumps 4 and 5 will normally be dedicated to dosing digester liquor and GBT filtrate. Pump 6 will normally be dedicated to the digesters, which will be dosed at static mixer in the Solids Processing Building. In the event of a failure, operators will need to adjust manual valves for dosing to other locations.
5. When dosing from plant influent flow, a maximum plant influent flow clamp shall be employed to the dosing signal such that additional plant influent flow above maximum clamp shall be ignored. The maximum flow clamp assures Alum is not overfed during high flow rain events.
6. W3 is used to flush alum lines when not in use. W3 flushing is accomplished by opening respective manual ball valves downstream of the alum pumps. The W3 supply includes local system pressure indication (125-PI-0161).
7. Alum lines that exit building 125 require heat tracing whose circuits are controlled by a Heat Trace Panel (125-HTP-1). Alum application points entering building 130, and entering the aeration basin effluent channels also require heat tracing.
8. Dosing methods are discussed below. Operator shall select which dosing method is used for each application point (or pump) at the HMI.
9. Each alum pump includes a local control station mounted directly on the pump. The local control panel includes a Local/Remote selector switch which is used to select mode of pump operation.

    a. **Local** – With the Local/Remote selector switch in Local, the following control options are available from the Local Control Station. *Local control is intended for maintenance purposes only.*

        1) **Start** – This selection energizes the Pump.
        2) Stop – This selection de-energizes the Pump.
        3) Speed – This selection is used to increase or decrease the pace rate.

    b. Remote – With the Local/Remote selector switch in Remote, the following control options are available from the HMI:

        1) **Manual** – With the Manual/Auto selector switch at the HMI in Manual, the following control options are available from the HMI.

            i. **Start** – This selection energizes the Pump.
            ii. **Stop** – This selection de-energizes the Pump.
            iii. **Dosing Rate** – This selection adjusts the Pump speed to deliver an Operator input dose in gallons per hour. *This mode does not take into consideration plant flows.*

        2) **Auto** – With the Manual/Auto selector switch at the HMI in Auto, the Operator will be able to select a dosing strategy for the pump through the PLC. The dosing

strategy selection must match the manual valve configuration downstream of the pumps as set by the operator.

i. Each ALUM Pump will have the ability to be placed into one of six Operator selectable “pump to” locations. The “pump to” locations are: effluent channel of the North Aeration Basin, effluent channel of the South Aeration Basin, Primary Influent upstream of grit removal, Digester liquor manhole, GBT filtrate at the Process Drain Pump Station, and to the digesters which will be dosed at static mixer in the Solids Processing Building.

ii. The “pump to” locations will allow the pumps to indicate on the HMI where they will be pumping Alum. The “pump to” selection for each pump will also generate a pop screen if being selected outside of its normal mode saying the following: SELECTED PUMP-TO LOCATION IS NOT DEFAULT LOCATION – CONFIRM CHEMICAL FEED LINE PIPING AND MANUAL VALVE ARANGEMENT. A pushbutton on the pop-up screen shall require the Operator to confirm valve arrangement. Default “pump to” locations are as follows: Alum Pump No. 1 (125-P-0111) shall be effluent channel of the North Aeration Basin, Alum Pump No. 2 (125-P-0112) shall be effluent channel of the South Aeration Basin, Alum Pump No. 3 (125-P-0123) shall be Primary Influent upstream of grit removal, Alum Pump No. 4 (125-P-0124) shall be Digester liquor manhole, Alum Pump No. 5 (125-P-0135) shall be GBT filtrate at the Process Drain Pump Station, and Alum Pump No. 6 (125-P-0136) shall be Digesters which dosed at static mixer in the Solids Processing Building.

iii. Each ALUM Pump will have the ability to be placed into one of three Operator selectable operating modes: Phosphorus Analyzer Mode, Flow Pace Mode, and Flow Pace Trim Mode.

iv. In Phosphorus Analyzer Mode, the Alum Pump will try to maintain an Operator settable effluent ortho-phosphorus target concentration (Range: 0.00 to 1.00 ppm). There will be an Operator settable deadband (0.00 to 0.25) about set-point. If the analyzer is within the deadband, no change in the pumping operation will occur. If outside the deadband, and above the target set-point, the pump percent output shall increase. If outside the deadband set-point, and below the target concentration set-point, then the pump output shall decrease. There will also be an Operator settable % pump change (0.00 to 10%) set-point, and an Operator settable time delay between pump adjustments (0 – 180 minutes). There will also be an Operator settable maximum change in pump percent over a 24 hour time span (0 – 100%). The maximum change in pump percent shall be set up to look at the % speed of the pump at the time of updating the historian and record this % speed. The pump shall be allowed to change in percent only by as much as the operator selectable maximum change in pump percent amount per 24 hour time period and using the % speed recorded at the time of the historian updating each day as the base percent.

v. In Flow Pace Mode, each Alum Pump will be flow paced based on the influent or effluent flow (Operator selectable). There will be a Minimum Flow Set-point (in MGD), Maximum Flow Set-point (in MGD), Minimum Speed Set-point, and Maximum Speed Set-point for each pump. The set-points determine the slope of the linear relationship of pump speed to flow. At the Minimum Flow Set-point, the pump will run at the Minimum Speed Set-point. At the Maximum Flow Set-point the pump will run at the Maximum Speed Set-point.

vi. In Flow Pace Trim Mode, each Alum Pump will have control as mentioned in Flow Pace Mode (above). In addition, there will be ramp control based on the Phosphorus Analyzer. There will be a Minimum Analyzer Set-point value, Maximum Analyzer Set-point value, Minimum Ratio Set-point, and Maximum Ratio Set-point. As the Phosphorus Analyzer value increases, the ratio will increase causing the Alum pump to increase in speed above what the flow ramp control is telling the pump to operate at (summation of flow pace and ramp).

This is considered the “trim” of the control. In this mode, the pump will turn on based on a Phosphorus Analyzer Start Set-point (high level, initially set at 0.8ppm). The pump will turn off when the Minimum Analyzer Set-point (low level, initially set at 0.4ppm) has been reached for an Operator adjustable delay (0.00-48.00 Hours). The intent is to have the Start Set-point be in the middle of the Trim Ramp Control.

10. Pump Interlocks and alarms:

    c. A hose break alarm shall inhibit pump operation and alarm the Operator at the HMI.
    d. A high pressure alarm measured on the downstream side of the pump shall inhibit pump operation and alarm the Operator at the HMI.
    e. If “pump to” location is set to GBT filtrate at the Process Drain Pump Station, then at least one GBT shall be in operation during Alum pumping. Alum Pump No. 5 is the default pump for this “pump to” location.
    f. If “pump to” location is set to Digesters (downstream of the Thickened Sludge Pumps, then at least one Thickened Sludge Pump shall be in operation during Alum pumping. Alum Pump No. 6 is the default pump for this “pump to” location.
    g. If a pump is called to run, and the running feedback signal is not received for 30 consecutive seconds, the pump shall be in alarm state.
    h. If a pump speed feedback is running at minimum or maximum speed for more than four hours, an alarm shall alert the Operator of the condition. This may be a result of insufficient pump range or possible pump electronics failure.
    i. If any of the ALUM Tanks that are “in-service” are below Low-Low set-point (Operator adjustable), then an alarm shall alert the Operator at the HMI, but the pumps shall not be inhibited from normal operation (verify with the Owner).

G. Functional Description – Building 120/125 Emergency Eyewash/Shower (009-N-1)

1. Buildings 120 and 125 include Emergency Eyewash and Emergency Eyewash/Shower in the event that plant staff comes into contact with ALUM or other substances that require eyewash/shower.
2. The Emergency equipment has a common tempered water header that is monitored by a thermal dispersion flow switch (120-FSH-0171) which will alarm and alert the Operator when any of the emergency stations has been activated.

H. Functional Description – Building 120 Temperature Control Panel (009-N-14)

1. The Temperature Control Panel (120-TCP-1) will produce an alarm signal and alert the Operator when equipment failure (stopped) is detected for Building 120.

I. Functional Description – Building 125 Temperature Control Panel (009-N-14)

1. The Temperature Control Panel (125-TCP-1) will produce an alarm signal and alert the Operator when equipment failure (stopped) is detected for Building 125.

J. Functional Description – Plant Entrance Arm Gates (009-N-13)

1. The Functional Description for the Plant Entrance Arm Gates is fully described below under SCC-900 section.
2. The Plant Entrance Arm Gates functionality includes a Main Gate Intercom-Video Sub-Master Station (120-ISM-1) which is located in the Control Room (Room 102). This allows staff to communicate with (and grant plant access to) those seeking vehicular access to the Plant via call button which is located at the Main Gate. Generally, this is used after normal Plant hours, as there is a Main Gate Intercom-Video Master Station (900-ICM-1) which is

located at the receptionist area (Room 120) of the Administration Building which is staffed during normal business hours.

2.05 SOLIDS PROCESSING BUILDING NETWORK RACK 600-NET-1

A. Rack

1. 12U Network Rack Enclosure.
2. For mounting of standard 19" rack equipment.
3. Wall Mount – Hinge Left.
4. Cooling fans as required.

B. Rack Mounted Equipment

1. UPS in accordance with Section 40 67 63.
2. Copper Patch Panel in accordance with Section 40 66 00.
3. Network Switch in accordance with Section 40 66 00.

2.06 SOLIDS PROCESSING BUILDING PLC PANEL SCC-A

A. Panel

1. Indoor Enclosure.
2. NEMA 12.
3. Free Standing – Single Door.
4. Dimensions (Nominal): 90"H x 36"W x 20"D. (Dimensions are estimated. System Integrator shall size according to space requirements, and in accordance with Section 40 67 00)
5. 120Vac Power Supply.

B. Front of Panel Mounted Devices

1. Data outlet.
2. 120Vac Power Light.

C. Rear of Panel Mounted Devices

1. PLC in accordance with Section 40 63 43.
2. PanelView in accordance with 40 62 00, and shall be configured to allow control of all Plant processes as described in Section 40 61 20.
3. Line Filter.
4. 24Vdc Power Supply.
5. Cooling fan with thermostat.
6. Circuit breakers and fuses as required.
7. Relocated Fiber Optic Patch Panel as shown on Drawings.

D. Signals and Wiring

1. Provide in accordance with Section 40 61 93 and as shown on Drawings.
2. Provide Ethernet connections for equipment as shown on Drawings.

E. Functional Description – W2 Booster Pumps (009-N-2)

1. The purpose of the W2 Booster Pump System is to increase pressure of the Plant W2 water supply in structure 600 for downstream loads such as seal water for the Thickened Sludge Pumps and also the Polymer Systems.
2. The W2 Booster Pump System is a self-contained system whereby a system pressure set-point is entered locally, and the variable speed pump maintains set-point pressure under varying demand.
3. The W2 Booster Pump System incudes total system redundancy with two pumps (600-P-0221, and 600-P-0222) and two Local Control Panels (600-LCP-0221, and 600-LCP-0222).
4. The redundant W2 Booster Pumps shall operate in a Lead/Standby configuration whereby only one pump shall operate at any given time.
5. Each W2 Booster Pump System will provide a common fault alarm to the PLC which will alert the Operator at the HMI when a system failure has occurred.
6. If the common fault originates from the Lead W2 Booster Pump System, then the Standby W2 Booster Pump System shall become Lead, and the failed W2 Booster Pump shall be deemed "out of service".
7. Each W2 Booster Pump System shall transmit actual header pressure to the PLC for monitoring at the HMI.
8. An equipment sequencer shall interpose Lead W2 Booster Pump weekly or at the direction of the Operator at the HMI. The enable signal from the PLC (SCC-A) shall determine which W2 Booster Pump System is the Lead.
9. The W2 Booster Pump System Local Control Panel is where the Operator will enter a W2 system pressure set-point and deadband. The W2 Booster Pump will adjust speed to maintain system pressure set-point.

F. Functional Description – W3 Booster Pumps (009-N-2)

1. The purpose of the W3 Booster Pump System is to increase pressure of the Plant W3 water supply in structure 600 for downstream loads such as the GBT washwater systems.
2. The W3 Booster Pump System is a self-contained system whereby a system pressure set-point is entered locally, and the variable speed pump maintains set-point pressure under varying demand.
3. The W3 Booster Pump System incudes total system redundancy with two pumps (600-P-0231, and 600-P-0232) and two Local Control Panels (600-LCP-0231, and 600-LCP-0232).
4. The redundant W3 Booster Pumps shall operate in a Lead/Standby configuration whereby only one pump shall operate at any given time.
5. Each W3 Booster Pump System will provide a common fault alarm to the PLC which will alert the Operator at the HMI when a system failure has occurred.
6. If the common fault originates from the Lead W3 Booster Pump System, then the Standby W3 Booster Pump System shall become Lead, and the failed W3 Booster Pump shall be deemed "out of service".
7. Each W3 Booster Pump System shall transmit actual header pressure to the PLC for monitoring at the HMI.
8. An equipment sequencer shall interpose Lead W3 Booster Pump weekly or at the direction of the Operator at the HMI. The enable signal from the PLC (SCC-A) shall determine which W3 Booster Pump System is the Lead.
9. The W3 Booster Pump System Local Control Panel is where the Operator will enter a W3 system pressure set-point and deadband. The W3 Booster Pump will adjust speed to maintain system pressure set-point.

G. Functional Description – Polymer Prep and Aging Systems (009-N-3)

1. The purpose of the polymer systems is to prepare and feed polymer to the polymer mixing valve assembly for the two gravity belt thickeners (GBT). Inside the mixing valve assembly, the polymer and sludge completely mix prior to entering the GBT. The polymer conditions the sludge before entering the GBT to aid in the thickening process.

2. The Polymer Prep System (600-M-0300) and Polymer Aging System (600-M-0350) are controlled via a single vendor supplied Local Control Panel (600-LCP-0300).
3. The Operator will have the option of using dry or liquid emulsion polymer.
4. The dry polymer will be stored in 50lb bags or large super sack totes. Dry polymer will be metered with a volumetric feeder during a preset period of time to prepare a polymer solution to the desired concentration. Dry polymer shall be pneumatically conveyed to a wetting device. Polymer solution is to be mixed in the mix/age tank to provide the feed tank with a fully aged batch upon demand. W2 water will be used for dilution water.
5. For the larger super sack totes, a Trolley Hoist (600-M-0341) is used to move the totes to the Incline Conveyor (600-M-0301) for transfer to the Hopper.
6. The liquid emulsion polymer will be stored in 300-gallon totes and pumped into the polymer mix chamber assembly, where it will be mixed with dilution water. Polymer solution will then be discharged to the mix/age tank to provide the feed tank with a fully aged batch upon demand.
7. Once the polymer solution is properly prepped, mixed, and aged, it is ready to be drawn by the Polymer Feed Systems to feed the GBT's. The Polymer Feed Systems are described in detail below.
8. The Polymer Prep System is controlled from the Local Control Panel (600-LCP-0300) which includes an Operator Interface Unit (OIU). The Polymer Prep System includes two auto modes of operation;

    a. **Auto Dry Polymer** – Dry Polymer preparation is sequenced according to manufacturer's controls as required to make-down polymer solution concentration to 0.5% with an aging time of 60 minutes. The Feed Tank supplies the Polymer Feed Systems and when the level in Feed Tank measured by the pressure transmitter falls, the motor operated transfer valve from the Mix/Age tank to Feed Tank opens. Polymer is prepared in batches with the dry polymer portion of the Polymer Prep System activating when the level in the Mix/Age Tank measured by pressure transmitter falls below a certain level. The Mix/Age Tank is mixed according to manufacturer's controls. The dry polymer portion of Polymer Prep System uses volumetric Auger Feeder (600-M-0311) to transfer dry polymer from the Dry Polymer Feed Hopper to the heated Feed Tunnel from where it is blown with Regenerative Blower (600-M-0321) to the Wetting Head above the Mix/Age Tank. Dry Polymer is mixed with W2 at the wetting head.
    b. **Auto Liquid Emulsion Polymer** – Emulsion polymer preparation is sequenced according to manufacturer's controls as required to make-down polymer solution concentration to 0.5% with an aging time of 60 minutes. The Feed Tank supplies the Polymer Feed Systems and when the level in Feed Tank measured by the pressure transmitter falls, the motor operated transfer valve from the Mix/Age tank to Feed Tank opens. Polymer is prepared in batches with the neat polymer portion of the Polymer Prep System activating when the level in the Mix/Age Tank measured by pressure transmitter falls below a certain level. The Mix/Age Tank is mixed according to manufacturer's controls. The Neat Polymer Pump (600-P-0331) transfers neat polymer to the mix chamber assembly above the Mix/Age Tank where it is mixed with W2.

9. **Interlocks:**

    a. Low W2 Water Pressure
    b. Mix/Age Tank Level - High
    c. Emergency Stop

H. Functional Description – Polymer Feed Systems (009-N-4)

1. The purpose of the Polymer Feed Systems (600-M-0401 and 600-M-0402) is to feed polymer to the polymer mixing valve assembly for the two gravity belt thickeners (GBT). Inside the mixing valve assembly, the polymer and sludge completely mix prior to entering

the GBT. The polymer conditions the sludge before entering the GBT to aid in the thickening process.

2. The Polymer Feed Systems are self-contained systems whereby Polymer Feed System No. 1 will typically feed (pump to) Gravity Belt Thickener No. 1 (600-M-0501), and Polymer Feed System No. 2 will typically feed (pump to) Gravity Belt Thickener No. 2 (600-M-0502). These are considered the default pump to locations for the Polymer Feed Systems.
3. Each Polymer Feed System has the ability to feed either GBT with manual crossover valve on the discharge side of the Polymer Feed Systems. The Operator will have the ability to feed (pump to) each GBT via selection at the HMI.
4. The "pump to" selection for each Polymer Feed System will generate a pop screen if being selected outside of default location saying the following: SELECTED PUMP-TO LOCATION IS NOT DEFAULT LOCATION – CONFIRM POLYMER FEED LINE PIPING AND MANUAL VALVE ARANGEMENT. A pushbutton on the pop-up screen shall require the Operator to confirm valve arrangement.
5. The GBT is the controlling equipment for the Polymer Feed Systems, and will call for polymer at a given dosing rate.
6. The local PLC (SCC-A) acts as an intermediary for all GBT operational signals.
7. Control of the Polymer Feed Systems are by Local Control Panels (600-LCP-0401 and 600-LCP-0402). Each LCP includes a Local-Off-Remote (LOR) selector switch.

    a. **Local** – With the Local//Off/Remote selector switch in Local, the following control options are available from the Local Control Station. *Local control is intended for maintenance purposes only.*

        1) **Start** – This selection energizes the Pump.
        2) Stop – This selection de-energizes the Pump.
        3) Speed – This selection is used to increase or decrease the pace rate.

    b. **Off** – With the Local/Off/Remote selector switch in Off, polymer operation is inhibited.
    c. **Remote** – With the Local/Off/Remote selector switch in Remote, the following control options are available from the HMI:

        1) **Remote Manual** – With the Manual/Auto selector switch at the HMI in Manual, the following control options are available from the HMI.

            i. Start – Runs Polymer Feed System continuously.
            ii. Stop – Stops the Polymer Feed System.
            iii. Speed - Speed control is available 0-100%.
            iv. A popup shall caution the Operator that remote manual operation may cause GBT equipment damage if the GBT is not running concurrently.

        2) **Remote Auto** – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

            i. The Polymer Feed System will activate when the GBT equipment calls for it. The polymer feed pump activates and the dilution water solenoid valve opens. Polymer rate is controlled by GBT signal.

8. **Auto Interlocks**

    a. GBT Ready
    b. Polymer – Low Flow
    c. Low W3 Pressure
    d. Feed tank low level
    e. PSH

I. Functional Description – Building 600 Emergency Eyewash (009-N-3)

1. Building 600 includes an Emergency Eyewash Station in the event that plant staff comes into contact with Polymer or other substances that require eyewash.
2. The Emergency equipment is fed with tempered water that is monitored by a thermal dispersion flow switch (600-FSH-0371) which will alarm and alert the Operator when the emergency station has been activated.

J. Functional Description – Gravity Belt Thickener Systems (009-N-5)

1. The purpose of the GBT Thickener Systems is to thicken waste activated sludge, primary sludge, and digested sludge. The thickened product will be discharged into a chute directly connected to a progressing cavity pump. Thickened Sludge will then be pumped to the Digesters or Sludge Storage Tanks.
2. The plant will have two Gravity Belt Thickeners (600-M-0501 and 600-M-0502) for thickening of bio-solids. Each GBT shall be configured to thicken primary sludge, waste activated sludge (WAS), digested sludge, or any combination of the three. GBT No. 1 – Enclosed unit to be used primarily for digested sludge. GBT No. 2 – Open frame unit to be used primarily for primary and waste activated sludge.
3. Feed Sludge. There are three sludge feed lines with associated feed pumps:

    a. WAS Feed Line (WAS Pumps P-313, P-314 and P-315 located in Structure 170 South Blower Building Lower Level).
    b. Primary Sludge (PSD) Feed Line (Primary Sludge Pumps P-110 and P-111).
    c. Secondary Digested Sludge Feed Line (Secondary Digester Transfer Pumps P-710 & P-711 located in Structure 710 Secondary Digester Building).

4. Five flow meters and five flow control valves in the Solids Processing Building upstream of the GBT's will be used to control flow to the GBT's. Flow control valves give the ability to reduce flow below limits of pump VFD's and also the ability to split flow evenly between GBT No. 1 and GBT No. 2 in the case of co-thickening WAS and primary sludge with two GBT's operating.

    a. GBT No. 1 (and 2) DSS Flowmeter: 600-FE/FIT-0521).
    b. GBT No. 1 (and 2) DSS Flow Control Valve: 600-FCV-0521).
    c. GBT No. 1 WAS Flowmeter: 600-FE/FIT-0531.
    d. GBT No. 1 WAS Flow Control Valve: 600-FCV-0531.
    e. GBT No. 2 WAS Flowmeter: 600-FE/FIT-0532.
    f. GBT No. 2 WAS Flow Control Valve: 600-FCV-0532.
    g. GBT No. 1 PSD Flowmeter: 600-FE/FIT-0541.
    h. GBT No. 1 PSD Flow Control Valve: 600-FCV-0541.
    i. GBT No. 2 PSD Flowmeter: 600-FE/FIT-0542.
    j. GBT No. 2 PSD Flow Control Valve: 600-FCV-0542.

5. Waste Activated Sludge. WAS Pumps P-313, P-314 and P-315 are called to run by the GBT. Pumps run on VFD. Operational signals are passed through Plant PLC's and SCADA network.
6. Primary Sludge. Primary Sludge Pumps P-110 and P-111 run on settable timer schedule (3am, 7am, 11am, 3pm, 7pm, and 11pm) with primary sludge pumps drawing from each of the 6 primary tanks 3 times each cycle. Pumps run on VFD. Operational signals are passed through Plant PLC's and SCADA network.
7. Digested Sludge. During normal operation, all digested sludge will pass through the Secondary Digester before being pumped to the Gravity Belt Thickeners by means of the Secondary Digester Transfer Pumps (P-710 and P-711). Secondary Digester Transfer

Pumps are called to run by the GBT. Secondary Digester Transfer Pumps can also pump to the Sludge Storage Tanks. Pumps run on VFD. Operational signals are passed through Plant PLC's and SCADA network.

8. In addition, the GBT will have the ability to call Digested Sludge Transfer Pumps P-705, P-706, and P-707 to pump Digested Sludge from Primary Digesters 1, 2 and 3 to the GBT through the Primary Sludge Feed Line. Pumps run on VFD. Operational signals are passed through Plant PLC's and SCADA network.
9. Control of the GBT's is initiated at the GBT Control Panel (600-LCP-0501 and 600-LCP-0502) where an Operator Interface Unit (OIU) is used to control the process.
10. **Auto:** With Local Control Panel in Auto, for automatic operation of GBT System, operator must manually initiate auto startup by depressing GBT System Auto Start pushbuttons. Provide Secondary Sludge Wasting Selector Switch at OIU. Selection of wasting mode and associated operator inputs for each wasting mode shall be recognized on both Gravity Belt Thickener Control Panel OIUs; whatever is selected or input on one OIU shall automatically be displayed on other OIU. PLC's in both Gravity Belt Thickener Control Panels shall also work in conjunction concerning wasting mode operations.
11. **Digested Sludge Thickening Mode.** GBT No. 1 is an enclosed, covered unit, and will primarily be used to thicken digested sludge before sending it to the sludge storage tanks. GBT start cycle will call the Secondary Digester Transfer Pumps P-710 and P-711 with desired flow rate (in GPM) to feed the GBT from the Secondary Digester. Pump will adjust speed to keep with desired flowrate of the GBT. If required, flow control valve near GBT's will be used to further reduce flow rate. The OIU shall have a lead/standby switch to identify which pump will be energized. Standby pump shall activate upon failure of lead pump. When pumps are called from the control system, the lead pump shall energize. Flow from pump shall be totalized.
12. **Primary Sludge / WAS Co-thickening Mode.** GBT No. 2 is an open-frame unit, and will primarily be used to thicken a blend of waste activated sludge and primary sludge before sending it to the primary digesters. The co-thickening operation is intended to be in constant operation. GBT No. 2 will operate in constant WAS/PSD co-thickening mode, unless adjusted by operator. In this mode, WAS/PSD flow will be controlled from SCADA. The plant has 3 WAS pumps. GBT start cycle will call WAS Pumps to turn on with desired flow rate. Pump rate is controlled with VFD and flow meter. During normal operation, two WAS pump will be operating at all times in order to waste a representative sample from the plant "north" and "south" treatment trains. WAS flow rate will be adjusted to maintain a target SRT (usually 10-14 days), sufficient for nitrification and enhanced biological phosphorus removal. An excel program will be used to determine target WAS flow rate by inputting target SRT (in days), MLSS concentration (in mg/L), RAS solids concentration (in mg/L), and plant flow (in MGD). When input at SCADA, the target WAS flowrate will be divided between two WAS pumps. Pumps will discharge and mix in common discharge pipe. If both GBT's are running in WAS / PSD CO-thickening, flow meters and flow control valves at each GBT will allow for even WAS flow split to GBTs. The plant has two primary sludge pumps. Primary sludge pumps run on settable timer schedule (3am, 7am, 11am, 3pm, 7pm, and 11pm) with primary sludge pumps drawing from each of the 6 primary tanks 3 times each cycle. During normal operation pumping will be to GBTs for co-thickening with WAS. Pump rate is controlled with VFD and flow meter.
13. Each GBT includes a Control Station (600-CS-0501 and 600-CS-0502) which is mounted within close proximity to the GBT equipment allowing the Operator to adjust the rate of sludge flow, polymer flow, and GBT belt speed. The GBT Jog pushbutton is used for realignment of the belts following a belt misalignment alarm. The emergency stop pushbutton initiates an equipment shutdown procedure.

K. Functional Description – Gravity Belt Thickener Discharge Chutes (009-N-6)

1. The purpose of the GBT Discharge Chutes is to provide a limited storage capacity prior to pumping to the Sludge Storage Tanks or the Digesters.

2. The solids level in the Discharge Chutes is measured with ultrasonic sensors (600-LE-0621 and 600-LE-0622) with remote transmitters (600-LIT-0621 and 600-LIT-0622) located in the Electrical Room. Level is displayed locally and at the HMI.
3. When the level in the Discharge Chute reaches the LSH setting, the respective Thickened Sludge Pump (see below) will start. The Pump will run until the liquid level reaches the LSL setting in the GBT Discharge Chute. Once the LSL setting has been reached, and the GBT is running, the pump will shut off. For shutdown mode, when the LSL is reached and the GBT is off, the corresponding GBT Discharge Chute Flush Valve (600-CV-0621 and 600-CV-0622) on the GBT Discharge Chute will open and fill the GBT Discharge Chute with W3 to the LSH setting. The pump will continue to operate during the W3 filling process for an Operator adjustable time, then stop. Once the Discharge Chute level reaches LSH, then the GBT Discharge Chute Flush Valve will close, and the respective Discharge Chute Drain Valve (600-CV-0632 and 600-CV-0632) will open to drain the remaining water from the GBT Discharge Chute until LSL is reached and the Discharge Chute Drain Valve shall close.
4. A LSHH level in the GBT Discharge shall be an interlock to GBT operation.

L. Functional Description – Thickened Sludge Pumping (009-N-6)

1. The purpose of the Thickened Sludge Pumping is to transfer Sludge that has been Thickened (TDSD) from the Gravity Belt Thickeners to either Sludge Storage or the Digesters
2. Thickened sludge exits each GBT through a dedicated GBT Discharge Chute.
3. During normal operation, co-thickened waste activated sludge (TWAS) and thickened primary sludge (TPSD) from the GBT Discharge Chute will be pumped to Primary Digesters No. 1, 2 and 3 to maximize residence time in digestion. Thickened sludge is pumped by means of Thickened Sludge Pumps (600-P-0601 and 600-P-0602). Thickened Sludge Pumps ON/OFF control is based on level in the GBT Discharge Chute. The VFD speed for the Thickened Sludge Pumps is controlled by an operator adjustable set-point. Existing electric actuating Primary Digester Sludge Feed Valves AOV-1 (To Digesters No. 1), AOV-2 (to Digesters No. 2), and AOV-3 (to Digesters No. 3) will control which Digester TWAS / TPSD will be fed to - based on a timer schedule (3am, 7am, 11am, 3pm, 7pm, and 11pm) that rotates through the 3 primary digesters. Alternately the operator can select which AOV to open.
4. During normal operation thickened digested sludge (TDSD) will be pumped to one of four Sludge Storage Tanks. The Operator has to manually open / close valves at Sludge Storage Tanks to pick which Sludge Storage Tank to pump to. TDSD is pumped by means of Thickened Sludge Pumps 600-P-0601 and 600-P-0602.
5. Each Gravity Belt Thickener will discharge Thickened Sludge into a Discharge Chute connected to a dedicated progressing cavity pump.
6. The Thickened Sludge Pump will begin pumping when the liquid level in the Discharge Chute reaches the LSH setting.
7. The Thickened Sludge Pump will de-energize when the LSL setting is reached.
8. If the liquid level in the Discharge Chute reaches a pre-determined LSHH level, the GBT Feed Pump, Polymer feed System, and Gravity Belt Thickener will de-energize and alarm.
9. The Thickened Sludge Pump shall be controlled in either Hand or Auto from the Local Control Station (600-CS-0601 and 600-CS-0602).
10. With the Thickened Sludge Pump Local Control Station in Hand, the Thickened Sludge Pump is energized and will run continuously. Operator has local control of speed using potentiometer. *Hand is intended for maintenance purposes only.*
11. With the Thickened Sludge Pump Local Control Station in Off, the Thickened Sludge Pump is off.
12. With the Local Control Station in Auto, and the Manual/Auto selector in Auto at the HMI the following shall be available from the HMI.

a. When the liquid level reaches the LSH setting in the Discharge Chute, the Thickened Sludge Pump shall start.
b. The Thickened Sludge Pump will run until the liquid level reaches the LSL setting in the Discharge Chute.
c. Once the LSL setting has been reached and the GBT is in the shutdown sequence, then a solenoid valve on the Discharge Chute will open and fill the Discharge Chute with W3 to the LSH setting then shut off the W3.
d. The pump will continue to operate and pump W3 through the discharge line for a predetermined length of time. The Operator may also set a timer for the W3 flushing process.
e. Alternately, the pump speed shall vary to keep pace with sludge production. This will allow the pump to run continuously during GBT operation rather than on/off operation of the pump.

13. With the Thickened Sludge Pump Local Control Station in Auto, and the Manual/Auto selector in Manual at the HMI:

    a. Start – This selection energizes the Thickened Sludge Pump.
    b. Speed – Operator shall have ability to control speed of Thickened Sludge Pump.
    c. Stop – This selection de-energizes the Thickened Sludge Pump.

14. Interlocks:

    a. Discharge Chute LSL/LSH
    b. Thickened Sludge discharge pressure low/high
    c. Motor overload.
    d. Motor overtemp

15. Critical Alarms for this equipment as follows:

    a. Discharge Chute LSHH
    b. Thickened Sludge Pump High discharge pressure
    c. Thickened Sludge Pump Motor Fail
    d. Thickened Sludge Pump VFD Fail

M. Functional Description – Process Drain Pump Station (009-N-7)

1. The purpose of the Process Drain Pump Station is to deliver flows from the Process Drain Pump Station to the Primary Tank Effluent Channel.
2. The Process Drain Pump Station receives flow from the following sources:

    a. Solids Processing Building Floor Drains, Sink and Sump Pump.
    b. GBT Filtrate from Solids Processing Building.
    c. GBT Discharge Chute Drain from Solids Processing Building.

3. The Process Drain Pump Station is an application point for the addition of Alum to the process (see Alum description above).
4. Liquid level in the wetwell is measured by radar level element (605-LE-0711) and transmitter (605-LIT-0711) which is located in the Process Drain Pumps Control Station (605-CS-0700).
5. Two ball float switches monitor low level pump cutout and alarm (605-LSL-0721) and high-high level alarm (605-LSHH-0722) at the station.
6. The Process Drain Pump Station includes a valve vault where local pressure indication (605-PI-0731 and 605-PI-0732) of pump discharge pressure is monitored.
7. The valve vault includes a vertical float switch (605-LSH-0741) which acts as a flood alarm for the vault, and will alert the Operator at the HMI.

8. The Process Drain Pump Station includes two submersible pumps (605-P-0701 and 605-P-0702) which are powered from VFD's (600-VFD-0701 and 600-VFD-0702) which are located in the Electrical Room in adjacent Solids Building 600.
9. The Pumps will operate as variable speed based on level control. Alternatively, the Owner may choose to run as a constant speed application based of level set-points.
10. The Pumps shall include an automatic sequencer available at the HMI as described in Section 40 61 20.
11. The Process Drain Pumps Control Station includes local display of wetwell level, pump running local indication, local emergency stops, local speed control, and local Hand/Off/Auto selector switch for pump control.
12. **Hand** – With the Local Control Station in Hand, the pump motor is energized and will run. *Hand is intended for maintenance purposes only.*
13. **Off** – With the Local Control Station in Off, Pump operation is inhibited.
14. **Auto** – With the Local Control Station in Auto, the following control options are available from the HMI.

    a. **Manual** – With the HMI Manual/Auto selector in Manual, the following control options are available from the HMI.

        i. **Start** –This selection energizes the Pump and will operate until the water level reaches the low level float.
        ii. **Stop** –This selection de-energizes the Pump.
        iii. **Speed** – This selection alters the speed of the Pump.

    b. **Auto** – With the HMI Manual/Auto selector in Auto, the following control options are available from the HMI.

        i. Variable Speed Operation - The Pump will be controlled based on readings from the level element. The Operator will input a level set-point. The Lead Pump will operate to maintain the level set-point in the wetwell. If a high level is reached, both Process Drain Pumps operate until the wet well level again reaches the level set-point. If low level is reached, the Process Drain Pumps shut off until the wet well level again reaches the level set-point. If both Pumps are operating concurrently, they shall operate at the same speed as described in Section 40 61 20.
        ii. Constant Speed Operation - The pump will be controlled based on readings from the level element. Upon reaching the Start Lead level with a rising wet well level, the Lead Process Drain Pump starts. Upon reaching the start lag level with a rising wet well level, the Lag Process Drain Pump starts. Upon reaching the stop lag level with a falling wet well level, the Lag Process Drain Pump shuts off. Upon reaching the stop lead level, the Lead Process Drain Pump shuts off. VFD speed shall be determined during operational testing, and shall include minimum and maximum speed clamps as required.

15. **Interlocks**

    a. VFD Fault.
    b. Motor Overtemp.
    c. Motor Seal Fail. (Confirm with the Owner whether this is a pump interlock or just an alarm at the HMI).
    d. Low level cutout.

N. Functional Description – Odorous Air System (009-N-8)

1. The purpose of the odor control system is to collect air from the Gravity Belt Thickener (GBT) Room in the Solids Processing Building to prevent the odors from escaping to the atmosphere and creating a nuisance to occupants. Collected odorous air will be treated with a bio-filtration system to remove the odors, predominantly hydrogen sulfide, and other compounds. The treated air stream will then be discharged to atmosphere external to the Solids Processing Building.
2. All odorous air is extracted from the space by Odorous Air Control Fan (610-EF-0801) which will discharge into the humidification chamber of the Biofilter. Water is continuously supplied to the humidification chamber while the Odorous Air Control Fan is running. The humidification chamber intends to saturate the air with moisture before entering the biofilter media chamber of the Biofilter. W2 water will be used for humidification and irrigation of the biofilter media. Water will collect in a sump at the bottom of the humidification chamber where it will be pumped back through a manufacturer provided water control box. This recirculation water will be temperature controlled with a manufacturer provided heater and returned to the humidification chamber.
3. Air leaves the first chamber saturated with moisture and is directed to the second chamber through openings in the bottom of a common wall. Within the second chamber, air is blown through an engineered media designed to support a biomass population. The biomass colonies will remove hydrogen sulfide as well as the more complex odorous compounds in the air stream. The media is kept moist with an irrigation system which is timer based. Treated air is then discharged to atmosphere.
4. Air flow from the Solids Processing Building to the Odorous Air Control Fan is measured by a mass flow thermal dispersion flow averaging meter (600-FE-0801) with remote transmitter (600-FIT-0801). The Operator will be able to select flow rate of odorous air removal from the GBT Room which will change the speed of the Odorous Air Control Fan.

    a. If the measured flow drops below an Operator adjustable rate (initially set at 2,500 scfm), an alarm will alert the Operator and the Loss of Ventilation beacons (shown on 009-N-14) shall be illuminated.

5. **Control -** At the manufacturer furnished local control panel, The Operator will have the following control options:

    a. **Hand** – With the Local Control Panel in Hand, the Operator will have local control of the system (*Hand is intended for maintenance purposes only)*:

        - Odorous Air Control Fan Start/Stop
        - Odorous Air Control Fan Speed Adjustment
        - Irrigation Valve Open/Close
        - Humidification Valve Open/Close
        - Recirculation Water Pump Start/Stop

    b. **Off** – With the Local Control Panel in Off, the system is off.

    c. **Auto** – With the Local Control Panel in Auto:

        - System will be active based on start command from Plant PLC (SCC-A). With call to start, humidification valve will open, Odorous Air Control Fan will energize, and Recirculation Pump will energize. Odorous Air Control Fan speed will be controlled by Plant PLC. Timer within LCP will open/close media irrigation valve on a user selected interval and duration. System will monitor recirculated liquid temperature entering biofilter and will energize recirculation heater as required to maintain set-point temperature.

6. At the HMI, The Operator will have the following control options:

a. **Hand** – HMI shall offer the following manual controls:

- Odorous Air Control Fan Start/Stop
- Odorous Air Control Fan Speed set-point
- System Start/Stop

b. **Off** – No system start command to LCP, unit shall remain off.

c. **Auto** – System will energize and run continuously. PLC (SCC-A) shall send system start command to LCP. PLC will monitor odorous air flow rate and vary blower speed as required to maintain adjustable flow set-point, initially set to 4,950 cfm. Upon receipt of "Loss of Ventilation" alarm for Building 600 GBT Room ventilation equipment, system shall stop.

7. **Interlocks**

a. Building 600 GBT Room ventilation system running.

O. Functional Description – GBT Room Hydrogen Sulfide Gas Monitoring (009-N-14)

1. The purpose of the Gas Monitoring System is to monitor possible air quality deficiencies when thickening sludge in the area of the GBT's.
2. The gas sensor/transmitter (600-AE/AIT-1420) monitors the concentration of Hydrogen Sulfide in the GBT Room.
3. The gas sensor/transmitter will provide analog signal of ppm H2S to the PLC where adjustable alarm set-points are maintained by the Operator.
4. The gas sensor/transmitter will also provide an alarm signal to the Operator when H2S level reaches 20ppm (OSHA PEL).
5. The 20ppm threshold shall energize the gas alarm beacons (600-YA-1421 through 600-YA-1425) throughout the Building.
6. The HMI and local OIT shall include an alarm override that shall inhibit the alarm beacons for 4 hours allowing time for the failure to be remedied. This functionality shall not inhibit the alarm at SCADA, which still requires acknowledging by the Operator.
7. The gas sensor/transmitter will also provide a common fault signal to the Operator which indicates an internal sensor or transmitter failure.

P. Functional Description – Building 600 Temperature Control Panel (009-N-14)

1. The Temperature Control Panel (600-TCP-1) will produce an alarm signal and alert the Operator when equipment failure (stopped) is detected for Building 600.
2. The Ventilation failure signal shall also alarm occupants of the building and warn at entrances that the ventilation system has suffered a failure. The alarm beacons (600-YA-1431 to 600-YA-1435) shall be energized when a ventilation failure is observed, and is reset when condition is remedied at the Temperature Control Panel.
3. A signal shall be transmitted to the PLC indicating when the supply fan is running in order to initiate the Odorous Air Fan (610-EF-0801).
4. The Temperature Control Panel monitors the return air for smoke, and will alarm the Fire Alarm Control Panel (600-FACP-1) when smoke is detected.
5. The HMI and local PanelView shall include an alarm override that shall inhibit the alarm beacons for 24 hours allowing time for the failure to be remedied. This functionality shall not inhibit the alarm at SCADA, which still requires acknowledging by the Operator.

Q. Functional Description – Surge Protective Device (009-N-14)

1. The Surge Protective Device provide a degree of electrical protection to the 3-phase circuits served by the Solids Processing Building power.
2. An alarm will alert the Operator if an internal failure is observed by the devices, which can be further investigated locally at the device interface.

R. Functional Description – Power Monitor (009-N-14)

1. The Power Monitor (600-PM-1) monitors 3-phase incoming power to the Solids Processing Building (structure 600).
2. Signals transmitted to SCADA for monitoring and trending are as follows:

    a. Bus Voltage: A-N, B-N, and C-N.
    b. Bus Voltage: A-B, B-C, and A-C.
    c. Bus Amperes: A, B, and C.
    d. Total Bus KW.
    e. Total Bus KVAR.
    f. Power factor.
    g. Frequency.
    h. Up to (6) additional as defined by the Owner.

S. Functional Description – Fire Alarm Control Panel (009-N-14)

1. The Fire Alarm Control Panel located in Building 600 monitors the space for smoke and heat alarm levels.
2. If levels of smoke or heat are exceeded in the space the Fire Alarm Control Panel will alert the Operator at the HMI.
3. The Fire Alarm Control Panel also includes a hardware failure output that will alert the Operator at the HMI that there is equipment trouble, whereby the Operator will then have to further investigate locally.

T. Functional Description – Heat Trace Control Panel (009-N-14)

1. The Heat Trace Control Panel located in Building 600 is used to control the heat trace circuits at the Odorous Air System (Structure 610) which are susceptible to freezing.
2. The Heat Trace Control Panel includes a hardware failure output that will alert the Operator at the HMI that there is equipment trouble, whereby the Operator will then have to further investigate locally.

U. Functional Description – Duplex Sump Pump Control Panel (009-N-14)

1. The purpose of the Duplex Sump Pump Control Panel System is to pump water from the sump area to the Process Drain Pump Station.
2. Three ball floats control two pumps with local indication for pump run, pump fail, control power, high water alarm, and motor overload.
3. The fourth ball float switch is for high level alarm providing an alarm signal to the Operator at the HMI.
4. Twin sump pump fail alarms from the Control Panel provides visual indication for the Operator at SCADA of equipment failure for each of the two pumps.
5. Equipment is specified under Section 22 00 05.

2.07 SCC-D/F PLC PANEL SCC-D/F

A. Panel

1. These are two existing enclosure panels that are mounted adjacent one another (sharing SCC-D/F equipment identification) that will be modified as described below.

2. Free Standing.
3. 120Vac Power Supply (existing).
4. For equipment not modified under this contract, maintain existing equipment functionality.
5. Programming required for existing equipment functionality due to replacement of SLC 5/05 processor with CompactLogix processor.

B. Front of Panel Mounted Devices

1. Maintain existing functionality.

C. Rear of Panel Mounted Devices

1. Gateways in accordance with Section 40 66 00.
2. DIN mount Network Switch in accordance with Section 40 66 00.
3. PLC in accordance with Section 40 63 43.
4. Remove SLC 5/05 processor and replace with Allen Bradley 1747-AENTR communications Module in accordance with Section 40 66 00.

D. Signals and Wiring

1. Provide in accordance with Section 40 61 93 and as shown on Drawings.
2. Provide Ethernet connections for equipment as shown on Drawings.

E. Functional Description – Aeration Basin Mixers (009-N-9/10/11)

1. The Aeration Basin Mixers will be installed in the South Aeration Basin (Structure 150), and the North Aeration Basin (Structure 160).
2. Each Aeration Basin has six tanks with two passes per tank. At the beginning of each tank pass will be constructed a series baffle walls creating three distinct contact zones. Each Contact zone will include one Mixer for a total of three Mixers per tank, and eighteen Mixers per Aeration Basin. For every three Mixers in a tank, the manufacturer will provide a Mixer Local Control Panel which controls the three Mixers in the respective tank. All Mixer Local Control Panels for a given Aeration Basin will be networked using Modbus RTU on a twisted shielded pair cable (see details 1 and 2 on 009-N-11) which is wired back to the Blower Building PLC Panel (SCC-D/F).
3. The Modbus RTU is converted to Ethernet/IP using gateway devices so communication with the plant SCADA network is possible.
4. Control of each Mixer is initiated at the Mixer Local Control Panel keypad where a selection of Local control or Remote control is available.
5. With a keypad selection of Local, the following options are available to the Operator from the keypad. *Local control is intended for maintenance purposes only.*

    a. **Start** – This selection energizes the Mixer.
    b. **Stop** – This selection de-energizes the Mixer.
    c. **Speed** – Mixer speed can be varied between 0% and 100%.

6. With a keypad selection of Remote, the following options are available to the Operator from the HMI.

    a. **Manual** – With the Manual/Auto selector switch at the HMI in Manual, the following control options are available from the HMI.

        - **Start** – This selection energizes the Mixer.
        - **Stop** – This selection de-energizes the Mixer.
        - **Speed** – Mixer speed can be varied between 0% and 100%.

b. **Auto** – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

- **Timed** –In the timed mode, the Operator will enter the interval and duration that each Mixer is to run. The Operator will monitor the ORP readings from the middle selector and use the data to fine tune Mixer on/off schedule and/or Mixer speed.

7. **Interlocks**

a. Motor over-temp
b. Motor seal fail
c. System Fault
d. Respective Aeration Tank in-service.

8. **Remote Start Operator Warning**

a. The Mixers are designed with a minimum submergence level for their protection.
b. When initiating remote control of each tank Mixers, a pop-up shall warn the Operator of the danger inherent with starting the Mixers without complete submergence. The Operator will have to acknowledge the tank as being in-service and water level above minimum submergence level for the Mixers in the respective tank.
c. Minimum submergence level as defined by the manufacturer.

F. Functional Description – South Aeration Basin Automated Valves and Gates (009-N-9/11)

1. The South Aeration Basin has six tanks with two passes per tank. Three of the six tanks will be improved including electrically actuated influent gates, and electrically actuated effluent valves.
2. Under normal conditions, tanks 2, 3, and 4 will be out-of-service. The electrically actuated influent gates, and electrically actuated effluent valves will be closed to these tanks preventing flow to enter.
3. During peak flow or peak loading conditions, these gates and valves will be opened to bring the tanks into operating service. The Operator will determine and manually select which tank to bring on-line based on varying flow/load conditions at the Plant.
4. All electrically actuated influent gates, and electrically actuated effluent valves are networked using Modbus RTU on a twisted shielded pair cable (see detail 3 on 009-N-11) which is wired back to the Actuator Master Station (170-AMS-1) where redundant hot-standby processors control the networked equipment.
5. The Modbus RTU is converted to Ethernet/IP internal to the Actuator Master Station so communication with the plant SCADA network is possible.
6. Signals communicated with Plant SCADA for actuator control are shown in detail 3 on 009-N-11.
7. Control of each electric actuator is initiated at actuator with a Local/Off/Remote selector switch.
8. **Local** – With the Local/Off/Remote selector switch in Local, the following control options are available from the electric actuator. Local control is intended for maintenance purposes only

a. **Open** – This selection runs the gate/valve to the 100% open position.
b. **Stop** – The gate/valve operator motor shuts down and gate/valve will hold last position.
c. **Close** – This selection runs the gate/valve to the 0% open position.

9. **Off** – With the Local/Off/Remote selector switch in Off, operation of the gate/valve is inhibited.

10. **Remote** – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. **Manual** – With the Manual/Auto selector switch at the HMI in Manual, the following control options are available from the HMI.

    - **Open** – This selection runs the gate/valve to the 100% open position.
    - **Stop** – The gate/valve operator motor shuts down and gate/valve will hold last position.
    - **Close** – This selection runs the gate/valve to the 0% open position.

    b. **Auto** – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

    - When Tank 2 is placed in-service:

        ✓ Slide Gates SG 6-3 and SG 6-4 are run to 100% open position and confirmed.
        ✓ Butterfly Valves BF 6-15 and BF 6-16 are run to 100% open position and confirmed.
        ✓ Aeration Flow Control Valve FCV-02 return to HMI Auto.
        ✓ Mixers 150-M-2A1, 150-M-2A2, and 150-M-2A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

    - When Tank 2 is placed out-of-service:

        ✓ Mixers 150-M-2A1, 150-M-2A2, and 150-M-2A3 are stopped.
        ✓ Slide Gates SG 6-3 and SG 6-4 are run to 0% open position and confirmed.
        ✓ Butterfly Valves BF 6-15 and BF 6-16 are run to 0% open position and confirmed.
        ✓ Aeration Flow Control Valve FCV-02 remains in Auto until the Operator switches the valve to off from the HMI.
        ✓ The tank may be drained at this time by the Operator.

    - When Tank 3 is placed in-service:

        ✓ Slide Gates SG 6-5 and SG 6-6 are run to 100% open position and confirmed.
        ✓ Butterfly Valves BF 6-17 and BF 6-18 are run to 100% open position and confirmed.
        ✓ Aeration Flow Control Valve FCV-03 return to HMI Auto.
        ✓ Mixers 150-M-3A1, 150-M-3A2, and 150-M-3A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

    - When Tank 3 is placed out-of-service:

        ✓ Mixers 150-M-3A1, 150-M-3A2, and 150-M-3A3 are stopped.
        ✓ Slide Gates SG 6-5 and SG 6-6 are run to 0% open position and confirmed.
        ✓ Butterfly Valves BF 6-17 and BF 6-18 are run to 0% open position and confirmed.
        ✓ Aeration Flow Control Valve FCV-03 remains in Auto until the Operator switches the valve to off from the HMI.
        ✓ The tank may be drained at this time by the Operator.

    - When Tank 4 is placed in-service:

- ✓ Slide Gates SG 6-7 and SG 6-8 are run to 100% open position and confirmed.
- ✓ Butterfly Valves BF 6-19 and BF 6-20 are run to 100% open position and confirmed.
- ✓ Aeration Flow Control Valve FCV-04 return to HMI Auto.
- ✓ Mixers 150-M-4A1, 150-M-4A2, and 150-M-4A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

- When Tank 4 is placed out-of-service:

  - ✓ Mixers 150-M-4A1, 150-M-4A2, and 150-M-4A3 are stopped.
  - ✓ Slide Gates SG 6-7 and SG 6-8 are run to 0% open position and confirmed.
  - ✓ Butterfly Valves BF 6-19 and BF 6-20 are run to 0% open position and confirmed.
  - ✓ Aeration Flow Control Valve FCV-04 remains in Auto until the Operator switches the valve to off from the HMI.
  - ✓ The tank may be drained at this time by the Operator.

11. **Interlocks**

    a. Fail to open/close
    b. Cable Fault
    c. Motor Overtemp
    d. Overtorque
    e. Jammed

G. Functional Description – North Aeration Basin Automated Valves and Gates (009-N-10/11)

1. The North Aeration Basin has six tanks with two passes per tank. Three of the six tanks will be improved including electrically actuated influent gates, and electrically actuated effluent valves.
2. Under normal conditions, tanks 8, 9, and 10 will be out-of-service. The electrically actuated influent gates, and electrically actuated effluent valves will be closed to these tanks preventing flow to enter.
3. During peak flow or peak loading conditions, these gates and valves will be opened to bring the tanks into operating service. The Operator will determine and manually select which tank to bring on-line based on varying flow/load conditions at the Plant.
4. All electrically actuated influent gates, and electrically actuated effluent valves are networked using Modbus RTU on a twisted shielded pair cable (see detail 3 on 009-N-11) which is wired back to the Actuator Master Station (170-AMS-1) where redundant hot-standby processors control the networked equipment.
5. The Modbus RTU is converted to Ethernet/IP internal to the Actuator Master Station so communication with the plant SCADA network is possible.
6. Signals communicated with Plant SCADA for actuator control are shown in detail 3 on 009-N-11.
7. Control of each electric actuator is initiated at actuator with a Local/Off/Remote selector switch.
8. **Local** – With the Local/Off/Remote selector switch in Local, the following control options are available from the electric actuator. Local control is intended for maintenance purposes only

   a. **Open** – This selection runs the gate/valve to the 100% open position.
   b. **Stop** – The gate/valve operator motor shuts down and gate/valve will hold last position.
   c. **Close** – This selection runs the gate/valve to the 0% open position.

9. **Off** – With the Local/Off/Remote selector switch in Off, operation of the gate/valve is inhibited.
10. **Remote** – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. **Manual** – With the Manual/Auto selector switch at the HMI in Manual, the following control options are available from the HMI.

    - **Open** – This selection runs the gate/valve to the 100% open position.
    - **Stop** – The gate/valve operator motor shuts down and gate/valve will hold last position.
    - **Close** – This selection runs the gate/valve to the 0% open position.

    b. **Auto** – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

    - When Tank 8 is placed in-service:

      ✓ Slide Gates SG 6-18 and SG 6-19 are run to 100% open position and confirmed.
      ✓ Butterfly Valves BFV 6-33 and BFV 6-34 are run to 100% open position and confirmed.
      ✓ Aeration Flow Control Valve FCV-08 return to HMI Auto.
      ✓ Mixers 160-M-8A1, 160-M-8A2, and 160-M-8A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

    - When Tank 8 is placed out-of-service:

      ✓ Mixers 160-M-8A1, 160-M-8A2, and 160-M-8A3 are stopped.
      ✓ Slide Gates SG 6-18 and SG 6-19 are run to 0% open position and confirmed.
      ✓ Butterfly Valves BFV 6-33 and BFV 6-34 are run to 0% open position and confirmed.
      ✓ Aeration Flow Control Valve FCV-08 remains in Auto until the Operator switches the valve to off from the HMI.
      ✓ The tank may be drained at this time by the Operator.

    - When Tank 9 is placed in-service:

      ✓ Slide Gates SG 6-20 and SG 6-21 are run to 100% open position and confirmed.
      ✓ Butterfly Valves BFV 6-31 and BFV 6-32 are run to 100% open position and confirmed.
      ✓ Aeration Flow Control Valve FCV-09 return to HMI Auto.
      ✓ Mixers 160-M-9A1, 160-M-9A2, and 160-M-9A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

    - When Tank 9 is placed out-of-service:

      ✓ Mixers 160-M-9A1, 160-M-9A2, and 160-M-9A3 are stopped.
      ✓ Slide Gates SG 6-20 and SG 6-21 are run to 0% open position and confirmed.
      ✓ Butterfly Valves BFV 6-31 and BFV 6-32 are run to 0% open position and confirmed.

- ✓ Aeration Flow Control Valve FCV-09 remains in Auto until the Operator switches the valve to off from the HMI.
- ✓ The tank may be drained at this time by the Operator.

- When Tank 10 is placed in-service:

  - ✓ Slide Gates SG 6-22 and SG 6-23 are run to 100% open position and confirmed.
  - ✓ Butterfly Valves BFV 6-29 and BFV 6-30 are run to 100% open position and confirmed.
  - ✓ Aeration Flow Control Valve FCV-10 return to HMI Auto.
  - ✓ Mixers 160-M-10A1, 160-M-10A2, and 160-M-10A3 are placed in HMI Auto and start when Operator acknowledges **Remote Start Operator Warning (**as described above).

- When Tank 10 is placed out-of-service:

  - ✓ Mixers 160-M-10A1, 160-M-10A2, and 160-M-10A3 are stopped.
  - ✓ Slide Gates SG 6-22 and SG 6-23 are run to 0% open position and confirmed.
  - ✓ Butterfly Valves BFV 6-29 and BFV 6-30 are run to 0% open position and confirmed.
  - ✓ Aeration Flow Control Valve FCV-10 remains in Auto until the Operator switches the valve to off from the HMI.
  - ✓ The tank may be drained at this time by the Operator.

11. **Interlocks**

    a. Fail to open/close
    b. Cable Fault
    c. Motor Overtemp
    d. Overtorque
    e. Jammed

H. Functional Description – Aeration Basin DO and ORP Sensors and Network (008-I-2, and 009-N-9/10)

1. New ORP sensors have been installed in the middle selector of each tank in both the North and South Aeration Basins.
2. The ORP sensors will not be included as a control variable in any Plant processes at this time, rather they will be used as a monitoring tool whereby the Operator may choose to alter the Mixer operational strategy based on ORP levels in the selector to improve process performance.
3. New DO sensors have been installed at the beginning of the second pass in each tank in both the North and South Aeration Basins.
4. The strategy for DO control shall remain as it currently exists for both Aeration Basins.
5. The DO and ORP sensors in each Aeration Basin are part of a network of sensors for that particular Basin (see 008-I-2), and are grouped such that two tank sensors are wired to a common network node or junction box.
6. Each node or junction box is mounted in a heated transmitter cabinet with a transparent window whereby the Operator may read DO and ORP levels for any sensor on the network when the portable transmitter/controller is installed at that network node location.
7. An additional network node is installed for each Aeration Basin network inside the Electrical Room in the Blower Building (Structure 170). The portable controller/transmitter may be installed at this network node as well. DO, ORP, and °F signals are extracted to the Plant

SCADA network at this node (JB4 for the South Aeration Basin, and JB8 for the North Aeration Basin).

8. An additional network node (JB10) has been added to the Laboratory (Room 103) in the Process Control Building (Building 120) whereby the Operator will calibrate DO and ORP sensors and make calibration adjustments to each sensor via the portable controller/transmitter.

I. Functional Description – Surge Protective Device (009-N-15)

1. The Surge Protective Device (170-SPD-1) provides a degree of electrical protection to the 3-phase circuits served by the Blower Building Power Panel.
2. An alarm will alert the Operator if an internal failure is observed by the devices, which can be further investigated locally at the device interface.

2.08 EFFLUENT FLOWMETER PLC PANEL 190-PLC-1

A. Panel

1. This is an existing enclosure panel mounted outdoors adjacent the effluent structure that will be modified as described below.
2. The panel includes an Allen Bradley MicroLogix 1100 controller with I/O points available for the signals shown on 009-N-12.
3. The panel includes a network switch (N-Tron 708-TX) with 5 copper ports available.
4. 120Vac Power Supply (existing).
5. For equipment not modified under this contract, maintain existing equipment functionality.
6. Programming required for new equipment functionality for installation of the Ortho-Phosphate Analyzer equipment.

B. Front of Panel Mounted Devices

1. Maintain existing functionality.

C. Rear of Panel Mounted Devices

1. Maintain existing functionality.

D. Signals and Wiring

1. Provide in accordance with Section 40 61 93 and as shown on Drawings.
2. Provide Ethernet connections for equipment as shown on Drawings.

E. Functional Description – Ortho Phosphate Analyzer (009-N-12)

1. The purpose of Ortho Phosphate Analyzer (195-OPA-1201) is to sample Plant effluent and measure Phosphate for visual indication to the Operator at SCADA, for reporting purposes, and for control of Alum addition.
2. The Analyzer shall sample W3 Plant effluent from the W3 Pump header via the Sample Preparation Unit (see below).
3. Analyzer operation and maintenance shall follow manufacturer recommendations.
4. Analyzer shall alert Operator of an internal problem that requires attention.
5. Analyzer shall provide SCADA with analog signal of Phosphate with range of 0.05 to 15mg/L.
6. An Operator adjustable Phosphate set-point will alarm the Operator when Phosphate level exceeds set-point (initially set at 0.8mg/L).

F. Functional Description – Sample Preparation Unit (009-N-12)

1. The purpose of the Sample Preparation Unit (195-SPU-1201) is to provide the Ortho-phosphate Analyzer with a continuous supply sample from the pressurized plant effluent water.
2. The Sample Preparation Unit filters suspended solids from the water sample.
3. Operation of the Sample Preparation Unit is autonomous and is per the manufacturer.
4. The Sample Preparation Unit will alert the Operator at the HMI when maintenance is required.
5. The Sample Preparation Unit will alert the Operator at the HMI of an alarm whereby the Operator will need to further investigate the alarm locally.

2.09 ADMINISTRATION BUILDING NETWORK RACK 900-NET-1

A. Rack

1. 48U Network Rack Enclosure.
2. For mounting of standard 19" rack equipment.
3. Free Standing – with casters and leveling feet.
4. Cooling fans as required.

B. Rack Mounted Equipment

1. UPS in accordance with Section 40 67 63.
2. Copper Patch Panels in accordance with Section 40 66 00.
3. Fiber Patch Panels in accordance with Section 40 66 00.
4. Network Switch in accordance with Section 40 66 00.
5. IT equipment supplied and installed by the Owner outside of this contract.

2.10 ADMINISTRATION BUILDING PLC PANEL SCC-900

A. Panel

1. Indoor Enclosure.
2. NEMA 12.
3. Wall Mount.
4. Dimensions (Nominal): 48"H x 36"W x 12"D. (Dimensions are estimated. System Integrator shall size according to space requirements, and in accordance with Section 40 67 00).
5. 120Vac Power Supply.

B. Front of Panel Mounted Devices

1. Data outlet.
2. 120Vac Power Light.

C. Rear of Panel Mounted Devices

1. PLC in accordance with Section 40 63 43.
2. Line Filter.
3. 24Vdc Power Supply.
4. Cooling fan with thermostat.
5. Circuit breakers and fuses as required.

D. Signals and Wiring

1. Provide in accordance with Section 40 61 93 and as shown on Drawings.

2. Provide Ethernet connections for equipment as shown on Drawings.

E. Functional Description – Sliding Gate Operator (009-N-13)

1. The Electric Heat mat, Control Panel, and remote controls are specified in Section 32 17 43.
2. The purpose of the Electric Heat Mat is to provide a heat source to exposed concrete east of Structure 900 entrance gate so the gate is allowed to operate regardless of snow conditions in winter.
3. The Electric Heat Mat operates manually or by thermostat set by the Operator. The thermostat remote control (900-RCU-1) is located within structure 900 Electrical Room.
4. The Sliding Gate Operator (002-M-1301) and controls are specified in Section 32 31 19.
5. Operation of the Sliding Gate shall be in accordance with manufacturer's standard operational procedures and as follows:

    a. During normal business hours, the Sliding Gate will be programmed to remain open.
    b. During non-business hours, the Sliding Gate will be closed until called to open by hardwire contact closure from the Plant PLC (SCC-900) for traffic entering the facility. The Sliding Gate will close (following an adjustable time delay) once the vehicle has cleared the Sliding Gate photoeye.
    c. When the Sliding Gate is closed, an exit loop detector will trigger the Sliding Gate to open when a vehicle approaches to exit the facility. The Sliding Gate will close (following an adjustable time delay) once the vehicle has cleared the Sliding Gate photoeye.
    d. The Sliding Gate shall open when an obstruction is detected.
    e. Business hours and calendar schedule shall be Operator adjustable at the HMI.
    f. The Operator shall have the ability to manually open and close the Sliding Gate at any time at the HMI.
    g. The Access Control Security System shall give a contact closure signal every time access has been granted into the facility at the Main Gate.
    h. At the HMI, the Operator will be able to review the number of times the Access Control Security System has granted access into the facility for every day, week, month, and year. Numbers shall be tabulated for current and previous for all time frames.

F. Functional Description – Arm Gate Operators (009-N-13)

1. The Arm Gate Operators (002-G-1311 and 002-G-1312) and controls are specified in Section 28 15 00.
2. Operation of the Sliding Gate shall be in accordance with manufacturer's standard operational procedures and as follows:

    a. The Arm Gate Operators and the Sliding Gate Operator operate independent of one another.
    b. The entrance island will include a pedestal where card access reader, call button, and video camera are installed.
    c. The Entrance Arm Gate will be closed until called to open by secure access granted by personal key fob at card reader, or by pressing the call button which alerts Main Gate Master Station (900-ICM-1) during normal business hours, and Main Gate Sub-Master Station (120-ISM-1) during non-working hours. The on-staff Operator then grants access to each caller. The Entrance Arm Gate will close (following an adjustable time delay) once the vehicle has cleared the Entrance Gate Arm and entrance ground loops.
    d. The Access Control Security System shall give a contact closure signal to the Plant PLC (SCC-900) every time access has been granted into the facility at the Main Gate.
    e. The Plant has free exit operation, and the opening of the Exit Arm Gate is triggered by driving over the exit ground loops. The Exit Arm Gate will close (following an

adjustable time delay) once the vehicle has cleared the Exit Gate Arm and exit ground loops.

3. Wiring and conduit for the Arm gate Operators shall terminate at 002-LCP-1311.
4. Arm gate Operators and associated controls are by the Security Access Control System Supplier.

G. Functional Description – Main Gate Camera (009-N-13)

1. The Main Gate Camera (002-CAM-1321) and controls are specified in Section 28 15 00, and allows the Operator to view incoming traffic with a specific emphasis on the rear vehicle license plates.
2. Desktop software client connections allow up to 5 Plant staff to view and control the camera.
3. Images will be stored on City IT hardware which may be external to this facility.
4. Camera components are by the Security Access Control System Supplier.

H. Functional Description – Building 900 Security (009-N-13)

1. Building 900 security and controls are specified in Section 28 15 00.
2. The purpose of Building 900 security improvements is to allow secure access to the facility, and to monitor the space for intrusion after normal business hours.
3. Each exterior door will include FOB card reader that will unlock the electric door strike if the credentials are accepted by the security access system.
4. Each door shall include proximity sensor which monitors whether the door is open or closed.
5. Select doors shall include request-to-exit infrared motion sensors.
6. Electric door strikes shall be individually and group programmable allowing doors to be unlocked during business hours.
7. After normal business hours door strikes shall be in the locked position. If a door has not received an unlock command by the security system, and the door has been opened and the request to exit sensor is active, then an intrusion alarm shall alert the Operator at the Plant.
8. Building Security equipment, programming, and low voltage signal wiring are by the Security Access Control System Supplier.

I. Functional Description – Main Gate and Building 900 Lighting (009-N-15)

1. The Operator will have the ability to control the outdoor lighting at the Main Gate, the Administration Building pole lights, and the Administration Building wall lights from the HMI.
2. The existing lighting functionality currently residing at the HMI will be expanded to include the three separate zones described above.

J. Functional Description – Building 900 Temperature Control Panel (009-N-15)

1. The Temperature Control Panel (900-TCP-1) will produce an alarm signal and alert the Operator when equipment failure (stopped) is detected for Building 900.

K. Functional Description – Fire Alarm Control Panel (009-N-15)

1. The Fire Alarm Control Panel located in Building 900 monitors the space for smoke and heat alarm levels.
2. If levels of smoke or heat are exceeded in the space the Fire Alarm Control Panel will alert the Operator at the HMI.
3. The Fire Alarm Control Panel also includes a hardware failure output that will alert the Operator at the HMI that there is equipment trouble, whereby the Operator will then have to further investigate locally.

L. Functional Description – Surge Protective Device (009-N-15)

1. The Surge Protective Device (900-SPD-1) provides a degree of electrical protection to the 3-phase circuits served by the Administration Building Power Panel.
2. An alarm will alert the Operator if an internal failure is observed by the devices, which can be further investigated locally at the device interface.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

A. Perform In-Factory inspection and testing of PCS control panels at site of panel fabrication. Inform Engineer at least 3 weeks prior to date of scheduled testing. Owner and Engineer shall witness test at their discretion.

B. In-Factory testing shall conform to Section 40 61 21.

C. Field installation and wiring of panel components shall be in accordance with approved submittals, manufacturer's recommendations, and any applicable federal, state, and local codes.

D. Perform field test of PCS upon completion of installation, wiring and field inspection.

E. Field testing shall conform to Section 40 61 21.

3.02 ADDITIONAL SYSTEM SUPPLIER'S SERVICES

A. During course of Work and Warranty period, furnish all software and firmware with latest revisions published.

B. Maintenance

1. Properly maintain operational equipment at factory or on-site throughout course of Work.
2. Keep maintenance records with equipment and make them available for inspection at any time during course of Work.

END OF SECTION

SECTION 40 62 00
COMPUTER SYSTEM HARDWARE AND ANCILLARIES

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes computer and related equipment for Process Instrumentation and Control Systems.

C. Description of Work:

1. Provide SCADA Workstation computer as shown on Drawings and as conforming to the requirements of this Specification.
2. Provide SCADA Workstation monitor conforming to the requirements of this Specification.
3. Provide SCADA software licensing conforming to the requirements of this Specification.
4. Provide OIT's at locations as shown on Drawings
5. Provide hardware cabling for a complete and functional computer system network.
6. Coordinate City-provided equipment and provide installation of said equipment.

D. All like products shall be furnished from a single manufacturer.

1.02 ABBREVIATIONS AND REFERENCES

A. EPA Environmental Protection Agency

B. NEC National Electric Code

C. NEIS National Electrical Installation Standards

D. NEMA National Electrical Manufacturers Association

E. NTFS New Technology File System

F. PCN Process Control Network

G. PCS Process Control System

H. SCADA Supervisory Control And Data Acquisition

I. UL Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for equipment in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Equipment shall be latest and most modern design at time of bidding.

C. As much as possible equipment shall be products of one manufacturer to achieve standardization for maintenance, operation, and service.

D. All software shall be fully compatible with hardware configurations.

1.05 SOFTWARE

A. Provide one iFix iClient v5.9 Thick Runtime license (part number IC59THREN) for installation on 900-WS-1.
B. System Integrator shall verify and coordinate software version and part number prior to submittal.

1.06 EQUIPMENT

A. Provide submittals under the specification section that is referenced for each instrument/device/equipment listed below.

B. Provide devices/instrumentation/equipment as listed below and as shown on Drawings:

Tag	Description	Equipment Type	Ref. Section
120-NET-1	19” Network Rack	48U with casters	40 66 00
120-UPS-1	Uninterruptible Power Supply	Rack Mount, On-line, 15 min.	40 67 63
120-SW-1	Network Switch	Ethernet, 24/2 copper/fiber, Rack	40 66 00
120-CEPP-1	Patch Panel, SCADA	Copper Ethernet, 2U 48-port	40 66 00
120-CEPP-2	Patch Panel, IT	Copper Ethernet, 2U 48-port	40 66 00
120-FOPP-1	Patch Panel, SCADA	Fiber, 1U 24-port	40 66 00
120-FOPP-2	Patch Panel, IT	Fiber, 1U 24-port	40 66 00
170-SW-1	Network Switch	Ethernet, 14/2 copper/fiber, DIN	40 66 00
170-GW-1	Gateway	Modbus RTU to Ethernet/IP	40 66 00

Tag	Description	Equipment Type	Ref. Section
170-GW-2	Gateway	Modbus RTU to Ethernet/IP	40 66 00
600-NET-1	19” Network Rack	12U wall mount	40 66 00
600-UPS-1	Uninterruptible Power Supply	Rack Mount, On-line, 15 min.	40 67 63
600-SW-1	Network Switch	Ethernet, 24/2 copper/fiber, Rack	40 66 00
600-PV-1	PanelView Plus 7 Performance	Operator Interface Terminal (OIT)	40 62 00
600-CEPP-1	Patch Panel, SCADA	Copper Ethernet, 2U 48-port	40 66 00
900-NET-1	19” Network Rack	48U with casters	40 66 00
900-UPS-1	Uninterruptible Power Supply	Rack Mount, On-line, 15 min.	40 67 63
900-SW-1	Network Switch	Ethernet, 24/2 copper/fiber, Rack	40 66 00
900-CEPP-1	Patch Panel, SCADA	Copper Ethernet, 2U 48-port	40 66 00
900-CEPP-2	Patch Panel, SCADA/IT	Copper Ethernet, 2U 48-port	40 66 00
900-CEPP-3	Patch Panel, IT	Copper Ethernet, 2U 48-port	40 66 00
900-FOPP-1	Patch Panel, SCADA	Fiber, 2U 48-port	40 66 00
900-FOPP-2	Patch Panel, IT	Fiber, 2U 48-port	40 66 00
900-WS-1	SCADA Workstation	Computer, Monitor, Keyboard, Mouse	40 62 00

1.07 DESKTOP WORKSTATION COMPUTER

A. Manufacturer:

1. Dell OptiPlex 7060.
2. Or equal.

B. General:

1. Intel Core i7 (6 cores/12MB).
2. Windows 10 Pro 64 bit.
3. 32GB 2666MHz DDR4 Memory.
4. 3.5 inch 2TB 7200rpm SATA hard Disk Drive.
5. NVIDIA GeForce GT 730 Video Card.
6. 8x DVD+/-RW Optical Disk Drive.
7. Microsoft Office Suite, standard.

1.08 DESKTOP WORKSTATION MONITOR

A. Manufacturer:

1. Dell.
2. Or equal.

B. General:

1. 24” diagonal viewing size.
2. 16:9 Aspect Ratio.
3. HD1080 (1920 x 1080 @ 60Hz) maximum resolution.
4. Include 100mm flat panel mounting stand.
5. Include optional soundbar.

6. 1 x HDMI and 1 x VGA.
7. 100 to 240Vac.
8. Wireless mouse.
9. Wireless keyboard.

1.09 OPERATOR INTERFACE TERMINAL (OIT)

A. Manufacturer:

1. Allen Bradley.
2. No substitutes permitted.

B. General:

1. PanelView Plus 7 Performance model.
2. Refurbished equipment is not acceptable.
3. Touchscreen. Analog resistive.
4. 19" diagonal viewable area.
5. Resolution: SXGA (1280 x 1024 @ 60Hz)
6. Aspect ratio: 5:4
7. 18-bit color graphics.
8. Operating temperature: 0°C to 50°C.
9. NEMA 4X.
10. 100-240Vac
11. Battery: CR2032 Lithium coin cell.
12. Memory: 512MB RAM, and 512MB storage.
13. One SD card slot with 1784-SD2.
14. Windows CE with extended features and MS Offices viewers,
15. FactoryTalk View Studio for Machine Edition.
16. FactoryTalk View Point.
17. Two 10/100Base-T Ethernet ports that supports Device Level Ring (DLR), linear, or star network topologies.
18. 3-year warranty.

C. Additional:

1. System Integrator shall review screen size, resolution, and aspect ratio and make determination as to whether these specifications align with the Owner's "path forward" regarding PanelView Terminals for the Plant. As the OIT specified above reflects the largest screen size, any changes will be at no additional cost to the Owner.
2. As this is the first PanelView OIT at the Plant, the System Integrator shall plan for extensive screen development encompassing all process throughout the Plant – effectively duplicating the existing SCADA system at the Plant.

1.10 CONFIGURATION SERVICES

A. General

1. All hard drives shall be formatted as NTFS volumes
2. Identify and setup all SCADA authorized users with proper clearances and passwords.
3. Each computer shall have a unique name shall be part of a domain. The computer shall have a static IP address, subnet mask and gateway addresses. Coordinate domain identifications, IP addresses, subnet masks and gateway addresses with the City.
4. All computers shall be tested for correct configuration as well as correct response.
5. All computers on the network shall be setup for time synchronization.

PART 2 – EXECUTION

2.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Specification includes hardware required for a fully functional Programmable Logic Control System.

B. Programmable Logic Control System shall be from single manufacturer.

1.02 ABBREVIATIONS

A. IEC: International Electrotechnical Commission

B. I/O: Input/Output

C. NRTL: Nationally Recognized Testing Laboratory

D. PLC: Programmable Logic Controller

1.03 REFERENCES

A. NEC: National Electric Code

B. NECA: National Electrical Contractors Association

C. NEIS: National Electrical Installation Standards

D. OSHA: Occupational Safety and Health Administration

E. UL: Underwriters Laboratories

1.04 SYSTEM DESCRIPTION

A. Specification includes hardware using the CompactlLogix PLC platform by Rockwell Automation.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for hardware specified.
2. Dimensional data of PLC equipment.
3. Interface terminations and cable data for each module.
4. Hardware manuals (4 sets).
5. Detailed bill of materials with manufacturer’s part numbers for each rack.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for hardware.
2. Wiring Diagrams: Show control connections and distinguish between factory-installed and field-installed wiring.
3. Addressing system and card layout, including special configuration rules and limitations for each rack.
4. Submit in accordance with Section 40 61 13.

D. Operation and Maintenance (O&M) Data:

1. Provide in accordance with Section 40 61 30 and Section 01 78 23.
2. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
3. Manufacturer's written instructions for periodic replacement of any backup batteries used on equipment including estimated battery replacement calendar dates.

1.06 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and system components to their final location in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage. Remove protection only after equipment is made safe from such hazards and ready to install.

B. Store items in a clean, dry, secure location.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, dated, and identified with labels describing contents.

a. One shelf spare for each type of I/O module used on project.
b. One shelf spare for each type of communications module used on project.
c. One shelf spare for each type power supply used on project.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Rockwell Automation.

B. No Substitute Permitted.

2.02 PROCESSOR

A. 1769-L36ERM 3MB memory.

2.03 POWER SUPPLY

A. 1769-PA4 120Vac power Supply.

2.04 NETWORK MODULES

A. EtherNet/IP™:

1. 1769-AENTR (when used with CompactLogix platform).
2. 1747-AENTR (when used with SLC 500 platform – SCC D/F).

2.05 I/O MODULES

A. I/O modules specifically designed for interfacing of I/O signals to PLC processor.

B. Include sufficient I/O modules to accommodate I/O with provisions for 20% spare I/O prewired to terminal strips. Where no I/O of a listed type (digital input, digital output, analog input, analog output) is shown, provide one spare prewired module.

C. I/O Modules shall be segregated by Process such that the failure of any one module shall not shut down all equipment in respective Process.

D. 120Vac Digital Input:

1. 120Vac as required by application.
2. 16 points per module.
3. LED indication of on/off status of each point.
4. 1769-IA16.

E. 24Vdc or 120Vac Relay Output:

1. 5-125VDC, 5-265VAC individually isolated relay contact outputs.
2. Contact Rating: 2.5 amps continuous at 120vac.
3. Contact configuration: Normally open
4. 8 points per module.
5. LED indication of on/off status of each point.
6. 1769-OW8I.

F. Analog Input:

1. 8 inputs per module.
2. Differential or single ended.
3. Accepts 4-20 mAdc.
4. 1769-IF8.

G. Analog Output:

1. 4 outputs per module.
2. Differential, individually isolated.
3. Transmits 4-20 mAdc.
4. 1769-OF4CI.

H. Reserve Module:

1. 1769-ARM.

2.06 WIRING AND TERMINATION SYSTEMS

A. Wiring of PLC I/O modules shall be in accordance with Section 13431.

B. Provide sufficient terminations to accommodate active I/O points, spares, and future expansion.

2.07 PLC PROGRAMMING

A. PLC shall be programmed using Rockwell Automation Studio 5000 Software.

1. Latest firmware version compatible with all supporting operating systems and hardware.
2. IEC 61131-3 compliant (as standard).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Each input will be imported into Joliet Eastside SCADA iFix system and screen design shall conform to existing Joliet Eastside Process Control System Configuration Standards.

B. Install hardware in accordance with manufacturer's written instructions.

C. Provide orderly shutdown on power failure, saving register contents with automatic restart on power restoration.

D. Each input shall be individually fused.

E. Include sufficient I/O modules to accommodate 20% spare I/O prewired to terminal strips. Where no I/O of a listed type (digital input, digital output, analog input, analog output, etc.) is shown, provide one spare prewired module.

F. I/O modules shall be segregated by process such that the failure of any single I/O module shall NOT shut down all equipment in respective process (i.e.: Each pump for a given wet well shall have its own set of DI, DO, AI, and AO modules exclusive from the other Pumps).

G. Analog I/O shall use specialty field terminal blocks specifically designed for 4-20mA signal wiring.

H. Communication software and configuration shall meet monitoring and control requirements of each process in accordance with functional descriptions.

I. Each hardware unit communicating over data highway shall include executive routines or traffic controller to control and coordinate activities on communication links. Use integrated, standard products for communication software to manage transmission protocols, line error detection, and message switching.

J. Install and wire in accordance with equipment manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 66 00
NETWORK AND COMMUNICATION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes plant-wide data highway communication devices, equipment, and processes.

C. General Design Requirements:

1. PLC Data Highway:

a. Provide high speed link between PLC's and Process Control Network to allow sharing of real-time data.
b. Provide expandable system to accommodate addition of future equipment as specified elsewhere.
c. Provide cabling suitable for conduit routing as shown elsewhere.
d. Provide data highway as shown on Drawings.
e. PLC data highway between buildings will be Multimode and Singlemode Fiber Optic Cable (1000Base-FX), 12-strand, indoor/outdoor, and shall meet 10 Gigabit Ethernet maximum transmission distance.
f. PLC data highway within buildings shall be Cat 6 UTP (100Base-TX).
g. Maximum distance between building nodes 2000 meters.
h. Maximum distance intra-building nodes is 100 meters.

1.02 ABBREVIATIONS AND REFERENCES

A. FCC Federal Communications Commission

B. IEEE Institute of Electrical and Electronics Engineers

C. ISO International Standards Organization

D. LAN Local Area Network

E. NEC National Electric Code

F. NEIS National Electrical Installation Standards

G. NRTL Nationally Recognized Testing Laboratory

H. PLC Programmable Logic Controller

I. UL Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cut sheets and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Cable routing drawings for PLC data highway.
3. Cable termination detail drawings.
4. Location and function of all communication module types.
5. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

PART 2 – PRODUCTS

2.01 MANAGED DATA SWITCH – RACK MOUNT

A. Manufacturer:

1. N-Tron 7026TX.
2. Red Lion Sixnet EL228.
3. Cisco Catalyst.

B. Features:

1. 24 Ethernet 10/100Base TX RJ-45 ports.
2. 2 SFP ports (Mini-GBIC) Gigabit Transceivers. MM.
3. Rack mount.
4. -40°C to 80°C Operating temperature.
5. ESD and Surge Protection Diodes on all RJ-45 ports.
6. Auto-negotiation on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth.
7. Configuration Backup via SD card.
8. SNMP v1, v2, v3 and Web Browser Management.
9. Detailed Ring Map and Fault Location Charting.
10. OPC Monitoring.
11. Redundant N-Ring Coupling.
12. 802.1d, 802.1w, 802.1D RSTP.
13. 802.1Q tag VLAN and Port VLAN.
14. 802.1p QoS, Port QoS, and DSCP.
15. Port Trunking.
16. Port Mirroring.
17. DHCP Server with Option 82 Relay, Option 61, and IP Fallback.
18. Local Port IP Addressing.
19. EtherNet/IP™ CIP Messaging.
20. 802.1AB-2005 LLDP (Link Layer Discovery Protocol).
21. Port Security - MAC Address Based.

22. UL Listed.
23. RoHS Compliant.

2.02 MANAGED DATA SWITCHES – PANEL MOUNT

A. Manufacturer:

1. N-Tron 716FX2
2. No substitutes allowed.

B. Features:

1. Managed EtherNet switch
2. Store and forward switch in compliance with IEEE 802.3, 2 priority classes in accordance with IEEE 802.1D, TCP/IP protocol.
3. Fiber modules (100BaseFX):

    a. 2-ports per switch.
    b. Multimode ST.

4. Copper modules (10/100BaseTX):

    a. 14-ports per switch.
    b. Autosensing full/half duplex, speed, and MDIX.
    c. RJ45 connection.

5. SNMP v1, v2, v3 and web browser management
6. EtherNet/IP™ CIP Messaging
7. Detailed ring map and fault location charting
8. Redundant N-Ring Coupling
9. OPC monitoring
10. 801.2D RSTP.
11. IGMP auto configuration
12. 802.1Q tagged VLAN and port VLAN
13. 802.1p QoS, port QoS and DSCP
14. LLDP (Link Layer Discovery Protocol)
15. GUI based DHCP Server, Option 61,Option 82 Relay Agent, Local IP Static Addressing and IP Fallback.
16. Port mirroring and trunking
17. Local Port IP Addressing
18. Port Security—MAC Address Based
19. Hardened ESD port protection.
20. Fully managed with RSTP.
21. Integrated Management Agent, SNMP protocol.
22. UL 60950-1; UL 508
23. Redundant Input Voltage: 10-30 VDC
24. Input Current (max): 1.53A @ 24 VDC (fully populated)
25. BTU/hr: 125.3 @ 24 VDC (fully populated)
26. Operating Temperature: -40°C to 70°C.
27. Operating Humidity: 10% to 95% (Non Condensing)
28. Operating Altitude: 0 to 10,000 ft.
29. Shock and Vibration (bulkhead mounted)
30. Shock: 50g @ 10ms
31. Vibration/Seismic: 30g, 10-200 Hz, triaxial
32. RoHS Compliant.

2.03 MULTI-MODE OPTICAL FIBER CABLE

A. Manufacturer:

1. Siemon XGLO 550 50/125µm (OM4+) 12 strand.
2. Or equal.

B. Fiber Characteristics

1. General Fiber Specifications:

a. All fiber shall be of same manufacturer.
b. Fiber shall meet the distance limitations for 10 Gigabit Ethernet Max Transmission Distance (m).
c. All fibers in the cable must be usable and meet required specifications following installation and testing.
d. Fibers shall have dual wavelength capability; transmitting at 850 and 1300nm ranges.
e. Outside Plant (OSP) Multimode.
f. 50/125µm (OM4+).
g. 12 strand (6-pair).
h. 7.3mm cable diameter.
i. Glass core, 50/125µm core/cladding; 250 m coating; 900 m tight buffered construction designed for outdoor installation; Kevlar aramid yarn strength members surrounding the cladding of each strand; plenum rated jacket.
j. Complies with TIA/EIA-568-B.3 for color-coding.
k. Maximum attenuation: (3.5dB km @ 850 nm) (1.5dB km @ 1300 nm).
l. Minimum bandwidth (500 MHz km @ 850) (500 MHz km @ 1300 nm).
m. Outer Jacket: UV & moisture resistant LSOH.
n. Optical Fiber proof stress: (1,500N).
o. Crush resistance: 5N/mm.
p. Operating temperature: -4º F to +158ºF (0 dB added attenuation).

C. Fiber Optic Cable Installation:

1. Provide an additional 10 feet of cable slack at each hand hole, and connection points, allowing for future reconfiguration of connection closets. Cable shall be neatly organized using cable management hardware.

2. Do not exceed cable manufacturers minimum bend radius under tension or final installation.

3. Cable tension:

a. Do not exceed cable manufacturer’s maximum tensile rating during cable installation.
b. No residual tension shall remain on cable after installation except that which is due to cable's weight in vertical rise.
c. Cable tension shall be monitored during installation if winch is used for installation. Hand pulls do not require monitoring.

4. Vertical Rises:

a. Secure vertical cable at top of run.
b. Attachment point shall comply with cable's minimum bend radius.
c. Provide intermediate support when manufacturer specified maximum cable rise has been reached.

5. Cable Splicing and Termination:

a. All fiber strands shall be terminated at both ends.
b. Use of splices shall not cause attenuation of signal exceeding allowable attenuation budget.
c. Make no splices within conduit or duct banks. Make splices within pull boxes or process control system equipment enclosures.

6. Fiber optic cable identification

a. All fibers shall be color coded to facilitate individual fiber identification.
b. Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL-969
c. Labeling shall conform to the requirements specified within ANSI/TIA/EIA-606-A or to the requirements specified by the Owner.

2.04 SINGLE-MODE OPTICAL FIBER CABLE

A. Manufacturer:

1. Siemon XGLO OS1/OS2.
2. Or equal.

B. Fiber Characteristics

1. General Fiber Specifications:

a. All fiber shall be of same manufacturer.
b. Fiber shall meet the distance limitations for 10 Gigabit Ethernet Max Transmission Distance (m).
c. All fibers in the cable must be usable and meet required specifications following installation and testing.
d. Fibers shall have dual wavelength capability; transmitting at 1310 and 1550nm ranges.
e. Outside Plant (OSP) Multimode.
f. OS1/OS2.
g. 12 strand (6-pair).
h. 7.3mm cable diameter.
i. Glass core, 250 m coating; tight buffered construction designed for outdoor installation; Kevlar aramid yarn strength members surrounding the cladding of each strand; plenum rated jacket.
j. Complies with TIA/EIA-568-B.3 for color-coding.
k. Outer Jacket: UV & moisture resistant LSOH.
l. Optical Fiber proof stress: (1,500N).
m. Crush resistance: 5N/mm.
n. Operating temperature: -4º F to +158ºF (0 dB added attenuation).

C. Fiber Optic Cable Installation:

1. Provide an additional 10 feet of cable slack at each hand hole, and connection points allowing for future reconfiguration of connection closets. Cable shall be neatly organized using cable management hardware.

2. Do not exceed cable manufacturers minimum bend radius under tension or final installation.

3. Cable tension:

a. Do not exceed cable manufacturer’s maximum tensile rating during cable installation.

b. No residual tension shall remain on cable after installation except that which is due to cable's weight in vertical rise.
c. Cable tension shall be monitored during installation if winch is used for installation. Hand pulls do not require monitoring.

4. Vertical Rises:

a. Secure vertical cable at top of run.
b. Attachment point shall comply with cable's minimum bend radius.
c. Provide intermediate support when manufacturer specified maximum cable rise has been reached.

5. Cable Splicing and Termination:

a. All fiber strands shall be terminated at both ends.
b. Use of splices shall not cause attenuation of signal exceeding allowable attenuation budget.
c. Make no splices within conduit or duct banks. Make splices within pull boxes or process control system equipment enclosures.

6. Fiber optic cable identification

a. All fibers shall be color coded to facilitate individual fiber identification.
b. Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL-969
c. Labeling shall conform to the requirements specified within ANSI/TIA/EIA-606-A or to the requirements specified by the Owner.

2.05 FIBER OPTIC CONNECTOR ASSEMBLIES

A. All fiber optic connector assemblies shall use high quality ST connectors installed with anaerobic adhesive on jacketed pigtails.

B. Assemblies shall be provided with control panels for field splicing to Plant-Wide Data Highway Cable upon installation of control panels.

C. Assemblies shall utilize a PC finish on the tip of the fiber to provide high yield during splicing, and to meet EIA and IEC standards for repeatability.

D. All connectors that are metallic in nature shall be corrosion proof and shall withstand minimum of 0.75 microns of corrosion per year.

2.06 FIBER DISTRIBUTION UNIT (PATCH PANEL)

A. Manufacturer:

1. Lucent Technologies.
2. Panduit OPTICOM.

B. Provide rack or panel mounted distribution panel (see 008-I-1) for terminations, cross connection, interconnection, splicing, and fiber identification for all strands of multimode and singlemode fibers depending upon location and fiber cables being terminated. Terminate each strand of fiber entering or leaving the panel.

C. Provide protection from mechanical stress on the cable and fibers and from macro-bending losses.

D. Provide fiber patch cords.

E. The connector panels shall accommodate ST simplex and duplex connectors.

F. The unit shall be UL® approved.

2.07 CAT6 DISTRIBUTION UNIT (PATCH PANEL)

A. Manufacturer:

1. Lucent Technologies.
2. Panduit.

B. 48 Port Cat 6.
C. 2U 19" rack mount.
D. UL Listed.
E. RoHS Compliant.

2.08 ENHANCED CAT 6 UTP CABLE

A. 4 pair Category 6 cable shall conform to TIA/EIA 568A Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and UL® LAN Certification and Follow-up Program.

B. Indoor installations shall be plenum rated.

C. Cables shall be marked as UL verified Category 6.

D. Cables, when traversing enclosures, vendor panels, MCC's, or VFD's containing 480Vac power shall include insulation rated for 600Vac.

E. Applications standards supported should include, but be not limited to, IEEE 802.3, 1Base5, 10BASE-T; IEEE 802.5, 4Mbps, 16Mbps (328 ft [100m], 104 Workstations) and TP-PMD.

F. In addition, cable shall be capable of supporting evolving high-end applications such as 100 Base - T and 52/155 Mbps ATM plus the added application of 1000 BASE-T Gigabit Ethernet.

G. Cable shall be round, and shall meet the following electrical requirements:

1. Attenuation (Guaranteed):

Frequency (MHz)	**Attenuation (dB/100m)**
1	2.0
4	4.0
10	6.40
20	9.2
25	10.3
31.25	11.6
62.5	16.8
100	21.7
150	27.7
200	32.0
310	41.3
350	44.3

2. Near End Cross Talk (NEXT) (Guaranteed):

Frequency (MHz)	+	NEXT (dB)
1		62
4		53
10		47
20		42
25		41
31.25		40
62.5		35
100		32
150		30
200		28
310		25
350		24

3. Attenuation to Crosstalk Ratio (Guaranteed):

Frequency (MHz)	ACR (dB/90m)
0.772	72.4
1	70.6
4	59.8
8	53.8
10	51.7
16	47.1
20	44.8
25	42.4
31.25	39.8
62.5	30.8
100	23.6
155	15.7
200	10.4
255	4.8
300	0.7

4. Structural Return Loss (Guaranteed):

Frequency (MHz)	SRL (dB)
1	23.0
4	23.0
10	23.0
20	23.0
25	22.0
31.25	21.0
62.5	21.0
100	21.0
150	19.0
200	19.0
310	17.0

Frequency (MHz)	SRL (dB)
350	16.0

2.09 UTP PATCH CORDS FOR EQUIPMENT ENCLOSURES

A. Manufacturer:

1. Lucent Technologies.
2. Panduit.

B. Provide Category 6 Modular Patch Cords as follows:

1. Power sum rated.
2. Patch cords shall not exceed 3 feet in length unless specifically required for application.
3. Conform to the requirements of EIA/TIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and UL® LAN Certification and Follow-up Program.
4. Equipped with molded 8 pin modular connector (RJ45, 8x8) on each end and conform to the length(s) specified on the detailed drawing.
5. Round, and 24-AWG copper, stranded conductors, tightly twisted into individual pairs.
6. Built-in exclusion features to prevent accidental polarity reversals and split pairs.

C. UL® Verified for EIA/TIA 568B Electrical Performance.

D. UL® and c (UL®) Listed for Fire Safety.

E. ISO 9001 Certified Manufacturer.

F. Austel Approved.

G. FCC Compliant.

2.10 DATA OUTLET – FRONT OF PANEL

A. Manufacturer:

1. Grace Port Grace Port
2. Hubbel
3. Automation Direct Zipport Series
4. Or equal

B. Features:

1. NEMA Rating to match panel.
2. Flush Mount.
3. Polycarbonate hinged cover.
4. GFI outlet wired to convenience outlets in panel.
5. RJ-style plug.
6. UL Listed.

2.11 DATA OUTLET – WALL MOUNT

A. Manufacturer:

1. Leviton.
2. Hubbell.
3. Cooper.
4. Or equal

B. Features:

1. (4) RJ-45 Data Ports.
2. UL Listed.

2.12 DATA OUTLET – FLOOR MOUNT

A. Manufacturer:

1. Garvin Industries.
2. Or equal

B. Features:

1. Brushed Stainless Finish.
2. Pop-up Data Ports.
3. (3) RJ-45 Data Ports.
4. UL Listed.

2.13 RACK ENCLOSURE – WALL MOUNT

A. Manufacturer:

1. Tripp-Lite
2. Dell
3. Or Equal.

B. General:

1. 12U Enclosure.
2. For standard 19” rack-mount equipment.
3. Locking Plexiglas Front Door.
4. Lockable, removable side panels.
5. (2) keys included
6. Hinged cabinet swigs away from wall bracket.
7. Capacity 200 pounds of equipment minimum.
8. Wall Mount.
9. Color: Black.
10. Fan not required if enclosure is ventilated.
11. IP20 Protection.
12. RoHS Compliant

2.14 RACK ENCLOSURE – LARGE EQUIPMENT RACK

A. Manufacturer:

1. Tripp-Lite SR48UB.
2. Dell
3. Or Equal.

B. General:

1. 48U Enclosure.
2. For standard 19” rack-mount equipment.
3. Maximum device depth: 37”.
4. Locking Plexiglas Front Door.
5. Lockable, removable side panels.
6. (2) keys included.
7. (4) casters and leveling feet.
8. Capacity: 3,000lb stationary, 2,250lb rolling.
9. Maximum installed depth: 21”.
10. Color: Black.
11. Fan not required if enclosure is ventilated.
12. IP20 Protection.
13. UL60950, RoHS Compliant, CE.
14. EIA/ECA-310-E Approval.
15. 5-year warranty.

2.15 GATEWAY

A. Manufacturer:

1. Moxa.
2. Or equal.

B. General Features:

1. 12-48Vdc.
2. UL Listed.
3. 5-year warranty.
4. Ambient Temperature: 32 to 140 °F

C. EtherNet Interface Features:

1. One port Modbus/TCP to EtherNet/IP.
2. 10/100 Mbps, Auto MDI/MDIX.
3. 8-pin RJ45.

D. Serial Interface Features:

1. One port Modbus RTU/ASCII to EtherNet/IP.
2. RS-232/422/485, software selectable.
3. DB9 male.
4. Terminator for RS-485: 120 ohm

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 FIBER OPTIC CABLE TESTING REQUIREMENTS

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B.In addition to the tests detailed in this document, the Contractor shall notify Owner of any additional testing that is deemed necessary to guarantee a fully functional system.

C. Testing procedure shall include testing the attenuation and polarity of the installed cable runs with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber endfaces shall also be verified.

D. Testing shall be performed on each cabling link (connector to connector).

E.Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the Owner. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenutation does not include devices such as optical bypass switches, couplers, repeaters, or optical amplifiers.

F. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and event tables for multimode and singlemode links and channels.

G. Owner witness and/or review field testing.

H. Owner shall be notified of the start date of the testing phase five (5) business days before testing commences.

I. Owner may require a parallel random sample of 5% of the installed links. The results of this parallel testing shall be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the Contractor. If more than 2% of the parallel test results differ in terms of the pass/fail determination, Contractor shall repeat 100% testing at no cost to the Owner.

3.03 FIBER OPTIC CABLE ACCEPTANCE PARAMETERS AND TESTING PROCEDURES

A. Unless otherwise specified by Owner, each cabling link shall be in compliance with the following test limits.

1. Optical Loss Testing Multimode and Singlemode Links

a. The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.

b. Link Attenuation(dB) = Cable_Attn(dB) + Connector_Attn(dB) + Splice_Attn(dB)

c. Cable_Attn(dB) = Attenuation_Coefficient (dB/km) * Length (km)

d. Connector_Attn(dB) = #_of_connector_pairs * connector_loss (dB)

e. Maximum allowable connector_loss = 0.75 dB

f. Splice_Attn(dB) = #_of_Splices * Splice_loss (dB)

g. Maximum allowable splice_loss = 0.3 dB

h. The values for the Attenuation_Coefficient (dB/km) are listed in the table table below.

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5	1300	1.5
Multimode 50/125 µm	850	3.5	1300	1.5
Single-mode 9/125 µm	1310	0.4	1550	0.3

2. OTDR Testing Parameters

    a. Reflective events (connections) shall not exceed 0.75
    b. Non-Reflective events (splices) shall not exceed 0.3 dB

3. Magnified endface inspection

    a. Fiber connections shall be visually inspected for endface quality
    b. Scratched, pitted, or dirty connectors shall be diagnosed and corrected.

B. Any link or channel that fails the test requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation as specified herein.

C. If one (1) pair of strands for each fiber optic cable are found to be broken the entire cable shall be abandoned, or removed, and a new cable shall be installed at no additional cost to Owner.

3.04 ADDITIONAL OPTICAL FIBER CABLE TESTING REQUIREMENTS

A. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

B. Fiber endfaces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting multimode fibers. 400X magnification shall be used for examination of singlemode fibers. Scratched, pitted, or dirty connectors shall be corrected. Endface images shall be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.

C. Testing of the cabling shall be performed using high quality test cords of the same fiber type as the cabling being tested. The test cords for OLTS testing shall be between 1m and 5m in length. The test cords for the OTDR testing shall be approximately 100m for the launch cable and at least 25m for the receive cable.

D. Optical loss testing on backbone links.

1. Multimode backbone links shall be tested at 850nm and 1300nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.

2. Singlemode backbone links shall be tested at 1310nm and 1550nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.

3. Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B, and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. Contractor shall follow the procedures established by these standards or application notes to accurately conduct

performance testing.

E. OTDR Testing

1. Fiber links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenutation and connector insertion loss.

   a. Multimode: 850nm and 1300nm
   b. Singlemode: 1310nm and 1550nm

2. Each fiber link and channel shall be tested in both directions

3. A launch cable shall be installed between the OTDR and the first link connection.

4. A receive cable shall be installed after the last link connection.

F. Length Measurement

1. The length of each fiber shall be recorded.

2. It is preferable that the optical length be measured using an OLTS or OTDR.

G. Polarity Testing.

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with clause E.5.3 of ANSI/TIA-568-C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.05 FIBER OPTIC CABLE TEST DOCUMENTATION

A. Test results documentation

1. Test results saved within the field test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e. “as saved in the field test instrument”. The file format, CSV (comma separated value) does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner during the installation and shall be provided to the Owner within 5 working days of completion of tests.

3. Test results shall be provided in an electronic database for each tested optical fiber and shall contain the following information.

   a. The identification of the customer site as specified by the end user.
   b. The name of the test limit selected to execute the stored test results.
   c. The name of the personnel performing the test.
   d. The date and time the test results were saved in the memory of the tester.
   e. The manufacturer, model and serial number of the field test instrument.
   f. The version of the test software and the version of the test limit database held within the test instrument.
   g. The fiber identification number
   h. The length for each optical fiber.
   i. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelengths and margin (difference between the measured attenuation and the test limit value).

j. Test results to include OTDR link and channel traces and event tables at the appropriate wavelengths.
k. The length for each optical fiber as calculated by the OTDR
l. The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

3.06 FIBER OPTIC CABLE TESTING REQUIREMENTS

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In addition to the tests detailed in this document, the Contractor shall notify Owner of any additional testing that is deemed necessary to guarantee a fully functional system.

C. Testing procedure shall include testing the attenuation and polarity of the installed cable runs with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber endfaces shall also be verified.

D. Testing shall be performed on each cabling link (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the Owner. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include devices such as optical bypass switches, couplers, repeaters, or optical amplifiers.

F. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode links and channels and OTDR traces and event tables for multimode links and channels.

G. Owner witness and/or review field testing.

H. Owner shall be notified of the start date of the testing phase five (5) business days before testing commences.

I. Owner may require a parallel random sample of 5% of the installed links. The results of this parallel testing shall be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the Contractor. If more than 2% of the parallel test results differ in terms of the pass/fail determination, Contractor shall repeat 100% testing at no cost to the Owner.

3.07 FIBER OPTIC CABLE ACCEPTANCE PARAMETERS AND TESTING PROCEDURES

A. Unless otherwise specified by Owner, each cabling link shall be in compliance with the following test limits.

1. Optical Loss Testing Multimode Links

a. The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.

b. Link Attenuation(dB) = Cable_Attn(dB) + Connector_Attn(dB) + Splice_Attn(dB)

c. Cable_Attn(dB) = Attenuation_Coefficient (dB/km) * Length (km)

d. Connector_Attn(dB) = #_of_connector_pairs * connector_loss (dB)

e. Maximum allowable connector_loss = 0.75 dB

f. Splice_Attn(dB) = #_of_Splices * Splice_loss (dB)

g. Maximum allowable splice_loss = 0.3 dB

h. The values for the Attenuation_Coefficient (dB/km) are listed in the table below.

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5	1300	1.5
Multimode 50/125 µm	850	3.5	1300	1.5
Single-mode 9/125 µm	1310	0.4	1550	0.3

2. OTDR Testing Parameters

a. Reflective events (connections) shall not exceed 0.75
b. Non-Reflective events (splices) shall not exceed 0.3 dB

3. Magnified endface inspection

a. Fiber connections shall be visually inspected for endface quality
b. Scratched, pitted, or dirty connectors shall be diagnosed and corrected.

D. Any link or channel that fails the test requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation as specified herein.

E. If one (1) pair of strands for each fiber optic cable are found to be broken the entire cable shall be abandoned, or removed, and a new cable shall be installed at no additional cost to Owner.

3.08 ADDITIONAL OPTICAL FIBER CABLE TESTING REQUIREMENTS

A. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

B. Fiber endfaces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting multimode fibers. 400X magnification shall be used for examination of singlemode fibers. Scratched, pitted, or dirty connectors shall be corrected. Endface images shall be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.

C. Testing of the cabling shall be performed using high quality test cords of the same fiber type as the cabling being tested. The test cords for OLTS testing shall be between 1m and 5m in

length. The test cords for the OTDR testing shall be approximately 100m for the launch cable and at least 25m for the receive cable.

D. Optical loss testing on backbone links.

1. Multimode backbone links shall be tested at 850nm and 1300nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.

2. Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B, and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. Contractor shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

E. OTDR Testing

1. Fiber links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

c. Multimode: 850nm and 1300nm

2. Each fiber link and channel shall be tested in both directions

3. A launch cable shall be installed between the OTDR and the first link connection.

4. A receive cable shall be installed after the last link connection.

F. Length Measurement

1. The length of each fiber shall be recorded.

2. It is preferable that the optical length be measured using an OLTS or OTDR.

G. Polarity Testing.

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with clause E.5.3 of ANSI/TIA-568-C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.09 FIBER OPTIC CABLE TEST DOCUMENTATION

A. Test results documentation

1. Test results saved within the field test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e. “as saved in the field test instrument”. The file format, CSV (comma separated value) does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner during the installation and shall be provided to the Owner within 5 working days of completion of tests.

3. Test results shall be provided in an electronic database for each tested optical fiber and shall contain the following information.

a. The identification of the customer site as specified by the end user.
b. The name of the test limit selected to execute the stored test results.

c. The name of the personnel performing the test.
d. The date and time the test results were saved in the memory of the tester.
e. The manufacturer, model and serial number of the field test instrument.
f. The version of the test software and the version of the test limit database held within the test instrument.
g. The fiber identification number
h. The length for each optical fiber.
i. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelengths and margin (difference between the measured attenuation and the test limit value).
j. Test results to include OTDR link and channel traces and event tables at the appropriate wavelengths.
k. The length for each optical fiber as calculated by the OTDR
l. The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

4. Test results documentation shall include a summary section at or near the front of detailed test documentation and shall be limited to 2 pages. Summary section shall indicate (at a glance) all tests and their corresponding pass/fail status.

END OF SECTION

SECTION 40 67 00
CONTROL PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes panel and enclosure requirements for Process Instrumentation and Control Equipment.

1.02 ABBREVIATIONS AND REFERENCES

A. ISA: Instrument Society of America

B. NEC: National Electric Code

C. NEIS: National Electrical Installation Standards

D. NEMA: National Electrical Manufacturers Association

E. NFPA: National Fire Protection Agency

F. NRTL: Nationally Recognized Testing Laboratory

G. OSHA: Occupational Safety and Health Administration

H. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for panels and enclosures specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for panels and enclosures specified.
2. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing panels and enclosures of types and materials indicated that have record of successful in-service performance.

B. Enclosures and components contained within the enclosure provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing

Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. In-Factory Inspection – see Section 40 61 21.

1. Verify following in accordance with approved submittals:

   a. Panel dimensions.
   b. Equipment layout.
   c. Wiring.
   d. Wire and terminal identification.
   e. Device identification.

2. Verify proper access to equipment for maintenance.
3. Verify proper access to field wire and fiber optic termination points.
4. Inspect for neatness of wiring and wire harness construction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and enclosures to their final locations in protective wrappings, containers, and other protection that will exclude dirt, moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards, and is ready for immediate installation.

B. Store panels and enclosures in clean, dry location.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below packaged with protective covering for storage, dated and identified with labels describing contents.

   a. Provide minimum of 5 or 10%, whichever is greater, of each type fuse used on project.
   b. Provide minimum of 5 or 10%, whichever is greater, of each type relay used on project.
   c. Provide minimum of 5 or 10%, whichever is greater, of each type pilot light replacement bulb used on project.

1.07 AMERICAN IRON & STEEL PRODUCTS

A. Pursuant to USEPA's March 20, 2014 Guidance Memorandum regarding the use of American iron and steel products, Section 436 of federal H.R. 3547 does **not** apply to this equipment.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Hoffman.
B. Saginaw.
C. Hammond.
D. Rittal.
E. No Substitute Permitted.

2.02 GENERAL REQUIREMENTS

A. Panels shall be constructed using factory-fabricated enclosures.

B. Follow PLC manufacturer's written installation requirements for layout of PLC-specific panels.

C. Provide a minimum of 25% free back panel space for future expansion unhindered by current devices, wiring, wireway, etc.

D. Provide a minimum of 25% free terminal blocks of each type used in each panel. This is in addition to planned spare wiring terminations. Spares shall be shown on panel drawings.

E. The panel builder shall be a current Underwriters laboratories listed UL-508A industrial control panel builder and shall present its follow-up service procedure file number on submittals. All devices within the panel shall be UL listed and/or recognized where applicable and shall be mounted and wired in accordance with the most current edition of UL-508A and the NEC. A serialized UL-508A label shall be applied to all control panels prior to shipment to the Project site.

F. The panel builder shall be a current Underwriters laboratories listed UL-698 Option 1 (UL Category NRBX, panel located in an unclassified location with intrinsically safe extensions into a hazardous location) and Option 2 (UL Category NNNY, panel located in a hazardous location) industrial control panel builder. Panel builder shall present its follow-up service procedure file number on submittals. The panel shall be UL listed and/or recognized where applicable and shall be constructed in accordance with the most current edition of UL-698 and the NEC. A serialized UL-698 label shall be applied to all control panels prior to shipment to the Project site.

G. Arrange panel to allow all conduits for intrinsically safe wiring to enter the panel enclosure within the intrinsically safe section of the panel. Provide separate terminal strips for intrinsically safe wiring entering and leaving the panel. Intrinsically safe wiring shall not occupy the same raceway, cabletray, or conduit as non-intrinsically safe wiring, and shall maintain a minimum of 2 inches separation. Intrinsically safe wiring, terminals, components, and conduit shall be identified. Intrinsically safe area within a panel may reside inside another enclosure and shall be considered adequate separation. All Intrinsically safe components, wiring, separation spaces, sealing, and identification shall be in accordance with Article 504 of NFPA 70 (National Electric Code).

H. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to job-site.

I. Standard Signal Interfaces:

1. Unless otherwise specified, discrete input and output signals shall conform to the following:

   a. Isolated non-powered (dry) contact closure.
   b. Dry contacts shall be powered from panel or device receiving signal.
   c. PLC based outputs shall be provided with an interposing relay when any of the following conditions apply:

      1) When driving solenoids or other inductive loads.
      2) Potential in-rush current exceeds 75% of rated capacity of the I/O Module.
      3) The current requirement of the driven device is insufficient to fully engage the output module consistently.
      4) The voltage required to drive the output is incompatible with the output module.

2. Unless otherwise specified, analog input and output signals shall conform to the following:

   a. 4-20 mAdc (HART) inputs.

b. 4-20 mAdc outputs.
c. For 2-wire, loop-powered transmitters, provide regulated, fused, and isolated 24Vdc power supply at panel for driving of devices. Size power supply for 30% minimum spare capacity minimum.
d. Where isolation is required for interfacing with particular equipment supplied, provide necessary I/I converters. Provide I/I converters where impedance capabilities of new or existing signal transmitter will be exceeded by addition of PLC input.

J. Wiring:

1. In addition to Division 26, NEC and NEMA requirements, wiring shall conform to following:

a. Power: 12 AWG stranded minimum, type MTW, 600V.
b. Control: 16 AWG stranded minimum, type MTW, 300V.
c. Analog Signal: Twisted pair, 18 AWG, Beldon 8760 or equal.

2. Wire color code:

a. AC neutral conductor: White.
b. AC hot conductor: Black.
c. Grounding conductor: Green.
d. AC control conductor, powered from within panel: Red.
e. AC control conductor, powered from remote source: Yellow.
f. DC (+) power conductor, discrete signal: Blue.
g. DC (-) power conductor, discrete signal: Blue with white stripe.
h. DC control conductor, discrete signal: Blue.
i. Twisted pair cable (+) signal conductor, analog signal: White.
j. Twisted pair cable (-) signal conductor, analog signal: Black.
k. Intrinsically safe wiring: Light Blue (see Article 504 of NEC for additional limitations).

3. Design control panels to keep 480Vac power, 120Vac power and discrete signals, and analog and other low voltage signals separated.

a. Do not run 480Vac power, 120Vac power and discrete signals, or analog or other low voltage signals in the same conduit or wire-duct.
b. Where 480Vac power, 120Vac power and discrete signals, or analog or other low voltage signals must cross, they shall do so at right angles.

4. Wiring Within Wire Duct:

a. Wherever feasible plastic wire duct with cover shall be used for routing of wire within control panel.
b. Size wire duct to be no more than 50% full.
c. Maintain 2” clearance between wire duct and terminals.

5. Wiring outside of wire duct.

a. Wiring outside of ducts shall be restrained by use of plastic wire-ties.
b. Restrain wiring every six inches (minimum).
c. Provide abrasion protection for wires passing through holes or across abrasive metal edges.
d. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed.

6. Each conductor or twisted pair cable shall be labeled near its termination point.
7. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its

termination point in addition to the overall jacket.

8. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.
9. Wiring of PLC I/O modules shall be through pre-wired cable assemblies. Cable assemblies shall have PLC I/O module-specific wiring arms on one end and cable connectors specific to terminal blocks on the other (or) interface module for field wiring (or) flying leads for terminal block termination, and may include LED status of each point.

K. Terminations:

1. Wiring within control panel shall be continuous and terminated only at terminal blocks or equipment terminals. Splices or butt connectors shall not be used within panel.
2. No more than two wires shall be terminated at any one terminal.
3. Make external connections by way of numbered terminal blocks on numbered terminal strips.
4. When signals are powered from remote location, switched terminal blocks shall be used where conductors enter or leave panel.
5. When signals are powered from within panel, fused terminal blocks shall be used where conductors enter or leave panel.
6. Provide integral bussing system on terminal block array where more than two terminations require common source or drain connection. Jumpered terminations shall not be acceptable.
7. Provide knife disconnect-type terminal blocks with test sockets for all analog loops.
8. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only. Shields shall run entire length of cable within panels. Running of twisted pairs without shields within panels is not permissible.
9. Provide separate terminal strips for each of the following types of signals.

    a. 480Vac power circuits.
    b. 120Vac power circuits.
    c. 120Vac discrete signals.
    d. 12Vdc, 24Vdc or 48Vdc discrete signals.
    e. Analog signals.
    f. Serial or parallel digital communication signals.
    g. Intrinsically safe circuits.

L. Power Distribution:

1. Panels having 240Vac or 480Vac power supply:

    a. Provide internal main circuit breaker to isolate power to panel.
    b. Provide circuit breakers for all motor starters provided.
    c. If panel includes separate 120Vac control power supply, provide auxiliary contact to isolate control power when main circuit breaker is opened.
    d. 480Vac to 120Vac control power transformer requirements:

        1) Both primary leads shall be fused.
        2) First secondary lead shall be fused.
        3) Second secondary lead shall be grounded.
        4) Provide single-phase surge suppression/line conditioner, sized for total panel loadings (Islatrol, or equal) between secondary leads and 120vac power distribution block.

2. Panels having 120Vac power supply:

    a. Provide circuit breaker on power supply entering panel.
    b. Provide single-phase surge suppression/line conditioner, sized for total panel loadings (Benden, Isotrol) between circuit breaker and 120Vac power distribution block.

3. Provide separately fused power supply to each major panel component.
4. Additional panel requirements.

    a. Provide separately fused power circuits for panel powered devices entering panel from field. Provide separate circuit for each device. Devices may be 5-Amp fused terminal blocks.

        1) Solenoid actuated valves
        2) Loop powered transmitters
        3) 120Vac switched cord and receptacles
        4) Relays

    b. Include digital transient surge suppressor/varistor installed in parallel with output contact at terminal strip for each PLC output signal driving an inductive load including:

        1) Relays.
        2) Solenoids.
        3) Motor starters.
        4) Motors.

M. Labels and Nameplates:

1. Panel Designation:

    a. Engraved with Engineer's tag number and description shown on the Drawings and in Specifications.
    b. Laminated white plastic with ½-in. high black characters.
    c. Fastened with stainless steel screws.

2. Front of panel mounted devices.

    a. Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed on Drawings and in Specifications.
    b. Laminated white plastic with 3/16-in. high black characters.
    c. Fastened with stainless steel screws.

3. Rear of panel mounted devices.

    a. Provide nametag for each rear of panel device with labels used on panel drawings.
    b. Thermo-embossed or laser printed with 1/8-in. high black characters on clear or white background or laminated white plastic with 3/16-in. high black characters.
    c. Self-adhesive backing.
    d. Clean area with mineral spirits prior to affixing labels

N. Panel Finish:

1. Remove mill scale, grease, and oil.
2. Primer thickness shall be 0.8 mil., minimum.
3. Finish coat shall be two-part epoxy or baked dry powder, 3-mil., minimum dry film thickness.
4. Color: Standard manufacturer's finish.

O. Conveniences:

1. Freestanding and floor mounted control panels shall be provided with door-activated, internal LED panel lighting units.

a. One unit shall be provided for every 3 feet of panel width and shall be mounted on the inside, top of the panel, and whose mounting hardware does not penetrate enclosure walls.
b. Lighting internal to panels shall be consistent for entire project.

2. Freestanding and floor mounted control panels shall be provided with 120Vac, service outlet circuits within the back-of-panel area. The circuits shall be provided with three-wire, 120Vac, 15-ampere duplex GFCI receptacles, one for every 3 feet of panel width and spaced evenly along the back-of-panel area. GFCI receptacles shall not be used for supplying power to UPS.
3. UPS receptacle – Provide simplex non-GFCI receptacle for plug in of UPS where applicable. Receptacle shall be labeled "120VAC FOR UPS ONLY".

P. Motor Protection Relays (MPR):

1. Submersible pump manufacturer uses proprietary pump monitoring units, supplied by the pump manufacturer. Units shall be installed into PLC panel as shown on Drawings. One unit shall be supplied for each of the pumps referenced. Coordinate size, mounting, and wiring requirements for monitoring units with Contractor. Units shall be the source of multiple alarm signals communicated to SCADA as shown on Drawings and described in the Specifications.

2.03 PANEL CONSTRUCTION – INDOOR AND OUTDOOR ENCLOSURES

A. indoor and outdoor enclosures shall conform to NEMA requirements as follows:

1. NEMA 7 for indoor or outdoor enclosures in Class 1, Division 1 or 2 hazardous (classified) locations.
2. NEMA 4X – type 316 stainless steel for outdoor enclosures or indoor enclosures in wet and/or corrosive environment;
3. NEMA 4X – FRP for outdoor enclosure for ALUM delivery;
4. NEMA 12 for indoor enclosures not in classified or corrosive environments.

B. In addition to NEMA standards, conform to the following requirements:

1. Minimum metal thickness: 14 Ga.
2. Indoor enclosures: equip with rubber-gasketed doors with continuous metal hinges. Equip doors with 3-point lockable latches.
3. Outdoor enclosures: equip with hinged dead-front inner doors and rubber-gasketed, continuous metal hinged outer weather doors. Equip weather doors with toggle style door clamps.
4. Equip outdoor enclosures with thermostatically controlled heaters capable of maintaining internal panel temperature of 50°F with 20mph wind at ambient temperature of -20°F. Heater shall operate at 120Vac, 60Hz power.
5. NEMA 4X enclosures shall be furnished with door gaskets.
6. Size to adequately dissipate heat generated by equipment mounted in or on panel.

C. Prior to final fabrication of panels, verify layout of front-of-panel devices with respect to rear-of-panel devices. Maintain minimum of 3 inches clearance between door and sub-panel mounted devices.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry

practices.

B. Coordinate housecleaning pad dimensions with enclosure dimensions.

C. Install control panels in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.

D. UL Listed Panels shall have engraved nameplate on outside of enclosure showing electrical data as required by UL Listing and NEC (i.e: voltage/phase/frequency, max FLA, AIC, etc.).

E. Touch-up panel finish if marred during installation using manufacturer's paint matching enclosure.

F. Each Panel shall have (3) sets of "as installed" final circuit Drawings.

3.02 IDENTIFICATION

A. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

SECTION 40 67 63
UNINTERRUPTIBLE POWER SUPPLY

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes UPS equipment.

C. Site Conditions:

1. Input power: 120Vac utility grade.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC National Electric Code

B. NEIS National Electrical Installation Standards

C. PLC Programmable Logic Controller

D. UL Underwriters Laboratories

E. UPS Uninterruptible Power Supply

1.03 SUBMITTALS

A. General:

1. Tabulated listing of all device and equipment power loads connected to UPS for each installation. This shall be used to identify UPS sizing requirements together with requirements listed below.
2. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
3. Submit Product Data and Shop Drawings in one complete submittal package.
4. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test for equipment in service.
3. Manufacturer's written instructions for periodic battery replacement for equipment in service.
4. Submit in accordance with Section 01 78 23.

PART 2 – PRODUCTS

2.01 UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturer:

1. Liebert.
2. No Substitutes Allowed.

B. Features:

1. UPS shall power all PLC control panel device loads, and external connected loads as shown on Drawings.
2. Size UPS at 125% of connected electrical load (minimum).
3. Minimum UPS size shall be 1500VA.
4. Form Factor: Rack Mount.
5. Shall be mounted external to PLC panel in 19" network rack.
6. True on-line non switching uninterruptible power supply (UPS).
7. Double power conversion on-line operation including rectifier and inverter, constantly conditioned AC output.
8. UL Listed.
9. Provide manual operated bypass switch or other means to bypass UPS to allow operation of system controls in event of UPS failure.
10. Each system shall consist of a static dc to ac sine wave inverter, a battery charger, sealed batteries, a monitor and transfer switch, and accessories as listed below.
11. Each system shall operate on a 120-volt, 60-Hz ac branch circuit. The input ac circuit shall supply energy to the battery charger which shall supply energy to the inverter as well as to the battery to maintain its charge. The output of the inverter shall supply energy to the load. If the input ac circuit is interrupted, the inverter shall continue to supply energy to the load without interruption, drawing power from the battery. If the input ac circuit is restored prior to discharge of the battery, the charger shall resume the supply of energy to the inverter and shall restore the battery to full charge. In the event of malfunction of the battery charger, battery or inverter that results in interruption of the output from the inverter, the monitor shall detect this condition and shall automatically transfer the load to the system's ac input circuit within 25 milliseconds. After the malfunction is corrected, the load shall be retransferred to the inverter manually.
12. System output voltage shall be regulated within plus or minus 3 percent for input voltages of +15% to -20%. The output characteristic shall be sinusoidal with not more than 5 percent total harmonic distortion at full load with input ac circuit at 120 volts. For a 20 percent instantaneous load change, voltage overshoot or undershoot shall be not more than plus or minus 10 percent. For a 10 to 90 percent load change, recovery time shall be not longer than 100 milliseconds.
13. Input protection shall be provided by a panel-mount circuit breaker. Each inverter shall be the load current-limiting type and each shall have overload and short circuit protection provided by a circuit breaker. Efficiency shall be 85 percent minimum.
14. UPS shall supply power to PLC, HMI, Ethernet Switches, DC power supplies, field instruments, and other low voltage control devices as specified and as shown on Drawings and Plans.
15. UPS shall have enough capacity to power connected devices for a period of 15 minutes after the utility power has failed. Provide with extended battery module(s) to meet this requirement.
16. UPS shall include dry contact I/O module: low battery, utility power fail, and equipment malfunction/failure.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Condition power as required to provide stable Process Control System.

B. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 70 00
INSTRUMENTATION OF PROCESS SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes instrumentation and initial parameters.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC National Electric Code

B. NEIS National Electrical Installation Standards

C. NEMA National Electrical Manufacturers Association

1.03 SUBMITTALS

A. Provide submittals under the specification section that is referenced for each instrument/device/equipment listed below.

B. Submittals are not required for Section 40 70 00.

C. Provide devices/instrumentation/equipment as listed below and as shown on Drawings:

PART 2 – PRODUCTS

2.01 CONTROL STATIONS – DEFINITIONS (Ref. Section 40 78 00)

A. TANK FULL, HORN SILENCE, LEVEL INDICATOR, HORN: Three red pilot lights for Tank Level Full indication, one black momentary pushbutton for Horn Silence, three process indicators displaying Tank Level in feet, one Horn for Tank Level High-High Alarm (any tank).

B. HAND/OFF/AUTO, RUN, ESTOP, POT: One 3-position selector switch with contact blocks (XOO/OOO/OOX) for Hand/Off/Auto, one green pilot light for pump running, one red maintained position pushbutton for E-Stop, one potentiometer for speed control.

C. HAND/OFF/AUTO, RUN, POT, LEVEL INDICATOR, MISC.: Two 3-position selector switch with contact blocks (XOO/OOO/OOX) for Hand/Off/Auto, two green pilot lights for pump running, two potentiometers for speed control, one process indicator displaying Tank Level in feet, level transmitter (605-LIT-0711), panel thermostat, heater, circuit breakers, terminal blocks, etc.

2.02 CONTROL STATIONS (Ref. Section 40 67 00)

A. Provide control stations as defined in CONTROL STATIONS – DEFINITIONS above.

B. Mount operators in common control station enclosures with specified rating in accordance with room classification shown on Drawings and listed in table below:

Tag	Equipment	Type	Material	NEMA Rating

Tag	Equipment	Type	Material	NEMA Rating
125-TFCP-1	ALUM Tanks Truck Fill Control Panel	A	FRP	4X
600-CS-0601	Thickened Sludge Pump 1 Control Station	B	316-SS	4X
600-CS-0602	Thickened Sludge Pump 2 Control Station	B	316-SS	4X
605-CS-0700	Process Drain Pumps Control Station	C	316-SS	4X

2.03 MAGNETIC FLOWMETERS (Ref. Section 40 71 00)

Tag	Description	Service	Pipe Dia. (in)	Liner	Range (gpm)
600-FE/FIT-0521	GBT's DSS Flow	Sludge	4	PTFE, PFA or ETFE	0-150
600-FE/FIT-0531	GBT 1 WAS Flow	Sludge	6	PTFE, PFA or ETFE	0-400
600-FE/FIT-0532	GBT 2 WAS Flow	Sludge	6	PTFE, PFA or ETFE	0-400
600-FE/FIT-0541	GBT 1 PSD Flow	Sludge	4	PTFE, PFA or ETFE	0-150
600-FE/FIT-0542	GBT 2 PSD Flow	Sludge	4	PTFE, PFA or ETFE	0-150

2.04 FLOW SWITCH, THERMAL DISPERSION (Ref. Section 40 71 00)

Tag	Description	Class 1 Div 1	Setting (gpm)
120-FSH-0171	120/125 Emergency Eyewash & Shower Stations	No	Minimum
600-FSH-0371	600 Emergency Eyewash & Shower Station	No	Minimum

2.05 FLOW AVERAGING TUBE, THERMAL DISPERSION (Ref. Section 40 71 00)

Tag	Description	Class 1 Div 1	Range (SCFM)
600-FE-0801 and 600-FIT-0801	GBT Room Odorous Air Flow	No	0-5,000

2.06 LEVEL ELEMENT AND TRANSMITTER, ULTRASONIC (Ref. Section 40 72 00)

Tag	Location	Range (ft)
600-LE-0621 and 600-LIT-0621	GBT Discharge Chute 1 Level	0-12
600-LE-0622 and 600-LIT-0622	GBT Discharge Chute 2 Level	0-12

2.07 LEVEL ELEMENT AND TRANSMITTER, MICROWAVE RADAR (Ref. Section 40 72 00)

Tag	Location	Range (ft)
605-LE-0711 and 605-LIT-0711	Process Drain Pump Station Level	0-15

2.08 LEVEL SWITCH, BALL FLOAT (Ref. Section 40 72 00)

Tag	Location	Trip Elevation

605-LSL-0721	Process Drain Pump Station Low/Cutout Alarm	511.25
605-LSHH-0722	Process Drain Pump Station High High Alarm	514.75

2.09 LEVEL SWITCH, VERTICAL FLOAT (Ref. Section 40 72 00)

Tag	Location	Trip Elevation
605-LSH-0741	Process Drain Valve Vault	2” above sump floor

2.10 PRESSURE GAUGE / INDICATOR (Ref. Section 40 73 00)

Tag	Location	Seal Type	Range
125-PI-0161	W3 Supply Pressure	Diaphragm	0-100 psi
600-PI-0601	Thickened Sludge Pump 1 Discharge Pressure	Annular	0-200 psi
600-PI-0602	Thickened Sludge Pump 2 Discharge Pressure	Annular	0-200 psi
605-PI-0731	Process Drain Pump 1 Discharge Pressure	Diaphragm	0-30 psi
605-PI-0732	Process Drain Pump 2 Discharge Pressure	Diaphragm	0-30 psi

2.11 PRESSURE INDICATING TRANSMITTER (Ref. Section 40 73 00)

Tag	Location	Seal Type	Range
125-PIT-0101	ALUM Tank No. 1 Pressure (Level)	Diaphragm	0-18ft
125-PIT-0102	ALUM Tank No. 2 Pressure (Level)	Diaphragm	0-18ft
125-PIT-0103	ALUM Tank No. 3 Pressure (Level)	Diaphragm	0-18ft
600-PIT-0510	GBT W3 Washwater Supply Pressure	Diaphragm	0-120psi

2.12 PRESSURE SWITCH (Ref. Section 40 73 00)

Tag	Location/Range	Seal Type	Settings (psi)
600-PSL/H-0601H	Thickened Sludge Pump 1 Discharge Pressure	Annular	High Set: 175 Low Set: 10
600-PSL/H-0602H	Thickened Sludge Pump 2 Discharge Pressure	Annular	High Set: 175 Low Set: 10

2.13 PRESSURE SEAL, ANNULAR (Ref. Section 40 73 00)

Tag	Description	Pipe Dia.	Service
600-PE-0601	Thickened Sludge Pump 1 Discharge	6”	Sludge
600-PE-0602	Thickened Sludge Pump 2 Discharge	6”	Sludge

2.14 ELECTRONIC TEMPERATURE INDICATING TRANSMITTER (Ref. Section 40 74 00)

Tag	Description	Range (°F)
600-TIT-0601	Thickened Sludge Pump 1 Casing Temperature	32-140
600-TIT-0602	Thickened Sludge Pump 2 Casing Temperature	32-140

2.15 ORP ANALYZER (Ref. Section 40 75 00)

Tag	Location	Range (mV)
150-AE-1A2	Tank 1, Selector Zone 1A2	+/- 2000
150-AE-2A2	Tank 2, Selector Zone 2A2	+/- 2000
150-AE-3A2	Tank 3, Selector Zone 3A2	+/- 2000
150-AE-4A2	Tank 4, Selector Zone 4A2	+/- 2000
150-AE-5A2	Tank 5, Selector Zone 5A2	+/- 2000
150-AE-6A2	Tank 6, Selector Zone 6A2	+/- 2000
160-AE-7A2	Tank 7, Selector Zone 7A2	+/- 2000
160-AE-8A2	Tank 8, Selector Zone 8A2	+/- 2000
160-AE-9A2	Tank 9, Selector Zone 9A2	+/- 2000
160-AE-10A2	Tank 10, Selector Zone 10A2	+/- 2000
160-AE-11A2	Tank 11, Selector Zone 11A2	+/- 2000
160-AE-12A2	Tank 12, Selector Zone 12A2	+/- 2000

2.16 DO ANALYZER (Ref. Section 40 75 00)

Tag	Location	Range (mg/L)
150-AE-1B	Tank 1, Pass B	0-10
150-AE-2B	Tank 2, Pass B	0-10
150-AE-3B	Tank 3, Pass B	0-10
150-AE-4B	Tank 4, Pass B	0-10
150-AE-5B	Tank 5, Pass B	0-10
150-AE-6B	Tank 6, Pass B	0-10
160-AE-7B	Tank 7, Pass B	0-10
160-AE-8B	Tank 8, Pass B	0-10
160-AE-9B	Tank 9, Pass B	0-10
160-AE-10B	Tank 10, Pass B	0-10
160-AE-11B	Tank 11, Pass B	0-10
160-AE-12B	Tank 12, Pass B	0-10

2.17 ORTHO-PHOSPHATE ANALYZER (Ref. Section 40 75 00)

Tag	Location	Range
195-OPA-1201	Building 195, Effluent Pumping Room	0.05 mg PO4-P/L to 15 mg PO4-P/L

2.18 ANALYTICAL TRANSMITTER/CONTROLLER (Ref. Section 40 75 00)

Tag	Home Location	Connection
120-AIT-0001	Building 120, Laboratory Room (for sensor calibration)	JB10
170-AIT-1000	Building 170, Electrical Room	JB4 or JB8
195-AIT-1200	Building 195, Effluent Pumping Room	JB9

2.19 PROCESS GAS MONITORING (Ref. Section 40 76 00)

Tag	Location	Gas Sensed	Range (ppm)
600-AE/AIT-1420	GBT Room	Hydrogen Sulfide	0-50

2.20 DOOR INTRUSION SWITCH (Ref. Section 40 79 00)

Tag	Location	NEMA Rating
600-ZS-0591	GBT Room, Stairwell Entrance	4X
600-ZS-0592	GBT Room, SE Entrance, Door 1	4X
600-ZS-0593	GBT Room, SE Entrance, Door 2	4X
600-ZS-0594	GBT Room, NE Entrance, Door 1	4X
600-ZS-0595	GBT Room, NE Entrance, Door 2	4X

2.21 INTERIOR/EXTERIOR MOUNTED ALARM LIGHTS (Ref. Section 40 79 00)

Tag	Location	Controlled By:	NEMA Rating
600-YA-1421	GBT Room, Interior	600-AE/AIT-1421	4X
600-YA-1422	GBT Room NE Entrance, Exterior	600-AE/AIT-1421	4X
600-YA-1423	GBT Room SE Entrance, Exterior	600-AE/AIT-1421	4X
600-YA-1424	GBT Room South Entrance, Exterior	600-AE/AIT-1421	4X
600-YA-1425	Pump Room, Lower Level, Interior	600-AE/AIT-1421	4X
600-YA-1431	GBT Room, Interior	600-TCP-1	4X
600-YA-1432	GBT Room NE Entrance, Exterior	600-TCP-1	4X
600-YA-1433	GBT Room SE Entrance, Exterior	600-TCP-1	4X
600-YA-1434	GBT Room South Entrance, Exterior	600-TCP-1	4X
600-YA-1435	Pump Room, Lower Level, Interior	600-TCP-1	4X

2.22 TRANSMITTER CABINET (Ref. Section 40 67 00)

A. Environmental protection for outdoor transmitters.
B. Transmitters specified elsewhere in Section 40 75 00.
C. Framed polycarbonate window in housing door or cover.
D. 60 watt panel heater (minimum) with adjustable thermostat.
E. Circuit breakers (4) for transmitter, GFCI, panel, and spare.
F. Mount weatherproof GFCI on external side of cabinet as convenience receptacle (separate 120V circuit). GFCI in accordance with Section 26 27 26.

Tag	Equipment	Sensors	NEMA Rating

150-TX-0901	Tanks 1 and 2 DO and ORP	150-AE-1A2	4X-SS
		150-AE-2A2	
		150-AE-1B	
		150-AE-2B	
150-TX-0902	Tanks 3 and 4 DO and ORP	150-AE-3A2	4X-SS
		150-AE-4A2	
		150-AE-3B	
		150-AE-4B	
150-TX-0903	Tanks 5 and 6 DO and ORP	150-AE-5A2	4X-SS
		150-AE-6A2	
		150-AE-5B	
		150-AE-6B	
160-TX-1005	Tanks 11 and 12 DO and ORP	160-AE-11A2	4X-SS
		160-AE-12A2	
		160-AE-11B	
		160-AE-12B	
160-TX-1006	Tanks 9 and 10 DO and ORP	160-AE-9A2	4X-SS
		160-AE-10A2	
		160-AE-9B	
		160-AE-10B	
160-TX-1007	Tanks 7 and 8 DO and ORP	160-AE-7A2	4X-SS
		160-AE-8A2	
		160-AE-7B	
		160-AE-8B	

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 71 00
FLOW MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field flow elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 MAGNETIC FLOWMETERS

A. Manufacturer:

1. ABB Watermaster.
2. No Substitute Permitted.

B. Design is based on startup average velocity of 3 ft/sec through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.

C. Flowmeter system accuracy shall be ±0.25% of flow rate over 10:1 turndown minimum. Repeatability shall be ±0.1% and response time programmable from 1 sec to 100 sec.

D. Meters shall be furnished with NIST certification of calibration.

E. Flow Element:

1. Low frequency, electromagnetic induction type producing dc pulse signal directly proportional and linear to liquid flow rate.
2. Splashproof and weather-resistant design housing with accidental submergence rating. Watertight external and internal electrical conduit connections.
3. Provide power from signal converter.
4. Unless otherwise specified, materials of construction shall be:

a. Flow meter liner: PTFE, PFA, or ETFE

b. Electrode materials: Hastelloy® C.
c. Electrode type; Bullet nose.
d. Grounding rings: 316 Stainless Steel.
e. See Section 40 70 00 for additional requirements.

5. Use 2x grounding rings or gaskets on each end of magnetic flow meter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
6. Sensing head interchangeable with meter body of same manufacturer without performing flow recalibration.
7. High impedance device of not less than 1012 ohms to minimize span shift due to electrode coating.
8. Explosion-proof sensor element certified by Factory Mutual Research for Class I, Division I, Groups C and D when sensor is located in hazardous area.
9. Laying length of meters shall be minimum of 1-1/2 times nominal meter size.

F. Transmitter:

1. Integrally mounted according to Drawings and Plans, microprocessor controlled.
2. Operate on 120Vac, 60 Hz power.
3. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
4. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
5. Span to be continuously adjustable between 2 and 31 ft/sec. Adjustment shall be by keypad.
6. Display shall have 2 rows of 16 alpha numeric characters minimum. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable.
7. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
8. Output: 4-20mA.
9. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units as listed in Section 40 70 00.
10. Noise reduction feature to minimize effects of noise generating processes.
11. Automatic empty pipe detection.
12. Suitable for -5°F to +140°F ambient temperature.

2.02 FLOW SWITCH, THERMAL DISPERSION

A. Manufacturer:

1. Fluid Components, Inc.
2. Sierra Instruments, Inc.
3. Endress and Hauser

B. General

1. System shall measure and transmit flow conditions as specified in Section 40 70 00.
2. Installation in accordance with detail N372.
3. Medium: Tempered city water for eyewash application.

C. Sensor:

1. 3/4” NPT adapter for process connection.
2. Integral electronics housing.
3. 120Vac Power supply.
4. AC relay (normally open) output.
5. Medium Temperature Range: 40°F to 140°F.
6. Thermal Dispersion type using dual RTD’s.

7. 316 stainless steel wetted parts.

2.03 FLOW AVERAGING TUBE, THERMAL DISPERSION

A. Manufacturer:

1. Eldridge Products Inc.
2. Or equal.

B. General

1. System shall measure and transmit flow conditions as specified in Section 40 70 00.
2. Installation in accordance with detail N373.
3. Medium: Odorous air from GBT operation application using digested sludge.

C. Sensor Element:

1. NPT process connection (coordinate with FRP manufacturer.
2. Integral electronics enclosure.
3. Medium Temperature Range: 40°F to 100°F.
4. 100:1 turndown ratio.
5. Thermal Dispersion type using dual RTD's.
6. Wetted materials: Hastelloy C276.

D. Transmitter:

1. Integral electronics housing.
2. Display: 2-line 16 character LCD (rate, total, milliwatts, temperature, event)
3. 120Vac Power supply.
4. Linear 4-20mA output for flow and temperature.
5. Two event relays.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 72 00
LEVEL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field level elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. PVDF: Polyvinylidene Fluoride (Kynar)

M. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 LEVEL ELEMENT AND TRANSMITTER, ULTRASONIC

A. Application: level measurement of thickened sludge in discharge chute.

B. Manufacturer:

1. Siemens LUT420.
2. No substitutes allowed.

C. Transducer:

1. 6° beam angle (maximum).
2. For wet applications.
3. Transducer shall emit ultrasonic signal with time lapse between transmitted and received signal converted into usable voltage capable of driving totalizer, sample rate counter, and liquid level indicator. DC voltage produced shall be proportional to distance from detector to material being measured.
4. Ambient temperatures: -40°F to +176°F.
5. Process temperatures: -40°F to +185°F.
6. Mounting shall be as shown on Drawings. Other methods of mounting will be considered if recommended by manufacturer.
7. Non-contact design detector with no moving parts or mechanical linkages.
8. Explosion-proof element certified by Factory Mutual Research for Class I, Division I, Groups C

and D when sensor is located in hazardous area.

D. Transmitter:

1. Built-in functions for open channel or weir flow calculations.
2. Ambient process area temperature compensation.
3. Shall have local LCD with bar graph indication.
4. Input Power: 120Vac.
5. Output: 4-20mA.
6. Nema type 4X PBT enclosure
7. </= 3mm resolution
8. Accuracy: +/- 1 mm + 0.17% of measured distance.
9. 10” maximum blanking distance.
10. Located indoors in non-corrosive environment.

E. Cable:

1. Provide sufficient standard length of manufacturer’s signal cable connecting meter and converter without splice.

F. Measurement Requirements:

1. Range of measurement as described in Section 40 70 00.

G. Additional Requirements:

1. Mounting in accordance with detail N283 and shall take into consideration sensor blanking distance.

2.02 LEVEL ELEMENT AND TRANSMITTER, MICROWAVE RADAR

A. Manufacturer:

1. Vega VEGAPULS64 with VEGADIS 82 remote signal conditioner and display.
2. Or Equal.

B. Antenna:

1. Design transducer to emit radar signal with time lapse between transmitted and received signal converted into usable voltage capable of driving totalizer, sample rate counter, and flow rate meter or liquid level indicator. DC voltage produced shall be proportional to distance from detector to material being measured.
2. Operation in the W-band (80GHz) frequency range.
3. Maximum beam angle of 3° (80mm antenna)
4. Operating temperature: -40°F to +176°F.
5. Process temperature: -40°F to +176°F.
6. Deviation: +/- 2mm.
7. Housing material: PP/PTFE/PBT.
8. Protection: IP68 (2bar).
9. Electronics: 2-wire 4-20mA (HART)
10. Impervious to damage from submersion in wastewater or concentrated ferric chloride or alum, and have high resistance to corrosive and gaseous industrial atmosphere.
11. Mounting shall be in accordance with detail N239. Other methods of mounting will be considered if recommended by manufacturer.
12. Non-contact design detector with no moving parts or mechanical linkages.
13. Explosion-proof certified by Factory Mutual Research (FM) or intrinsically safe for Class I,

Division I, Groups C and D when sensor is located in hazardous area.

C. Transmitter:

1. Provide remote signal conditioner and display (VEGADIS 82).
2. Output: 4-20 mA, signal for remote indication from each monitoring unit.
3. Enclosure: Aluminum housing, IP66/IP68.
4. Temperature: -4°F to 140°F.

D. Cable:

1. Provide sufficient length of cable as standard to connect antenna to local junction box without splicing.

E. Design Requirements:

1. Based on Drawings, installation details, and Section 40 70 00, radar manufacturer shall select radar equipment; type of antenna, horn diameter, antenna length, or extensions required, and flange connection with Contractor for each location.
2. Radar shall be configured and programmed by manufacturer's representative on-site.
3. All hardware and/or software required for programming, calibration, and signal interrogation shall be included.

2.03 LEVEL SWITCH, BALL FLOAT

A. Manufacturers:

1. Contegra FS 90.
2. Siemens 9G-EF.
3. Or Equal.

B. Float: Teflon coated Stainless Steel.

C. Provide sufficient length of PVC jacketed cable to connect to junction box without splice.

D. For Class 1, Divisions 1 or 2 hazardous (classified) locations, provide intrinsically safe barriers in corresponding control panel.

E. Mounting Hardware: 316 Stainless Steel on vertical mounting pipe as indicated on detail Drawings.

F. Switch: Non-Mercury tilt type 1A@150Vac/Vdc non-inductive.

2.04 LEVEL SWITCH, VERTICAL FLOAT

A. Manufacturer:

1. Contegra FS 202.
2. No Substitute Permitted.

B. Stem: PBT.

C. Float: Buna-N.

D. Retention clip: PVDF (Kynar).

E. When located in Class 1, Divisions 1 or 2 hazardous (classified) locations, provide intrinsically safe

relay in corresponding control panel.

F. Mounting shall be in accordance with manufacturer's recommendations.

G. Switch: Magnetically actuated, hermetically sealed, snap action reed switch for low potential, low current, dry circuit applications.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 73 00
PRESSURE, STRAIN, AND FORCE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field pressure elements, sensors, switches, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. PVDF: Polyvinylidene Fluoride (Kynar)

M. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 PRESSURE GAUGE / INDICATOR

A. Manufacturers:

1. Ashcroft 1009.
2. U.S. Gauge, Division of Ametek, Inc.
3. No substitutes permitted.

B. Gauge Housing Material: 316 Stainless Steel

C. Mounting: Stem

D. Dial Size: 3-1/2 inch

E. Units shall be bellows or Bourdon tube actuated pressure gauges. Gauges shall be stem mounting with 3-1/2-inch dial size, unless otherwise noted.

F. Accuracy shall be ±1% of span at ambient conditions of 73.4°F and 29.92” Hg barometric pressure. ASME B40.100 Grade 1A minimum.

G. The sensing element material shall be phosphor-bronze if coupled with diaphragm seal, otherwise provide type 316 stainless steel.

H. Element shall sense pressure or vacuum with scale range as specified in Section 40 70 00.

I. Element shall be suitable for temperatures of media monitored.

J. Liquid filled for alleviation of vibration.

K. For positive displacement pump applications:

1. In addition to liquid filled, provide throttle plug pulsation dampener on the discharge side.
2. Select material and NPT connection based on application and installation.

L. Accessories:

1. Include isolation valve to isolate from process when being serviced.
2. When noted in Section 40 70 00, provide with diaphragm seal as specified in this Section.

2.02 PRESSURE INDICATING TRANSMITTER

A. Manufacturers:

1. Foxboro.
2. No substitute permitted.

B. Capacitance open loop principle device to produce analog current signal as function of liquid level input to it.

C. Housing: Threaded cover, aluminum.

D. Wetted Parts (Process Side): Flush mount, Type 316 stainless steel diaphragm.

E. Measurement Requirements:

1. Range of measurement as described in Section 40 70 00.

F. Output: 4-20 mAdc into 400 ohms (24Vdc power) or 1,000 ohms (45Vdc power).

G. Adjustments: Zero, span, and dampening.

H. Performance:

1. Accuracy: ±0.15% of span including temperature and static pressure effects.
2. Turndown: 100:1 or better.
3. Temperature: Operating range -40°F to +185°F, minimum.

I. Construction: NEMA 7 explosion-proof, FM approved for Class I, Division 1 service when located in classified area.

J. Accessories:

1. Weatherproof integral output indicator scaled to engineering units indicated in Section 40 70 00.
2. Provide with 316 SST 2-valve manifold if required by application.
3. Mounting as shown in N detail drawings.

2.03 PRESSURE SWITCH

A. Manufacturers:

1. Ashcroft Type 400/700 Series.
2. United Electric 100 Series.
3. No substitute permitted.

B. Independently adjustable dual set-point pressures.

C. Set Point Repeatability: +/- 1% of range.

D. Pressure set-points as noted in Section 40 70 00.

E. Fixed deadband.

F. Hermetically sealed SPDT rated at 5 amps, 120Vac. (may be wired normally open or normally closed).

G. Process connection: ½ inch NPT.

H. Type: Housed diaphragm type.

I. Actuator Seal: Buna-N (for process temperatures 0°-150°F), Viton (for process temperatures 150°-300°F).

J. Housing: NEMA 4 or NEMA 7 as required for installation environment.

K. Adjustment: External tamperproof.

L. When more than one discrete signal is shown on drawings, provide dual SPDT outputs.

M. Accessories:

1. Include isolation valve to isolate from process when being serviced.
2. When noted in Section 40 70 00, provide with diaphragm seal as specified in this Section.

2.04 PRESSURE SEAL, ANNULAR

A. Manufacturers:

1. Red Valves Series 40.
2. RKL (a Red Valve Company).
3. Onyx Valve Company.
4. No substitute permitted.

B. End Connections: ANSI 150 pound flanged unless otherwise noted

C. Flange Construction: Carbon Steel.

D. Flexible Cylinder: Viton (Polymer)

E. Filling Fluid: Silicone

F. Unit shall be pressure-sensing, pipe spool type suitable for measuring dirty or corrosive fluids.

G. Unit shall consist of a carbon steel pipe spool and an elastomeric liner with a space between filled with the noted fluid.

H. Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the spool wall to a pressure-sensing device attached and sealed to the spool by a drilled and threaded boss.

I. Unit shall be sized as noted in Section 40 70 00.

J. Seal shall be suitable for fluid pressures to 200 psig and shall be furnished with a Buna-N flexible cylinder, unless otherwise noted.

K. Unit shall have fill connections and other features required to permit refill of the seal volume and calibration of unit in the field.

L. All wetted materials shall be fully compatible with thickened sludge media.

2.05 PRESSURE SEAL, DIAPHRAGM

A. Manufacturers:

1. Ametek, Mansfield and Green Division, Type SG.
2. Ashcroft Type 101.
3. Chemline Plastics SG series (for chemical applications)
4. No Substitute Permitted.

B. Diaphragm Material: Type 316 Stainless Steel (PTFE for chemical applications).

C. Lower Housing Material: Type 316 Stainless Steel with flushing connections (PVDF for chemical applications).

D. Upper Housing Material: Steel with bleed screw (PVDF for chemical applications).

E. Connections: Threaded Female NPT.

F. Filling Fluid: Silicone.

G. Unit shall be pressure-sensing suitable for measuring dirty or corrosive fluids.

H. Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the lower housing to a pressure-sensing device attached and sealed to the upper housing by a drilled and threaded boss.

I. Seal shall be suitable for fluid pressures to 500 psig (180 psig for chemical applications).

J. Unit shall have fill connections and other features required permitting refill of the seal volume and calibration of unit in the field.

K. Unit shall be suitable of for temperature of media monitored.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel (lamicoid plastic when installed in chemical applications) tag permanently affixed to each instrument.

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 74 00
TEMPERATURE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes thermal field elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 ELECTRONIC TEMPERATURE INDICATING TRANSMITTER

A. Manufacturers:

1. PR Electronics 7501.
2. Rosemount 3144P.
3. Endress+Hauser TMT142.
4. No Substitute Permitted.

B. Features:

1. Housing: 4X painted aluminum ½-14 NPT
2. Cover O-rings: Buna-N.
3. Output: 4-20mA
4. Single sensor input.
5. FM Explosion-proof approved for Class I, Division 1 service when located in classified area.
6. LCD display including engineering units.
7. Internal transient protection.
8. Update time: 1 second or less.
9. Accuracy: +/- 0.2% of span for RTD’s.
10. Temperature limits: -40 to 185°F.
11. Accepts inputs from any the following:

a. 2-wire RTD’s.
b. 3-wire RTD’s.

c. 4-wire RTD's.
d. Thermocouple (Types B, E, J, K, N, R, S, T).
e. Millivolt (-10 to 100mV).
f. 2,3,4-wire ohm (0 to 2,000 ohms).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 75 00
PROCESS LIQUID ANALYTICAL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field mounted sensors and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS

A. CPVC: Chlorinated PolyVinyl Chloride

B. LCP: Local Control Panel

C. ORP: Oxidation Reduction Potential

D. RTD: Resistance Temperature Detector

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NRTL: Nationally Recognized Testing Laboratory

J. OSHA: Occupational Safety and Health Administration

K. UL: Underwriters Laboratories

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.06 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 ORP ANALYZER

A. Manufacturer:

1. Xylem-YSI SensoLyt 700IQ with SensoLyt PtA.
2. No Substitute Permitted.

B. General:

1. Probe to sense/indicate/transmit oxidation-reduction potential for continuous monitoring *in situ* using PtA electrode.
2. Connect sensor to field-mounted junction box input modules as shown on Drawings.
3. System components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer’s warranty when installed using manufacturer’s recommended components per manufacturer’s instructions.

C. Probe:

1. Probe shall contain glass and reference electrode, thermo-compensator, and pre-amplifier for electrode.
2. Range: +/-2000 mV.
3. 316 Stainless steel or PVC/LCP case, platinum electrode, refillable reference electrode with ceramic plug.
4. Sensitivity: < 0.5 mV.
5. Operating Temperature: 32°F to 140°F (0°C to 60°C).
6. Pressure:

    1) 0°C to 20°C: 10 bar.
    2) 30°C: 5 bar.
    3) 40°C: 3 bar.
    4) 60°C: 1 bar.

7. Provide adequate length of sensor connection cable to connect sensor to field-mounted junction box input modules as shown on Drawings plus an additional 15ft.
8. Mounting apparatus shall be by sensor manufacturer. Quick-release stainless steel adapted to fit on handrail specified elsewhere.
9. Locations and quantities as shown on drawings and listed in Section 40 70 00.

2.02 DISSOLVED OXYGEN ANALYZER

A. Manufacturer:

1. Xylem-YSI FDO 700IQ.
2. No Substitute Permitted.

B. General:

1. Probe to sense/indicate/transmit dissolved oxygen for continuous monitoring *in situ* using optical sensors that measure lifetime of luminescence caused by the presence of oxygen.
2. Connect sensor to field-mounted junction box input modules as shown on Drawings.
3. System components shall be designed to be part of a process control system that is protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.

C. Probe:

1. Probe shall contain optical source and detectors.
2. Cable length as required by application
3. 316 Stainless steel or PVC/LCP case.
4. Submersible mounting, as shown on Drawings.
5. Measuring Range: 0 to 20 mg/L.
6. Operating Temperature: 32 to 140ºF.
7. Sensor Pressure limit: less than 10 bar.
8. Accuracy:

    a. ± 0.05 mg O_2/L in the range less than 1 mg O_2/L
    b. ± 0.10 mg O_2/L in the range greater than 1 mg O_2/L

9. Repeatability: ± 0.05 mg O_2/L.
10. Resolution: 0.01 mg O_2/L.
11. Provide adequate length of sensor connection cable to connect sensor to field-mounted junction box input modules as shown on Drawings plus an additional 15ft.
12. Mounting apparatus shall be by sensor manufacturer. Quick-release stainless steel adapted

to fit on handrail specified elsewhere.
13. Locations and quantities as shown on drawings and listed in Section 40 70 00.

2.03 ORTHO PHOSPHATE ANALYZER

A. Manufacturer:

1. Xylem-YSI P 700 IQ.
2. No Substitute Permitted.

B. Application - An automatic analyzer for rapid batch analysis of ortho-Phosphorous in wastewater plant effluent water.

C. Range as described in Section 40 70 00.

D. Accuracy: ± 2% or ±0.05 mg/l. (whichever is greater).

E. Resolution: 0.01 mg/L.

F. Automatic calibration interval: 6 to 96 hours (user-selectable).

G. Cycle Time: 10 minutes to 12 hours (field programmable).

H. The analyzer shall automatically detect ortho-Phosphorous through a detection cell in potable water or wastewater samples that contain up to 15 ppm of suspended solids. Provide filtering if required to meet 15 ppm requirement. Sample flow shall be from a sample line able to deliver a minimum of one liter per minute sample flow to the analyzer at specified pressure.

I. The analyzer shall provide an operator interface including a back lit LCD display. The analyzer shall be capable of auto-calibration.

J. The analyzer shall provide a continuous, isolated 4-20mA analog output. The analyzer shall provide 3 programmable dry contact outputs.

K. The analyzer shall be supplied in a NEMA-4X enclosure. Power for the analyzer shall be 100 to 240Vac, 50/60 Hz, 120Vac through a ½" conduit size hole for a field-wired option.

L. The analyzer shall be furnished with an Operation and Maintenance manual containing installation instructions, instructions for startup, instructions for adjustment during operation, plus instructions for periodic and routine maintenance. A one year supply of reagents for low concentration analysis shall be furnished. Reagents shall have a minimum 1 year shelf life under normal storage conditions.

M. The analyzer shall carry a minimum warranty of two years from the date of shipment, covering workmanship, materials and components.

N. The analyzer shall carry a CSA-US or other approved NRTL and shall be designed to operate in an ambient environment of 5-50°C.

O. Provide Sample Preparation Unit (195-SPU-1201) as follows:

1. The system shall continuously supply a sample free of bacteria and suspended solids.
2. The system shall be a self-cleaning type with 0.4-micron pore filtration elements.
3. The system shall deliver up to 3.6 liters per hour of filtrate.
4. The system shall be capable of operating for up to six months between required maintenance.

5. The system shall be housed in a 316 stainless steel enclosure.
6. Ambient temperature operating range shall be 0° C to 40° C.
7. Sample flow requirements to the system shall be 2 to 8 gallons per minute.
8. The system will operate on 115/230 VAC, 50/60 Hz power.

2.04 TRANSMITTER/CONTROLLER

A. Manufacturer:

1. Xylem-YSI 2020 XT.
2. No Substitute Permitted.

B. General:

1. Shall be capable of communicating Ethernet/IP with communications module as an accessory mounted in locations detailed in Section 40 70 00.
2. Graphical display, 320 x 240 pixels, backlit.
3. Integrated lightning protection.
4. Operating temperature: -4°F to 131°F.
5. Material: ASA (Acrylonitrile-Styrene-Acryloesterpolymer) or ABS.
6. Rating: IP-66, equivalent to NEMA 4X (not suitable for conduit connection)
7. Dimensions: 210 W x 170 H x 40 D mm (8.27 W x 6.69 H x 1.57 D in)
8. Weight: 0.7 kg (1.54 lbs)
9. Capable of accepting up to 20 sensors on network.
10. Data logging of 525,600 data sets.
11. Warranty: 3 years.
12. Locations and quantities as shown on drawings and listed in Section 40 70 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.
B. Provide controller communications modules, power supply modules, and sensor modules as shown on drawings and for a complete and operable network system(s).

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 76 00
PROCESS GAS ANALYTICAL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field mounted sensors and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS

A. CPVC: Chlorinated PolyVinyl Chloride

B. LCP: Local Control Panel

C. ORP: Oxidation Reduction Potential

D. RTD: Resistance Temperature Detector

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electric Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NRTL: Nationally Recognized Testing Laboratory

J. OSHA: Occupational Safety and Health Administration

K. UL: Underwriters Laboratories

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.06 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 PROCESS GAS MONITORING (HYDROGEN SULFIDE)

A. Manufacturer:

1. MSA Ultima X5000.
2. No substitute permitted.

B. Provide sensor and transmitter in quantities as shown on Drawings and as listed in Section 40 70 00.

C. Sensor/Transmitter Operating Requirements:

1. Operating Voltage - The sensor/transmitter can operate between 10-30Vdc.
2. Sensor/transmitter electronics shall consist of one PCB. The PCB shall offer expandability to allow for optional LED’s and relays. The single PCB shall not require tools for installation or removal. The single PCB must be self-aligning in the enclosure.
3. Sensor/transmitter shall require the following wiring configurations:

a. 3-wire cable for electrochemical (toxic and oxygen sensors) units configured with LED and relay options.

4. Sensor/transmitter shall allow for optional reset connector for resetting latched alarms.
5. Set-up and start-up of the sensor/transmitter will be so that the enclosure need not be opened during this process.
6. Sensor/transmitter shall be factory calibrated, ready for use out of the box. A gas check is all that is required to ensure proper operation.
7. Sensor/transmitter output signal shall be capable of 4 to 20mA. The toxic gas sensor/transmitter will operate on a 2-wire or 3-wire current loop.

D. Sensor/Transmitter Display:

1. There will be a local display indicating the gas type being monitored and the concentration of gas present.
2. The display will alternate between the gas type (1 second) and gas concentration (5 seconds).
3. The display will be an integral part of the sensor/transmitter enclosure. The display will be visible from a minimum of 5 feet and will be present always, and will not require being turned on or off. This readout will be three, one half-inch (3-1/2") digit Liquid Crystal Displays (LCD).
4. Sensor/transmitter display shall indicate all diagnostic check/fault conditions with a scrolling message detailing the condition. Error codes shall not be used.
5. Sensor/transmitter will display 3 levels of alarm. Alarm levels will be user adjustable.

E. Smart Sensor Technology:

1. Sensors shall be contained in sensor modules mounted external to the main enclosure.
2. All sensor modules shall have the capability of replacement while the unit is under power (hazardous areas) without the need for tools.
3. Sensor modules shall contain all relevant sensor information within the module. This information shall include sensor manufacturer date, gas type, gas range, calibration data, and default relay parameters.
4. Sensor module shall store all calibration data so that the module may be calibrated off site and installed in the field without the necessity of recalibration. The sensor module shall not require a battery or power source to store this data.

F. LED / Relay Options:

1. Sensor/transmitter shall have optional LED's, viewable from 50 feet minimum. The LED's shall operate as follows:

   a. Solid green LED – normal operation (measure mode)
   b. Solid red LED – fault condition
   c. Blinking red LED – alarm condition

2. Sensor/transmitter shall have optional relays. Relays shall be rated at 5 amps @ 30VDC, 5 amps @ 220VAC, single-pole, double-throw and consist of three for alarm levels and one for fault. All relay contact activation will be monitored. If the relay cannot activate for any reason, the trouble relay will change state. All relays shall be field selectable through a non-intrusive hand-held wireless remote control unit (Controller) or a HART hand held communicator. Selectable features include:

   a. Alarm level
   b. Latching / Non-latching
   c. Upscale / Downscale

d. Normally-opened / Normally-closed
e. Energized / De-energized

G. Other Features:

1. Sensor/transmitter shall allow for full range scaling of the 4-20mA-output signal.
2. Sensor/transmitter will be capable of storing and displaying average, minimum and maximum gas concentrations over selected periods of time.
3. The sensor/transmitter will give an indication of when sensor is nearing the end of its useful life by means of the front panel LCD. This indication that the sensor is nearing its useful life will be based on the sensor output. It shall not be based on the time the sensor was in service.
4. The sensor/transmitter units can be located remote from a monitor/readout unit by up to 4,000 feet via properly gauge wire.

H. Sensing Element Warranty:

1. All electrochemical sensing elements (sensors) will have a minimum useful life of one year. The supplier will provide replacement sensors at no charge for any sensor that does not meet the minimum requirement.
2. All Infrared sensing sources shall be warranted for 10 years. The supplier will provide replacement sensors at no charge for any sensor that does not meet the minimum requirement.

I. Sensor Enclosure Parameters:

1. Explosion-proof Sensor/Transmitter will be in an aluminum enclosure suitable for location in Class I, Division 1 & 2, Groups A, B, C & D classified areas.
2. The enclosure shall have a minimum of four entries, allowing for flexible mounting options for sensor, power, signal, and optional relay wiring.
3. The enclosure shall offer a means to mount without using an entryway.
4. Explosion-proof Sensor/Transmitter will be mounted in a single condulet. The back portion of the enclosure shall be separate from the electronics, allowing for mounting and wiring of the unit without the electronics present.
5. The readout portion of the sensor/transmitter shall have a display of the concentration of gas present. The display will be visible from a minimum of 5 feet and will be present at all times. It will not be required to be turned on or off. This readout will be three, one half inch (3-1/2”) digit Liquid Crystal Displays (LCD).

J. Approvals:

1. The explosion-proof monitor shall have Class I, Division 1 & 2, Groups A, B, C, and D; Class II, Division 1, Groups F & G; Class III approval. The explosion-proof Remote Sensor shall have Class I, Division 1 & 2, Groups A, B, C, and D, Class II, Division 1, Groups F & G; Class III approval.

K. Non-intrusive Calibration Capability:

1. Include one calibration kit with gas cylinders capable of calibrating all sensors on project for a period of two years using manufacturer printed scheduled maintenance procedures.
2. Include one full featured IR programmer/controller.
3. All sensor/transmitters can be calibrated without opening any enclosures.
4. By means of a non-intrusive hand held wireless remote control unit or a HART hand held communicator, the sensor/transmitter will enter the calibration mode. The display of the sensor/transmitter will instruct the user on when to apply zero and span gas. The sensor/transmitter will automatically adjust its internal settings to the proper calibration

values without further intervention by the user. Upon completion of a successful calibration, the sensor transmitter will exit the calibration mode. Date stamp of last successful calibration will be retained in the sensor/transmitter internal memory, with capability to be displayed on LCD. If calibration is unsuccessful for any reason, the display must show an unsuccessful calibration attempt and revert to its previous calibration settings. Use of flashlight type devices, magnets or clamp-on devices to achieve calibration is not acceptable. The acceptable methods are to use a transmitter, which employs a digitally encoded infrared light beam, or a HART hand held communicator.

5. A non-intrusive hand held wireless remote control will let the user not only do the functions of the small remote control but activate all functions and features of the sensor/transmitter.
6. The sensor/transmitter will not be affected by low level ambient light either natural or man-made.

L. Manufacturer Capability Requirements:

1. As a minimum, the Gas Monitoring Equipment manufacturer must meet the following requirements:

a. The manufacturer must be capable of supplying all equipment used to check or calibrate the sensor/transmitter units.
b. The manufacturer must be capable of providing on-site service with factory trained personnel.
c. The manufacturer must be capable of providing on-site training for owner/operator.

M. Additional

1. Tools required for sensor replacement.
1. Gas Test Kits with adapter.
2. Manufacturer shall be capable of supplying all equipment necessary to check or calibrate the sensor/transmitters.
3. The manufacturer must be capable of providing on-site service with factory trained personnel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13.

B. Section includes control panel devices for Process Instrumentation and Control Systems.

1.02 ABBREVIATIONS AND REFERENCES

A. IEC: International Electrotechnical Commission

B. IEEE: Institute of Electrical and Electronics Engineers

C. NEC: National Electric Code

D. NEIS: National Electrical Installation Standards

E. NEMA: National Electrical Manufacturers Association

F. NRTL: Nationally Recognized Testing Laboratory

G. OSHA: Occupational Safety and Health Administration

H. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Submit in accordance with Section 01 33 0.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Devices shall be latest and most modern design at time of bidding.

C. As much as possible devices shall be products of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

PART 2 – PRODUCTS

2.01 PILOT DEVICES.

A. Manufacturer:

1. Allen Bradley 800T/800H.
2. Square D Class 9001, Type K.
3. No Substitute Permitted.

B. Construction:

1. Heavy duty.
2. Watertight.
3. Oil-tight.
4. Flush panel mounting.
5. Size to mount in 30.5-mm diameter cutout.
6. Match NEMA rating of device with the installed location environmental classification.

C. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200 va make, 720 va break.
    c. Single pole, single throw.
    d. Up to six tandem blocks.

3. Momentary contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

D. Emergency Stop:

1. Red mushroom head.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200va make, 720va break.
    c. Single pole, single throw.
    d. Up to six tandem blocks.

3. Push/pull.
4. Maintained contact.

5. Non-illuminated.
6. Legend plates:

    a. Extra large.
    b. Yellow.
    c. Round.

E. Selector Switches:

1. Maintained position unless specified elsewhere.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200va make, 720va break.
    c. Single pole, double throw or double pole, single throw.
    d. Up to six tandem blocks.

3. Operators:

    a. Number of positions as specified elsewhere.
    b. Standard knob type unless specified elsewhere.

4. Legend plates as required for type of operation or specified elsewhere.

F. Pilot Lights:

1. LED Lamp.
2. Transformer type.
3. Bayonet, 6Vac bulb.
4. Colored lens as specified elsewhere.
5. Interchangeable lenses.
6. Transformer rated for 120Vac
7. Push to test.
8. Legend plates as specified elsewhere.

G. Potentiometers:

1. Three-terminal potentiometer.
2. Resistance: 10 kOhm.
3. Power Rating: 2 watt, 50V ac/dc.
4. Resolution: 1 percent.
5. Linearity: +/- 5 percent.

H. Control Stations.

1. Describes enclosures used to house pilot devices.
2. NEMA rating as follows:

    a. NEMA 7 in Class 1, Division 1 or 2 Hazardous (Classified) Locations.
    b. NEMA 4X 316 Stainless Steel in indoor wet or corrosive locations or outdoors. Exception: if located in chemical room where chemical is corrosive to stainless steel (such as ferric), then material shall be FRP or similar.
    c. NEMA 12 in other areas.

3. Nameplates:

a. Engraved laminated plastic.
b. Letters 3/16 in. high.
c. Black letters on white background.
d. Identify per equipment controlled, using names found on Drawings.

2.02 MOTOR STARTER CONTROL RELAYS.

A. Manufacturer:

1. Square D.
2. Cutler-Hammer.
3. Or Equal.

B. Construction:

1. Industrial type.
2. 300Vac rated.
3. Ac operation.
4. Used for operation of large motor starter coils or other 120Vac loads whose current requirements (continuous or inrush) exceed capacity of control relays listed below.

C. Operating data:

1. Pickup time: 11 ms maximum.
2. Dropout time: 6 ms maximum.

D. Coil:

1. Molded construction.
2. 120Vac, 60Hz.
3. Continuous rated.
4. 155va inrush, maximum.
5. 22va sealed, maximum.

E. Contacts:

1. Double break.
2. Silver alloy.
3. Convertible.
4. Color-coded to indicate status.
5. 60 amp make, 6 amp break (120Vac inductive).

F. DIN rail-mounting capability.

G. Accessories:

1. Add-on pole attachment.

a. 4 NO and 4 NC contacts.
b. Add-on to 0 to 4-pole relay.

2. Latch attachment.

2.03 CONTROL RELAYS.

A. Manufacturer:

1. Allen Bradley
2. Potter and Brumfield.
3. Idec.
4. Or Equal.

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: -45°F to 150°F.

C. ac Coil:

1. 120Vac.
2. Continuous rated.
3. 3.5va inrush maximum.
4. 1.2va sealed, maximum.
5. 50-60 Hz.
6. Light to indicate energization.
7. Minimum Dropout Voltage: 10% of coil rated voltage.

D. dc Coil:

1. 24Vdc.
2. Continuous rated.
3. Light to indicate energization.
4. Minimum Coil Resistance:

    a. 24Vdc: 450 Ω.

E. Contacts:

1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
2. Silver cadmium oxide.
3. 3 form C.
4. 300Vac.
5. 10 amp make, 1.5 amp break, (inductive).

F. Rated at 10 million operations.

G. 11 pin, square socket.

H. DIN rail mountable.

I. Enclosed and protected by polycarbonate cover.

J. Visible indication of energized coil.

K. Provide relay-retaining clips.

2.04 TERMINAL BLOCKS

A. Manufacturer:

1. Phoenix Contact.

2. Weidmuller.
3. Or Equal.

B. 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

C. Clamping screw type.

D. Isolating end caps for each terminal.

E. Identification on both terminals.

F. Clip-mounted on DIN rail.

G. Accepts AWG 12 to 22.

H. Feed-Through Terminals:

1. 20 Amp rating

I. Switched Terminals:

1. Knife disconnect with test sockets.
2. 10 Amp rating.

J. Fused Terminals:

1. Hinged fuse removal/disconnect.
2. 10 Amp rating.
3. Include blown fuse indication.

2.05 DC POWER SUPPLIES

A. Manufacturer:

1. Phoenix Contact.
2. Sola/Hevi-Duty.
3. Idec.
4. Or Equal.

B. General:

1. Power supply shall be fully enclosed, and provide screw terminations. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529. Housing shall be at IP20 or equal minimum.
2. Power Supplies shall have an efficiency of at least 80% with high efficiency models (~90%) available
3. The power shall have an MTBF (Mean Time Between Failures) greater than 500,000 hours according to IEC 1709.
4. The power supply shall be able to withstand shock of 30G in all space directions according to IEC 68-2-27 and vibration up to 2.3G 90 min. (<15hz, amplitude = +/-2.5mm/15-150hz) according to IEC 68-2-6.
5. Power supplies shall be UL-508A listed to allow the use of the power supply at full rated output amperage with no "de-rating".

C. Mounting:

1. All power supplies shall have integral metal mounting foot to attach to 35mm DIN-rail conforming to DIN EN50022.

D. Wire Connections:

1. Attach wires to the power supplies by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated with non-ferrous, non-corrosive materials.
2. Wire connection for currents less than 20A shall use pluggable terminals on both input and output ends.
3. Pluggable terminals shall accept wire sizes 24 through 14 AWG.

E. Equipment:

1. Nominal current rating to be based on an operating temperature of 60°C or higher
2. Power supplies shall have a visible "DC Power OK" indicator. This indicator will flash when the output drops below 10% of the adjusted output voltage.
3. Ambient temperature range for operation shall be at least -25°C to +70°C
4. Residual ripple shall not exceed 100 mV peak to peak at nominal current values
5. Integral "fine" surge suppression shall be incorporated into the power supply
6. Power supplies shall conform to CE electromagnetic compatibility as described in EN61000-6-2 and EN 50081-2.
7. Power supplies shall have means of limiting DC current in case of short circuit or an overload and shall automatically reset themselves when the fault is corrected.
8. Power supplies when wired in parallel will not require external circuitry.
9. Power supplies shall have a voltage monitoring relay contact and signaling output.
10. Input must auto-range between 85 to 264VAC and 90 to 350VDC for 1 phase power supplies with no manual intervention.
11. Input must auto-range between 320 to 575VAC and 450 to 800VDC for 3 phase power supplies with no manual intervention.
12. Power supplies shall have a power factor of at least 0.6, with higher power factor models available as described by EN61000-3-2.

2.06 AUDIBLE ALARM ANNUNCIATOR

A. Manufacturers:

1. Federal Signal
2. Edwards
3. RAB.
4. Crouse Hinds.
5. Appleton Electric Company.

B. 120Vac

C. Sustained Tone – 100dBa minimum

D. Construction: NEMA 4X for general locations, NEMA 7 explosion-proof, FM approved for Class I, Division 1 service when located in classified area.

E. Surface-mounted, provide mounting lugs. Body to include mounting lugs.

F. 3/4 in. conduit hubs.

2.07 PROCESS INDICATOR

A. Manufacturer:

1. Precision Digital, PD 6000 Series.
2. Red Lion, PAX 2D.
3. No Substitute Permitted.

B. 6-digit programmable digital display.

C. 120/240Vac or 12/24Vdc powered.

D. Input: 4-20 mAdc.

E. Output: 4-20 mAdc.

F. Two relays.

G. Mounting: Front of Panel, NEMA 4X.

H. Operating temperature: 32 to 133ºF.

2.08 ELECTRONIC CURRENT ISOLATOR

A. Manufacturer:

1. Phoenix Contact Model MCR Series.
2. PR Electronics.
3. No Substitute Permitted.

B. Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power-boosted output.

C. Mounting: DIN Rail.

D. Temperature compensated, calibration-free.

E. Input: 4-20 mAdc into 50 ohms.

F. Output: 4-20 mAdc into output load up to 500 ohms.

G. Isolation: Common mode up to 700Vac between input and output.

H. Accuracy: 0.5% of span.

I. Provide power supply specific to isolator.

2.09 SURGE PROTECTORS

A. Manufacturer:

1. Islatrol - IE-100 series
2. SOLA STFE Elite Series.
3. No Substitute Permitted.

B. High frequency noise filter/surge protector to protect control panel incoming power supply.

C. Wire to protect specified microprocessor based process control system devices including:

1. PLC
2. Ethernet Switches
3. HMI and/or panel mounted computer
4. Any other microprocessor based equipment located in or powered from PLC Panel.

D. Input power:

1. 120 or 240Vac, model dependant.
2. 47-63 Hz.

E. Peak surge current: Minimum 10,000 amp line-neutral, line to ground, and neutral to ground.

F. Frequency response:

1. Normal mode: 90 dB max, 100 kHz to 50 MHz.
2. Common mode: 60 dB max, 5 MHz to 50 MHz.

G. Response time:

1. < 0.5 ns normal mode.
2. <5 ns common mode.

H. Transient protection per IEEE C62.41:

1. Category A Ringwave (6kV, 200A, 100 MHz): < 60 V peak.
2. Category B Ringwave (6kV, 500A, 100 MHz): < 100 V peak.

I. LED status indicator.

J. Form C contact for remote status indication.

2.10 ETHERNET SURGE PROTECTORS

A. Manufacturer:

1. Emerson/Edco CAT6-5 POE Series
2. Phoenix Contact
3. Or Equal

B. Suitable for Category 5 and Category 6 Power over Ethernet applications.

C. Operating Voltage: 60 VDC

D. Clamping Voltage: 65 VDC

E. Operating Current: 300 mA

F. Peak Surge Current: 60 A (10 x 1000 1/4 second)

2.11 INTRINSICALLY SAFE BARRIERS

A. Manufacturer:

1. PR Electronics
2. No Substitute Permitted.

B. Intrinsically safe barrier located in safe area, allow intrinsically safe interface to devices located in Class 1, Division 1 or 2, Group C or D hazardous (classified) locations per National Electrical Code ANSI/NFPA 70 (NEC).

C. Non-Zener Diode mode of protection

D. UL and CE listed, FM approved.

E. Operating temperature range -20 to 60 degrees F.

F. Supply voltage: 20–35 VDC.

G. DIN rail mounted.

H. Isolation: 250 V rms between safe and hazardous area terminals.

I. LED indication of operation status and malfunction.

J. Discrete Input

1. Suitable for monitoring of switch closure, NAMUR sensors.
2. Capable of line fault detection when specified, provide series and parallel resistors at switch location when line fault detection specified.
3. Safe area contact ratings: 125 VAC, 0.5 A, resistive.

K. Analog Input

1. Suitable for monitoring of 4-20 mAdc signals.
2. Safe area output: Isolated 4-20 mAdc, active or passive dependant on application.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed adjacent to each device that has Engineer tag number referenced on Drawings.

B. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

SECTION 40 79 00
MISCELLANEOUS CONTROL SYSTEM FIELD DEVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13.

B. Section includes field instrumentation and control devices for Process Instrumentation and Control Equipment.

1.02 REFERENCES

A. NEC: National Electric Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

D. NRTL: Nationally Recognized Testing Laboratory

E. OSHA: Occupational Safety and Health Administration

F. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation and control devices specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and

capacities indicated that have record of successful in-service performance.

B. Items provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

PART 2 – PRODUCTS

2.01 INTRUSION PROXIMITY SWITCHES

A. Manufacturers:

1. Sentrol.
2. GE Interlogix.
3. ADT.
4. Or equal.

B. Proximity switch for monitoring of building or control panel door position.

C. Solid State Hall Effect sensor with magnetic actuating bar.

D. Switch shall be industrial grade. Inductive, tubular or barrel type switches are not acceptable.

E. Provide dry contact suitable for connection to PLC input. Use switch manufacturer's recommended switching relay/amplifier as necessary to affect proper interface. Relay/amplifier shall be installed in PLC panel.

2.02 INTERIOR/EXTERIOR MOUNTED ALARM LIGHTS

A. Manufacturer:

1. Federal Signal
2. RAB.
3. Crouse Hinds.
4. Appleton Electric Company.
5. No Substitute Permitted.

B. 120Vac.

C. Strobe style. High Intensity LED.

D. Construction: NEMA 4X for general locations, NEMA 7 explosion-proof, FM approved for Class I, Division 1 service when located in classified area. See 40 70 00 for NEMA classification.

E. Surface-mounted, provide mounting lugs. Body to include mounting lugs.

F. Mounting about exterior doors shall be 18 inches from door or vent openings.

G. Aluminum mounting hood.

H. Ruby Red globe with guard for gas alarm.

I. Amber globe for loss of air flow alarm.

J. 3/4 in. conduit hubs.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed adjacent to each device.

B. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING SYSTEMS

SECTION 43 23 57
PROGRESSING CAVITY PUMP EQUIPMENT

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Thickened Sludge Pump Nos. 1 and 2 (600-P-0601, -0601)
2. Thermal Sensors (600-TSH-0601, 600-TSH-0602)
3. RTD (600-TE-0601, 600-TE-0602)
4. Seal Water System
   a. Seal Water Pressure Switches (600-PSL-0611, -0612)
   b. Seal Water System Solenoid (600-SV-0611, -0612)

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. OSHA: Occupational Safety and Health Act

1.03 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pump shall be positive displacement, progressing cavity type with gear joint or a positively sealed and lubricated pin joint drive train.
2. Pumping equipment shall comply with the Progressing Cavity Pump Schedule(s) of this Section.
3. Equipment shall be suitable for thickened waste activated sludge (TWAS) at solids concentrations up to 7.5 percent, thickened primary sludge (TPSD) at solids concentration up to 7.5 percent and thickened digested sludge (TDSD) at solids concentrations up to 7.5 percent or any combination of the above.
4. Motor horsepower shall be sized so each pump is non-overloading throughout entire pump performance curve.
5. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.
6. Equipment shall continuously operate without damage while operating under load.
7. Design equipment so parts are readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for progressing cavity equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for progressing cavity pumping equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of progressing cavity equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of progressing cavity pumping equipment in service.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: System manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain progressing cavity equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver progressing cavity equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store progressing cavity equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One complete set of O-rings, gaskets, and seals per pump model.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Moyno Industrial Products.

B. Netzsch.

C. Seepex.

D. No Substitutions Permitted.

2.02 MATERIALS

A. Suitable for application specified in the Progressing Cavity Pump Schedule(s) and as specified below.

1. Suction Housing: thick-walled cast iron.
2. Bearing Housing: thick-walled cast iron.
3. Rotor: Alloy steel, SAE 1045, ASTM A331-90, grade 4150 cold finish with yield strength greater than 55,000 pounds per square inch plated with 0.01-inch of hard chrome or 316 stainless steel Duktil Coated (1250 Vickers Hardness).
4. Stator: Nitrile 100, 70 Durometer hardness chemically bonded to high strength steel tube.
5. Gear joints: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8620.
6. Pin joints: High speed steel, air hardened to 60-65 HRc.
7. Connecting rod: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8630.
8. Drive shaft: Machined from carbon steel, SAE 1045, ASTM A519-90, grade MT1020, yield strength of 32,000 pounds per square inch.

2.03 PUMP FABRICATION

A. General:

1. All cast iron parts shall be free from sand holes, blow holes, and other defects.
2. Suction connection shall be flanged.
3. Discharge connections shall be flanged with bolt hole dimensions and spacing to ANSI standards.

B. Pump:

1. Suction housing shall include two inspection ports, 180 degrees apart, to permit access to the suction housing interior without disconnecting the feed chute.

C. Rotor:

1. Rotor shall be of one-piece (two-stage) construction with integrally machined rotor head.
2. Rotors cut to length with welded rotor heads shall not be acceptable.
3. Rotor shall have single helix design.

D. Stator:

1. Stators shall be double helix (two-stage) design and chemically bonded to the inside of a carbon steel tube.
2. The opening of the stator, on the suction side of the pump, shall be beveled to at least a 30 degree angle from the vertical to lesson entrance losses.
3. Stator shall be rigidly fastened to the suction housing and discharge flange by one of the following methods:

    a. Stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid.
    b. Fasten stator to pump with four thru-bolts.

4. Stators shall be manufactured to size. Stators made in long lengths and cut to size are not acceptable.
5. Seal ends of stator tube at the suction and discharge to prevent the material being pumped from contacting the stator tube.

E. Bearings:

1. Bearing shall be integral to the pump or gear/motor, designed for all loads imposed by specified service.
2. Bearings shall be grease lubricated, tapered roller or ball bearing type with diverging pressure angles to maximize shaft stability.
3. Bearings shall be designed for a minimum B-10 life of 100,000 hours under maximum operating conditions and shall not require periodic lubrication.
4. Bearings shall be protected from contaminates by means of a bearing cover plate bolted to the bearing housing.

F. Drive Components:

1. Drive:

    a. Drive shaft shall be of solid drive shaft design to avoid clocking and / or trapping of solids, which could interrupt movements of connecting rod or disturb seal of rear gear joint or a connecting rod that shall be of the rigid, splined design, connecting the gear joints of the drive shaft and eccentrically moving rotor.
    b. Connecting rod shall also serve as a conveyor assembly to move the pumped material from the suction housing to the pumping elements.
    c. Connecting rod shall be constructed of machined alloy steel.
    d. All diameters of connecting rod are to be concentric to within +/- 0.003 inches TIR.

2. Gear Joints:

    a. Gear joints shall be grease or oil lubricated, crown gear type constructed of machined alloy steel. Sealed gear type joint, factory lubricated with oil and sealed from pumped material is acceptable.
    b. Gear joint shall be totally enclosed and protected by a wire reinforced elastomeric seal.
    c. Mechanical components of gear joint assembly shall be designed to operate for 10,000 hours at manufacturers published maximum speeds and pressures.

3. Bushed Pin Joints:

    a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod.

b. Joint shall be grease lubricated with a high temperature (450 degrees Fahrenheit), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.
c. Stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass.
d. Universal joints shall carry a separate warranty of 10,000 operating hours.

4. Drive shaft:

a. Shaft shall be of one-piece construction through the bearings and shaft seal area.
b. Drive shaft shall be plated with 0.01-inch of hard chrome.

G. Stuffing Box:

1. The stuffing box shall be equipped with a split packing gland and split Teflon lantern ring to permit repacking of the pump without removing the bearings or drive shaft components.
2. Fittings shall be provided for grease lubrication of the packing.

H. Seal water system for 6-10 gal/hr flush with W2 non-potable water for each pump. Seal water system shall include ball valve, Y-strainer, ball valve, solenoid valve (600-SV-0611, -0612), pressure regulator valve, pressure switch low (600-PSL-0611, -0612), and low flow sight indicator on supply side. Seal water system shall include pressure indicator and needle valve on seal water system drain. Pressure switch, solenoid and pressure indicator shall be as per pump manufacturers recommendations and in accordance with 40 73 00. Piping and valves shall be as per Detail M520 on Drawing 999-M-1.

I. Pump and motor shall be mounted on a common fabricated steel base.

J. Motors:

1. 460 Volt, 3-phase, 60 Hertz.
2. Maximum horsepower and speed as stated in Progressing Cavity Pump Schedule(s).
3. Inverter duty rated.
4. Provide motors Class F insulation, totally enclosed fan cooled (TEFC) motor for each pump to achieve specified capacity and not exceed Code G starting characteristics.
5. Gearbox/Gearmotor shall be coupled to the pump shaft with suitable coupling for torque required. Close-Coupled / Flange Mounted designs are not acceptable.
6. Motor shall conform to requirements of Section 26 05 84.
7. Motors shall be suitable for use with adjustable frequency drives provide under Section 26 29 23. Provide torque, horsepower and speed requirements and additional information required to adjustable frequency drive manufacturer.
8. Size to prevent overheating and damage to motor when operating over entire range of specified operating conditions.
9. Provide a thermal sensor (600-TSH-0601 and 600-TSH-0602) for each pump imbedded in windings to provide signal for alarm and shutdown at high motor temperature.

2.04 CONTROLS

A. Control Station (600-CS-0601, -0602) provided under Division 40.

B. Variable Frequency Drive (600-VFD-0601, -0602) provided under Division 26.

C. RUN DRY PROTECTION: Provide 3-wire 100-ohm RTD (600-TE-0601 and 600-TE-0602) in the pump casing (without external controller) for dry run protection. Controls provided by others.

2.05 COATING

A. Manufacturer is responsible for surface preparation, priming, and finish coating of equipment prior to shipment.

B. Provide coatings in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install progressing cavity equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

    a. 1 man-day for Installation Services.
    b. 1 man-day for Instructional Services.
    c. 1 man-day for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier’s or Manufacturer’s field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

PROGRESSING CAVITY PUMP SCHEDULE	
Name of Pump(s)	Thickened Sludge Pump No. 1 and 2
Tag Number(s)	600-P-0601, 600-P-0602
Number of Pumps	Two
Fluid Pumped	Thickened Waste Activated Sludge (TWAS) Thickened Digested Sludge(TDSD) Thickened Primary Sludge (TPSD)
Maximum Motor Horsepower	20
Maximum Full Load Amps	24
Maximum RPM	200
Discharge	6
Suction	6
Motor	460 volt, 3-phase, 60 Hertz
Motor Mounting	Belt Drive
Minimum Spherical Solids Size	
Constant or Variable Frequency	Variable Frequency
Hazardous Classification	N/A
Performance Requirement at Rated Speeds	
Maximum Speed (rpm)	190
Design Operating Point 1	
Capacity (gpm)	57
Total Dynamic Head (psi)	166
Design Operating Point 2	
Capacity (gpm)	72
Total Dynamic Head (psi)	80
Design Operating Point 3	
Capacity (gpm)	100
Total Dynamic Head (psi)	20
Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" or "C" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

SECTION 43 25 13
SUBMERSIBLE CENTRIFUGAL PUMPING EQUIPMENT

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Process Drain Pump No. 1 (605-P-0701)
2. Process Drain Pump No. 2 (605-P-0702)
3. Pump removal mechanism for each pump.
4. Controls-related equipment for each pump.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

B. ASTM: American Society of Testing and Materials.

C. NEC: National Electrical Code.

D. NEMA: National Electrical Manufacturers Association.

1.03 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pumping equipment shall comply with Submersible Centrifugal Pump Schedule(s) of this Section.
2. Equipment shall be suitable intended installation.
3. Equipment shall be suitable for pumping materials indicated in Submersible Centrifugal Pump Schedule(s).
4. Equipment shall be suitable for continuous operation at maximum fluid temperature of 104 degrees Fahrenheit (F) at all operating speeds specified and without external cooling fluid.
5. Motor horsepower of each pump shall be non-overloading throughout entire pump performance curve.
6. Design motor for up to 15 evenly spaced starts per hour.
7. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.
8. Motor housing shall be air filled to provide dissipation of heat, permanent bearing lubrication and prevent airborne moisture contamination.
9. Equipment shall be continuous operation without damage while operating under load and unsubmerged.
10. Design equipment for continuous submergence under water without loss of watertight integrity to depth of 65-feet.
11. Design equipment for removal and reinstallation of pumps without need to enter wet well and without removal of fasteners.
12. Design pump removal guide mechanism and permanently mounted discharge connection elbow so no part of pump bears on wet well structure.
13. Connection of pump to permanently mounted discharge elbow shall not leak.
14. Design equipment so parts readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.
15. Entire pumping unit, including pump, motor and power cable assembly, monitoring equipment, and pump removal system shall be suitable for installation in Class I, Division 1 or 2, Group D

hazardous classified locations as approved by Factory Mutual. Locations specified in Submersible Centrifugal Pump Schedule(s) of this Section.

16. Casing shall be end suction with centerline discharge.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for submersible centrifugal pumps specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for submersible centrifugal pumps.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of submersible centrifugal equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible centrifugal equipment in service.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: Manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain submersible centrifugal pump system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver submersible centrifugal pumps and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store submersible centrifugal pumps a in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

   a. One set of bearings for each pump model.
   b. One mechanical seal set for each pump model.
   c. One gasket set complete for each pump model.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Flygt.

B. Wilo.

C. No Substitutions Permitted.

2.02 MATERIALS

A. Suitable for application specified in Submersible Centrifugal Pump Schedule(s) of this Section and as specified below:

1. Pump case: Cast iron, ASTM A-48, Class 35B C.I.
2. Motor housing: Cast iron, ASTM A-48, Class 35B C.I.
3. Impeller: ASTM A-532 (Alloy III A) 25% chrome cast iron.
4. Seal housing: Cast iron, ASTM A-48, Class 35B C.I.
5. Discharge base elbow: Cast iron, ASTM A-48, Class 35B C.I.
6. Pump/motor shaft: ASTM A479 S43100T or A276 Type 420 Stainless Steel
7. O-rings: Viton or NBR.
8. Fasteners: Stainless steel, ASTM A276, Type 316.
9. Lower seal faces: Tungsten-carbide (rotating seal ring) versus Tungsten-carbide.
10. Upper seal faces: Silicon or Tungsten-carbide (rotating seal ring) versus Tungsten-carbide.
11. Guide rails and brackets: Stainless steel, ASTM A276, Type 316.
12. Lift chain or cable: Stainless steel, Type 316 Stainless Steel.
13. Power/control cable: chloropene rubber or neoprene.
14. Anchor bolts: Stainless steel, ASTM A276, Type 316. See Section 05 50 00.

2.03 PUMP FABRICATION

A. General:

1. Provide metal-to-metal contact machined surfaces.
2. Machine and fit mating surfaces with O-rings where watertight sealing is required. All mating surfaces shall be flame proof joints with special labyrinth joint to prevent flame or spark travel to pumped media.
3. Rectangular cross sectioned gaskets, elliptical O-rings, grease, or secondary sealing compounds are not acceptable.
4. Pump with attached rail guides and discharge sealing flange.

B. “N” Impeller (Flygt):

1. Non-clog type, semi-open, multi-vane, back swept design passing minimum spherical solid size specified in Submersible Centrifugal Pump Schedule(s) of this Section.
2. Impeller design shall handle solids, fibrous materials, heavy sludge, rag-laden and other matter found in waste water.
3. Leading edges shall be mechanically self-cleaned upon each rotation across a spiral groove located on volute bottom.
4. The volute shall have replaceable suction cover insert ring which is cast spiral-shaped, sharp-edged grooves, insert ring shall be ASTM A-532 (Alloy III A) 25% chrome cast iron.
5. Internal volute bottom shall provide effective sealing between pump volute and impeller.
6. Sharp spiral grooves shall provide shearing edges across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed.
7. Clearance between internal volute bottom and impeller leading edges shall be adjustable.
8. Impeller vanes shall have screw-shaped leading edges hardened to Rockwell (Rc) 45.
9. Balance statically and dynamically.
10. Impellers shall be locked to the shaft.
11. All impellers shall be coated with an alkyd resin primer.

C. Impeller (Wilo):

1. Non-clog type, single or multi-vane (maximum 3 vanes), passing minimum spherical solid size specified in Submersible Centrifugal Pump Schedule(s) of this Section.
2. Impeller design shall handle solids, fibrous materials, heavy sludge, rag-laden and other matter found in waste water.
3. Balance statically and dynamically.
4. Impellers shall be keyed to the shaft.
5. All impellers shall be coated with an acrylic dispersion zinc phosphate primers.
6. Impeller wear rings shall be stainless steel. Casing wear rings shall be hardened stainless steel to 45 Rockwell.

D. Shaft:

1. Provide common pump/motor shaft. Pump shaft shall be extension of motor shaft. Pump shaft and motor shaft with connection coupling is not acceptable.

E. Shaft Seals:

1. Provide 2 totally independent mechanical seals each with its own independent spring system, installed in tandem, with an oil chamber between seals.
2. Provide 1 stationary and 1 positively driven rotating seal ring for each seal.
3. Easily inspected and replaced.
4. Shall not require maintenance or adjustment.
5. Shall not depend on direction of rotation for sealing.

6. Shall not rely on pumped media for sealing.
7. Lower seal shall be replaceable without disassembly of seal chamber or use of special tools.
8. Pump-out vanes shall be present on backside of impeller to keep contaminants out of seal area.
9. Provide seal leak detection probe in motor housing.
10. Provide drain and inspection plug with positive anti-leak seal easily accessible external to pump.

F. Bearings:

1. Heavy-duty single row to provide minimum L-10 life of 100,000 hours at axial and radial loadings while operating at specified operating conditions.

G. Motor:

1. Horsepower as specified in Submersible Centrifugal Pump Schedule(s) of this Section.
2. 480v, 3-ph, 60 Hz.
3. Minimum motor efficiency of 85 percent at 100 percent of full load.
4. 1.15 minimum service factor per NEMA Standards.
5. Inverter duty rated, NEMA MG 1, Part 31.
6. Moisture resistant, Class H insulation rated for 180 degrees Celsius (C).
7. Use trickle impregnation method using Class F monomer-free polyester to fill voids in windings. Shall meet 95 percent fill factor. Multiple step dip and bake-type stator insulation process is not acceptable.
8. Explosion proof rated for Class 1, Division 1 or 2 area where specified in Submersible Centrifugal Pump Schedule(s) in this Section.
9. Suitable for continuous operation at 40 degrees C over ambient temperature.

H. Cooling system: Provide motor cooling to comply with design and performance requirements.

I. Power/Control Cable:

1. Size in conformance with National Electric Code (NEC) standards.
2. Provide watertight cable entry seal to comply with design and performance requirements.
3. Provide length to connect to splice box without splicing.

2.04 PUMP MONITORING MODULES

A. Pump monitoring modules and sockets to be installed under Division 40 of the Project Documents for all pumps listed in the Submersible Centrifugal Pump Schedule(s) of this Section.

B. Pump monitor shall provide dual function monitoring for both over-temperature via bi-metal, thermistor, or RTD sensor and seal failure via moisture sensor or float switch. Only low-voltage leakage system allowed.

C. Each module shall provide dual color (red/green) light-emitting diodes (LED) for alarm status (one for each fault indication), power LED as well as Test and Reset push buttons.

D. Module shall provide independent 100 ma, 24 Volt AC or 5 amps, 210 Volt AC rated Form C outputs for both over-temperature and seal failure. Module shall have a 24 Volt AC or 24-240 Volt AC input power range, a 2.8 watt power consumption, and shall be UL approved.

2.05 PUMP REMOVAL SYSTEM

A. Provide guide rail, pump mounting base, discharge base elbow, and lifting chain and cable for pump removal. Provide anchor bolts and accessories for complete system. System shall comply with design and performance requirements and as specified. See Section 05 50 00.

B. Guide system - Provide two Type 316 stainless steel guide rails, upper and intermediate guide brackets as recommended by pump manufacturer for connecting rail(s) to structure, and slide bracket for connecting pump to guide rail(s). Guide cables in lieu of guide rails are not acceptable.

1. Guide rail diameter and thickness as recommended by pump manufacturer.
2. Provide upper guide rail bracket with integral hooks on both sides of guide plate that fastens to structure.
3. Contractor to verify elevations during submittal process.

C. Discharge base elbow:

1. Provide for automatic, leak-tight connection to pump discharge.
2. ANSI B16.1 Class 125 flange for connection to piping.
3. Provide for connection of guide rails.

D. Grip-Eye Lifting System: Furnish pump lifting-chain positive-recovery system consisting of the following:

1. Provide Grip-Eye System or equal for each pump.
2. Provide high tensile strength proof-tested Type 316 stainless steel chain, minimum 10 links, of required capacity to lift pump. Connect short-length of lifting chain to lifting bail of submersible pump.
3. Provide length of Type 316 Stainless Steel guide cable (wire-rope) connected to short-length of lifting chain to extend min. 5-feet beyond top of wet well.

    a. Guide cable shall be suitably sized to support chain and length of cable hanging.
    b. Connecting link between guide cable and chain shall be sized to allow grip-eye to slip over to access chain links.
    c. Ends of cable shall not be frayed. Weld or epoxy ends to prevent fraying.
    d. Contractor shall coil additional length at top of wet well and use Type 316 stainless steel wire to hold coil shape.
    e. If no hooks are provided with upper guide bracket, Contractor shall provide Type 316 stainless steel hook at top of wet well from which to hang guide cable. Type 316 stainless steel wire tie coil to hook.
    f. At free end of guide cable attach plastic tag or stainless steel tag with the words “NOT FOR LIFTING PUMP” stamped into tag. Grip-Eye shall be able to slip over attached tag without interference.

4. Furnish forged Grip-Eye of stainless steel, provided separately to connect to the end of the lifting cable or chain of Owner’s pump lifting device.
5. Grip-Eye shall be sized per pump manufacturer’s recommendation.
6. Provide miscellaneous hardware for installation, including shackles to connect short-length of lift chain to pump lifting bail and link to connect short-length of lift chain to guide cable. Material: Type 316 Stainless Steel.

E. Anchor bolts: Stainless Steel. Comply with pump manufacturer’s requirements and in accordance with Section 05 50 00.

2.06 CONTROLS

A. Control Station (605-CS-0700) provided under Division 40.

B. Variable Frequency Drive (600-VFD-0701, -0702) provided under Division 26

2.07 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of equipment prior to shipment.

B. Provide in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holes with protective grease.

2.08 SOURCE QUALITY CONTROL

A. Factory Certified Performance Test(s):

1. Perform on each pump in accordance with test requirements of Hydraulic Institute (HI14.6 – Grade 1U).
2. Determine capacity, head, brake horsepower and hydraulic efficiency.
3. Test each pump at minimum of 6 points including shutoff, at rated capacity specified, and at flow rate greater than maximum capacity specified in Submersible Centrifugal Pump Schedule(s).
4. Prepare and submit certified performance curves.
5. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable.

B. Factory Certified Hydrostatic Test(s):

1. Perform on each pump.
2. Minimum test pressure shall be 1.5 times pump shutoff head.
3. Prepare and submit report of results.
4. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install submersible centrifugal pumps in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for

assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 1 man-day for Installation Services.
b. 1 man-day for Instructional and Post Startup Services.

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 78 23.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier's or Manufacturer's field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. Supplier or Manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than wastewater treatment process. See Section 01 79 10.

SUBMERSIBLE CENTRIFUGAL PUMP SCHEDULE 1	
Name of Pump(s)	Process Drain Pump No. 1 and Process Drain Pump No. 2
Tag Number(s)	605-P-0701 and 605-P-0702
Number of Pumps	Two
Fluid Pumped	GBT Filtrate
Maximum Motor Horsepower	5
Maximum Full Load Amps	6.6
Maximum RPM	1,800
Discharge	4 inch
Suction	Flooded
Motor	480 volt, 3-phase, 60 Hertz
Minimum Spherical Solids Size	3-inch
Constant or Variable Frequency	Variable Frequency
Hazardous Classification	Class 1, Division 1, Group D
Performance Requirement at Rated Speeds	
Maximum Speed (rpm)	1,800
Operating Point	
Capacity (gpm)	400
Total Dynamic Head (ft)	20.6
Minimum efficiency	65
Design Operating Point	
Capacity (gpm)	275
Total Dynamic Head (ft)	14.3
Minimum efficiency	53
Maximum Operating Point at Maximum Speed	
Capacity (gpm)	720
Total Dynamic Head (ft)	5
Minimum Shutoff Head	
Total Dynamic Head (ft)	38
Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

SECTION 43 41 43
CHEMICAL STORAGE TANKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Alum Tank No. 1, 2, and 3 (125-T-0101, 125-T-0102, and 125-T-0103).
2. Tank Accessories
3. Flex Connectors.
4. Chemical Storage Tank Pad.
5. Access Ladders.

1.02 REFERENCES

A. ANSI: American National Standards Institute:

1. ANSI B16.5: Pipe Flanges and Flanged Fittings.

B. ASTM: American Society of Testing Materials:

1. ASTM D638: Standard Test Method for Tensile Properties of Plastics.
2. ASTM D746: Brittleness Temperature of Plastics and Elastomers by Impact.
3. ASTM D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
4. ASTM D883: Standard Definitions of Terms Relating to Plastics.
5. ASTM D1505: Density of Plastics by the Density-Gradient Technique
6. ASTM D1525: Vicat Softening Temperature of Plastics.
7. ASTM D1693: ESCR Spec. Thickness 0.125” F50 – 10% lgepal.
8. ASTM D1998: Standard Specification for Polyethylene Upright Storage Tank: Section 11.3: Low Temperature Impact Test and Section 11.4: Oxylene-Insoluble Fraction (Gel Test)

C. References above shall be most recent revision in effect.

D. OSHA: Occupational Safety and Health Association

1.03 SYSTEM DESCRIPTION

A. Provide double wall high density cross-linked polyethylene tanks.

B. The assembly shall consist of one cylindrical closed top inner primary tank and one cylindrical open top containment outer tank.

C. The assembly shall be designed to prevent debris from entering the containment tank.

D. Provide storage tank constructed of material suitable for chemical contained.

E. Tanks shall have sufficient sidewall and hoop strength to minimize tank deflections between full and empty conditions.

F. All tank fittings not integrally molded shall be leak tight.

G. Hardware used for flanged bulkhead fittings shall be suitable for chemical contained.

H. Provide chemical storage tank pad for tank each tank.

I. Provide flex connectors suitable for connection to chemical storage tank, compatible with media stored within tank, with vertical and horizontal movement characteristics per chemical tank manufacturer’s recommendations.

1.04 SUBMITTALS

A. General:

1. Submit Product Data and Shop Drawings in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals shall not be reviewed.

B. Shop Drawings and Product Data:

1. Submit shop drawings and product data of all system components.

a. Manufacturer's specification data and descriptive literature.
b. Chemical resistance charts verifying that resins, fittings, hardware, gaskets and construction materials used are suitable for intended service.
c. Fitting and attachment locations as specified in Schedule and as shown on Drawings.
d. Detailed layout and other drawings required for proper installation.
e. Submit design calculations stamped by a structural engineer registered in the State of Illinois.
f. Certification of Compliance from tank manufacturer stating:

i. All fittings have been installed by tank manufacturer.
ii. Hydrostatic tests have been performed by manufacturer and all fittings were installed prior to tests.

C. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of chemical storage equipment with referenced standards.

D. Submit above in accordance with Section 01 33 00.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests.
3. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain chemical storage equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 SHOP TESTING

A. Tank manufacturer shall have quality control procedures adequate to ensure that all fabrications comply with specifications herein.

B. Quality control shall include written record of process and final inspections for each tank available upon request by Engineer. Final acceptance by Engineer shall be contingent on satisfactory inspection upon arrival, the delivery, and installation at project site.

C. Tank manufacturer shall perform tests described below prior to shipping. Test samples shall be taken from cut out areas where fittings are inserted in each tank.

1. Impact Test: ASTM 1998-Section 11.3 shall be used. Sample shall not shatter at 120 foot pounds with sample at minus 20 degrees F for a ½ inch wall thickness.
2. Degree of Crosslinking Test: ASTM 1998-Section 11.4 shall be used. Minimum 70 percent Gel shall be obtained.
3. Hydrostatic Test: Each tank shall be filled with water and checked for leaks no less than one hour after filling.
4. Wall Thickness: Each tank shall have an actual wall thickness measurement taken at every 90 degrees, at each one foot elevation, up to three feet from bottom of tank.

D. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness shall be per ASTM D 1998. Fitting placement tolerance shall be +/- ½ inch vertical and +/- 1 degree radial.

E. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

F. Engineer or Owner shall have option of witnessing these factory tests.

1.07 WARRANTY

A. Manufacturer shall furnish written 5 (five) year standard warranty from date of substantial completion to guarantee there shall be no defects in material or workmanship in any item supplied.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver chemical storage equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store chemical storage equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

D. Carefully follow Manufacturer's instructions for moving tanks into final position. Remove all rocks and debris from path of travel and final tank resting place.

E. Tanks damaged beyond repair shall be replaced with undamaged tanks.

F. Store tanks in manner to minimize exposure to ultraviolet radiation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Assmann Corporation of America

B. No Substitutions Permitted

2.02 SERVICE CONDITIONS

A. Design Conditions:

1. Tanks shall be suitable for indoor storage of following liquid chemicals:

Item	Normal Concentration Percent by Weight	Nominal Specific Gravity
Alum	45-55%	1.33
Ferric Chloride	30%-40%	1.3-1.4

2. Tank shall conform to requirements listed in Table 1 and 2 of this Section.

3. Tank shall be designed and constructed based on the following design criteria and conditions:

a. Building Code: IBC 2015
b. Wind Load: Not Applicable (interior exposure)
c. Live Load: 5 psf horizontal
d. Seismic Load:

Risk Category/Use Group	III
Soil Site Class	D
Design Category	B
Importance Factor	1.25
Ss	0.159g
S1	0.069g

2.03 MATERIALS

A. Plastic:

1. Tanks shall be rotationally-molded from high density crosslinked polyethylene.
2. Resin shall be Schulink XL 350 or approved equal.

B. Fillers and Pigments:

1. Plastics shall not contain any fillers.
2. All plastics shall contain minimum 0.25 percent UV stabilizer and maximum 0.60 percent.

C. Provide flange and gasket material suitable for contained chemical.

1. Provide Titanium bolts and EPDM Gaskets. Bolts shall have max. torque value of 25ft lbs. without breaking. Dimension shall be suitable for bolt pattern application.

2.04 HIGH DENSITY CROSSLINKED POLYETHYLENE TANKS

A. Tank shall be designed as specified in Tank Schedule.

B. Design, manufacturing, and testing requirements shall be in accordance with ASTM D1998.

C. High density crosslinked polyethylene tanks shall be constructed by rotational molding process.

D. Tanks shall be capable of storing specified chemicals at temperatures up to 130 degrees F.

E. Nominal properties of material for molded parts shall be as follows:

PROPERTY	ASTM SPECIFICATION	VALUE	UNITS
Density (Resin)	D1505	0.940-0.947	g/cc
Specific Gravity		1.9	
Tensile (Yield Stress 2"/min)	D638 Type IV spec	2,830	psi
Elongation at Break (2"/min)	D638	700	%
ESCR (10% Igepal, Cond. A; 0.125" Thickness, F50)	D1693	>1,000	hrs
Vicat Softening Temperature	D1525	250	Degrees F
Flexural Modulus	D790	100,000-110,000	psi
Brittleness Temperature	D746	-130	Deg. F

F. Tanks shall be designed with a hoop stress of no greater than 600 pounds per square inch at 100 degrees F, with a safety factor of no less than 2.

G. Top head must be integrally molded with cylinder shell.

H. Minimum top head thickness shall be equal to top of straight wall.

I. Provide mechanically fastened lifting lugs.

J. Provide minimum 1,300 square inches flat area on top head for fitting locations.

K. Finished tank wall shall be free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delamination.

L. All cut edges for openings shall be trimmed smooth.

2.05 ACCESSORIES

A. Provide flange and gasket material suitable for contained chemical.

1. Provide Titanium bolts and EPDM Gaskets. Bolts shall have max. torque value of 25ft lbs. without breaking. Dimension shall be suitable for bolt pattern application.

B. Manways:

1. Provide 16” clear opening` manways.
2. Manway cover shall be bolt on or screw on lid type manufactured out of crosslink polyethylene.
3. Manway bolts shall be polyethylene, nylon or a compatible plastic material.

C. Access Ladder:

1. FRP access ladders shall be provided with the polyethylene chemical storage tank. Use proper chemical resistant materials when anchoring to tank dome or sidewall.
2. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion/contraction due to temperature and loading changes. Use chemical resistant materials for anchoring to tank dome or sidewall.
3. Ladders shall be designed to meet applicable OSHA standards: OSHA 2206: 1910.27, fixed ladders.
4. Provided with cage and return.

D. Side Wall Fittings

1. On dual wall tanks bottom fittings must be design to maintain 110% secondary containment integrity.
2. All secondary containment fittings and hardware shall be resistant to chemical fume corrosion.
3. Provide flange and gasket material suitable for contained chemical.
4. Bolted Double 150-pound Flanges:

    a. Required for below liquid level installation of sizes larger than 2-inch.
    b. ANSI/ASME B16.5, 150 pound flanges shall be suitable for contact with media stored in tank. Construct single bolted flange fittings of virgin polyethylene. Bolts shall be welded to a common backing ring and encapsulated with polyethylene preventing fluid contact with the metal material. Flange shall have one full face gasket to provide a sealing surface against the flange and the tank surface.
    c. Gasket shall be minimum ¼-inch thick and suitable for media stored in tank.
    d. Minimum four full threaded bolts per installation. Bolt holes shall straddle the principal centerline of the tank.
    e. Bolt head and minimum ¼-inch of threads closest to bolt head shall be fully encapsulated in Type II Polyethylene.
    f. Bolts and gaskets shall be suitable for contact with media stored in tank.
    g. Size, number and locations as specified in tables below and/or shown on drawings.

E. Dome Fittings:

    a. All dome fittings 1 inch and less shall be bulkhead universal ball style.
    b. The gasket material shall be suitable for media stored in vessel.
    c. All dome fittings larger than 1 inch shall be two-flange universal ball dome style. Flange attached to the tank wall shall be PVC 150 pound ANSI. There shall be a minimum of four titanium bolts with bolt heads encapsulated in elastomer. Elastomeric encapsulation shall fully cover the bolt head and a minimum of ¼-inch of the threads closest to the bolt head. Each bolt shall have a gasket on the inside of the tank, and each flange shall have a gasket on the outside of the tank. Gaskets shall be suitable for media stored inside vessel.
    d. Sized as specified in tables below.

F. Fill Pipe:

1. Provide fill piping, diameter as specified in tables below, to extend down into tank within 1-foot of tank bottom.

2. Pipe shall be supported maximum 5-foot intervals with support structures.

G. Overflow Pipe:

1. Provide sidewall flange fitting set as high in tank sidewall as possible to receive 3-inch schedule 80 PVC Overflow pipe installed by Contractor.
2. Pipe shall be supported maximum 5-foot intervals with support structures.

H. Vents:

1. Each tank shall be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA standards. Vents size shall be 6 inches.

I. Flex Connectors:

1. All fittings on the lower third sidewall and including the fill and vent connections shall have 100% virgin PTFE flexible expansion joint. Expansion joint shall have a minimum of 3 convolutions with rods and flanges of material compatible with liquid chemicals stored in tank. Galvanized parts are not acceptable. Expansion joint shall meet the following criteria:

   a. Axial Compression ≥ 1.5”
   b. Axial Extension ≥ 0.625”
   c. Lateral Deflection ≥ 0.75”
   d. Angular Deflection ≥ 14°
   e. Torsional Rotation ≥ 4°

2. Flex connector size per tank connection.
3. Flanged connections.
4. Connector shall be suitable for conveyance of stored media. Material shall be abrasion resistant, yet flexible enough to accommodate tank manufacturer’s horizontal and vertical moment requirements.
5. Fasteners shall be suitable for media stored in tank.

J. Flange connection with blind flange for future instrumentation.

K. Outlet Nozzle

1. Outlet Nozzle will be shipped installed and hydrostatically tested.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment specified herein as recommended by manufacturer’s written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 10. Coordinate field location with Engineer.

3.03 FIELD TESTING

A. Hydrostatic Testing: Each tank shall be filled with water and check for leaks for 24 hours. If leaking occurs Contractor shall make all repairs necessary to correct leaking and testing shall be restarted until each tank passes the 24 hour test.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's field representative shall be onsite to make bottom fill connection between inner and outer tank for each storage tank installed.

B. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.

C. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

TABLE 1
SECTION 43 41 43
CHEMICAL STORAGE TANKS

Tag No.	Tank Designation	Nominal Capacity (Gallons)	Nominal Diameter*	Nominal Overall Height*
125-T-0101 125-T-0102 125-T-0103	Alum Tank No. 1, No. 2, and No. 3	4,050	8’	14’-9”

* If tank dimensions vary from nominal dimensions shown, Contractor shall coordinate required changes in the concrete pad and pipe connections.

TABLE 2
SECTION 43 41 43
CHEMICAL STORAGE TANKS

Fitting/ Nozzle Size	Fitting/Nozzle	Connection	Quantity	Location on Tank
3”	Bolted Flanged Fitting with anti-foam elbow	Fill	1	Top – As shown on Drawings
6”	Bolted Flanged Fitting	Vent	1	Top – As shown on Drawings
6”	Bolted Flanged Fitting	Future Instrumentation	1	Top – As shown on Drawings
16”	Bolted and sealed w/ 16” clear access	Manway	1	Top – As shown on Drawings
2”	Bolted Flanged Fitting	Withdrawal/ Drain	1	Side – As shown on Drawings
3”	Bolted Flanged Fitting	Overflow	1	Side – As shown on Drawings

END OF SECTION

DIVISION 44

POLLUTION AND WASTE CONTROL EQUIPMENT

SECTION 44 31 21
ODOR CONTROL BIOFILTERS

PART 1 – GENERAL

1.01 SUMMARY

A. Work required under this specification consists of furnishing a complete odor control system consisting of a biofilter vessel, biofilter media, exhaust fan, irrigation system with permanent recirculation function for humidification stage, intermittent irrigation system for biofilter media, interconnecting duct work between the fan and the vessel, local read instrumentation, fluid controls, and control panel as specified to properly operate and monitor the odor control system. System components required are as follows and where otherwise specified:

1. Biofilter vessel.
2. Biofilter media.
3. Humidification and biofilter media irrigation.
4. Local control panel.
5. Equipment.
6. Waterbox.
7. Valves.
8. Instrumentation.
9. Ductwork.

B. All other system appurtenances, including but not limited to, concrete pad, plumbing system, ducting and the installation thereof shall be furnished by the Contractor per the plans and specifications.

1.02 SUBMITTALS

A. Product Data - Submit manufacturer's technical data for Biofilter System including all major system components and as follows:

1. Equipment specifications.
2. Capacity ratings including pressure drop at specified air flows.
3. Technical data for all supplied equipment.
4. Certified documentation of the media supplied.
5. Dimensional plan and sectional drawings of concrete required for media support as well as design loadings.
6. Layout of all piping systems provided.
7. Detailed drawings of irrigation piping and humidification.
8. Component weights.
9. Materials of construction.
10. Accessories furnished.
11. Utility requirements.
12. Calculations indicating detention time and irrigation/humidification flow rates required.
13. Installation instructions.
14. Statement of warranty.
15. Reference list of at least five (5) similar installations operating for a minimum of three (3) years.

B. Shop Drawings - Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details. Shop drawings shall specifically note all grounding connections and grounding installation requirements.

C. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance Data:

1. Submit in accordance with Section 01 78 23.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A single manufacturer who shall have sole-source responsibility for the design of the system shall provide all internal components including media for the biofilter system. The system designer shall have at least five (5) successful years of experience in the design, construction and operation of equipment of the type specified and a minimum of (10) installations in the United States.

B. Regulatory Requirements:

1. All electrical equipment shall be designed and constructed in accordance with the latest edition and revision of applicable codes and regulations, including the following:

a. Institute of Electrical and Electronic Engineers (IEEE)
b. National Electrical Manufacturers Association (NEMA)
c. National Electrical Code (NEC)

2. All mechanical components shall be designed and constructed in accordance with the latest edition and revision of applicable codes and regulations, including the following:

a. National Bureau of Standards (NBS).
b. American Society for Testing Materials (ASTM).

1) ASTM D883 – Definition of terms relating to plastics.
2) ASTM D4097 – Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks.
3) ASTM D3299 – Standard Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks
4) ASTM C582 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
5) ASTM D2583 – Test for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
6) ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials.
7) ASTM D2563 – Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.

c. American National Standards Institute (ANSI).
d. American Society of Mechanical Engineers (ASME).
e. Occupational Safety and Health Administration (OSHA).
f. Air Movement Control Association International (AMCA).
g. American Composites Manufacturers Association (ACMA).
h. Underwriters Laboratories (UL).
i. National Fire Protection Association (NFPA).

1.04 DELIVERY AND STORAGE

A. Product delivery, storage, and handling shall comply with Manufacturer’s instructions and as follows.

B. The biofilter media shall be stored on a clean level, surface. Avoid cross-contamination of foreign materials during handling and placement. All media shall be delivered in loose bulk or bulk bags. Media shall be covered if stored longer than one week.

C. All electrical and ancillary equipment shall be stored in a climate controlled building greater than 50 degrees F.

D. All packing slips and shipments must be inspected upon delivery to ensure shipments are complete and no damage has occurred during transportation. Contact Manufacturer in the case of an incomplete shipment or if damage has occurred.

1.05 WARRANTY AND GUARANTIES

A. The Manufacturer shall warrant the biofilter media not to compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer's printed Operation and Maintenance Manuals.

B. All mechanical components shall be warranted free of manufacturing defects a period of 12 months from Substantial Completion, or 18 months from equipment delivery to site, whichever occurs first.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manufacturer:

1. Biorem Technologies, Inc. (Contact: Richard Hussey, LAI, Ltd., 847-392-0990)
2. Or equal

B. The system shall be capable of removing hydrogen sulfide and other sewer odor causing compounds from the air stream by the use of biofiltration. The biofilter system shall consist of a humidification section followed by a biofiltration media compartment installed in a modular vessel.

C. The system shall be sized to allow for continuous, 24-hour/day, 365 day/year operation.

D. The air to be treated shall be forced by a centrifugal blower into the humidification section where the airflow will be washed by a recirculated water. The air will then pass into the biofilter chamber. After treatment, the air shall pass through a no loss stack in the vessel top to the atmosphere.

E. Design criteria:

1.	System Design Capacity:	4,950	SCFM
2.	H2S Loading:	1	ppmv (average)
		50	ppmv (maximum)
3.	Discharge H2S Concentration	< 0.1	ppmv at average
			99% removal at maximum
4.	Raw Air Inlet Relative Humidity:	30 at 50°F	% (minimum)
5.	Design Raw Air Inlet Temperature:	50-100°F	°F (range)
6.	Humidifier Recirculation Rate:	50	gpm
7.	Humidification Media Volume:	48	Cubic feet
8.	Nominal Media Depth:	4	Feet
9.	Empty Bed Retention Time:	0.01	Seconds
10.	Biofilter Irrigation Rate:	247	gpd

11. Biofilter Media Volume:	3,300	Cubic feet
12. Nominal Media Depth	6	Feet
13. Empty Bed Retention Time:	40	Seconds
14. Maximum Initial System Pressure Drop:	6	IN. W.C.

F. All components of the biofilter shall be compatible with the conditions and chemicals to which they will be subjected during normal operation of the system. Compounds with which the materials must be compatible include, but are not limited to:

1. Hydrogen Sulfide.
2. Other Reduced-sulfur Compounds.

G. The system shall be capable of simultaneously removing hydrogen sulfide and other sewer odors.

H. The equipment manufacturer and the contractor shall be responsible for any license fees that may apply to this system.

I. All components specified shall be furnished by the Manufacturer to be installed by the Contractor.

2.02 BIOFILTER VESSEL

A. The vessel shall be designed to handle a pH of 5-8 as sulphuric acid.

B. The vessel shall be manufactured so that all parts are proportioned to have liberal strength and stiffness and to be especially adapted for the intended working conditions.

C. Vessel shall be designed to operate under the positive pressure of 15” W.C.

D. Construction Materials:

1. The vessel shall be constructed of fiberglass reinforced isophthalic polyester resin as follows:
2. The inner shell shall be approximately 25 percent glass and 75 percent resin. The inner shell shall be provided with an internal C-glass surface veil liner to provide for adequate corrosion resistance.
3. Reinforcing material shall be commercial grade glass fiber containing a coupling agent to produce a suitable bond with the resin used.
4. All materials shall be suitable for exposure to hydrogen sulfide fumes at a concentration of up to 300 ppm and sulfuric acid at a pH of 5-8.
5. Ultraviolet absorbers shall be added to the exterior surface for improved weather resistance. Insulated tanks, where applicable, shall have a light gray pigmented exterior gelcoat layer.
6. All surfaces shall be finished so as to obtain complete cure of the resin without air inhibition. The finished laminate shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes and pimples. The vessels shall conform to the Manufacturer’s minimum standard for Barcol hardness.
7. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8-inch diameter and not over 1/32-inch deep and are covered by sufficient resin to avoid exposure of inner surface fabric. Some waviness is permissible as long as the surface is smooth and free of pits.

E. The vessel shall be equipped with the accessories as listed below:

1. Lifting eyebolts (minimum of 4) shall be provided for use in transporting and placing the vessel.
2. Hold down fastener connections (minimum of 4) used for anchor bolting to the concrete foundation.
3. All necessary access doors, nozzles and other attachments. Vessel connection flanges shall be compatible with connecting piping and ductwork.
4. Manways shall be provided for each spray nozzle assembly and shall be a minimum of 24-inch diameter with bolted flanged covers, and are rated for 10-psi minimum. Bolted manways shall be provided with 1/8 inch thick full face neoprene gaskets with 316 stainless steel bolts. Provide manways as needed for inspection and access to internals of the vessel.
5. All bolts and fasteners shall be Type 316 stainless steel.
6. All gaskets shall be EPDM.
7. The media support shall be molded or pultruded FRP grating. Packing support plates and mid-span supports shall be suitable to support the weight of the media.

2.03 HUMIDIFICATION CHAMBER IRRIGATION SYSTEM

A. Recirculation Nozzles and Distribution Manifold:

1. Provide a quantity of nozzles required to ensure complete coverage and wetting of humidification media. Nozzles shall be of PVC construction with a maximum pressure drop of 25-psi at the design flow rate.
2. Distribution manifold shall be fabricated of schedule 80 PVC. All piping interior to the vessel shall be furnished with system.

2.04 BIOFILTER IRRIGATION SYSTEM

A. Media Irrigation System:

1. Provide a series of surface water sprays capable of saturating the entire surface of the biofilter media.
2. System shall be fabricated from schedule 80 PVC pipe supported with brackets along outside of the vessel.
3. System shall be sloped to drain from the biofilter if taken out of service.
4. System shall be piped to the exterior of the biofilter.
5. Design and piping of Media Irrigation System and spray nozzles shall be provided by Biofilter Manufacturer.

2.05 BIOFILTER MEDIA

A. Media shall consist of inorganic, inert hydrophilic cores in uniform shape.

B. Media size shall be ¼-in. to ¾-in.

C. Media shall not shrink or swell with varying moisture contents.

D. Media shall be formulated with nutrients, buffering agents, and adsorbents.

E. Media pressure drop shall not exceed 1-in. W.C. per foot of media depth at system start-up.

F. Media shall be warranted for a period of ten years from the date of substantial completion.

2.06 ODOROUS AIR SYSTEM LOCAL CONTROL PANEL

A. Tag: 610-LCP-0800.

B. Power: Single power connection, 480V/3-Phase/60Hz, maximum 100 full load amps.

C. Construction Material: NEMA 4X, Type 304 stainless steel enclosure with pedestal legs.

D. Panel shall include the following minimum components:

1. Odorous Air Control Fan VFD.
2. Recirculation Pump motor starter.
3. Circulation Heater temperature controller.
4. Irrigation system adjustable timer.
5. Maximum 800W, 120V, LCP powered enclosure heater.
6. 480V to 120V Transformer.
7. 24V Power Supply.

E. Front of panel shall include the following minimum components:

1. Fused Main Disconnect.
2. Odorous Air Control Fan Running pilot light.
3. Recirculation Pump Running pilot light.
4. Recirculation Pump Low Flow Alarm pilot light.
5. Circulation Heater On pilot light.
6. Alarm Reset push button.
7. Circulation Heater Off – Enable switch.
8. Odorous Air Control Fan Hand – Off – Auto switch.
9. Recirculation Pump Hand – Off – Auto switch.
10. Irrigation Valve Open – Close – Auto switch.
11. Circulation Heater Temperature Controller with local setpoint adjustment.

F. Panel shall include the following hardwire outputs to Plant PLC:

1. VFD Fault.
2. Speed Feedback. (analog)
3. Common System Alarm.

G. Panel shall include the following hardwire inputs from Plant PLC:

1. System Enable.
2. Fan Required.
3. Fan Speed. (analog)

2.07 EQUIPMENT

A. Odorous Air Control Fan (610-EF-0801):

1. Manufacturers: Hartzell, New York Blower, or equal.
2. Type: Provide belt driven, blower type fan, manufactured of FRP.
3. Fan shall be designed for the following specifications:

a.	Airflow rate	4,950	SCFM
b.	Static Pressure to System Inlet	1.2	in-wc
c.	Total Pressure Drop	7.7	in-wc
d.	Maximum Motor Size	15	hp

4. Fan wheel shall be statically and dynamically balanced.
5. Fan wheel shall be non-overloading design, backward inclined or backward curved.

6. Fan shall be provided with a horizontal bottom discharge, counterclockwise rotation.
7. Fan shall be graphite impregnated and grounded.
8. Fan shall have slip inlet and flanged outlet.
9. Components to be suitable for exposure to the specific service conditions. Shaft shall be 316 stainless steel.
10. Fan shall have self-aligned grease-packed bearings, Bearings shall be minimum 100,000 B-10 life.
11. Shaft seal shall be Teflon or Neoprene
12. OSHA approved weatherproof motor and drive cover. Housing shall contain drain connection.
13. Motor shall be TEFC with a 1.15 service factor and suitable for 480V/3-Phase/60Hz. Motor shall be inverter duty rated in accordance with Section 26 05 84.
14. Powered from VFD contained within the Odorous Air System LCP (610-LCP-0800).
15. Provide a thermal sensor imbedded in windings to provide signal for alarm and shutdown at high motor temperature.
16. Grounding:

    a. All fans shall have a “carbon rich” resin coat on all interior airstream surfaces.
    b. Provide grounding straps secured from side of fan housing to steel base.

B. Recirculation Pump (610-P-0811):

1. Manufacturers: Finish Thompson DB Series, or Equal.
2. The centrifugal pump shall be non-metallic magnetic drive type, closed impeller design.
3. Casing shall be one-piece, molded and made from glass fiber reinforced polypropylene (GFRPP).
4. Impeller assembly shall be closed, molded GFRPP with glass reinforced molybdenum disulfide filled PTFE front and rear axial thrust rings.
5. The magnets shall be constructed of high strength, rare earth neodymium iron boron magnets and be hermetically sealed from the environment by two layer shots of unfilled plastic and one layer shot of reinforced plastic.
6. The shaft shall be constructed of alumina ceramic, have an anti-rotation flat for fitting the shaft in the containment shell.
7. The recirculation system shall be operated continuously for entire life of odor control system.
8. Pump shall be sized to provide Manufacturer recommended flow rate through all Manufacturer furnished components as well as amount of piping depicted on Plans (approximately 70” of 2” diameter pipe).
9. Pump shall have union connections.
10. Maximum 3-hp; 460V/3-phase/60-Hz electrical characteristics.
11. Furnish disconnect switch in accordance with Section 26 28 00.
12. TEFC motor, meeting the requirement of Section 26 05 84.
13. Powered from starter contained within the Odorous Air System LCP (610-LCP-0800).
14. Provide with FRP suction strainer.

C. Circulation Heater (610-HTR-0841):

1. Type: Instantaneous circulation heater.
2. Construction Material:

    a. Sheath: Incoloy.
    b. Electrical enclosure: NEMA 4X Type 304 stainless steel.
    c. Circulation vessel: 316 stainless steel.

3. Maximum 50kW, 480V/3-phase/60-Hz. Delta configuration, Wye is not acceptable.
4. Maximum pressure drop of 3.5-psi.

5. Furnish disconnect switch in accordance with Section 26 28 00.
6. Type K Thermocouple high limit temperature sensor.

2.08 WATERBOX

A. Construction Material: NEMA 4X, Type 304 stainless steel insulated, pre-plumbed enclosure with pedestal legs.

B. Waterbox shall include the following components factory piped within enclosure. All components shall meet applicable additional requirements of Valves and Instrumentation paragraphs.

1. Flow Indicator/Switch (610-FSL-0821) on recirculation line.
2. Variable area rotameter (flow indicator) on blowdown line.
3. Flow Totalizing Indicator (610-FIQ-0831) on biofilter irrigation line.
4. Solenoid Valve (610-SV-0831) on biofilter irrigation line.

    a. Construction Material: Stainless steel.
    b. Powered from LCP.
    c. Fail close.

5. Pressure Indicator (610-PI-0831) on water supply line.
6. Isolation and flow adjusting diaphragm valves.
7. Lot fluid control valves.
8. Maximum 800W, 120V, LCP powered enclosure heater.

2.09 VALVES

A. Furnish valves and components below to be shipped loose and installed by installing Contractor. Reference Drawing No. 610-MPH-2.

1. Strainers:

    a. PVC construction.
    b. Mesh per Manufacturer's recommendation.
    c. Provide two parallel units for main recirculated piping.

2. Isolation ball valves:

    a. PVC construction.

3. Water supply pressure reducing valve:

    a. Capable of reducing pressure from 125-psig to system required pressure.

4. Ball Float Valve:

    a. Non corrosive material

5. Instrumentation identified in Instrumentation Paragraph.

2.10 INSTRUMENTATION

A. Manufacturer shall provide the following instrumentation/control components to be shipped loose and installed by installing Contractor. Components shall be of materials suitable for application.

1. Temperature Indicators (610-TI-0801, 610-TI-0861) for indication of entering air temperature and for indication of biofilter media temperature.

2. Pressure Indicators (610-PI-0811, 610-PI-0871, 610-PI-0872) for indication upstream of strainers, downstream of strainers/Recirculation Pump suction, and Recirculation Pump discharge pressure.

    a. Provide with diaphragm seals.

3. Pressure Differential Indicators (610-PDI-0801, 610-PDI-0805, 610-PDI-0861) for differential pressure across fan, across humidification media, and across biofilter media
4. Level Switch Low (610-LSL-0810) to stop Recirculation Pump and alarm on low level condition in sump.

2.11 DUCTWORK

A. Manufacturer shall provide the following ductwork, fittings, and accessories to be shipped loose and installed by installing Contractor. Components shall be of materials suitable for application. Reference Drawing No. 610-MPH-1.

1. Transition piece from fan outlet to 24" diameter FRP ductwork.
2. Transition piece from 24" diameter FRP ductwork to Odorous Air System Vessel inlet.
3. 24" FRP ductwork tee.
4. Two 24" butterfly dampers for isolation service.
5. 24" FRP ductwork with 45-degree cutoff covered with HDPE mesh screen.
6. 24" high velocity no-loss discharge stack.

B. Provided materials shall meet the requirements of Division 23 31 16.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All Biofilter components shall be installed in accordance with Manufacturer's installation instructions.

B. Contractor responsible for providing the following:

1. All equipment offloading, temporary storage, and placement.
2. Labor, materials, and equipment for the installation and assembly of all Manufacturer supplied equipment and instrumentation. Supply and install all other materials or equipment required for a complete operational system.
3. Site preparation and clearing of materials.
4. Design and supply an appropriately sized reinforced concrete slab to handle full load of system components such as modular vessels, exhaust fans, control panel, and waterbox. Provide collection and analysis of any geo-technical data as required.
5. Supply and install all required protective coatings or paint such as UV paint for piping or concrete paint.
6. Supply and install hold down fasteners (minimum of 16) each consisting of Type 316 stainless steel anchor bolts. The anchor bolts shall be used for anchor bolting to the concrete foundation.
7. Supply and install all external water piping and drain piping to and from the treatment vessel, waterbox, and other fluid equipment including heat tracing, insulation, piping

supports, drainage traps where necessary and / or UV protective paint.

8. Supply and install air ductwork to and from the odor control system including exhaust stack, flexible connectors, interconnecting ducting, manual or actuated dampers, filters, insulation and piping supports, unless otherwise indicated above.
9. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.
10. Supply make-up water at a minimum pressure of 40 psi. Water analysis for hardness or other parameters as necessary.
11. Provide main electrical service and system field wiring outside the main control panel. All electrical requirements for heat tracing and equipment not specifically provided by Manufacturer to be provided by others.
12. Provide duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by Others as may be specified.

C. All non-valved drain piping exiting biofilter shall be provided with a minimum 1'-6" trap to prevent pressurization of plant sanitary drain system.

3.02 MANUFACTURER'S SERVICES

A. A representative from the Manufacturer shall be present to inspect the final installation and supervise the start-up and training of operations personnel. This will consist of a minimum of 4 trips with 8 eight- (8) hour days allocated including time required for testing described below.

B. The performance of the biofiltration system shall reduce the hydrogen sulfide as set forth in Design Criteria of this Specification.

C. After initial system start-up, a period of up to four (4) weeks will be allowed for the media to acclimate. At this time a performance test (delineated below) to demonstrate the ability of the system to meet the Design Criteria of this Specification shall be performed by the Manufacturer.

D. Performance Testing of the System: Verify conformance to specified parameters, to be conducted using actual inlet conditions of the site. Testing to be completed no sooner than three weeks, but not later than 10 weeks, after system start-up and shall include:

1. Verification of proper airflow.
2. Measurement of inlet and outlet H2S concentrations.
3. Test will be conducted for a period of not less than 6 continuous hours with H2S readings being collected every 30 minutes.
4. Record pressure drop readings across media lift. Airside differential pressure across system shall be measured and confirmed to be less than specified maximum
5. In addition, bag samples will be collected at two different times, on the inlet and outlet of the system, for odor panel analysis.
6. A report of the test results shall be provided.

E. Odor Testing: Owner reserves the right to test odor removal efficiency at any time over the warranty period of the equipment. Removal efficiency shall be based on removal of hydrogen sulfide odors in comparison to specified removal efficiency. Costs to be paid by the Owner. If testing indicates failure of the equipment to meet specified design parameters, all required subsequent testing to prove compliance shall be paid by Manufacturer.

F. Instructional Services. Prior to systems demonstration (Section 01 79 10) and after PLC/HMI programming and integration is complete (work of Division 40), provide one 8 hour day for manufacturer's instructional services. Provide training outline and resume to be submitted to Engineer at least 30 days prior to training for approval by Owner and Engineer.

3.03 WARRANTY

A. Contractor shall warrantee the whole system, both in material and workmanship for a period of one year from the day of final acceptance. This period shall not extend beyond 18 months after delivery of equipment to job site. The Manufacturer shall warrantee the media and media support system for 10 years from the day of final acceptance.

END OF SECTION

DIVISION 46

WATER AND WASTEWATER EQUIPMENT

SECTION 46 33 33
POLYMER PREP, AGE AND FEED EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Polymer Prep Skid (600-M-0300)

1. Bulk Bag Frame for 2-ton super sacks with Motorized Trolley Hoist (600-M-0341).
2. Incline Conveyor (600-M-0301)
3. Hooper
4. Auger Feeder (600-M-0311)
5. Heated Feed Tunnel
6. Eductor
7. Regenerative Blower (600-M-0321)
8. Neat Polymer Pump (600-P-0331)
9. Polymer Prep System Local Control Panel (600-LCP-0300)

B. Polymer Aging Skid (600-M-0350)

1. Mix / Age Tank
2. Feed Tank
3. Wetting Head
4. Mix Assembly
5. Tank Mixer (600-M-0351)
6. Dilution Water Assembly
7. Polymer Aging Skid Junction Box (600-JBOX-0350)

C. Polymer Feed System No. 1 (600-M-0401)

1. Polymer Feed Pump No. 1 (600-P-0401)
2. Assembly
3. Polymer Feed System No. 1 Local Control Panel (600-LCP-0401)

D. Polymer Feed System No. 2 (600-M-0402)

1. Polymer Feed Pump No. 2 (600-P-0402)
2. Assembly
3. Polymer Feed System No. 2 Local Control Panel (600-LCP-0402)

E. Provide ancillary equipment and controls required for a complete and operable system.

F. Contractor responsibilities are specified herein.

1.02 OTHER RELATED WORK

A. Other related Contractor’s work includes but is not limited to:

1. Electrical power and instrumentation wiring systems.
2. Piping and piping supports.

1.03 DEFINITIONS

A. NPT: National Pipe Thread.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for chemical feed equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for chemical feed equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of chemical feed equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of chemical feed equipment in service.
3. Submit in accordance with Section 01 78 23.

PART 2 – PRODUCTS

2.01 General

A. Provide Polymer Prep Skid (600-M-0300), Polymer Aging Skid (600-M-0350) and Polymer Feed Systems (600-M-0401 & -0402) as shown on drawings and specified herein.

B. Provide one (1) modular polymer preparation system consisting of Polymer Prep Skid (600-M-0300) and Polymer Aging Skid (600-M-0350) designed to prepare a minimum of 18.0 #/hour of active polymer in liquid emulsion or dry form at a 0.5% solution concentration. The system shall be a modular design with all required components necessary for a complete system. System shall not exceed 20 FLA.

C. Provide Polymer Feed System No. 1 (600-M-0401) and Polymer Feed System No. 2 (600-M-04012) as shown on drawings and specified herein to meter polymer solution from the feed tank to the point of application and dilute the metered solution to the desired feed concentration via secondary dilution after the metering pumps. Each solution metering pump shall have a range of 1 to 10 GPM. Each system shall not exceed 6 FLA.

D. Manufacturer

1. Fluid Dynamics
2. VeloDyne
3. No substitutions permitted.

2.02 Polymer Prep Skid (600-M-0300)

A. General

1. Provide skid as shown on 009-N-3.
2. Bulk Bag Frame for 2-ton super sacks (maximum 13.5-feet tall, Structure 600 ceiling height is 14-feet) with motorized Trolley Hoist (600-M-0341) and Incline Conveyor (600-M-0301) may be on separate skids from rest of Polymer Prep Skid. Contractor shall coordinate wiring and piping requirements with manufacturer. The Bulk Bag Frame, Incline Conveyor and Polymer Prep Skid shall be installed within approximate 6.5-ft wide x 16.5-ft long footprint shown on drawings.
3. Provide a stainless-steel skid incorporating the hopper system, auger feeder, heated feed tunnel, regenerative blower and neat polymer pump.
4. All welds shall be passivated.

B. Bulk Bag Unloading System

1. Provide a bulk bag frame system designed to position and support a bulk-bags weighing up to 2,000 pounds over the feed to the incline conveyor via electric trolley and hoist (600-M-0341).
2. The frame system shall be constructed of 3" structural steel tubing with a minimum of 1/4" wall thickness. Each corner shall have gusset reinforced construction, with the exception of the travel zone of the big-bag.
3. Provide a bag untie box complete with hinged gasketed doorway and Iris valve for safe untying of the bulk bag.
4. Provide a quick disconnect flexible transition
5. Provide max 2 horsepower incline conveyor (600-M-0301) designed to transfer dry polymer from bulk bag frame to the hopper system free of dust.
6. Bulk bag frame shall not exceed 13.5ft tall and shall be assembled from a minimum two sections on-site to allow for delivery and installation.
7. Provide NEMA 4X Junction Box as required for Trolley Hoist wire connections.

C. Hopper System

1. The storage hopper shall be designed for receiving polymer from the incline conveyor.
2. The hopper shall be fabricated of not less than 11 gauge 304 stainless-steel.
3. The storage hopper shall include a capacitance type low level sensor (LSL) positioned at approximately 2 cubic feet of remaining polymer storage.
4. Provide a stainless-steel screen in the hopper to prevent foreign material from entering auger. The screen shall have 1/4-inch square area minimum openings and constructed 12-gauge wire or expanded metal.
5. Hopper shall include a door for dumping 50 pound bags manually.
6. All welds shall be ground & polished smooth and passivated.

D. Auger Feeder (600-M-0311)

1. Provide a volumetric screw feeder to accurately and reliably meter dry polymer from the feed hopper to the pneumatic transfer line through the feed funnel described below.
2. The volumetric feeder body shall be fabricated of not less than 10 gauge 304 stainless-

steel. The lower portion of the hopper shall be not less than 70 degrees to facilitate flow of the dry product with varying degrees of angle of repose to the ensuing screw feeder.

3. The drive shall be mounted to the feeder body with a stainless steel adapter having a double lip seal to seal the feed section of the hopper from the feeder drive or the drive shall be direct mounted on the feeder body.
4. The screw auger shall be direct driven by a minimum ½ HP. Maximum auger speed shall not exceed 90 RPM. Motor shall be in accordance with Section 26 05 84.
5. The screw auger shaft shall be supported by dual, heavy duty bearings.
6. The auger shall be 304 stainless-steel and of the solid shaft design. Open helix screws shall not be considered.
7. The volumetric feeder design shall allow the motor, gear reducer and auger to be removed as a single unit and the hopper shall provide an access hatch for accessing, removing and replacing the auger. Accessing the hopper from the storage section shall not be required. Auger shall be able to be removed from the face of the feeder without disassembling the drive end of the feeder without tools.
8. The screw feeder shall be sized to supply dry polymer at a feed rate of up to 6 pounds per minute based on 40 #/CF.
9. All welds shall be ground & polished smooth and passivated.

E. Heated Feed Tunnel (600-HTR-0341)

1. A dry polymer feed funnel shall be supplied to receive metered product from the screw feeder and allow for smooth transition of the product into the pneumatic conveyance line.
2. A compound pressure gauge with adjusting valve shall be supplied to balance the pressure / vacuum inside the feed funnel.
3. The dry polymer feed funnel shall be equipped with heater.
4. Provide an eductor designed to reliably pneumatically convey up to 8.25 pounds per minute of dry polymer. The eductor shall be fabricated of 304 stainless-steel. A calibration port shall allow the volumetric feeder to be calibrated without removal of the feed funnel.
5. Eductor shall be removable for cleaning and calibration without tools.
6. The dry polymer feed funnel and eductor shall be fabricated of 304 stainless steel. All welds shall be passivated.
7. The heated feed funnel shall include a capacitance type high level sensor (LSH).
8. The whole feed funnel shall be able to be removed from the feeder without tools.

F. Regenerative Blower (600-M-0321)

1. Provide a regenerative blower to pneumatically convey the dry polymer from the feed funnel via the air eductor up to the tank-top mounted wetting heads. The blower shall be designed to meet the process requirements specified. The blower shall be designed for continuous operation.
2. The blower shall provide 90 SCFM free air flow and a maximum pressure of 40-inch H2O.
3. The blower shall be equipped with a maximum 1.5 HP TEFC electric motor, S.F. 1.15 operation on 460 volt, 3 phase, 60 Hz. Motor shall be in accordance with Section 26 05 84.
4. Provide twenty (20) feet of 2-inch 304 stainless-steel pneumatic conveyance tubing, three (3) 12-inch wide radius elbows and seven (7) compression type tube clamps with neoprene seals.

G. Neat Polymer Pump (600-P-0331)

1. Provide a skid mounted emulsion polymer metering, dilution and activation system. The emulsion polymer metering and activation system shall include:
2. One (1) stainless-steel & viton progressive cavity type neat polymer metering pump. The metering pump shall be driven by a 1/2 HP, TEFC 480 VAC, 3 PH, 60 Hz. gear motor. The pump speed shall not exceed 585 RPM.
3. One (1) calibration column rigidly mounted to the stainless-steel skid sized for a 1 minute

draw-down at maximum metering pump output. The graduations shall be in mL and GPH.

4. Thermal type loss of neat polymer flow sensor to detect low polymer flow, shut the system down and output an alarm.

H. Polymer Prep System Local Control Panel (600-LCP-0300)

1. One control panel shall be supplied to control the entire liquid / dry polymer preparation system. Separate controls shall be provided for controlling the solution feed pumps.
2. Major components of the polymer prep system control panel shall include, but not be limited to, the following items:

    a. NEMA 4X enclosure
    b. Fused disconnect
    c. Provide a 10-inch color touch screen operator interface: Allen Bradley PanelView Plus
    d. White pilot light – LED power
    e. Emergency stop button
    f. PLC: Allen Bradley MicroLogix
    g. Ethernet Switch
    h. Power supplies
    i. Control relays
    j. Control power transformer
    k. Motor Controllers
    l. Motor starters
    m. Fuse blocks and fuses
    n. Terminal blocks

3. The control panel shall be mounted on the skid with the hopper and pre-wired to the feeder skid mounted components.
4. If the control panel is mounted remote from the feeder skid, provide a 304 stainless-steel junction box with main power disconnect and emergency stop push button.
5. A rotary style fused main power door mounted disconnect switch shall be provided.
6. Main power supply shall be terminated directly to the disconnect switch. The disconnect switch shall allow for connection of at least 8 AWG wires.
7. An emergency stop push button with red knob shall be provided labeled "EMERGENCY STOP".
8. All relays, motor starters, breakers, timers, transformers, motor controllers and appurtenances required for manual and fully automatic operation shall be provided.
9. Terminal blocks with number tabs and legend shall be provided for connection of all external wiring to the panels, excluding the main power supply connection. Control wiring terminal blocks shall be sized for 14 AWG copper wires. Terminal block shall be as manufactured by Allen Bradley.
10. All interior connecting wiring and wiring to terminals for external connection shall be in accordance with NFPA 79. Whereby, circuits rated to 10 Amps circuits are of 16 AWG, circuits rated to 15 Amps circuits are of 14 AWG, and circuits rated to 20 Amps circuits are of 12 AWG. All wiring shall be insulated for not less than 600 volts with a moisture and heat-resistant material and flame retardant nonmetallic covering. All wiring shall be grouped or cabled and firmly attached to the panel through wire raceways. Wire numbers shall be heat shrink type with printed numbers. Hand written labels and or adhesive labels shall not be used.
11. All instruments and devices shall be separately fused to protect the equipment.
12. Auxiliary relays and timers shall have 120 VAC, 60 Hz continuous duty coils and 10 ampere, 120 VAC contacts.
13. The control panel shall be provided with Ethernet communication.
14. The programmable logic controller(s) shall provide for manual or fully automatic operation of the entire polymer system.
15. At a minimum, the touch screen operator interface shall provide the following screens -

manufacturers standard screens that do not include the following features must be modified to meet these specifications:

a. Graphical display of the entire polymer make-down system (not including solution metering pump system).
b. Auto Process: To display equipment run status, timer countdown status, valve status, and tank levels.
c. Manual Operation: To allow access to manual control and function of individual system components.
d. Settings: Screen showing operator input settings and calculated auto process parameters. Allowing access to factory settings screens.
e. Factory setting screens to set batch size, mixer speeds (if applicable), volumetric feeder rate, solution concentration range.
f. Calibration: Screen to automatically run the volumetric feeder or metering pump for an exact calibration time, allowing the operator to simply input the test results in order to calibrate the device.
g. Alarms: provide indication of the following alarms and their recommended corrective actions, output a general alarm dry contact, and sound an alarm horn and light an alarm beacon if any of the following alarms occur:

1) Emergency stop
2) Power failure
3) Low water pressure
4) High-High mix / age tank level
5) Low-Low feed tank level
6) Low hopper level
7) High feed funnel level
8) Loss of neat polymer flow (if applicable)
9) Motor overload

h. Totalizer: Screen to display re-settable batch counter total, total polymer consumed, and non-re-settable continuous batch counter.
i. Cost Calculator: Screen to display polymer costs

16. Additionally, the panel shall provide a normally open contact only for remote indication of the following:

a. Low-Low mix / age / feed tank level alarm for solution metering pump shutdown.

17. The polymer system control panel shall provide Ethernet for remote indication of all system parameters.
18. Selector switches shall be Allen Bradley 800H series, when supplied.
19. Control panel shall be fabricated using UL listed components and have a UL approval label.

2.03 Polymer Aging Skid (600-M-0350)

A. General

1. Provide a stainless-steel skid incorporating the metering pump, metering pump calibration column, dilution water inlet piping, automatic valves, instrumentation and a NEMA 4X junction box. All welds shall be passivated. Provide skid as shown on 009-N-3.
2. The tank system shall be the over-under, sequential batch design.

B. Mix / Age Tank

1. One (1) minimum 400 usable gallon mix / age tank shall be provided to mix and age polymer solution. The polymer shall be fully wetted prior to entering the mix tank. The mix tank shall provide aging, after all of the polymer has been delivered to the tank, and shall effectively and thoroughly mix the polymer solution without damaging its molecular structure.
2. The tank shall be constructed of 304 stainless-steel and shall be rectangular, flat bottom, open top and supported over and by the feed tank. All welds shall be ground & polished smooth and passivated The mix / age tank shall have a stainless-steel FNPT connection as follows:

    a. One (1) 2-inch solution transfer

3. Level Sensor: Provide a pressure transducer type level sensor. The controller shall output a 4-20mA signal proportional to level for system batch cycle control.
4. Provide a 304 stainless-steel mix tank bridge of substantial construction to support the mixer, wetting device and water control devices.
5. Transfer Valve: The transfer valve shall be a 2-inch motor operated ball valve. The valve materials of construction shall be PVC and Viton.

C. Feed Tank

1. One (1) minimum 450 usable gallon feed tank shall be provided to deliver polymer solution to the solution metering pump systems.
2. The tank shall be constructed of 304 stainless steel and shall be rectangular, flat bottom, open top. All welds shall be ground & polished smooth and passivated. The mix tank shall have a stainless steel FNPT connection as follows:

    a. One (1) 2-inch solution feed

3. Level Sensor: Provide a pressure transducer type level sensor. The controller shall output a 4-20mA signal proportional to level for system batch cycle control.

D. Wetting Head

1. Dry product shall be pneumatically conveyed to a tank top mounted, non-mechanical dry polymer disperser and wetting device mounted on the tank.
2. The device shall be of substantial construction: the water manifold shall be stainless-steel, spray nozzles shall be of brass construction, and the wetting containment cylinder constructed of clear PVC.
3. The wetting chamber shall be designed with a minimum 6-inch wetting chamber to optimize surface area for wetting.
4. Provide a means for accessing the wetting containment chamber and internal area of the water manifold without the need for tools.
5. Lanyards shall be provided on each component to allow access to wetting containment chamber and to prevent the part from being dropped into the mix tank during service.
6. The disperser shall have a proven track record and shall be specifically designed for dry product wetting.
7. Devices that do not completely disperse polymer prior to contact with water, or which utilize eductors or “wetting bowls” prone to ineffective polymer-particle wetting and or plugging shall not be considered.

E. Mix Assembly

1. One (1) liquid polymer activation module.

    a. The device shall be a hydro-dynamic, non-mechanical device designed to effectively

blend and activate liquid emulsion polymer prior to the polymer entering the mix / age / feed tank.

b. The activation module shall be rated for up to 50 GPM.
c. Mixing energy shall be derived from a high velocity water jet produced by a pressure drop across a stainless-steel orifice.
d. The orifice shall be designed to direct the water jet directly at a polymer injection quill.
e. The injection quill shall be positioned to prevent water from backing up into the check valve when the unit is running.
f. The design of the mixing chamber shall provide plug flow to prevent polymer build up and mixing chamber plugging; systems that allow for low velocity areas in the mixing chamber shall not be considered.
g. Systems which rely on conventional static mixers or mixing tees for polymer activation or which utilize the dry polymer wetting device to blend and activate liquid polymer shall not be considered.

2. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water.

a. The valve shall be designed with an open, unobstructed path to the valve seat.
b. The valve body shall be constructed of Teflon with Viton seals.
c. The poppet and spring shall be stainless-steel and designed to prevent polymer from flowing through the spring, which may cause build-up and plugging.
d. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement.
e. Conventional check valves, ball checks, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

F. Tank Mixer (600-M-0351)

1. Provide a tank mixer to ensure adequate agitation of the polymer solution before transfer to the polymer age/feed tank.
2. The mixer drive shall be capable of handling solution viscosity up to 3300 CPS.
3. Provide 316 stainless-steel dual mixing impellers supported on 316 stainless-steel shaft.
4. The impellers shall be affixed to the shaft in locations to provide for optimum mixing of the polymer solution.
5. The mixer motor shall be 1.5 HP, 480 VAC/3PH/60Hz. An integral gear reducer shall be provided to reduce the shaft speed to not more than 350 RPM. Motor shall be in accordance with Section 26 05 84.

G. Dilution Water Assembly:

1. Provide water hammer arrestor.
2. Provide an electric 1-1/2 inch motor operated ball valve for on/off control of make-down water flow to the dry polymer wetting head.
3. Provide an electric 2-inch motor operated ball valve for on/off control of make-down water flow for rapid fill.
4. Provide an electric 1-1/2 inch motor operated ball valve for on/off control of make-down water flow to the liquid emulsion polymer system mix assembly.
5. Provide a 4-1/2 inch stainless-steel liquid filled pressure gauge (Ashcroft Series 1279 or equal) shared between the two dilution water control systems
6. Provide a single pressure switch shared between the two dilution water control systems to sense low water pressure. The pressure switch shall be rated NEMA 4X and shall have a pressure range from 25 to 150 psi and a proof pressure greater than 150 psi. Systems with a proof pressure below 150 psi will not be acceptable.

H. Polymer Aging Skid Junction Box (600-JBOX-0350)

1. Estop
2. Terminal blocks for wire connections
3. NEMA 4X.

2.04 Polymer Feed System No. 1 (600-M-0401) and Polymer Feed System No. 2 (600-M-0402)

A. General

1. Provide skids as shown on 009-N-4.
2. Provide a rugged stainless-steel skid built of box tubing and fabricated members incorporating the metering pump, post dilution system and controls.
3. Structural angle shall not be used for frame construction.
4. All welds shall be passivated.

B. Polymer Feed Pump No. 1 (600-P-0401) and Polymer Feed Pump No. 2 (600-P-0402)

1. Provide two (2) progressive cavity solution metering pumps to meter polymer solution to the point of application. The pumps shall be constructed of stainless-steel and Viton and have a packing seal.
2. 1.5 HP, 480 VAC premium efficiency motor and gear reducer.
3. Maximum speed shall not exceed 400 RPM.
4. Motor shall be in accordance with Section 26 05 84.
5. Provide water hammer arrestor.
6. Provide calibration column.
7. Provide a thermal type loss of flow sensor to sense loss of polymer flow and protect the pump from running dry.
8. Provide a high discharge pressure switch (PSH) with pressure gauge (PI) and stainless-steel diaphragm seal to sense high discharge pressure and shut the metering pump down. The pressure gauge shall be stainless-steel, liquid filled with a range of 0-160 psi. The pressure switch shall be rated NEMA 4X, have an adjustable range from 15 to 100 psi and a minimum burst pressure of 500 psi.

C. Post Dilution System

1. The post dilution assembly shall provide additional dilution of the polymer solution as required by the application.
2. The post dilution assembly shall include:

a. Strainer
b. Pressure reducing valve
c. Water rate adjusting globe valve
d. Solenoid valve
e. Rotameter type flow indicator: 0.5 to 5 GPM
f. Static mixer
g. Inlet pressure gauge

D. Polymer Feed System No. 1 Local Control Panel (600-LCP-0401) and Polymer Feed System No. 2 Local Control Panel (600-LCP-0402)

1. Provide an integral control panel to control the solution metering pumps. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel shall consist of all power transformers, digital displays, potentiometers, switches, lights, relays, motor controllers and other control devices required for a complete operable system. Power shall be 480 VAC, 3PH, 60 Hz (max 17 full load amps per local control panel). Provide a rotary

style, fused, main power disconnect. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with heat-shrink type labels with printed numbers. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Each pump shall include the following control features:

a. ON / OFF / REMOTE start / stop switch: In ON mode the pump starts. In REMOTE mode the pump starts on a remote dry contact closure.
b. HAND / AUTO rate control: In HAND mode the metering pump rate is controlled by the local ten-turn potentiometer. In AUTO mode the pump follows a 4-20mA flow pace input signal.
c. Emergency stop button
d. Secondary Dilution ON / OFF / AUTO: In ON mode the secondary dilution water solenoid valve opens. In AUTO mode the secondary dilution water solenoid valve opens when the metering pump starts and closes when the metering pump stops.
e. Status / Alarm Indicators:
    1) Main Power ON
    2) LED Display of Metering Pump Rate

f. Inputs (signals by others):
    1) Remote Start / Stop (discrete dry contact)
    2) Pacing Signal Based on Process Flow (4-20mA)

g. Outputs:
    1) System Running (discrete dry contact)
    2) Remote Mode (discrete dry contact)
    3) Polymer Pump Rate (4-20mA)
    4) Loss of polymer flow (discrete dry contact)
    5) Low dilution water pressure (discrete dry contact)
    6) High pump discharge pressure (discrete dry contact)

2.05 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components prior to shipment.

B. Provide in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

2.06 INCIDENTAL MATERIALS

A. Contractor shall provide all incidental materials required for complete and operable installation. Materials shall conform to applicable section of these Specifications for intended service.

B. Anchor bolts, bolts, nuts, and washers shall be 316 stainless steel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install Polymer Prep, Age and Feed Equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 2 man-day for Installation Supervision and Startup Services.
   b. 1 man-day for Instructional Services.
   c. 1 man-day for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier’s or Manufacturer’s field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. Supplier or Manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than wastewater treatment process. See Section 01 61 00.

END OF SECTION

SECTION 46 33 44
PERISTALTIC CHEMICAL FEED EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Alum Feed Skid No. 1 (125-M-0110) with Alum Feed Pump Nos 1 and 2 (125-P-0111 and 125-P-0112)
2. Alum Feed Skid No. 2 (125-M-0120) with Alum Feed Pump Nos 3 and 4 (125-P-0123 and 125-P-0124)
3. Alum Feed Skid No. 3 (125-M-0130) with Alum Feed Pump Nos 5 and 6 (125-P-0135 and 125-P-0136)
4. Variable Speed Drives.
5. Controls Related Equipment.
6. Chemical Feed System Skid
7. Polyethylene Tubing on system skid

1.02 DEFINITIONS

A. NPT: National Pipe Thread

1.03 REFERENCES

A. NEMA: National Electrical Manufacturers Association

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Positive displacement, peristaltic type tubing pump with brushless variable speed motor, non-spring loaded roller assembly located in pumphead, integral tube failure detection system, and flexible tubing with attached connection fittings.

B. Performance Requirements:

1. Pumping equipment shall comply with Chemical Feed System Schedule.
2. Equipment shall be suitable for continuous operation at maximum fluid temperature of 104 degrees F at all operating speeds specified and without external cooling fluid.
3. Adequately size motor horsepower so each pump is non-overloading throughout entire pump performance curve.
4. Design motor for up to 15 evenly spaced starts per hour.
5. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.
6. Design equipment so parts readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.

C. Pump and accessories shall be suitable for chemical being pumped:

1. Alum:

a. Concentration: 48.5 percent
b. Specific Gravity: 1.35

2. Ferric Chloride:

    a. Concentration: 30-40%
    b. Specific Gravity: 1.3-1.4

D. Feed pump and pump accessories factory mounted on corrosion resistant stands. Suction piping, pumps, valves, discharge piping, and piping accessories shown on Drawing 009-N-1 shall be piped together at factory.

E. Provide termination box with dual power receptacles to be mounted on stand for each individual pump.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for chemical feed equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for chemical feed equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of chemical feed equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of chemical feed equipment in service.
3. Submit in accordance with Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: System manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain chemical feed equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 WARRANTY

A. Manufacturer shall furnish written one year standard warranty from date of substantial completion to guarantee there shall be no defects in material or workmanship in any item supplied.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver chemical feed equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store chemical feed equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect equipment and parts shipped to job site.

1.09 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

   a. One check valve rebuild kit per chemical feed system as identified in Chemical Feed System Schedule(s).
   b. Supply four spare tube elements of the specified size per pump.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Blue-White Industries.
B. No substitutions permitted.

2.02 MATERIALS

A. Suitable for application specified in the Peristaltic Chemical Feed Equipment Schedules.

2.03 PUMP FABRICATION

A. Metering Pumps (125-P-0111, -0112, -0123, -0124, -0135, -0136):

1. Pumps shall be positive displacement peristaltic type complete with non-spring-loaded roller assembly pumphead, self-contained variable speed drive, and flexible extruded tube as specified.

2. Peristaltic pumping action is created by the compression of the flexible tube between the pumphead rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.
3. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 5 feet vertical water column. Maximum pressure rating: 30 pounds per square inch.
4. Pump shall not require the use of check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.
5. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed.

B. Pump Head:

1. Pumphead shall consist of a fixed track, a hinged guard door, and non-spring loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and tension shall be factory set to accommodate 2.4 millimeter wall thickness tubing and shall not require adjustment.
2. Pumphead guard shall be transparent for the purpose of viewing direction of rotation. When closed, the pump head guard shall seal against the pump track for leak containment and controlled waste through the pump head waste port in the event of a tube failure. For operator and environmental safety, pumps in which the direction of rotation cannot be visually verified and/or do not have a controlled waste port are not acceptable.

    a. Pumphead Assembly

        1) Pump Track Geometry must have a minimum 96.6 millimeter swept diameter through a minimum track angle of 180 degrees.
        2) Provide high corrosion/impact materials as specified:

            Track Construction: polyphenylene sulfide (PPS)
            Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
            Rotor Construction: polyphenylene sulfide (PPS)

    b. Rotor Assembly

        1) Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:

            Twin non-spring loaded roller arms located 180 degrees apart, each fitted with compressing roller for occlusion of the tube twice per rotor revolution.
            Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18 millimeters.
            Provide non-compressing guide rollers constructed of corrosion resistant Nylatron.

        2) Driveshaft is “D” shaped, which fits into a “D” shaped hole in the rotor assembly, which when disengaged will automatically re-engage after one full rotation.

        3) Mounting: To prevent slip, the rotor assembly shall be axially secured to the output shaft of the gearmotor via a slotted collet and central retaining screw.

        4) Pumpheads requiring disassembly or special tools for tube changing are not acceptable.

C. Pump Tube Assembly:

1. Pump shall be supplied with a one-piece molded tubing assembly, including tube heads, which shall be self-locating when fitted into the pumphead. Tube element shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by the element fittings. The tubing shall be replaceable without the use of tools and with no disassembly of the pumphead. To achieve maximum service life, pump heads with a track angle of less then 180 degrees and/or without tube elements are not acceptable.
2. Load Sure Element shall be constructed with Flex-A-Prene or Norprene tubing with male PVDF Quick Release Connectors.
3. Supply One tube element of the specified size per pump.
4. Supply Two, one-meter long flexible reinforced PVC hoses for connection of pump to suction and discharge process lines. Flexible hose shall have a PVDF female Quick Release fitting for connection to the Loadsure Element and male Quick Release fitting for connection to NPT adaptor with built in shut off valve for ease of maintenance and connection to process lines.
5. Supply Two Quick Release to ½" NPT Adaptors

D. Drive System:

1. Rating: Continuous 24 hour operation, 40 degree Celcius ambient.
2. Skid will be setup for 1.10-1.120 V with an eight-foot power cord.
3. Maximum drive power consumption: 135VA.
4. Enclosure: NEMA 4X
5. Housing: aluminum with exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including 316 stainless steel, are not acceptable.
6. Pumps must meet the following minimum requirements for operator interface functionality.

    a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
    b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
    c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
    d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
    e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
    f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 revolutions per minute.

7. Supply auto control features to meet the following minimum functionality requirements for use with the SCADA system. All control signal features must be located internally to the pump.

    a. Remote Control Inputs

        1) Speed Control:

        - Primary Analog 4-20mA or 0-10VDC speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.
        - Secondary Analog 4-20mA or 0-10VDC scaling input, with input signal trimmable and programmable scaling factor.
        - Provisions for alternative remote accessory potentiometer (if supplied by others) for primary speed control or secondary speed scaling.

2) Start/Stop Control: via 5V TTL, 24V industrial logic or dry contact- Configurable command sense allowing open to equal run or open to equal stopped.
3) Forward/Reverse Control: via 5V TTL, 24V industrial logic or dry contact.
4) Auto/Man Mode Control: via 5V TTL, 24V industrial logic or dry contact.
5) Leak Detector Run/Stop Control: via 5V TTL, 24V industrial logic, or dry contact.

b. Status Outputs

1) Four relay contacts rated for a 120V AC with a maximum load of 30W, NO or NC software configurable to indicate the following:

Running/Stopped status
Forward/Reverse status
Auto/Manual status
General Alarm status
Leak Detected status

2) Speed output – Analog 4-20mA or 0-10 VDC

c. Accepts RS485 data protocol.
d. Termination: supply screw down terminals suitable for up to18 AWG field wire and accessible through four glanded cable entry points on the pump.

8. Drive motor- brushless DC motor with integral gearbox and tachometer feedback.

a. Speed Control Range of 2200:1 from 0.1 to 220 revolutions per minute plus or minus 0.1 revolutions per minute throughout the range.
b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 revolutions per minute and synchronous mode with magnetic field rotation control below 35 revolutions per minute.
c. Circuitry complete with temperature and load compensation and protection.

9. Mounting: Drive shall be self-supporting and shall not require anchoring.
10. Leak Detection- Pump manufacturer shall supply float-type leak sensor within the bottom of the pump head for leak detection and pump shut down in the event of a tubing failure.

2.04 CHEMICAL FEED SYSTEM SKID DESIGN

A. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to site on single skid. Components to be mounted on skid are as indicated on Drawings 009-N-1 and shall include, but not limited to, metering pumps, calibration columns, piping, valves, piping accessories as detailed in Drawings, and wiring integral to skid. Chemical metering pump manufacturer shall be responsible for providing complete skid package and shall be responsible for all equipment, valves and piping within skid boundary.

B. Chemical feed system skids shall be constructed from plastic with adequate supports for all equipment and piping.

C. All piping and fittings shall be Schedule 80 PVC and readily available locally. Special machined fittings/blocks that are not of standard manufacture will not be accepted.

D. Pulsation Dampener as per peristatic chemical feed equipment manufacturer's recommendations.

E. Backpressure valves shall be of in-line diaphragm design. Backpressure valve shall be set from factory at 10-20 psig above specified operating pressure. Once in field, backpressure valve should

be set at 10-20 psig above injection pressure.

F. Provide clear calibration column as indicated on drawings such that one pump can be calibrated while the other pump(s) are fully operational. Provide flexible tubing as required to connect calibration column vent to floor drain when in use.

G. Provide unions on inlet and outlet of calibration column in order to allow removal of column with disturbing piping assembly.

H. Suction, discharge and calibration column isolation valves shall be tru-union PVC ball valves.

I. All components of skid-mounted system (pumps, piping, calibration column and controls) shall be factory pressure tested with water prior to shipment. Certification of factory testing shall be included in installation, operation and maintenance manuals.

J. Provide unions on suction and discharge of metering pump in order to allow removal of pump without disturbing suction or discharge piping.

K. All piping / accessory support shall be from skid base or rear panel.

a. Provide 2" liquid filled pressure gauge on discharge of pump (125-PI-0111, -0112, -0123, -0124, -0135 and -0136). Each gauge shall be protected by glycerin filled diaphragm seal. Pump discharge pressure status output shall include a Pressure High Alarm (125-PSH-0111, -0112, -0123, -0124, -0135 and -0136). Casings of gauge shall be stainless steel and accuracy shall be 2% or better. Standard operating pressures for each pump shall be determined during installation & operational testing, and Pressure High Alarm setpoint will be set 50% above standard operating pressure.

b. Discharge gauges 125-PI-0111, 125-PI-0112, 125-PI-0123, and 125-PI-0124 shall be 0-30 psig.

c. Discharge gauges 125-PI-0135 and 125-PI-0136 shall be 0-100 psig.

L. Gauge assemblies shall incorporate isolation valve on process side of diaphragm seal. Provide gauge assemblies in accordance with Section 40 73 00.

M. All piping accessories shall be securely fastened to frame or supported with stand-offs. Use of steel bands or strapping shall not be acceptable.

2.05 POLYETHYLENE TUBING

A. General:

1. Provide tubing compatible with chemical being pumped.
2. Provide tubing on and within pump skids. Off-skid carrier tubing will be provided under Section 40 05 05.

B. Material:

1. Tubing: ASTM D2737, AWWA C901 Pressure Class 160, DR 9.
2. All joints shall be socket welded or fusion welded.

2.06 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components prior to shipment.

B. Provide in accordance with Section 09 96 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install chemical feed equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

    a. 1 man-day for Installation Services.
    b. 1 man-day for Instructional Services.
    c. 1 man-day for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier’s or Manufacturer’s field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. Supplier or Manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than wastewater treatment process. See Section 01 61 00.

EASTSIDE WASTEWATER TREATMENT PLANT PERISTALTIC CHEMICAL FEED EQUIPMENT SCHEDULE 1	
Name of Pump(s)	Alum Pump Nos. 1, 2, 3, and 4
Tag Number(s)	125-P-0111 125-P-0112 125-P-0123 125-P-0124
Number of Pumps	Four
Fluid Pumped	Alum
Concentration (Percent by Volume)	48.5
Specific Gravity	1.35
Maximum Suction Lift (ft)	5
Motor Horsepower	N/A
Motor Voltage	120
Constant or Variable Speed	Variable Speed
Tube Material	Flex-A-Prene or Norprene
Installation	Skid Mount
Maximum Operating Point at Maximum Speed	
Alum Pump Nos. 1 through 4	
Capacity (gph)	36
Total Dynamic Head (psi)	30
rpm = revolutions per minute gph = gallons per hour psi = pound per square inch ft = feet	

EASTSIDE WASTEWATER TREATMENT PLANT PERISTALTIC CHEMICAL FEED EQUIPMENT SCHEDULE 2	
Name of Pump(s)	Alum Pump Nos. 5 and 6
Tag Number(s)	125-P-0135 125-P-0136
Number of Pumps	Two
Fluid Pumped	Alum
Concentration (Percent by Volume)	48.5
Specific Gravity	1.35
Maximum Suction Lift (ft)	5
Motor Horsepower	N/A
Motor Voltage	120
Constant or Variable Speed	Variable Speed
Tube Material	Flex-A-Prene or Norprene
Installation	Skid Mount
Maximum Operating Point at Maximum Speed	
Alum Pump Nos. 5 through 6	
Capacity (gph)	36
Total Dynamic Head (psi)	100
rpm = revolutions per minute gph = gallons per hour psi = pound per square inch ft = feet	

END OF SECTION

SECTION 46 41 17
STATIC MIXER

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. In-line static mixers for mixing of Alum solution into thickened waste activated sludge (TWAS) and thickened primary sludge (TPSD).

1.02 SYSTEM DESCRIPTION

A. Design static mixer to mix Alum solution into TWAS and TPSD.

B. Alum Solution Characteristics:

1.	Normal Concentration, Percent by weight:	45-55%
2.	Nominal Specific Gravity:	1.33
3.	Flow Range	0 to 35 gph

C. TWAS and TPSD Sludge Characteristics

1.	Solids Concentration	3% to 7%
2.	Flow Range	50 gpm to 150 gpm

D. This in-line static/motionless mixer must be of non-clogging design as the municipal sludges contain solid and fibrous materials of sufficient quantities and types to accumulate and cause fouling or plugging conditions in standard mixers. It shall be designed to prevent “stapling” of stringy materials in the flow. A single threaded injector port connection shall be provided which provides dual feeding injection points into the main sludge line

E. Size: 6-inch Static Mixer

1.03 SUBMITTALS

A. General:

1. Submit Product Data and Shop Drawings in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in 1 complete submittal package. Partial submittals are unacceptable

B. Product Data:

1. Catalog cuts and product specifications for each product component specified.

C. Shop Drawings:

1. Installation drawings and specifically prepared technical data.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of chemical feed equipment in service.

3. Submit in accordance with Section 01 78 23.

PART 2 – **PRODUCTS**

2.01 MANUFACTURERS

A. Komax, type Hi-Pass.

2.02 STATIC MIXER

A. Mixers shall be non-clogging design capable of mixing materials listed in Section 1.02.

B. Material of construction shall be Schedule 80 PVC.

C. Maximum pressure drop through mixer at a sludge solids concentration of 4 percent and a sludge flow rate of 150 gpm shall be 5.0 psi.

D. Mixer flanges ANSI B16.5 150-lb standard.

E. 3/4" NPT Additive Input Port

F. Size: 6-inch Static Mixer

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved submittals.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

    a. 1/2 man-day for Installation Services.
    b. 1/4 man-day for Instructional Services.
    c. 1/4 man-day for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

SECTION 46 41 23
SUBMERSIBLE MIXING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Submersible Mixers with Integrated Variable Frequency Drives. (150-M-1A1 thu -6-A1, 150-M-1A2 thru 6A2, 150-M-1A3 thru -6A3, 160-M-7A1 thu -12-A1, 160-M-7A2 thru 12A2, and 160-M-7A3 thru -12A3)
2. Mixer supports / alignment masts.
3. Controls. (150-LCP-1A thru -6A and 160-LCP-7A thru -12A)

1.02 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide submersible mixers for three selector basins located in the first pass of each of the 12 aeration basins.
2. Selector basin dimensions 37 feet long by 30 feet wide by 15 feet side water depth.
3. Basins shall contain mixed liquor (combined primary effluent and return activated sludge), with a suspended solids concentration between 2,000 and 4,000 mg/L.
4. Each mixer shall be capable of the following performance:

Parameter	Units	Value
Number of Mixers		36 + 1 additional spare unit
Mixer Full Speed	Revolutions per Minute	18
Motor	Volts / Phase / Hertz	460/3/60
Maximum Nominal Motor Horsepower	Horsepower	3
Full Load Amps	Amps	5
Thrust Produced at full speed	Newtons	522
Minimum Required Submergence	Inches	≥ 24

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.
2. Submit in accordance with Section 01 33 00.

B. Product Data:

1. Catalog cuts and product specifications for submersible mixing equipment specified.
2. Motor data.
3. Coating Systems in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for submersible mixing equipment.

2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of submersible mixing equipment with referenced standards.
2. Mixer thrust shall be certified using ISO 21630 thrust test.
3. Certified reports of field tests and observations.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible mixing equipment in service.
3. Submit in accordance with Section 01 78 39.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: System manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain submersible mixing equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver submersible mixing equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store submersible mixing equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish per mixer extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One full set of bearings
b. One full seal set
c. One complete O-ring set
d. Ten sets of fuses
e. 2 keypads

f. 2 terminal boards

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with name and number of equipment to which they belong.
4. Furnish one complete spare mixer including blades with a long (100') power and control cable.

1.07 WARRANTY

A. Full one and a half (1.5) year warranty on all mixer parts (inclusive of variable frequency). After 1.5 years, warranty drops to 50% for the next 22 months and 25% until month 60, after which the warranty is invalid.

B. Three (3) year warranty on control panels and all inclusive components.

C. One (1) year warranty on all additional parts and accessories.

PART 2 – PRODUCTS

2.01 MIXER FABRICATION

A. Manufacturer:

1. SR 4320, by Flygt (a Xylem company)

2. No Substitutions Permitted

B. General:

1. Submersible, gear driven, axial mixer suitable for mixing of activated sludge with a square or mast system.
2. Mixer shall be able to be raised and lowered and shall be easily removable for inspection or service without the need for personnel to enter the tank.
3. Mixer, with cables and appurtenances, designed for continuous submergence under water without loss of watertight integrity to a depth of 50-feet.
4. All metal components in contact with the mixed media shall be 304 stainless steel.
5. Mixer shall be capable of mixing with minimal introduction of oxygen, maintaining anaerobic conditions.
6. Mixer shall be capable of being locally controlled, monitored, and configured via keypad, and remotely monitored and controlled via Modbus RTU communications. Provide gateway device converting Modbus RTU to Ethernet/IP for communications and control via Plant Process Control System.

C. Propeller:

1. Constructed of fiberglass reinforced polyurethane
2. Propeller shall handle solids, fibrous materials, heavy sludge and other matter found in sewage applications.

D. Shaft:

1. Shaft shall be of 316 stainless steel.
2. Shaft seals shall have dual seals to isolate oil in housing from surrounding liquids.

E. Bearings:

1. Bearings shall be rated for 100,000 hours of operation, L-10 rated life.
2. Bearings shall have inner and outer races of metal construction.
3. Outboard propeller bearing shall be an angular contact bearing.
4. Motor shaft shall be supported by two bearings.
5. Roller and angular contact ball bearing shall take up the axial and radial loads.
6. Angular contact ball bearing shall take up axial loads.
7. Bearings shall be pre-loaded by bearing loading nut located on motor end of shaft.
8. Bearings shall be permanently lubricated.

F. Oil Housing:

1. Each mixer shall have an oil chamber for the shaft sealing system, and a second separate oil chamber for the gear box. Plugs for drainage and inspection of the oil shall be easily accessible from the outside.
2. Oil housing cover plate shall be of corrosion resistant composition.

G. Casing:

1. Grey cast iron, ASTM A-48 Class 35B construction designed to prevent moisture from entering motor compartment.
2. Provide 304 stainless steel guide bracket designed to mount on support mast.

H. Mechanical Seals:

1. Each mixer shall be provided with three seals to separate the various parts of the mixer.
2. The outer seal on the propeller shaft shall be a mechanical seal made of corrosion resistant cemented carbide (WCCR). The seals shall operate in an oil reservoir that hydrodynamically lubricates the seal faces at a constant rate. Only the seal faces of the outer seal shall be exposed to the mixed media.
3. The inner seal on the propeller shaft shall be a nitrile rubber lip seal isolating the propeller shaft oil chamber from the gear box oil chamber.
4. The third seal shall be a viton rubber lip seal mounted on the motor shaft to isolate the gear box oil chamber from the stator housing.
5. The seals shall require neither maintenance nor adjustment, but should be accessible to check or replace.

I. Motor:

1. 460 volt /3-phase. Minimum service factor of 1.15.
2. See System Description for motor horsepower.
3. Stator windings shall be of Class H insulation rated for 180 degrees Celsius (C) and insulated by trickle impregnation method with Class F monomer-free polyester resin.
4. Multi-pole motor shall be directly connected to the propeller.
5. Designed for continuous duty and inverter duty rated.
6. Sized to prevent overheating with stator cooled by surrounding mixed media.
7. Designed for a minimum of 10 evenly spaced starts per hour.
8. Rotor bars and short circuit rings shall be aluminum.

J. Variable Frequency Drive:
1. The mixer shall include an integrated variable frequency drive.

K. Elastomers:

1. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces.

L. Mixer/Motor Monitoring:

1. Mixer monitor shall provide dual function monitoring for both over-temperature via bi-metal, thermistor, or RTD sensor and seal failure via moisture sensor or float switch. Only low-voltage leakage system allowed.
2. Temperature and seal failure status, and capability to acknowledge alarms, shall be available to remote mounted keypad and via Process Control System via communication link.
3. Communication signal wiring shall be incorporated into overall mixer power cable.

M. Cable entry:

1. Cable entry shall be an integral part of the back plate.
2. Designed for submerged service to prevent moisture from entering motor compartment under all operating conditions.
3. Provide length of power cable (without splices) to reach Mixer Panel.
4. Provide double set of elastomer grommets.
5. Comprise of two cylindrical elastomer grommets, each flanked by washers and ferrule designed with close tolerance fit against cable outside diameter and entry inside diameter.
6. Assembly shall bear against a shoulder in stator casing opening and be compressed by a gland nut threaded into it.
7. Interaction between the gland nut and the ferrule shall move the grommet along the cable axially instead of with a rotary motion.
8. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top.
9. Connection shall be made between the threaded compressed type binder post thus securely affixing the cable wires to the terminal board, rendering the motor compartment leak proof from liquid which may enter the terminal compartment.

N. Mast Assembly:

1. Mast shall be constructed of 316 stainless steel.
2. Provide mixer with a minimum of 50-foot 316 stainless steel lifting cable.
3. Provide 316 stainless steel wall brackets (upper, intermediate, and lower) of the quantity and locations recommended by manufacturer.
4. Provide cable holders and power cable support grips as recommended by manufacturer.
5. Mast assembly shall allow for rotation of mast to allow mixing flexibility.

O. Mounting:

1. Bottom mounted tripod – guide bar type in 316 stainless steel

    a. Guide Bar Type
    b. 316 Stainless Steel
    c. Capable of supporting the mixer's weight and designed to resist all forces on the mixer during operation without deflection or damage
    d. Configured to allow for easy lifting of the mixer by davit crane/cable for servicing without draining the tank.

2. When in place, mixer should rest on support arm designed to carry mixer's full weight and minimize movement from unbalanced or intermittent torsional forces.

2.02 CONTROLS

A. Each mixer shall be furnished with remote mounted keypad. Keypad shall be installed in a NEMA 4X polycarbonate remote control cabinet. Three keypads shall be installed in each cabinet, such

that each treatment train may be controlled from a single mixer panel. Twelve such mixer panels will be required. Mixer panels will be located within 200 feet of respective mixers being controlled. Mounting by Contractor.

1. Commands Including:
   a. Start
   b. Stop
   c. Speed Adjustment
   d. HOA functionality to enable local and remote control
2. Parameter Display and Configuration:
   a. Current Speed
   b. Amp Draw
   c. Power Draw
   d. Operating Mode
   e. Running Hours
   f. Alarm status
   g. Alarm acknowledgement
   h. Alarm Details:
      1) Mixer internal over temperature
      2) Mixed fluid over temperature
      3) Overcurrent (excessive load)
      4) Communication failure
      5) VFD Diagnostics
3. Intermittent signal to verify connectivity with mixer
4. All settings stored in non-volatile memory such that the mixer will resume normal operation when power is restored.
5. User configurable to start when 3 phase power is provided or require re-established communications before resuming.

B. Provide technical assistance to Contractor prior to installation for coordination of and to provide input to Contractor for the following:
   1. Recommended Modbus addressing.
   2. Coordination of Modbus register maps for remote monitoring, configuration, and control parameters.

2.03 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components prior to shipment.

B. Provide in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holds with protective grease.

E. Contractor shall store equipment inside a building for protection against corrosion.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install sludge submersible mixing equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 10. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 12 service-days for Installation Services.
b. 2 service-days for Instructional Services.
c. 2 service-days for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.

SCHEDULE 1 – SUBMERSIBLE MIXING EQUIPMENT

Mixer ID	Location	Zone ID	Cable Length
150-M-1A1	150 - South Basin	1A	Long - 100'
150-M-1A2	150 - South Basin	1A	Standard - 65'
150-M-1A3	150 - South Basin	1A	Standard - 65'
150-M-2A1	150 - South Basin	2A	Long - 100'
150-M-2A2	150 - South Basin	2A	Standard - 65'
150-M-2A3	150 - South Basin	2A	Standard - 65'
150-M-3A1	150 - South Basin	3A	Standard - 65'
150-M-3A2	150 - South Basin	3A	Standard - 65'
150-M-3A3	150 - South Basin	3A	Standard - 65'
150-M-4A1	150 - South Basin	4A	Standard - 65'
150-M-4A2	150 - South Basin	4A	Standard - 65'
150-M-4A3	150 - South Basin	4A	Standard - 65'
150-M-5A1	150 - South Basin	5A	Standard - 65'
150-M-5A2	150 - South Basin	5A	Standard - 65'
150-M-5A3	150 - South Basin	5A	Standard - 65'
150-M-6A1	150 - South Basin	6A	Long - 100'
150-M-6A2	150 - South Basin	6A	Standard - 65'
150-M-6A3	150 - South Basin	6A	Standard - 65'
160-M-7A1	160 - North Basin	7A	Standard - 65'
160-M-7A2	160 - North Basin	7A	Standard - 65'
160-M-7A3	160 - North Basin	7A	Standard - 65'
160-M-8A1	160 - North Basin	8A	Standard - 65'
160-M-8A2	160 - North Basin	8A	Standard - 65'
160-M-8A3	160 - North Basin	8A	Standard - 65'
160-M-9A1	160 - North Basin	9A	Standard - 65'

160-M-9A2	160 - North Basin	9A	Standard - 65'
160-M-9A3	160 - North Basin	9A	Standard - 65'
160-M-10A1	160 - North Basin	10A	Standard - 65'
160-M-10A2	160 - North Basin	10A	Standard - 65'
160-M-10A3	160 - North Basin	10A	Standard - 65'
160-M-11A1	160 - North Basin	11A	Standard - 65'
160-M-11A2	160 - North Basin	11A	Standard - 65'
160-M-11A3	160 - North Basin	11A	Standard - 65'
160-M-12A1	160 - North Basin	12A	Standard - 65'
160-M-12A2	160 - North Basin	12A	Standard - 65'
160-M-12A3	160 - North Basin	12A	Standard - 65'
Extra Mixer			Long - 100'

END OF SECTION

SECTION 46 51 33
FLEXIBLE MEMBRANE DISC DIFFUSERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fine bubble, membrane disc fixed header aeration systems for South Aeration Basin, Tank 1, Selector Zone 3; Tank 2, Selector Zone 3; Tank 3, Selector Zone 3; Tank 4, Selector Zone 3; Tank 5, Selector Zone 3; Tank 6, Selector Zone 3; and North Aeration Basin, Tank 7, Selector Zone 3; Tank 8, Selector Zone 3; Tank 9, Selector Zone 3; Tank 10, Selector Zone 3; Tank 11, Selector Zone 3; Tank 12, Selector Zone 3.

    a. Stainless steel drop pipes.
    b. PVC manifolds and air distributors.
    c. Diffuser saddles and clamps.
    d. Stainless steel supports and anchors.
    e. Bolts, nuts and gaskets for aeration system flange connections.
    f. Air distributor purge systems.
    g. Membrane disc diffusers and O-ring gaskets.

2. All aeration equipment shall be manufactured by the same manufacturer and at the same location.
3. Disc diffusers shall match sizing of existing diffusers in Pass 2 for all 12 basins.

1.02 DEFINITIONS

A. EPDM: Ethylene Propylene Diene Monomer

B. MIG: Metal Inert Gas

C. PSI: Pounds per Square Inch

D. PVC: Polyvinyl Chloride

E. SCFM: Standard Cubic Feet per Minute

F. TIG: Tungsten Inert Gas

1.03 REFERENCES

A. ASCE: American Society of Civil Engineers

B. ASTM: American Society of Testing and Materials

1.04 SYSTEM DESCRIPTION

A. General Design and Performance Requirements:

1. System shall evenly diffuse air throughout respective zone for all specified conditions.
2. Diffusers shall operate throughout specified airflow range and be designed for an airflow rate of 200 percent of the maximum airflow rate.

B. North and South Aeration Basin General Requirements:

a.	Type of System:	Membrane Disc Fixed Header
b.	Number of Basins:	2
c.	Basin Volume:	1,246,000 gallons per basin
d.	Pass Dimensions:	185 feet long by 30 feet wide per basin
e.	Maximum Pass Water Depth:	15 feet 9 inches per basin
f.	Average Pass Water Depth:	15 feet per basin
g.	Selector Zone Dimensions:	37 feet long by 30 feed wide

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for fine bubble aeration systems specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for fine bubble aeration systems.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of fine bubble aeration systems with referenced standards.
2. Certified reports of field tests and observations.
3. Submit certified oxygen transfer performance curves to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.
4. Certify and stamp all curves by a Professional Engineer.
5. Submit curves for all specified conditions for approval by the Engineer prior to manufacturing aeration equipment.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of fine bubble aeration systems in service.
3. Submit in accordance with Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain coarse bubble aeration systems components from single manufacturer with responsibility for entire system. Unit shall be representative product built from

components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fine bubble aeration system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store fine bubble aeration system in clean, dry location.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. 20 Membrane Disc Diffusers.
b. 20 Diffuser Retainer Rings.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Stamford Scientific International, Inc.

B. Sanitaire

C. Aquarius

2.02 MATERIALS AND FABRICATION

A. Stainless Steel – Pipe, Fittings and Supports

1. Fabricate all welded parts and assemblies from sheets and plates of 304 stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.

2. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

3. Welds & Welding Procedure

a. Weld in the factory with ER 304 filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.
b. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of joint.
c. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

4. Corrosion Protection and Finishing - Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

a. Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or deburring and finish grinding wheels.
b. Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

B. Natural Rubber – Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 plus / minus 5.

C. Polyvinyl Chloride (PVC) – Pipe and Fittings

1. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 7000 psi.
2. Provide lower drop pipe, manifold and air distributors as follows:

Diameter	Wall Thickness	ASTM Standard
4-inch	SDR 33.5	D3915, 3034
6-inch and Larger	Schedule 40	D1784, 1785, 2466

3. Design air distributors and manifolds to withstand 125 degrees Fahrenheit mean wall temperature.
4. Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for manifolds, air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation. PVC piping shall consist of 2 percent average TiO_2 content with minimum sampling concentration of 0.5 percent TiO_2.
5. Factory solvent weld all PVC joints.

D. EPDM - Membrane Disc Diffusers and Gaskets

1. Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (i.e. plasticized PVC or polyurethane) are not acceptable.
2. Add carbon black to the material for resistance to ultraviolet light.
3. Design diffuser as one piece injection molded part with a minimum thickness of 0.080 inches for 9 inch diameter unit.
4. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 SCFM/square foot of material. Furnish proportionately thicker material for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching.
5. Produce diffusers free of tears, voids, bubbles, creases or other structural defects.
6. Furnish diffuser material to meet the following:

Item	Values / Units	ASTM Standard
Base Polymer	EPDM	D573
UV Resistance	Carbon Black	
Specific Gravity	1.25 or less	
Durometer – Minimum	58 percent plus/minus 5 percent	D2240
Modulus of Elasticity	500 psi	D412
Ozone Resistance (72 hours: 40 degrees Celsius; 50 parts per million per hour)	No cracks at 2X magnification	D1171, Test A
Tensile Strength	1200 psi	D412
Elongation (Percent)		

Item	Values / Units	ASTM Standard
• Retained 70 hours at 100 degrees Celsius	• 75 Percent Maximum	• D573
• Minimum at break	• 350 Percent	• D412

7. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

E. Provide all flanges for attachment of stainless steel to carbon steel with a follower flange design having a drilling conforming to Standard for 150-pound flanges.

F. Furnish all nuts, bolts and washers including anchor bolts in 316 stainless steel. Anchor bolts for support systems shall be epoxy adhesive anchor bolts as recommended by manufacturer and in accordance with Section 05 50 00.

2.03 AERATION EQUIPMENT

A. Coordinate layout with location of submersible mixers, see Section 46 41 23.

B. Drop Pipes:

1. Provide 12 ga. 304 stainless steel drop pipes from the isolation valve, or as shown on Drawings, at the air main connection to the drop pipe connection on the manifold.
2. Provide a stainless steel Van Stone style flange with a 150-pound bolt pattern for the top connection.
3. Provide a stainless steel band clamp coupling with gasket for the lower drop pipe to manifold connection.
4. Support drop pipe from upper connection.

C. Manifolds:

1. Provide PVC manifolds for connection to the air distribution headers.
2. Fabricate manifolds with 4-inch diameter fixed threaded union or flanged joints for connection to the air distributors.
3. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125 degrees Fahrenheit.
4. Connect manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart.
5. Support manifold with minimum two stainless steel supports.

D. Air Distributors and Diffuser Holders:

1. Provide 4-inch diameter air distributors perpendicular to the air manifold.
2. Fabricate distributors with single 9-inch disc diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength. Saddle mount assembly is also acceptable. Diffuser holders shall be installed by manufacturer. Field installation of diffuser holders will not be acceptable.
3. Design distributors and holders to resist a dead load of 200 pounds applied vertically to the outer edge of the diffuser holder.
4. Provide 4-inch diameter threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor.

E. Air Distributor and Manifold Connection Joints

1. Join air distributor sections with positive locking fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation.
2. Design threaded union joints with spigot section connected to one end of the distribution header, a threaded socket section connected to the mating distribution header, an “O” ring gasket and a threaded screw on retainer ring. Solvent welding shall be done in the factory.
3. Design flanged joints with 125-pound drilling angle face ring, follower flange and stainless steel hardware.
4. Provide adjustable fixed PVC flange joints and type 316L stainless steel bolts, nuts, and washers. Bolts shall be a minimum 5/16-inch. PVC flanges shall be minimum 7/32-inch wall thickness.

F. Support System:

1. All supports shall be constructed of 304 stainless steel.
2. Provide each section of manifold and air distributor with a minimum of two supports.
3. Supports shall be minimum 0.5 in diameter in tanks with submersible mixer.
4. Limit maximum support spacing to 8 feet.
5. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125 degrees Fahrenheit and to minimize stress build up in the piping system.
6. Design supports to be adjustable without removing the air distributor from the support.
7. Design supports to allow for complete removal from the tank to facilitate installation of additional headers and in-tank maintenance except anchor bolts.
8. Manifold Support – 6 inch diameter and larger

    a. Design supports to include hold down guide straps, support structure and anchor bolts.
    b. Design guide straps with a 2-inch minimum width to eliminate point load on manifold and minimize binding.
    c. Design support for 2-inches plus or minus vertical adjustment for leveling of manifold.
    d. Attach supports to tank floor with two stainless steel anchor bolts.

9. Air Distributor and Manifold Supports – 4-inch diameter.

    a. Provide guide and fixed type supports to allow expansion/contraction.
    b. Design supports with hold down straps, support structure and anchor bolt.
    c. Design support for 1 ½-inch (plus or minus) vertical adjustment for leveling air distributor to plus or minus ¼-inch.
    d. Guide support

        1) Guide straps to have 1 ½-inch wide top and bottom contoured bearing surface with chamfered edges to minimize binding and resistance to movement of air distributor under full buoyant uplift load.
        2) Design strap with 1/8-inch clearance around distributor so strap is self-limiting and cannot be over tightened.

    e. Fixed supports

        1) Fixed straps to have 1 1/2-inch wide top and bottom contoured bearing surface with punched burrs to positively grip the air distributor when tightened.
        2) Design strap to be self-limiting to prevent stressing the distributor if the clamp is over tightened.

    f. Attach supports to tank floor with one stainless steel anchor bolt.
    g. Supports shall be minimum 0.5 in diameter in tanks with submersible mixer.

G. Liquid Purge Assembly

1. Liquid Purge System - Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and control valve.

H. Flexible Membrane Disc Diffuser Assemblies

1. Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice.

2. Membrane Diffuser

a. Incorporate an integral check valve into the membrane diffuser.
b. Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches plus or minus 20 percent water column at 1.0 SCFM/diffuser and 2-inches submergence.
c. Visual Uniformity – Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 SCFM/diffuser and 2-inches submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.
d. Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

3. Diffuser Holders Support Plate and Retainer Rings

a. Design holder with air flow control orifice and plenum chamber below the diffuser. Holder to provide peripheral support for the diffuser.
b. Diffuser Support Plate – Provide a support plate to form an air plenum under the diffuser and support for the membrane when the air is off.
c. Design retainer ring to seal the diffuser and O-ring in the holder to prevent air leakage around gasket.
d. Design retainer ring threads with minimum cross section of 1/8-inch and allow for one complete turn to engage threads.

I. Anchor Bolts

1. Anchor bolts shall be constructed of 316 stainless steel.
2. Design anchor bolts for embedment in 4,000 psi concrete with a pullout safety factor of 4.
3. Provide epoxy adhesive anchor bolts in accordance with Section 05 50 00 of the Project Specifications.

2.04 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of equipment prior to shipment.

B. Coatings shall comply with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install fine bubble aeration systems in accordance with manufacturer's written instructions.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

    a. 3 workdays for Installation Services.
    b. 2 workday for Instructional Services.
    c. 1 workdays for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.03 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier's or Manufacturer's field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

SCHEDULE 1 –SOUTH AERATION BASIN AERATION ZONES						
Location*	**TANK 1 SELECTOR ZONE 3**	**TANK 2 SELECTOR ZONE 3**	**TANK 3 SELECTOR ZONE 3**	**TANK 4 SELECTOR ZONE 3**	**TANK 5 SELECTOR ZONE 3**	**TANK 6 SELECTOR ZONE 3**
System Type	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header
Number of Diffusers per Grid	240	240	240	240	240	240
Minimum Number of Air Distribution headers per Grid	8	8	8	8	8	8
Maximum Air Rate per Diffuser (SCFM)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Air Rate per Diffuser (SCFM)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Drop Pipe Diameter (inches)	4	4	4	4	4	4
Maximum Pressure at Top of Drop (PSIG)	7.06	7.06	7.06	7.06	7.06	7.06
Clean Water Minimum SOTE (Percent)**	28	28	28	28	28	28
Average Airflow Rate (scfm)	640	640	640	640	640	640

PSIG – Pounds Per Square Inch Gauge
SCFM – Standard Cubic Feet Per Minute
SOR – Standard Oxygen Requirement
SOTE – Standard Oxygen Transfer Efficiency
% - Percent
lb O_2/day – Pounds of Oxygen per Day

SCHEDULE 2 –NORTH AERATION BASIN AERATION ZONES						
Location*	**TANK 7 SELECTOR ZONE 3**	**TANK 8 SELECTOR ZONE 3**	**TANK 9 SELECTOR ZONE 3**	**TANK 10 SELECTOR ZONE 3**	**TANK 11 SELECTOR ZONE 3**	**TANK 12 SELECTOR ZONE 3**
System Type	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header	Fine Bubble Membrane Disc – Fixed Header
Number of Diffusers per Grid	240	240	240	240	240	240
Minimum Number of Air Distribution headers per Grid	8	8	8	8	8	8
Maximum Air Rate per Diffuser (SCFM)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Air Rate per Diffuser (SCFM)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Drop Pipe Diameter (inches)	4	4	4	4	4	4
Maximum Pressure at Top of Drop (PSIG)	7.06	7.06	7.06	7.06	7.06	7.06
Clean Water Minimum SOTE (Percent)**	28	28	28	28	28	28
Average Airflow Rate (scfm)	640	640	640	640	640	640

PSIG – Pounds Per Square Inch Gauge
SCFM – Standard Cubic Feet Per Minute
SOR – Standard Oxygen Requirement
SOTE – Standard Oxygen Transfer Efficiency
% - Percent
lb O_2/day – Pounds of Oxygen per Day

END OF SECTION

SECTION 46 76 21
SLUDGE THICKENING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Gravity Belt Thickeners (GBT):

a. GBT No. 1 (600-M-0501) – Enclosed unit to be used primarily for digested sludge
b. GBT No. 2 (600-M-0502) – Open frame unit to be used primarily for primary sludge and waste activated sludge

2. Polymer Mixing Valve Assemblies (600-M-0551 and 600-M-0552)
3. Control Stations:

a. GBT No. 1 Control Station (600-CS-0501)
b. GBT No. 2 Control Station (600-CS-0502)

4. Control Panels:

a. GBT No. 1 Control Panel (600-LCP-0501)
b. GBT No. 2 Control Panel (600-LCP-0502)

5. Washwater Systems
6. Belt Alignment and Tensioning System
7. Power Unit
8. Accessories

1.02 DEFINITIONS

A. GBT: Gravity Belt Thickener

B. Solids Capture: The percent of the feed solids that remain in the thickened end product on a weight basis. For purposes of this specification, "Capture" is defined as:

% Capture = (C/F) [(F-E)/(C-E)] x 100%

Where: C = Thickened Sludge Total Solids (% TS)

F = Feed (% TSS); excluding dilution from polymer solution flow

E = Filtrate (% TSS); excluding dilution from polymer solution and belt wash water flows

C. Polymer Consumption: To be based on 100% active polymer.

1.03 REFERENCES

A. AGMA: American Gear Manufacturers Association

B. ASME: American Society of Mechanical Engineers

C. ASTM: American Society of Testing and Materials

D. ANSI: American National Standards Institute

E. IEEE: Institute of Electrical and Electronics Engineers

F. NEC: National Electrical Code

G. OSHA: Occupational Safety and Health Act

H. UL: Underwriters Laboratory

I. NFPA: National Fire Protection Association

1.04 SYSTEM DESCRIPTION

A. Design Criteria:

1. GBT shall extract water from sludge after conditioning of sludge with polymer solution.
2. GBT No. 1 is a 1.5-meter enclosed gravity belt thickener for thickening primary, waste activated sludge, and digested sludge, and any combination of the three. Primary use will be digested sludge.
3. GBT No. 2 is a 1.5-meter open frame gravity belt thickener for thickening primary, waste activated sludge, and digested sludge, and any combination of the three. Primary uses will be primary sludge and waste activated sludge.
4. Provide complete sludge thickening systems consisting of, but not limited to, following main components:

    a. Structural frame and base plates.
    b. Sludge conditioning system and feed assembly.
    c. Drainage pans.
    d. Gravity dewatering zone.
    e. Belt wash system.
    f. Belt aligning system.
    g. Belt tensioning system.
    h. Scraper blades.
    i. Filter belts.
    j. Bearings, roller, and shafts.
    k. Electric motors and variable speed drive systems.

5. Unless otherwise specified, “running” signals shall be derived from equipment motor starter or VFD normally open auxiliary contacts.
6. Electrical wiring and controls shall conform to OSHA, local, state and federal codes and regulations.
7. Equipment on panels shall be identified as follows:

    a. Equipment in Operation: Indicating Light Green
    b. Equipment not in Operation: Indicating Light Red
    c. Equipment in Alarm Condition: Indicating Light Blue
    d. Equipment Status Information: Indicating Light Amber
    e. Control Power On: Indicating Light White

8. Failure of equipment, after having been “called to run”, shall generate a Fault alarm. Typical points of failure are motor overload, motor overcurrent, fail-to-start and power fail. In addition to loss of control power, power fail shall include tripping of equipment circuit breaker or disconnect while equipment is called to run. Provide necessary logic to sense discrepancy between “called to run” and “running” signals and activate Fault Alarm signal after adjustable

time delay. Unless otherwise noted, all faults of a particular piece of equipment shall be combined into a Common Fault Alarm.

9. References to “selector switch” refer to maintained contact type functions. Loss and return of control power to circuit does not change control mode or requirement as dictated by switch position.
10. References to “pushbutton” refer to momentary contact type functions. Loss and return of control power to circuit reverts control mode or requirement to default condition. Initiating pushbutton is required to reestablish control mode or requirement.

B. Performance Requirements:

1. Thickener performance shall meet performance as specified in the Belt Thickener Performance Schedule in this Section.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.
2. Submit in accordance with Section 01 33 00.

B. Product Data:

1. Catalog cuts and product specifications for sludge thickening equipment specified.
2. Motor data in accordance with Section 26 05 84.
3. Coating Systems in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for sludge thickening equipment.
2. Wiring Diagrams and component specification sheets: Show power and control connections and distinguish between factory-installed and field-installed wiring. Drawings shall be presented in a ladder logic format, specific to project requirements. Submit drawings in accordance with Section 01 78 23.
3. Panel fabrication and dimensions drawings.
4. Front of panel layout drawings.
5. Interior panel layout drawings.
6. Nameplate legend.
7. Ladder logic type internal wiring and piping diagrams. Include reference numbers on each line for cross-referencing. Each device on ladder to be cross-referenced with line numbers indicating wherever else the device or part of the device is located.
8. Terminal to terminal interconnection schematic showing connections between panel and external panels / MCCs and field devices.
9. Component specification sheets.
10. Instruction manuals including detailed sequence descriptions.
11. Parts list.
12. Recommended spare parts list.
13. Include Engineer tag number when available on each drawing, specification sheet, and manufacturer’s catalog cut in submittal for each component included in system.
14. Submit all indicating and control parameters in English Engineering Units.

D. Record drawings:

1. Provide record drawings of all controls shop drawings updated to as-installed conditions.
2. Provide list of parameter settings for devices provided which have programmable or adjustable settings. Parameter list shall be updated to as-installed conditions.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of sludge thickening equipment in service.
3. Submit in accordance with Section 01 78 39.

F. Submit in accordance with Section 01 33 00.

1.06 WORK FOR HIRE

A. Any and all configuration, programming, setup or other software functions performed on all intelligent devices provided as part of this Project is to be considered “Work for Hire” under the 1976 Copyright Act as amended (title 17 of the United States Code). The Software shall be owned by Owner and shall be turned over to Owner fully documented and capable of future modification by Owner as the work is completed.

B. Owner intends to obtain the Software for its own use only.

C. Owner will not prevent the Software supplier from reuse of the Software concepts and ideas for other projects. Any reuse of the Software concepts and ideas generated under this Project is solely the responsibility of the Software supplier. The Software supplier shall defend, indemnify and hold harmless Owner from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of Software concepts and ideas.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: System manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain sludge thickening equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.
C. Inspect and test control panels at factory prior to shipment.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

B. Deliver sludge thickening equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

C. Store sludge thickening equipment in clean, dry location.

1.09 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. The following quantities are for each unit.

a. Two belts.
b. Four rubber seals.
c. Two wear strips.
d. 16 scraper blades.
e. 25 percent of chicanes or Roto-Kones.

2. Provide special tools required for checking, testing, parts replacement, and maintenance
3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 Manufacturer

A. Komline Sanderson

B. No Substitutions Permitted.

2.02 GRAVITY BELT THICKENERS

A. Materials:

1. Structural steel shall conform to ASTM A36.
2. Iron castings shall conform to ASTM A48 and shall be of a class suitable for the purpose intended.
3. All metal components in contact with polyelectrolyte or sludge shall be Type 304 stainless steel.
4. All fasteners shall be Type 316 stainless steel.
5. Carbon steel plates, shapes, brackets, etc. shall have a minimum thickness of ¼-inch and shall be hot-dip galvanized in accordance to ASTM A-123, coating grade 100.

B. Performance:

Belt Thickener Performance Schedule	
Item	Waste Activated Sludge
Feed Solids Concentration (% Dry Weight Solids)	≤ 1.0
Feed Solids Volatile Solids Content (%)	≤ 80
Feed Solids pH	6.0 – 9.0
Minimum Hydraulic Capacity (GPM)	500
Minimum Solids Throughput (lbs dry weight solids / hour)	1,500
Minimum Thickened Sludge Concentration (% Dry Weight Solids)	5
Minimum Solids Capture (%)	95
Maximum Active Polymer Usage (lbs Dry Weight Polymer / Ton Dry Weight Sludge)	10

Belt Thickener Performance Schedule	
Item	Waste Activated Sludge
% = percent GPM = gallons per minute lbs = pounds / = per	

Belt Thickener Performance Schedule	
Item	Primary Sludge
Feed Solids Concentration (% Dry Weight Solids)	1.5-3.0
Feed Solids Volatile Solids Content (%)	≤ 80
Minimum Hydraulic Capacity (GPM)	300
Minimum Solids Throughput (lbs dry weight solids / hour)	2,000
Minimum Thickened Sludge Concentration (% Dry Weight Solids)	6.5
Minimum Solids Capture (%)	95
Maximum Active Polymer Usage (lbs Dry Weight Polymer / Ton Dry Weight Sludge)	10
% = percent GPM = gallons per minute lbs = pounds / = per	

Belt Thickener Performance Schedule	
Item	Digested Sludge
Feed Solids Concentration (% Dry Weight Solids)	1.5-3.5
Feed Solids Volatile Solids Content (%)	≤ 80
Minimum Hydraulic Capacity (GPM)	300
Minimum Solids Throughput (lbs dry weight solids / hour)	1,800
Minimum Thickened Sludge Concentration (% Dry Weight Solids)	6.5
Minimum Solids Capture (%)	95
Maximum Active Polymer Usage (lbs Dry Weight Polymer / Ton Dry Weight Sludge)	10
% = percent GPM = gallons per minute lbs = pounds / = per	

C. Gravity Belt Thickener No. 1 (600-M-0501)

1. GBT No. 1. Shall be capable of thickening either digested sludge or blend of waste activated sludge and primary sludge to the performance described above.
2. The structural main frame shall be fabricated of ¼ inch 304 stainless plate into a rigid structure adequately braced to withstand loads with a maximum deflection of 0.010 inches at mid-span. The frame shall have a minimum safety factor under maximum load of five (5) times the yield strength of the member.
3. The framework shall be of welded and/or bolted construction. All welding shall conform to the American Welding Society Structural Welding Code. All bolts and fasteners used in the assembly of the structural frame shall have a minimum diameter of no less than 1/2 inch.
4. Maximum load shall be based on the summation of forces applied to the frame from roller mass forces and belt tension forces. The belt tension forces exerted on the frame shall include a minimum loading of 40 pounds per lineal inch (pli) of belt width on the rollers, which equates to a belt tension of 20 pli.

5. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. Permanent lifting lugs shall be provided as necessary to allow installation and removal of the gravity belt thickener. The frame shall be anchored to the concrete floor using a minimum of six anchor bolts.
6. Structural members shall be structural beams, channel, pipe, or tubing with a minimum flange thickness of 3/8 inch and a minimum web/wall thickness of 1/4 inch. All bolts and fasteners used in the assembly of the structural frame shall have a minimum diameter of no less than 1/2 inch.
7. The construction shall allow easy access of all internal components.
8. The enclosed frame shall provide for complete capture of all filtrate and wash water inside the unit for discharge into separate pipe discharge for filtrate and wash water discharge. These pipes are intended for future hookup to separate GBT filtrate and wash water discharge. As installed provide fittings as required to discharge onto floor beneath GBT. The frame shall not require any special piers for support of the unit. Units that require sumps or special piers shall not be acceptable under these specifications.
9. Precision laser drilled holes shall accurately locate the bearings and other components. Alignment of the bearings shall be built into the frame and adjustment or shimming is not permitted. The plate frame shall provide extreme rigidity so that rollers cannot be moved out of proper alignment by external or internal force or by human error. All operating forces shall act in the plane of the plate frame, which is the direction of greatest stiffness.
10. The framework shall also feature a fully integrated feed tank. The feed tank will be part of the frame structure so that no additional civil work is required for mounting. The feed tank will be complete with feed and drain connections. The design of the feed tank shall include hinged covers to reduce the possibility splashing outside the tank. These covers shall be furnished when the unit includes the odor control hood. The feed tank shall be a minimum of 187 gallons for a 1.5-meter thickener.
11. The framework shall have filtrate drain trays and wash stations
12. The framework shall include a stainless steel discharge flange through which all thickened solids are discharged. The flange shall be capable of accepting a discharge hopper so that all solids, odors, etc. are captured inside the unit without splashing, spilling or misting.
13. The frame shall also include an internal stainless steel belt guide that facilitates the installation of the belt.
14. Machine joints and interconnection faces.
15. The enclosed frame shall provide centralized venting of fumes and released gases by the addition of vent hoods and piping.

D. Gravity Belt Thickener No. 2 (600-M-0502)

1. GBT No. 2. Shall be capable of thickening either digested sludge or a blend of waste activated sludge and primary sludge to the performance described above.
2. The structural main frame shall be fabricated of ¼ inch 304 SS into a rigid structure adequately braced to withstand loads with a maximum deflection of 0.010 inches at mid-span. The frame shall have a minimum safety factor under maximum load of five (5) times the yield strength of the member.
3. The framework shall be of welded and/or bolted construction. All welding shall conform to the American Welding Society Structural Welding Code. All bolts and fasteners used in the assembly of the structural frame shall have a minimum diameter of no less than 1/2 inch.
4. Maximum load shall be based on the summation of forces applied to the frame from roller mass forces and belt tension forces. The belt tension forces exerted on the frame shall include a minimum loading of 40 pounds per lineal inch (pli) of belt width on the rollers, which equates to a belt tension of 20 pli.
5. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. Permanent lifting lug s shall be provided as necessary to allow installation and removal of the gravity belt thickener. The frame shall be anchored to the concrete floor using a minimum of six anchor bolts.

6. Structural members shall be structural beams, channel, pipe, or tubing with a minimum flange thickness of 3/8" and a minimum web/wall thickness of 1/4 inch. All bolts and fasteners used in the assembly of the structural frame shall have a minimum diameter of no less than 1/2".
7. The construction shall allow easy access and visual contact of all internal components.
8. The frame shall provide for complete capture of all filtrate and wash water inside the unit for discharge into separate pipe discharge for filtrate and wash water discharge. These pipes are intended for future hookup to separate GBT filtrate and wash water discharge. As installed provide fittings as required to discharge onto floor beneath GBT. The frame shall not require any special piers for support of the unit. Units that require sumps or special piers shall not be acceptable under these specifications.
9. Precision laser drilled holes shall accurately locate the bearings and other components. Alignment of the bearings shall be built into the frame and adjustment or shimming is not permitted. The frame shall provide extreme rigidity so that rollers cannot be moved out of proper alignment by external or internal force or by human error. All operating forces shall act in the plane of the plate frame, which is the direction of greatest stiffness.
10. The framework shall also feature a fully integrated feed tank. The feed tank will be part of the frame structure so that no additional civil work is required for mounting. The feed tank will be complete with feed and drain connections. The design of the feed tank shall include hinged covers to reduce the possibility splashing outside the tank. These covers shall be furnished when the unit includes the odor control hood. The feed tank shall be a minimum of 187 gallons for a 1.5-meter thickener.
11. The framework shall have filtrate drain trays and wash stations
12. The framework shall include a stainless steel discharge flange through which all thickened solids are discharged. The flange shall be capable of accepting a discharge hopper so that all solids, odors, etc. are captured inside the unit without splashing, spilling or misting.
13. The frame shall also include an internal stainless steel belt guide that facilitates the installation of the belt.
14. Machine joints and interconnection faces

E. Polymer Mixing Valve Assemblies (600-M-0551 and 600-M-0552):

1. Provide Polymer Mixing Valve Assemblies or sludge conditioning systems to be installed by Contractor, designed to efficiently mix polymer with sludge and to flocculate sludge for optimum thickening.
2. Polymer Mixing Valve Assembly shall be mounted by Contractor upstream of thickener and consist of the following components:

    a. Flow splitting manifold.
    b. Four port vortex polymer injection ring.
    c. In-line, non-clog, variable orifice mixer.

3. In-Line Mixer:

    a. Shall be a flanged, cast housing.
    b. Provide adjustable orifice plate, with shaft and o-ring seal, connected to an externally mounted lever and counterweight with removable side plate for inspection and cleaning.
    c. Open throat area of mixer shall be fully adjustable downward and shall open automatically to prevent clogging.
    d. Position of counterweight on externally mounted orifice plate lever shall be fully adjustable.
    e. Allow for adjustment of mixing energy, regardless of mounting angle, while unit is in operation.
    f. The use of modified check valves, static mixers or mixers requiring a tank and motor driven propeller are not acceptable.
    g. Mixer shall automatically open to allow solids, which are larger than the preset opening, to pass through the mixer without clogging and then return to the preset position.

h. O-ring shall be rubber. Counterweight and lever arm shall be hot-dipped galvanized cast iron. All other part shall be constructed of Type 316 stainless steel.
i. Connecting fittings shall be 125-pound ANSI flanges.

4. Flow-Splitting Polymer Manifold:

a. Manifold inlet shall be fitted with ¾-inch male hose fitting connection.
b. Four manifold outlets shall be fitted with ½-inch male hose fittings.
c. Four polymer injection ring inlets shall be fitted with ½-inch male hose fittings.
d. Provide 4-foot length of ¾-inch clear flexible tubing.
e. Provide length(s) of ½-inch clear, flexible tubing as required to connect flow-splitting manifold outlets to polymer injection ring inlets. Provide stainless steel clamps.

5. Energy of mixing polymer and sludge shall be adjustable and independent of thickener operating.
6. Polymer and sludge shall be instantaneously mixed (less than 1.0 second at 60 gallons per minute) by sludge conditioning system.
7. Polymer addition systems which utilize tanks with mixers or inject polymer directly into sludge line are not acceptable.
8. After sludge/polymer mixing, flocculation time shall be adjustable. Adjustment of flocculation time may require disassembly of components. Flocculation may occur in properly designed pipe work approved by manufacturer.
9. Retention time at maximum flow rates shall 20 seconds at a minimum to ensure flocculation.

F. Retention tank and feed chute:

1. Retention tank and feed chute shall be removable for ease of maintenance and cleaning and shall have guides to evenly distribute and minimize turbulence and destruction of flocculated sludge over entire width gravity dewatering belt.
2. Retention tank and feed chute shall be Type 316 stainless steel with a minimum of 11 gauge thickness.
3. Sludge inlet shall be an ANSI 150-pound raised face flange.

G. Gravity Drainage Section:

1. Gravity drainage section shall be fitted with an inlet distributor to accept sludge from sludge conditioning system and evenly distribute conditioned sludge over the effective width of the moving filter belt.
2. Contain sludge within belt area by Type 316 stainless steel barriers, minimum 14-gauge thickness, equipped with replaceable rubber seals to prevent leakage.
3. Effective drainage area shall be defined as the belt width between sludge containment barriers times the belt length where drainage actually occurs
4. Support filter belt within gravity drainage section with corrosion resistant slotted grid plate to facilitate filtrate removal.
5. Grid plate shall be Type 316 stainless steel with replaceable high density polyethylene wear bars spaced maximum 2 ½-inch on center along length of zone.
6. Wear bars constructed of fiberglass, other high-friction materials, or table rollers, which require maintenance due to coatings and bearings are not acceptable.
7. Grid shall be minimum 2-inch wider than width of belt and so designed to reduce belt wear.
8. Provide readily removable, high density polyethylene furrowing devices (chicanes or Roto-Kones) to furrow conditioned sludge to facilitate drainage.
9. Provide 7-8 rows of plows or 5 rows of Roto-Kones arranged in lateral rows along length of gravity dewatering section.
10. Roto-Kones or Chicanes shall promote sludge dewatering and insure even distribution of material across the entire filter belt width.

11. Configure Roto-Kones or chicanes in alternating rows of compression, division, and displacement.
12. Roto-Kones or chicanes shall be designed to permit horizontal and lateral adjustment and to lift individual rows free from engagement with solids and lock in raised position for cleaning while belt thickener continues to operate.
13. Manufacturer shall demonstrate individual Roto-Kones or chicanes shall allow a 1-inch vertical obstruction on the belt to pass under them without damage.
14. All surfaces of chicanes, and other devices, contacting the filter cloth shall be a material softer than the filter belt and prevent abrasions of the belt surface.
15. Design of sludge-furrowing plows shall allow replacement of worn contact areas without replacing plow in its entirety.
16. Fasteners shall be stainless steel, Type 316.

H. Rollers:

1. End shafts and plates shall be welded in place or forged end construction.
2. Rollers shall be supported by bearings.
3. Construction:

    a. Rollers shall be constructed of Type 316 stainless steel.
    b. One-piece forge shafts and end plates.
    c. Shaft – ASTM A572 Grade 50 Type 2.
    d. Roller Shells – ASTM A53.
    e. Drive rollers coated with ¼-inch minimum Buna-N on belt contact surfaces.

4. All rollers shall be designed for a maximum deflection at mid-span of 0.05-inch when under maximum roller loading conditions. The maximum stress shall be less than 1/5 of the yield strength of the material when under maximum roller loading conditions.
5. The drive roller shall be coated with 0.25-inch of BUNA N rubber on the belt contact surface and 1/8" minimum thickness elsewhere so that no steel surface is exposed. Non-drive rollers coated with 25-mil thermoplastic nylon is also acceptable. Coatings shall extend down the end plate and to the point of insertion into bearing housing.

6. BUNA N coating shall have the following properties:

a.	Tensile strength, ASTM D-412	2,500 pounds per square inch
b.	Tear strength, die C, ASTM D-624	250 pounds per square inch
c.	Elongation at break, ASTM D-412	160 percent
d.	Hardness, Shore A, ASTM D-676	90

I. Bearing:

1. Roller shafts shall be equipped with heavy-duty greasable type, self-aligning roller bearings in sealed, splash-proof, horizontal split case, pillow block housings.
2. Bearings shall be attached to the shaft in a direct mount/shrink-fit fashion.
3. All bearings shall have a nominal L_{10} life rating of 1,000,000 hours calculated using ANSI/AFBMA Standard 11-1990.
4. Bearing lubrication shall be performed through a monel or Type 316 stainless steel standard grease fitting mounted on the bearing housing.
5. The roller bearing journals shall be turned 75-milimeters to accept direct mounted 75-milimeters bore bearings.
6. Bearings shall be externally mounted with grease fittings extended to face of thickener frame. All bearings shall be greasable while unit is operating.
7. Lubrication shall not be required more often than once every six months.
8. All hardware shall be Type 316 stainless steel.

9. Bearing seal in pillow block shall be nonmetallic construction with a carrier/flinger which rotates with the roller shaft.
10. Provide secondary labyrinth seal between carrier/flinger and bearing housing.
11. Roller side of bearing housings minimum double sealed and roller shaft with splash deflector to provide water and grime seal.
12. Provide split case bearing housing with two or four mounting bolts for each housing to frame of belt thickener or solid pillow block housings with a gasketed end cap. Housing shall allow for the changing of the bearings without changes in the factory alignment of the roller.
13. Bearing housings shall be class 30 cast iron.

J. Belt Instrumentation:

1. Provide high sludge level switch to shutdown equipment and activate alarm at gravity belt thickener control panel in event of high sludge level on the belt.
2. Provide belt broken switch to shutdown equipment and activate alarm at gravity belt thickener control panel in event of a broken belt.
3. Provide mis-alignment correction or notification:
   a. For Gravity Belt Thickener No. 1, provide grip tubes to correct mis-alignment.
   b. For Gravity Belt Thickener No. 2, provide mis-alignment switches.
4. Provide two kill switches, mounted to either side of the Gravity Belt Thickener to shutdown equipment and activate alarm at gravity belt thickener control panel in event of an operator emergency.
5. Wire all belt instrumentation in conduit to a common junction box mounted to the machine.

K. Belt Wash System:

1. Provide a filter belt wash station for each gravity belt thickener.
2. System shall consist of a spray pipe, fitted with spray nozzles, contained within a fabricated housing which encapsulates a section of each belt. Housing and nozzle assembly shall be removable to facilitate cleaning.
3. Belt wash system shall be suitable for use with non-potable city water or plant effluent water (maximum 50 mg/L solids) supplied at a pressure of 90 pounds per square inch.
4. House belt wash pipe and nozzles in Type 316 stainless steel, minimum 14 gauge thickness, housing encapsulating upper and lower part of belt to contain spray and mist. Synthetic housings are not acceptable. Spray housing:

   a. Belt shall not function as part of housing.
   b. Allow easy access for cleaning nozzles without housing disassembly.
   c. Housing shall be sealed against belt with rubber or brush type seals which are replaceable without disassembly of wash station.
   d. Seals shall be removable without disassembly of housing.

5. Spray Header:

   a. Nozzle spray pattern and spacing shall be designed such that spray from adjacent nozzles overlap on the belt surface. Spray piping and nozzles shall be stainless steel.
   b. Belt wash station shall extend over the full width of the filter belt by a minimum of two inches.
   c. Spray header shall be equipped with external handwheel which actuates an internal stainless steel brush. One full turn of the handwheel shall cause bristles to enter the nozzles, and dislodge solid particles.

   d. Provide means at end of spray header to flush loosened solids. Provide ball valve piped to discharge in containment area. Route discharge pipe far enough under machine towards containment area drain to prevent splashing of personnel opening drain valve. Drain pipe shall not rest on sloped containment area floor, support from machine.

e. Belt washing shall be performed after the cake has been discharged from the belt.

6. Provide Pressure Control Valve (PCV).

   a. Provide such that 95 pounds per square inch washwater pressure is not exceeded.

7. Provide Pressure Gauge (PI) and Low Pressure Switch (PSL).

   a. Provide pressure gauge. Gauge range shall be 0-160 pounds per square inch.
   b. Provide pressure switch. Low pressure switch shall alarm at 90 pounds per square inch. Switch and connections shall be suitable for washdown area. Factory route wire in conduit on machine to common control junction box.
   c. Provide diaphragm seal. Materials of construction suitable for plant effluent.
   d. Provide stainless steel full-port isolation ball valves.
   e. Do not support assembly from pressure pipe tap. Mount to member of machine if necessary. Use stainless steel shapes and fasteners.
   f. Provide pressure gauges and pressure switches in general locations shown on Drawing 600-M-2 and as laid out on Drawing 009-N-5.

8. Provide GBT No. 1 and No. 2 Washwater Solenoid Valves (600-FV-0511 and 600-FV-0512) to isolate spray header when belt does not require cleaning. Solenoids shall be slow closing anti water hammering type with stainless steel body. Provide solenoid valve in general locations shown on Drawing 600-M-2 and as laid out on Drawing 009-N-5.

L. Belt Alignment and Tensioning System:

1. The belt shall be self-aligning via UHMWPE guides in the gravity zone. Gravity belt thickeners that require independent steering systems or hydraulic or pneumatic control shall not be acceptable under these specifications.
2. The unit shall be provided with a belt tensioning system. The belt shall be furnished with one tension roller. Rollers for the belt tensioning system shall be constructed as specified under “Rollers”. The ends of the shaft shall be supported by bearings, as specified under “Bearings”. The belt tensioning system shall be designed such that daily adjustment is not required.
3. Design belt tracking system to minimize belt and roller wear and extend working life of filter bed.
4. Provide belt misalignment switches to shutdown equipment and activate alarm at belt press control panel in event of belt over-travel. Wire all belt instrumentation in conduit to a common junction box mounted to the machine.
5. Tensioning struts and rack and pinion devices shall be composed of 316L stainless steel or high strength nylon composite.
6. Belt shall be spring tensioned.
7. Belt tensioning system shall accommodate at least 3 percent increase (not less than 24-inches) in belt length.
8. Belt tension shall be adjustable without shutdown of thickener.

M. Belt Drive:

1. Belt and rollers shall be driven by variable frequency drive unit to achieve infinitely and uniformly variable speed adjustment while the thickener is in operation. Drive roller speed reduction shall be obtained by means of a helical-bevel mounted gear reducer.
2. Belt-drive motor:

   a. Maximum 3 hp, 1800 rpm, TEFC, NEMA B motor.
   b. 480v, 3ph, 60Hz
   c. Inverter, severe duty rated.

d. AGMA Class II rated.
e. Belt speed range minimum 8 to maximum 40 meters per minute.
f. Class F insulation.
g. Service factor shall be 1.4 or greater.
h. Provide motor in accordance with Section 26 05 84.

3. Provide a thermal sensor (TSH) imbedded in windings to provide signal for alarm and shutdown at high motor temperature. Sensor shall be wired in conduit to common junction box provided with equipment.

N. Filter Belt:

1. Belt shall be seamed and fabricated of monofilament polyester, wear-resistant plastic materials, or combination monofilament polyester and stainless steel material.
2. Mesh design shall be selected for optimum thickening of the sludge to be processed with minimum binding of the filter bed.
3. Belt selection shall be determined by manufacturer based on testing of sludge during start-up.
4. Belt and connecting splice shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt is subjected. Splice shall be designed to fail before the belt and shall be constructed of Type 304 stainless steel.
5. Belt shall have a minimum life of 2,000 hours continuous operation at the rated design conditions. Minimum belt life shall include belts damaged due to manufacturing defects and the splice.
6. Belts shall be designed for ease of replacement with a minimum thickener down time.

O. Doctor Blades:

1. Doctor blade shall be mounted so that thickened sludge shall be continuously removed from the belt at the discharge of the gravity zone.
2. Blade shall be wider than the belt.
3. Blade shall be constructed of ultra high molecular weight polyethylene and shall be replaceable and designed to wear before the filter belt.
4. Blade shall be affixed to a hot dipped galvanized counter weight assembly with a Type 304 stainless steel holder.
5. Blade and assembly shall be fabricated with sufficient stiffness so that the blade does not warp, distort or bow under normal service conditions.
6. Blade and mounting assembly shall be designed to be quickly released and locked in position away from contact with the belt for cleaning and maintenance.
7. Blade shall have a manual lever on side of thickener.

P. Drainage Pans:

1. Pans shall be supplied to contain all filtrate within the thickener without splashing and prevent re-wetting of the sludge.
2. Minimum 14 gauge, Type 316 stainless steel construction and fasteners.
3. Locate pans for easy access during cleaning and such that the moving belt does not come into contact with the pans under any condition.
4. Pipe discharge separately to drainage basin below thickener and to minimize splashing.
5. Drain connection to be self-venting to prevent overflow.
6. Provide flanged connection(s) on pan for connection to drain piping.

2.03 GBT No. 1 Control Station (600-CS-0501) and GBT No. 2 Control Station (600-CS-0502)

A. Panel:

1. NEMA 4X Stainless Steel.

2. Wall Mount.
3. Powered from LCP.
4. Provide I/O as defined on PID's
5. All Parameters shall indicate and control in English Engineering Units.
6. Alarm Beacon

B. Front of Panel Mounted Devices as shown on 009-N-5.

C. Devices above shall interface to and be powered from respective GBT Control panel.

2.04 GBT No. 1 Control Panel (600-LCP-0501) and GBT No. 2 Control Panel (600-LCP-0502)

A. Panel:

1. NEMA 4X Stainless Steel.
2. Free Standing.
3. Lockable door latch.
4. Air to air heat exchanger (HEX).
5. 480 vac/3 phase/60Hz power supply.
6. Door-interlocked disconnect and circuit breaker.
7. Allen Bradley CompactLogix PLC with Ethernet capability.
8. PLC shall interface to plant's Process Control System (PCS) using Ethernet/IP protocol.
9. An Allen Bradley Powerflex style variable frequency drive (VFD) shall be supplied for the belt drive.
10. Control power transformer (XFMR) with 120vac transient voltage surge suppressor, and fused primary and secondary.
11. All Parameters shall indicate and control in English Engineering Units.

B. Front of Panel Mounted Devices as shown on 009-N-5.

C. Rear of Panel Mounted Devices as shown on 009-N-5 and as noted below.

Qty	Device	Description	Interface
1	Programmable Logic Controller	Allen Bradley PLC With Ether/IP	Network
1	Ethernet Switch	Industrial Ethernet Switch	
1	Surge Protector		PLC
1	Transformer (External to Panel) with Surge Suppressor	480VAC to 120VAC transformer	
AR	Control Relays	Sufficient Relays to perform Functionality	
AR	Terminal Blocks	Sufficient to provide 20% Spare	
1	Variable Frequency Drive	Main Drive	Motor

D. System shall be controlled to provide fully automatic or manual operation. System shall be provided with all necessary controls, instrumentation, and interlocks required for proper operation of the gravity belt thickener and ancillary equipment.

E. Control panel shall be a standalone Allen-Bradley platform used to control the Gravity Belt thickener Assembly in conjunction with the Sludge Conditioning Equipment, Polymer Feed System, Thickened Sludge Pumps, and WAS Pumps via SCC-A (Plant PLC).

F. Control Panel shall be provided with Ethernet switch and be compatible with site PCS network. Configuration, setup and IP addressing of all Ethernet devices in control system shall be coordinated with Systems Integrator.

G. All PLC data registers shall be coordinated with System Integrator and Engineer to insure integration with rest of PCS for necessary control and monitoring of Sludge Conditioning Equipment, Polymer Feed System, Thickened Sludge Pumps, and WAS Pumps.

H. Functional Description. Following control options shall be available at the Gravity Belt Thickener Control Panel OIU:

1. Control Power On/Off pushbuttons.
2. Hand/Off/Auto selector switch.

    a. With Local Control Panel in Hand, provide local control to independently start/stop Belt Drive Motor, selected GBT Feed Pump and Polymer System.
    b. With Local Control Panel in Off, all available system motors shall be off.
    c. With Local Control Panel in Auto, for automatic operation of GBT System, operator must manually initiate auto startup by depressing GBT System Auto Start pushbuttons. Provide Secondary Sludge Wasting Selector Switch at OIU. Selection of wasting mode and associated operator inputs for each wasting mode shall be recognized on both Gravity Belt Thickener Control Panel OIUs; whatever is selected or input on one OIU shall automatically be displayed on other OIU. PLCs in both Gravity Belt Thickener Control Panels shall also work in conjunction concerning wasting mode operation.

3. Following describes sequence of operation for Startup in both Automatic and Hand (Manual) modes:

    a. Turn System Control Power On.
    b. Open GBT Washwater Valve.
    c. Reset alarms and reset system control power by Start pushbutton.
    d. After delay to allow belts to become wetted, start Polymer System.
    e. Start selected GBT Feed Pump.

4. Following describes sequence of operation for Shutdown in both Automatic and Hand (Manual) modes:

    a. Stop Sludge Feed Pump and Polymer System.
    b. After delay to allow for sludge discharge and washdown of belts, close GBT Washwater Valve.
    c. Stop Belt Drive.
    d. Stop Hydraulic System.

5. Provide adjustable Delay Timers initially set as required for manufacturer's recommended operation of GBTs.
6. Provide GBT Feed Pump selector at OIU.
7. Provide for transmission of following signals to Owner's Process Control System via Ethernet communications link and as shown on 009-N-5.

    a. GBT System ESTOP.
    b. GBT System Manual.
    c. GBT System Auto.
    d. Belt Drive Running.
    e. Belt Drive Fail.
    f. Belt Drive Speed Feedback.

g. Belt Misalignment.
h. Belt Broken.
i. Belt Motor Overtemp.
j. Belt Sludge Level High.
k. GBT Feed Pump Selection.
l. Start GBT Feed Pump.
m. Stop GBT Feed Pump.
n. Start Polymer System.
o. Stop Polymer System.
p. Washwater Pressure Low

8. Provide circuitry to accommodate following interlocking and monitoring signals from Owner's Process Control System via Ethernet communications link to Control Panel to allow GBT operation:

    a. Enable/Disable. Shall initiate Shutdown of all equipment. Washdown cycle is bypassed and Hand mode is inhibited. Manual Reset shall be required to reestablish both Hand and Auto Modes.
    b. GBT Feed Pump Available.
    c. Polymer Feed System Available.
    d. Filtrate Wetwell Level (below LSHH).
    e. TWAS Hopper Level (below LSHH).

9. Following faults shall alarm and initiate Auto Shutdown sequence (normal Washdown and Stop). Hand Mode is not inhibited. Manual Reset must be initiated to reestablish Auto Mode.

    a. High Level Sludge on Belt.
    b. LSHH in TWAS Wetwell.
    c. Sludge Feed Pump Fail.
    d. Polymer System Fail.

10. Following faults shall alarm and initiate Shutdown of all equipment. Washdown cycle is bypassed and Hand mode is inhibited. Manual Reset must be initiated to reestablish both Hand and Auto Modes.

    a. Any one of ESTOP switches.
    b. Washwater Pressure Low.
    c. Belt Broken.
    d. Belt Misalignment.
    e. Motor Overload.
    f. LSHH in Filtrate Wetwell.
    g. LSHH in TWAS Wetwell

B. Additional Requirements

1. "Overload" signals shall be included as part of fault sense circuitry to cutout equipment on malfunction. Equipment shall require Clearing of Fault and manual Reset before operation can be resumed. Refer to article 1.03.D in this section for definition of Fault signal.

2.05 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components prior to shipment.

B. Coatings shall be in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holds with protective grease

PART 3 – EXECUTION

3.02 INSTALLATION

A. Install sludge thickening equipment in accordance with manufacturer's written instructions.

3.03 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 10. Coordinate field location with Engineer.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 4 service-days for Installation Services.
   b. 1 service-days for Instructional Services.
   c. 1 service-days for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.

END OF SECTION

SECTION 46 76 33
TRAILER MOUNTED CENTRIFUGE DEWATERING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Centrifuge Assembly

a. Main Drive Motor
b. Bowl Flush Valve
c. Discharge Flush Valve
d. Magnetic Flow Meter
e. Belt Guards
f. Vibration Monitors
g. Vibration Isolators
h. Main Bearing Temperature Monitors

2. Back Drive System

3. Feed Pump

4. Diverter Gate or Reversible Conveyor

5. Solids Discharge Conveyor

6. Centrifuge Control Station

7. Centrifuge Control Panel

8. Polymer System

9. Booster Pump (if required)

10. Trailer

11. Support Frame.

12. Access Platform.

13. Instrumentation and Controls.

14. Portable Connection Cabinet

15. Remote Monitoring Feature

16. Accessories.

1.02 DEFINITIONS

A. Solids Capture: The percent of the feed solids that remain in the thickened end product on a weight basis. For purposes of this specification, "Capture" is defined as:

% Capture = (T/F) [(F-C)/(T-C)] x 100%

Where: T = Dewatered Sludge Total Solids (% TS)

F = Feed (% TSS); excluding dilution from polymer solution flow

C = Centrate (% TSS); excluding dilution from polymer solution and belt wash water flows

B. Polymer Consumption: To be based on 100% active polymer.

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. IEEE: Institute of Electrical and Electronics Engineers

1.04 SYSTEM DESCRIPTION

A. General:

1. The centrifuges specified herein are of the counter-current design, horizontal, solid bowl type. The bowl of the centrifuge must be removed vertically from the frame and casing.
2. Each centrifuge shall be continuously fed sludge conditioned with polymer by individual progressive cavity type feed pumps. The sludge shall be fed into the center of the equipment where the solids are thrown against the wall of the bowl, which is rotating at high speeds thus generating high centrifugal forces. An internal screw conveyor shall continuously move the solids deposited against the bowl wall to one end of the machine where they are plowed up a beach and discharged out a solids discharge chute. The cake shall discharge onto cake conveying equipment. The clarified liquid shall continuously flow over adjustable weirs at the other end of the machine where it discharges into a centrate chute that connects to plant piping. The centrifuges shall be provided with back drives to infinitely vary the speed of the conveyor to optimize sludge processing.

B. Design Criteria:

1. The centrifuges shall be capable of processing typical wastewater treatment sludge.
2. The sludge shall be as described herein:

a. Feed type: Anaerobically Digested Blend of Primary Sludge and Waste Activated Sludge
b. Feed Concentration (% T.S.): 2.0% to 3.0%
c. Total Volatile Solids (%T.V.S.): 70% of TSS

3. The centrifuges shall be manufactured to meet or exceed each of the following physical parameters:

a. Minimum inside bowl diameter, (in): 18
b. Minimum bowl length, (in): 70
c. Minimum operating centrifugal force (G) at inside bowl wall diameter: 3,000

4. The water supply available at each unit shall be as follows:

a. Bowl Flushing: 20-40 gpm at 40 psi
b. CIP Flushing: 20-40 gpm at 40 psi

c. Temperature: Ambient (40 - 90° F)

5. Bowl Flushing and Discharge Flushing shall be controlled by the solenoid valves.

C. Performance Requirements:

1. When processing sludge with characteristics as specified above, the centrifuge shall be capable of exhibiting the following process parameters:

a. Solids Rate: Variable range of up to 1,200 dry lbs/hr.
b. Duty Point:

1) Sludge Flow: 80 gpm sludge flow
2) Percent Cake Solids (%T.S.): Minimum 18%
3) Percent Capture (%T.S.S.): Minimum 95%.
4) Polymer Consumption (active lb/dry ton): Maximum 30 lb/dry ton.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.
2. Catalog cuts and product specifications for sludge dewatering equipment specified.
3. Motor data in accordance with Section 26 05 84.
4. Coating Systems in accordance with Section 09 96 00.

B. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for sludge dewatering equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

C. Test Results:

1. Certified reports of manufacturers' factory production and shop tests indicating compliance of sludge dewatering equipment with referenced standards. Shop testing shall include:

a. Running test: Each machine, shall conduct a dry run for a minimum of 8 hours of continuous operation at proposed design operating speed. Fluids required for testing supplied by manufacturer.
b. Demonstrate that all equipment is capable of continuous operation in a satisfactory manner without mechanical defects or operational difficulties. Measure and record vibrations and temperature of the main bearings.
c. If necessary, tests shall be repeated until satisfactory results are obtained.

2. Certified reports of field tests and observations.

D. Submit in accordance with Section 01 33 00.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in

O&M Manual.

2. Manufacturer's written instructions for periodic tests of sludge dewatering equipment in service.

3. Submit in accordance with Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: System manufacturer or manufacturer's representative maintains service center capable of providing training, parts, and emergency maintenance and repairs of all components with exception of bowl, scroll conveyor, and gearbox at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain sludge dewatering equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver sludge dewatering equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store sludge dewatering equipment in clean, dry location.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One (1) Set of Lubricants for Start-Up.
b. One (1) Set of Bearings and Seals.
c. One (1) Set of O-rings and Seals.
d. One (1) Set of Matched Drive Belts.
e. Three (3) Sets of Plate Dams or power tubes as selected by manufacturer.

2. Provide special tools required for checking, testing, parts replacement, and maintenance including:

a. One (1) Bowl Lifting Device.
b. One (1) Conveyor Lifting Device.
c. One (1) Bearing Puller.

3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

1.09 PERFORMANCE TESTING

A. The sludge dewatering equipment shall undergo a field performance test to demonstrate compliance with the performance requirements specified in paragraph 1.04.C. above.

B. During performance testing, feed hydraulic loading rate will be fixed.

C. Performance testing shall be completed as soon as possible after completing systems demonstration of the dewatering system as specified in Section 01 79 10 when representative sludge is available.

D. Performance testing shall take place while the wastewater treatment plant is operating at stabilized conditions and at such time as acceptable to Owner and Engineer. Owner and Engineer shall witness performance tests.

E. Performance testing must be completed before project substantial completion will be certified.

F. Contractor shall notify Owner in writing at least 14 days prior to when performance testing will occur.

G. Performance testing shall be conducted over two consecutive days.

H. Manufacturer's representative, assisted by the Contractor and Owner, shall startup and operate the dewatering equipment for a period of 8 hours per day of testing. All centrifuge operations and associated Manufacturer's field services required to adjust machine settings shall be performed prior to and exclusive of the above specified performance test duration.

I. Manufacturer's representative shall conduct each test, analyze collected data, and certify the centrifuge's performance during testing. Steady state operation at the specified sludge feed solids rates shall be maintained throughout the test and all hourly quantities shall be averaged during the test period.

J. During each performance test runs, Manufacturer's representative shall take measurements and collect all required samples for analysis in order to make the following determinations:

1. Sludge Feed Rate: gpm.
2. Sludge Feed Concentration: The total dry solids concentration of the feed sludge entering the centrifuge (percent TS).
3. Dewatered Sludge Concentration: The total dry solids concentration of the sludge discharged from the centrifuge (percent TS). Take two duplicate samples (four samples total) per sample interval.
4. Centrate Concentration: The total suspended solids concentration of the centrate discharged from the centrifuge (percent TSS).
5. Solids Capture: Percent.
6. Feed Hydraulic Loading Rate (Exclusive of Polymer Solution and Carrier Water): gpm.
7. Feed Solids Loading Rate (Exclusive of Polymer): lbs/hr of total dry solids.
8. Polymer Feed Rate, if any: gpm.
9. Polymer Consumption, if any: Pounds active per dry ton of feed solids.

K. Manufacturer's representative shall collect samples at approximate 30 minute intervals for a minimum of 6 hours during each day of testing.

L. Laboratory testing of samples shall be performed under Section 01 45 29.

M. If retesting is required due solely to feed sludge characteristics outside of the specified range, Owner may waive retesting or may compensate the Manufacturer for reasonable costs to retest at Owner's sole option.

N. The results from the samples collected over each of the six-hour steady state runs will be mathematically averaged and the average will be used to determine conformance with performance requirements.

O. Manufacturer shall prepare and submit a Performance Test Report to Engineer within 10 days of completion of testing. The Report shall include:

1. A narrative description of performance testing including any descriptions of interruptions, operational changes, or equipment adjustments.
2. Data collected during testing.
3. Conclusions

P. Cost of power, water, polymer, feed sludge, and disposal for purposes of performance testing shall be borne by Owner.

Q. In the event that the Engineer determines the centrifuge does not meet the performance requirements of the specifications during the performance test, Manufacturer shall make such changes to the equipment and methods of operation as deemed necessary and as approved by Engineer. Necessary adjustments shall be made as soon as practical, but within a period not to exceed 30 days. Following the adjustments, Manufacturer shall conduct second performance test similar to the first at no additional cost to Owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Centrisys Corporation

B. Andritz

C. Flottweg

D. Alfa Laval

E. No Substitutions Permitted

2.02 MATERIALS OF CONSTRUCTION

A. Unless otherwise specified all parts of the centrifuge in contact with the feed shall be made of 316 or 316L stainless steel, except O-ring, seals and abrasion resistant materials.

B. The O-ring and seals shall be manufactured of the following:

1. O-ring: Buna-N
2. Lip Type Seals: Buna-N

C. The feed tube will be constructed of stainless steel or a fiberglass and stainless steel combination.

D. The frame will be fabricated from structural tubular steel and shall contain no weighted aggregate.

E. The upper casing will be 316 stainless steel with 316 stainless protecting the wetted parts of the lower casing.

F. The belt guard will be constructed of stainless steel or molded fiberglass.

2.03 CENTRIFUGE ASSEMBLY

A. Bowl

1. The bowl shall be manufactured from centrifugal castings of type 316 or 2304 duplex stainless steel, and designed to operate at a minimum of 3,000 G's at the inside bowl wall diameter for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design operating speeds with adequate safety factors. The bowl shall be inspected for cracks, shrinkage, porosity, or other defects. As an alternate, static cast bowl will be allowed.
2. Nominal bowl thickness of the cylindrical and conical sections will be a minimum of 0.63 inches. The front and rear bowl hubs shall have a minimum nominal thickness of 1.49 inches and 1.10 inches respectively. The centrifuge bowl shall be supported by ball or roller bearings mounted in pillow blocks and fitted for convenient external lubrication.
3. Flow through the centrifuge shall be counter current such that there are no centrate tubes to maintain. Pool depth shall be readily adjustable via weir plates located at the large diameter end of the bowl that do not require removing the rotating assembly from the frame. Solids shall be discharged at the small diameter end of the bowl.

B. Scroll Conveyor

1. Each centrifuge shall include a 316 or 316L stainless steel conveyor hub for horizontal conical-cylindrical sections, with 316 or 316L stainless steel on the conical section helical flights independently mounted concentrically within the bowl. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool, and to the maximum advantage of the variable speed back drive described in this section. The scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination.
2. The edge and the face of the conveyor flights shall be protected from wear as described in the abrasion protection section, paragraph 2.06.
3. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone. The feed material leaving the conveyor hub will pass through feed ports. The feed shall be evenly discharged into the bowl. The flights on the conveyor shall be designed with flow equalization windows to allow axial flow of centrate for minimum disturbance to the pool and maximum settling of fine particles.

C. Frame and Casings

1. The rotating assembly and bearings of the centrifuge will rest on a steel frame.
2. The frame and casing shall be supplied on a modular frame and shall be fabricated from structural tubular steel. The modular frame shall support both the drive motor and backdrive. The casing assembly will be provided with a 316 stainless steel upper casing, specifically designed for rigidity and noise reduction. The case shall be designed to act as a protective guard and to provide a complete enclosure for odor containment. The casing top shall be gasketed.
3. Bottom of the casing shall be fitted with a flexible splashguard for cake discharge. The liquid discharge shall be fitted with a flexible connection fitted with a 8 inch hose or chute for the centrate. The lower casing shall be fabricated from carbon steel with stainless steel cladding on the wetted parts.
4. The case top shall be hinged (left or right sided) or removable bolted in place.

D. Main Bearings

1. The main bearing shall be pillow block ball or roller type. The bearings shall have an L-10 life of 100,000 hours minimum at 24 hours per day service.
2. The bearings shall be lubricated by a manual or automatic grease lubrication system.

E. Feed Tube

1. The flexible feed connection to the centrifuge shall be a minimum 20 inches long, and constructed of black neoprene or stainless steel hose with a 2 inch hose fitting mounted on a 4 inch 150 lb. flange connection. The feed tube shall also include a (¾") three quarter inch NPT connection for polymer, downstream of the flange to flex connection.
2. The feed flow to the centrifuge shall be monitored by a magnetic flow meter as per manufacturers' recommendations and in accordance 40 71 00.

F. Access Platform:

1. An equipment access platform shall be designed and furnished by the Manufacturer for installation by the Contractor.
2. The platform shall be designed to provide easy access for routine equipment operation and maintenance.
3. The platform components shall be constructed from aluminum including stairs, support members, handrail, and grating.
4. The access platform shall not make direct contact with the equipment frame system.
5. Hardware shall be Type 316 stainless steel.

2.04 MAIN DRIVE MOTOR

A. The main drive motor shall be designed, manufactured, and tested in accordance with the latest NEMA, IEEE and ANSI standards and have the following characteristics:

1.	Type:	Squirrel-Cage, Inverter Duty Rated
2.	Max Horsepower:	75 HP
3.	Service Factor:	1.15
4.	NEMA Design:	B
5.	Insulation Class:	F or H
6.	Code Letter:	G
7.	Voltage:	460 volts
8.	Phase:	3-phase
9.	Ambient Temperature Rating:	40° C
10.	Maximum Temperature Rating:	120° C
11.	Mounting:	Horizontal
12.	Enclosure:	TEFC
13.	Duty Cycle:	Continuous
14.	Starting Method:	Reduced voltage
15.	Bearing Life:	100,000 Hrs. as defined by AFBMA B-10 Standards.
16.	Full Load:	Not less than 94 percent
17.	Efficiency:	Power factor of 0.88.

B. The motor shall be equipped with a thermal protection system to protect the motor from temperatures damaging the stator windings resulting from motor overload, frequent starting locked-rotor current, and a variable frequency inverter.

C. Motor shall comply with Section 26 05 84.

2.05 SCROLL DRIVE SYSTEM

A. A Scroll Drive or independent gear drive shall be supplied with the centrifuge to provide speed variation between the conveyor and the bowl.

B. In the automatic mode, the scroll drive system shall continuously monitor changes in internal torque created by variations in influent feed solids and automatically maintain a proper filling level by allowing the differential speed and torque to vary.

C. Shall cause an automatic centrifuge shutdown in the event that excessive torque is detected.

D. In the event that torque exceeds the normal operating range, the sludge feed pump shall be automatically stopped to allow the centrifuge to clear itself and shall automatically restart when the torque drops to the normal operating range. In the event that the torque approaches the limit of the drive, the second set of contacts shall automatically initiate shutdown of both the feed pump and centrifuge. In this instance manual reset of the alarm is required before the centrifuge can be restarted

E. In case of a high torque shutdown, the scroll drive should not trip but maintain full torque for the entire shutdown so that the machine clears itself while under reduced G-force, allowing the centrifuge to be clean when coming to a complete stop.

F. Scroll drive system must be designed to offer cleaning capabilities while the centrifuge bowl is at a standstill.

2.06 ABRASION PROTECTION

A. In order to minimize wear due to abrasive materials in the feed, hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge. The following shall be considered a minimum degree of hard surfacing required.

1. Bowl Wall: The bowl wall and conical extensions shall be protected with minimum of eight (8) welded ribs (or integrally machined grooves) designed to trap a protective layer of solids between the bowl wall and the conveyor.
2. Conveyor Feed Ports: The conveyor feed ports shall be protected from abrasion by field replaceable solid sintered tungsten carbide elements or chilled alloy steel.
3. Solids Discharge Ports: The solids discharge ports shall be protected from abrasion by field replaceable tungsten carbide or chilled alloy steel wear saddles.
4. Solids Discharge Casing: a replaceable stainless steel or urethane insert shall protect the solids discharge casing.
5. Scroll Conveyor Flights: The edge and face of the conveyor flights shall be protected against abrasion from the solids by a series of welded-on sintered tungsten carbide tile assemblies from two wraps beyond the feed zone through the solids discharge end. Each tile assembly shall be weight correct, and consist of a solid sintered tungsten carbide wear part braised to a stainless steel back-up holder. Each assembly shall be individually replaceable and shall include the ability to monitor wear by means of visual inspection. The tile assemblies must extend 0.5 inches beyond the radial edge of the conveyor flight. The remaining scroll conveyor edge and face shall be protected from abrasion by flame sprayed hardsurfacing containing a minimum 40% tungsten carbide particles. Stellite or ceramic hardsurfaced tiles are not acceptable.

2.07 VIBRATION ISOLATORS

A. The centrifuge shall be mounted on rubber-type vibration isolators. The number and vibration constant of the isolator shall be as recommended by the manufacturer for the load and impact resulting from the operation of the centrifuge provided.
B. There shall be no rigid connections to the centrifuge.

2.08 NOISE AND VIBRATION

A. The centrifuge shall be equipped with noise suppression devices of an energy efficient design, such that the average noise level measured at three (3) feet around the periphery of the complete centrifuge assembly shall not exceed the 88 dBA when tested at the manufacturing facility without feed and with the inlet and discharge closed.
B. The centrifuge shall be equipped with an accelerometer type vibration monitors located on each pillow block or on the frame to protect against excessive vibration. The monitor shall be interlocked with the controls to shut down the centrifuge if excessive vibration is sensed. The monitors shall provide an analog output signal proportional to the vibration magnitude for display and monitoring at the HMI operator interface.
C. The centrifuge, when running without feed, shall be measured for vibration at the manufacturing facility. The vibration shall be less than or equal to 6.5 mm/s RMS when measured at the pillow blocks under dry shop conditions.

2.09 LUBRICATION

A. All bearings on the centrifuge shall be grease lubricated through suitably located fittings.
B. Bearing temperature monitors will be provided on each main bearing pillow block, with an analog output signal sent to the DMS for display and monitoring at the HMI operator interface.
C. The lubrication shall be self-contained and consist of high performance lubricant.

2.10 ANCHOR BOLTS

A. Anchor bolts shall be sized by the centrifuge manufacturer, and shall be supplied by the installing contractor. Anchor bolts shall be 304 stainless steel.

2.11 FLEXIBLE CONNECTORS

A. To insure a quiet installation, flexible connectors shall be provided to isolate the centrifuge from the building structure. Flexible connectors include the solids discharge splashguard, flexible feed connections, flexible centrate connection, and flexible polymer connection for the feed tube. These items are to be supplied by the centrifuge manufacturer:

    1. The flexible solids splashguard shall be 12 inches long and constructed of 1/8 inch black neoprene. All hardware shall be constructed of 304 stainless steel.
    2. The flexible centrate connection shall be 8 inches long and constructed of black neoprene with a 10 inch hose or 150 lb. flange connection.
    3. Provide two 8-inch hoses, up to 50-feet in length, with camlock connections. Length to be determined by engineer based on approved trailer layout.
    4. Connection shall not leak.

B. The installing contractor shall furnish all electrical flexible connectors including: drive motor, backdrive and centrifuge junction boxes. The installing contractor shall insure that all electrical codes are met.

2.12 FLUSH VALVES

A. Provide Bowl Flush Valve and Discharge Flush Valve solenoid valves.

B. Flush valves shall be:

    1. 120 V, 1-ph, 60 Hz
    2. 304 stainless steel construction.
    3. Rated for 150 psi maximum operating pressure.

2.13 FEED PUMP

A. Feed pump shall be suitable for thickened digested sludge at solids concentrations up to 7.5 percent, and flow rates up to 100 GPM.

B. Pump and motor shall be mounted on a common fabricated steel base.

C. All cast iron parts shall be free from sand holes, blow holes, and other defects.

D. Motor

1. 460 Volt, 3-phase, 60 Hertz

2. TEFC with Class F Insulation

3. In accordance with Section 26 05 84

4. Motor shall be driven by variable frequency drive to achieve infinitely and uniformly variable speed adjustment while pump is in operation.

a. Match VFD output power to motor.

b. Manufacturers:

1) Allen Bradley
2) ABB

E. Pump type shall be either Progressive Cavity Pump or Rotary Lobe Pump:

1. Progressive Cavity Pump

a. Materials suitable for application specified and as specified below:

1) Suction Housing: thick-walled cast iron.
2) Bearing Housing: thick-walled cast iron.
3) Rotor: Alloy steel, SAE 1045, ASTM A331-90, grade 4150 cold finish with yield strength greater than 55,000 pounds per square inch plated with 0.01-inch of hard chrome or 316 stainless steel Duktil Coated (1250 Vickers Hardness).
4) Stator: Nitrile 100, 70 Durometer hardness chemically bonded to high strength steel tube.
5) Gear joints: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8620.
6) Pin joints: High speed steel, air hardened to 60-65 HRc.
7) Connecting rod: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8630.
8) Drive shaft: Machined from carbon steel, SAE 1045, ASTM A519-90, grade MT1020, yield strength of 32,000 pounds per square inch.

b. General:

1) Suction connection shall be flanged.
2) Discharge connections shall be flanged with bolt hole dimensions and spacing to ANSI standards.

c. Pump:

1) Suction housing shall include two inspection ports, 180 degrees apart, to permit access to the suction housing interior without disconnecting the feed chute.

d. Rotor:

1) Rotor shall be of one-piece (two-stage) construction with integrally machined rotor head.
2) Rotors cut to length with welded rotor heads shall not be acceptable.
3) Rotor shall have single helix design.

e. Stator:

1) Stators shall be double helix (two-stage) design and chemically bonded to the inside of a carbon steel tube.
2) The opening of the stator, on the suction side of the pump, shall be beveled to at least a 30 degree angle from the vertical to lesson entrance losses.
3) Stator shall be rigidly fastened to the suction housing and discharge flange by one of the following methods:

- Stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid.
- Fasten stator to pump with four thru-bolts.

4) Stators shall be manufactured to size. Stators made in long lengths and cut to size are not acceptable.
5) Seal ends of stator tube at the suction and discharge to prevent the material being pumped from contacting the stator tube.

f. Bearings:

1) Bearing shall be integral to the pump or gear/motor, designed for all loads imposed by specified service.
2) Bearings shall be grease lubricated, tapered roller or ball bearing type with diverging pressure angles to maximize shaft stability.
3) Bearings shall be designed for a minimum B-10 life of 100,000 hours under maximum operating conditions and shall not require periodic lubrication.
4) Bearings shall be protected from contaminates by means of a bearing cover plate bolted to the bearing housing.

g. Drive Components:

1) Drive:

- Drive shaft shall be of solid drive shaft design to avoid clocking and / or trapping of solids, which could interrupt movements of connecting rod or disturb seal of rear gear joint or a connecting rod that shall be of the rigid, splined design, connecting the gear joints of the drive shaft and eccentrically moving rotor.
- Connecting rod shall also serve as a conveyor assembly to move the pumped material from the suction housing to the pumping elements.
- Connecting rod shall be constructed of machined alloy steel.
- All diameters of connecting rod are to be concentric to within +/- 0.003 inches TIR.

2) Gear Joints:

- Gear joints shall be grease or oil lubricated, crown gear type constructed of machined alloy steel. Sealed gear type joint, factory lubricated with oil and sealed from pumped material is acceptable.

- Gear joint shall be totally enclosed and protected by a wire reinforced elastomeric seal.
- Mechanical components of gear joint assembly shall be designed to operate for 10,000 hours at manufacturers published maximum speeds and pressures.

3) Bushed Pin Joints:

- Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod.
- Joint shall be grease lubricated with a high temperature (450 degrees Fahrenheit), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.
- Stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass.
- Universal joints shall carry a separate warranty of 10,000 operating hours.

4) Drive shaft:

- Shaft shall be of one-piece construction through the bearings and shaft seal area.
- Drive shaft shall be plated with 0.01-inch of hard chrome.

h. Stuffing Box:

1) The stuffing box shall be equipped with a split packing gland and split Teflon lantern ring to permit repacking of the pump without removing the bearings or drive shaft components.
2) Fittings shall be provided for grease lubrication of the packing.

i. Seal water system for 6-10 gal/hr flush with W2 non-potable water for each pump. Seal water system shall include ball valve, Y-strainer, ball valve, solenoid valve, pressure regulator valve, pressure switch low, and low flow sight indicator on supply side. Seal water system shall include pressure indicator and needle valve on seal water system drain. Pressure switch, solenoid and pressure indicator shall be as per pump manufacturer's recommendations.

2. Rotary Lobe Pump

a. General:
1) Gearbox and intermediate chamber oil drain shall be easily accessible with side mounted drain screw.
2) Suction and discharge connections shall be 150-pound flanges with bolt hole dimensions and spacing to ANSI standards.

b. Pump Casing and Protection Plates:

1) Shall be manufactured from Cast Iron, ASTM A48 grade 40, with a minimum hardness of 264 Brinell.
2) Rear of pump casing and front cover shall be protected with replaceable wear plates with a minimum hardness of 550 Brinell.
3) Front cover protection plate shall be reversible.
4) Pump casing shall be equipped with radial pump casing protection plates with a hardness of 550 Brinell or utilize external housing adjustments to restore lobe tip clearances.
5) Quick release cover shall be held in place by four eye nuts.
6) Provide RTD casing temperature switches to stop pump for dry run protection.

c. Rotors:

1) Rotors shall be tri-lobe or quad-lobe, helical-type design.
2) Tri-lobe rotors shall have lobe tips that are individually replaceable. Tips shall be cast iron core coated with abrasion-resistant Buna-N Durometer hardness 72.
3) Quad-lobe rotors shall have solid cast iron cores or lobe tips that are individually replaceable, coated with abrasion-resistant Buna-N Durometer hardness 72. Rotor core geometry shall be the same as that of the finished rotor.
4) Rotors shall be keyed to shaft with cylindrical bore.
5) Length of rotor shall not exceed its diameter, stacking lobes is not acceptable.

d. Shafts:

1) Shaft shall be non-sludge wetted.
2) Rotor/shaft connection shall not come in contact with the pumped fluid.
3) Rotor/shaft connection shall be oil-lubricated fed from an intermediate chamber to ensure an oil exposure of the entire shaft.
4) Shafts shall be carbon steel ASTM A293.

e. Mechanical Seal:

1) Pumps shall be fitted with maintenance free mechanical seals with hardened Duronit V or tungsten carbide seal faces.
2) Seals shall be operating in a common oil-filled intermediate chamber (Quench for lubrication and cooling). Purge systems for the seals are not acceptable.
3) Design of the pump shall allow removal and replacement of the seal via the front cover.

f. Gearbox / Timing Gear / Bearings:

1) Bearings and timing gear shall be located in a common oil-filled cast iron gearbox, fitted with a built in sight class to monitor oil level.
2) Timing gear shall maintain non-contact between the rotors.
3) Bearing life to be designed for L-10 bearing life rating of 100,000 hours.

g. Pump and Drive Base:

1) Pump and drive shall be fitted on a common base made of hot dipped galvanized steel.
2) Provide suitable bolt and grout holes to facilitate mounting at the side.

2.14 REVERSIBLE CONVEYOR

A. Centrifuge shall come with a reversible conveyor, capable of diverting liquid flow away from the centrifuge and collecting and removing dewatered solids. Diverted flow will be directed to the centrate line.

B. Diverter Gate/Conveyor Flush Nozzle

1. Water supply line size, ½" FNPT

Supply Pressure	Flow (gpm)	Orifice Size	Angle
20 PSI	7.07	.25	30 º
40 PSI	10	.25	30 º
100 PSI	15.8	.25	30 º

2.15 SOLIDS DISCHARGE CONVEYOR

A. The solids discharge conveyor shall be a minimum of 14 feet in length, and capable of diverting dewatered solids away from the centrifuge and to a container to be supplied separately.

B. The solids discharge conveyor shall be pivoting for storage on the trailer during transportation.

C. Solids discharge conveyor shall be capable of discharging solids into the bed of a dump truck.

2.16 POLYMER FEED SYSTEM

A. General:

1. Polymer prep, aging (if required), and feed system shall prepare polymer at use dilution from a liquid polymer emulsion.
2. System skid: 304 stainless steel
3. Hardware: Type 316 stainless steel
4. Inlet and Outlet fittings: 304 stainless steel
5. Piping & pipe fittings: schedule 80 PVC
6. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
7. Water solenoid valve: brass
8. Pressure gauges: stainless steel, liquid filled
9. Pressure switches: NEMA 4, brass connection
10. Flow meter: acrylic, stainless steel, PVC and or polypropylene
11. Water control valve: stainless steel with stainless steel seat
12. Mixing chamber body / flanges: stainless steel
13. Mixing chamber cover / chamber: clear polycarbonate
14. Mixing Chamber Discharge: stainless steel
15. Impeller: 316 stainless steel
16. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
17. Mixing chamber pressure relief valve: stainless steel
18. Metering pump wetted parts: stainless steel & Viton
19. Metering Pump Shaft Seals: Viton, stainless steel ceramic, carbon
20. Control enclosure: 316 stainless steel.
21. Ball Valves: PVC with Viton o-rings.

B. Liquid Polymer Pump and Assembly

1. Calibration Column

a. Provide a calibration column with two full port PVC ball valves having Viton o-rings.
b. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters.
c. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets.
d. Mounting the calibration to the liquid polymer inlet piping shall not be acceptable.
e. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.

2. Liquid Polymer Pump and Motor

a. The unit shall have two (2) neat polymer metering pump(s) integrally mounted on the systems skid.
b. The pump shall be a positive displacement, progressive cavity type constructed of

stainless steel and Viton.

c. The shaft seal shall be a lip seal type riding on a ceramic sleeve.
d. Mechanical seals shall not be used.
e. A 0.5 maximum horsepower, 1,750 revolutions per minute, 90 VDC wash-down duty totally enclosed non-ventilated (TENV) motor with gear reducer shall drive the pump.
f. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM.
g. The motor shall be controlled by an SCR motor controller located in the system control panel.
h. Provide a non-intrusive type loss of polymer flow sensor. Flow sensors that restrict flow or rely on an insertion type sensing probe, such as thermal flow sensors, and therefore are prone to polymer build-up and failure shall not be used. There will be no exception to this requirement.

3. Pressure Relief Valve (PRV)

a. Provide a pressure relief valve on the discharge of the metering pump, adjustable between 25 and 100 psi.
b. The valve shall be factory plumbed to the suction of the pump.
c. The valve shall have a stainless steel or PVC body with stainless steel, Viton and Teflon internals.
d. Brass pressure relief valves shall not be acceptable.

4. Polymer Flow Sensor

a. Provide a non-intrusive type loss of polymer flow sensor. Flow sensors that restrict flow or rely on an insertion type sensing probe, such as thermal flow sensors, and therefore are prone to polymer build-up and failure shall not be used. There will be no exception to this requirement.

5. Polymer Injection Points

a. Centrifuge system shall be plumbed with multiple points for polymer injection with the following minimum as options:
   1) Injection at feed pipe
   2) Injection before feed pump
   3) Injection after feed pump
   4) One intermediate injection point between feed pump and feed pipe
b. Each of the above injection points shall be equipped with a ball valves for isolation when out of service.
c. Polymer shall be delivered to selected polymer injection point using a braided flexible tubing.

2.17 BOOSTER PUMP

A. Provide booster pump for washwater pressure requirements over 40 psi.

2.18 TRAILER

A. Trailer shall be a 53’ dual axle flatbed with electric brakes, spring suspension, pintle-hitch or gooseneck arrangement, DOT compliant for use on highway.

B. The trailer-mounted dewatering centrifuge system is to be provided fully mounted on a semitrailer and including all above items with piping and wiring, catwalk and handrails, and polymer feed system and storage.

C. Hinged grating and stairs provided for access to centrifuge and equipment for maintenance while parked.

D. Storage for one tote of polymer will be available on the trailer and accessible by forklift.

E. Aluminum plated decking mounted to trailer.

F. Enclosed Trailer with independently sliding curtain sides.

G. Retractable roof for maintenance.

2.19 CONTROLS

A. Provide Dewatering Centrifuge Control Panel:

1. Stainless Steel enclosure
2. Allen Bradley Compact Logix PLC
3. Allen Bradley 10" PanelView Plus 7

B. Variable Frequency Drive:

1. Manufacturers:
   a. Allen Bradley: PowerFlex 753 Series
   b. ABB ACS 880 Series
   c. No substitutions allowed.

C. Instrumentation:

1. Provide instrumentation as needed for a fully functional installation.
2. Instrumentation shall be manufacturers standard and suitable for the service conditions.
3. Instrumentation shall include, at a minimum, the devices listed in paragraph 1.01.

2.20 REMOTE MONITORING FEATURE

A. Manufacturer shall provide hardware to remotely monitor the centrifuge system by Plant Operators.

B. Manufacturer is responsible for providing remote monitoring that is accessible by mobile device or PC to keep track of operation and view alarms.

C. Monitoring system shall provide real-time text and/or email alerts for any system alarm requiring Operator intervention for either centrifuge equipment or supporting equipment.

D. If monitoring system is cellular based, then Verizon system shall be selected.

E. Monitoring system shall be capable of alerting up to ten (10) plant staff.

F. Monitoring system shall be field adjustable allowing the Operator to select which staff is alerted based on location of portable centrifuge equipment.

2.21 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components prior to shipment.

B. Coatings shall be in accordance with Section 09 96 00.

C. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

D. Coat machined or bearing surfaces and holds with protective grease.

2.22 PORTABLE CONNECTION CABINET

A. Provide in accordance with Section 26 32 09

B. Portable Centrifuge cables:

1. #1/0 AWG for phase and ground, total of 4.
2. Diesel locomotive cable
3. Black, chlorinated polyethylene jacket.
4. Premium-grade 90º C ethylene propylene insulation.
5. Minimum length of 60'-0" per cable, length to be determined by engineer based on approved trailer layout.
6. See Section 26 32 09 for cam-lok requirements. Contractor shall connect female cam-loks to both end of cables.

2.23 SPARE PARTS

A. Provide spare parts as listed in Paragraph 1.08 A.

B. Provide special tools required for checking, testing, parts replacement, and maintenance.

C. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install sludge dewatering equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 2 workday for Start-Up Services.
b. 1 workdays for Instructional/Post Startup Services
c. 2 workdays for Performance Testing

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than

wastewater treatment process. See Section 01 61 00.

3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

APPENDIX

TABLE OF CONTENTS

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Contractor's Application for Payment No. _____

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE			**$** _____
2. Net change by Change Orders			**$** _____
3. Current Contract Price (Line 1 ± 2)			**$** _____
4. TOTAL COMPLETED AND STORED TO DATE			
(Column F total on Progress Estimates)			**$** _____
5. RETAINAGE:			
a.	**X** _____	**Work Completed**	**$** _____
b.	**X** _____	**Stored Material**	**$** _____
c. Total Retainage (Line 5.a + Line 5.b)			**$** _____
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)			**$** _____
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)			**$** _____
8. AMOUNT DUE THIS APPLICATION			**$** _____
9. BALANCE TO FINISH, PLUS RETAINAGE			
(Column G total on Progress Estimates + Line 5.c above)			**$** _____

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;
(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and
(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding or Financing Entity (if applicable) (Date)

Progress Estimate - Lump Sum Work

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

			Work Completed		E	F		G
A		B	C	D				
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
	Totals							

Progress Estimate - Unit Price Work

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

A					B	C	D	E	F		
Item		Contract Information				Estimated Quantity Installed	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description	Item Quantity	Units	Unit Price	Total Value of Item ($)						
	Totals										

Stored Material Summary

Contractor's Application

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B	C		D		E		F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month ($)	Subtotal Amount Completed and Stored to Date (D + E)	Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount ($)			Date (Month/ Year)	Amount ($)	
				Totals							

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CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: ☐ None ☐ As follows

Amendments to Contractor's responsibilities: ☐ None ☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
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Phone: (703) 684-2845
Fax: (703) 836-4875
e-mail: aschwartz@nspe.org

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(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, D.C. 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

Work Change Directive No.

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

☐ Non-agreement on pricing of proposed change.

☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price $ [increase] [decrease].

Contract Time days [increase] [decrease].

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price

☐ Cost of the Work ☐ Other

RECOMMENDED:	AUTHORIZED BY:	RECEIVED:
By:	By:	By:
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title:	Title:	Title:
Date:	Date:	Date:

Approved by Funding Agency (if applicable)

By: Date:

Title:

EJCDC®

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

Field Order No. _____

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference: _____ (Specification(s)) _____ (Drawing(s) / Detail(s))

Description:

Attachments:

ISSUED:	RECEIVED:
By: _____	By: _____
Engineer (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

CERTIFICATE OF INSTALLATION SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature	Date

Name (print)

Title

Representing

CONTRACTOR

Signature	Date

Name (print)

Title

Comments:

This form shall be completed and submitted to ENGINEER prior to training of OWNER'S personnel in accordance with Section 01 61 00.

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has instructed OWNER'S personnel in the startup, operation, and maintenance of this equipment as required in the Specifications.

CONTRACTOR

Signature	Date

Name (print)

Title

I hereby certify that my operating personnel received _____ days instruction from

_____

for startup, operation, and maintenance of this equipment.

OWNER

Signature	Date

Name (print)

Title

Comments:

This form shall be completed and submitted to ENGINEER after training of OWNER'S personnel in accordance with Section 01 61 00.

CERTIFICATE OF POST STARTUP SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment, made adjustments and calibrations, and that it is operating in conformance with the design, Specification, and manufacturer's requirements. Notation of improper operation shall be detailed and recommendations made and attached to this form.

MANUFACTURER'S REPRESENTATIVE

Signature | Date

Name (print)

Title

Representing

CONTRACTOR

Signature | Date

Name (print)

Title

OWNER

Signature | Date

Name (print)

Title

Comments:

This form shall be completed and submitted to OWNER upon completion of the 1-year reinspection as required by the Specifications.

CHANGE ORDER NO. ____

CHANGE ORDER DATE OF ISSUANCE _____

COMMENCEMENT OF CONTRACT TIME _____

OWNER _____

CONTRACTOR _____

PROJECT _____ CONTRACT NO. _____

ENGINEER _____

YOU ARE DIRECTED TO MAKE THE FOLLOWING CHANGES IN THE CONTRACT DOCUMENTS:
DESCRIPTION:

REASON FOR CHANGE ORDER:

ATTACHMENTS:

CHANGE IN CONTRACT PRICE
Original Contract Price: $_____
Net increase (decrease) from previous Change Orders: $_____
Net increase (decrease) of this Change Order: $_____
Revised Contract Price: $_____

CHANGE IN CONTRACT TIMES
Original Contract Times: *(days or dates)* Substantial Completion: _____ Ready for Final Payment: _____
Net increase (decrease) from previous Change Orders: *(days)* Substantial Completion: _____ Ready for Final Payment: _____
Net increase (decrease) of this Change Order: *(days)* Substantial Completion: _____ Ready for Final Payment: _____
Revised Contract Times: *(days or dates)* Substantial Completion: _____ Ready for Final Payment: _____

CONTRACTOR agrees that this Change Order includes any and all costs associated with or resulting from the change ordered herein, including all impacts, delays, and accelerated costs. Other than the dollar amount and time allowance listed above, there shall be no other dollar or time compensation as a result of this Change Order.

THIS DOCUMENT SHALL BECOME AN AMENDMENT TO THE CONTRACT AND ALL STIPULATIONS AND COVENANTS OF THE CONTRACT SHALL APPLY HERETO.

RECOMMENDED:	APPROVED:	ACCEPTED:
By: _____	By: _____	By: _____
ENGINEER *(signature)*	OWNER *(signature)*	CONTRACTOR *(signature)*
Date: _____	Date: _____	Date: _____

Note: OWNER is required to complete the Change Order Authorization form on the back if change increase or decrease is for $10.000 or more, or time of completion is 30 days or more.

CHANGE ORDER AUTHORIZATION

for

Illinois Public Projects

Name of Project: _____

Change Order No.: _____

Date: _____

This Change Order authorizes: *(check applicable boxes)*

☐ (a) an increase/decrease in Contract cost by $10,000 or more $ _____ (amount)

☐ (b) an increase/decrease in Contract completion date by 30 days or more _____ (amount)

☐ **(c) other (please describe below)**

_____

_____

OWNER (or it's designee _____) has determined that the circumstances said to necessitate the change in performance, which are: *(give circumstances requiring change)*

_____

_____

(check one)

☐ (a) were not reasonably foreseeable at the time the Contract was signed.

☐ (b) were germane to the original Contract as signed.

☐ (c) are in the best interest of the District and authorized by law.

_____ _____

Prepared by ENGINEER Date

_____ _____

Authorized by OWNER Date

OWNER shall preserve a copy of this Authorization in a permanent Contract file that is open to the public in accordance with P.A. 85-1295, Ill. Rev. Stat. Ch. 38, par. 33E-9.

CONTRACTOR'S REQUEST FOR SUBSTITUTION

(Include With Submittal)

Provisions requiring submittal of this form are described in Specification Sections 01 33 00 and 01 61 00 and paragraph 6.05 of the General and Supplementary Conditions.

Substitution Request No.: _____

Project: _____

Contract: _____

We hereby apply for consideration of _____
(*Proposed Substitute Manufacturer*)
as a substitute manufacturer to the manufacturer(s) named in Specification Section _____

Paragraph/Drawing No. _____ for the following reasons. (*Check one or more.*)

_____ The specified equipment or material is unavailable or the time of delivery will substantially delay the construction of the project, but not as result of CONTRACTOR'S failure to pursue Work promptly or coordinate various activities. (*Provide supporting information.)*

_____ The proposed equipment or material will provide for packaging and coordination with other equipment from a single source supplier. *(Submit name of source supplier and other equipment to be packaged.)*

_____ The proposed equipment or material is a "Substitute Item" to that specified and the CONTRACTOR will provide the OWNER with a credit of $_____ if the equipment or material is accepted.

We certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to the specified, be suited to the same use as that specified, and will not prejudice CONTRACTOR'S achievement of Substantial Completion on time.

Contractor: _____

Signature: _____ Date: _____

Name (print): _____

Title: _____

NOTE: ENGINEER may require CONTRACTOR to furnish, at CONTRACTOR'S expense, additional data about the proposed substitute including but not limited to, an analysis by CONTRACTOR of the equivalency of the proposed substitute to the named item.

A. Physical Characteristics of Proposed Substitute (if applicable).

Operating Weight:_____ Height:_____ Width:_____ Depth:_____

Voltage:_____ Hertz:_____ KW or HP:_____

B. Will acceptance of the proposed substitute by the OWNER:

1. Require a change in the Drawings or Specifications: Yes_____ No_____
   If yes, attach an explanation and detailed drawings or specifications.
2. Require payment of any license fee or royalty: Yes_____ No_____
   If yes, attach an explanation.
3. Result in a change of contract time: Yes_____ No_____
   If yes, attach an explanation.

C. Variations of proposed substitute from specified material, equipment, methods or procedures include: *(If none, state none. Attach separate listing if more space is needed.)*

1. _____
2. _____
3. _____
4. _____

D. Service Source (Maintenance, Repair, and Replacement) Availability:

1. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No____

2. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No_____

E. Identify costs, direct or indirect, if any, associated with acceptance of this proposed substitute.
(If none, state none.)

_____

_____

INSTALLATION LIST

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

REQUEST FOR INFORMATION

Request No.	Date:
Contractor:	Specification Section / Drawing No.:
Project:	
Contract:	
This is a request for a information on the following:	
Prepared By:	Date Response Needed:
Response:	
Prepared By:	Date:
Response Returned to Contractor On:	
cc: Owner:_____ Resident Project Representative:_____	

CONTRACTOR'S SUBMITTAL TRANSMITTAL

CONTRACT: _____

DONOHUE	
To: Donohue & Associates, Inc. 125 S Wacker Dr. Ste 1850 Chicago, IL 60606	**From:**

Specification Title:	
Description:	

Applicable Contract Clarification / Interpretation Request(s) were submitted and response(s) received:

___ No ___ Yes If Yes, List RFI Numbers:_____

Submittal includes variations from the requirements of the Contract Documents:

___ No ___ Yes If Yes, Variations are identified below and in accordance with paragraph 7.16 of the General Conditions:

Variations are as follows:

1.

Contractor certifies that this submittal has been prepared in accordance with paragraph 7.16 of the General Conditions and Contractor has reviewed and approved this submittal in accordance with paragraph 7.16 of the General Conditions:

___ Yes ___ No

Contractor:	
Signature:	Date:
Name *(print):*	
Title:	