Arlington County Water Pollution Control Bureau

Early Work Package, Preliminary Specifications

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General provisions applicable to all demolition and removals.
   2. Civil/site demolition and removals.
   3. Architectural and structural demolition and removals.
   4. Mechanical demolition and removals
   5. Electrical demolition and removals.
   6. Disposal of demolition debris, materials, and equipment.
   7. Protection of construction and improvements to remain.
   8. Salvaged items for Owner retention.

B. Scope:
   1. Design Builder shall provide all labor, materials, equipment, tools, and incidentals as shown, specified and required for demolition, removals, disposal and protective Work for the Early Work Implementation. Requirements for the remainder of the Work shall be specified by the Design Professional.
   2. The Work under this Specification section includes, but is not necessarily limited to:
      a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of hazardous materials, structural concrete, foundations, foundation piles, walls, doors, windows, structural steel, metal systems and equipment, pavement and similar existing materials, equipment, and items.
      b. Demolition and removal of all above-grade facilities and Underground Facilities and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are specifically shown or indicated as to remain.
      c. Remove from slabs, foundations, walls, and footings that are to be demolished all utilities and appurtenances embedded in such construction.
   3. Demolitions and removals indicated in other Specifications sections shall comply with requirements of this Specifications section.
   4. Perform demolition Work within areas shown or indicated.
   5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
   6. Carefully protect all work not scheduled for demolition or removal.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

B. Regulatory Requirements:
   1. Demolition, removals, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T – Demolition), and all other Laws and Regulations.
   2. Comply with requirements of the EPA and authorities having jurisdiction.

C. Qualifications:
   1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in Arlington County, Virginia.

2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber(s) legally qualified to perform plumbing construction and plumbing work in Arlington County, Virginia.
3. Design Builder shall employ a registered professional engineer to design and oversee construction of shoring, bracing and other required supports, whether temporary or permanent.
    a. Details of permanent new features shall be submitted for information to the Program Manager and Owner.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations.
2. Review procedures under this and other Specifications sections and coordinate the Work that will be performed with or before demolition and removals.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
1. Procedure Submittals:
    a. Demolition and Removal Plan: Not less than thirty (30) days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
        1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
        2) Other proposed procedures as applicable.
        3) Equipment proposed for use in demolition operations.
        4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
        5) Planned demolition operating sequences.
        6) Detailed schedule of demolition Work in accordance with the Schedule accepted by Program Manager.
2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Specifications Section.
3. Field Quality Control Test Results:
    a. Results of megger-testing of existing motors to remain Owner's property.
4. Qualifications Statements:
    a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
    b. Name and qualifications of entity performing plumbing removals,

1.5 JOB CONDITIONS

A. Owner makes no representation of condition, hazards or structural integrity of area(s) to be demolished or where removals are required by the Contract Documents.

B. Obtain and pay for permits required by authorities.

C. Notify affected utilities of work to be executed.

D. Owner will make provisions for inspection of facilities prior to bidding. Conditions not readily apparent shall not be cause for extra work cost claims.

E. Separate, store and dispose of any hazardous or toxic materials in accordance with local and EPA regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Notification:
   1. Not less than 7 days prior to commencing demolition or removal, advise Owner in writing of planned start of demolition Work. Do not start removals without permission of Owner.
   2. Where demolition or removals has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, and utilities, furnish required notices to owners and occupants of properties, buildings, and structures that may be affected by the demolition of removal.
   3. In accordance with Laws and Regulations, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
   4. Submit to Owner copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.

B. Protection of Adjacent Areas and Facilities:
   1. Perform demolition and removal Work in manner that prevents damage and injury to unscheduled property, structures, facilities, occupants, and the public. Do not interfere with use of, and free and safe access to and from, structures and properties unless allowed by the Contract Documents or otherwise allowed in writing by Owner.
   2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
   3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removals work in the subject area is complete or until other Work requires removal of temporary partitions after deemed not necessary.
   4. Provide appropriate temporary barriers, lighting, sidewalk enclosures, and other necessary protection.
   5. Repair damage as a result of Design Builder's operations to facilities that are to remain.

C. Existing Utilities
   1. Sanitary Sewerage: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
   2. Water Piping and Related Facilities: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished. Ensure compliance with Laws and Regulations regarding water quality.
   3. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as plant process lines, fuel and gas; compressed air; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
   4. Shutdown of utility services shall be coordinated by Design Builder, assisted by Owner as required relative to contacting utility owners.

D. Remediation:
   1. Prior to performing demolition Work that disturbs asbestos, remove and dispose of asbestos in accordance with all Laws and Regulations.
   2. Prior to performing demolition Work involving lead-based paint, remediate lead in accordance with all Laws and Regulations.
   3. Prior to performing demolition Work involving Polychlorinate Biphenyls (PCBs), remediate PCBs in accordance with all Laws and Regulations.

4. If unanticipated Hazardous Environmental Condition is believed to be encountered during demolition and removals, comply with requirements of this Specification and the General Conditions.

3.2 DEMOLITION - GENERAL

A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

B. Pollution Controls:
   1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05 - Temporary Controls, and Laws and Regulations.
   2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
   3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work.

C. Explosives:
   1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.

D. Building or Structure Demolition and Removals:
   1. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
   2. Break up and remove foundations, mats, and slabs-on-grade unless otherwise shown or indicated as remaining in place.
   3. Temporary Bracing and Supports:
      a. Provide temporary and permanent bracing and supports sufficient to maintain safety, stability, and resist all loads to which the structure may be subject during demolition and removals, until entirety is permanently removed or permanently stabilized.
      b. Temporary and permanent bracing and supports shall be sufficient for associated dead load, live load, transient loading, and dynamic loads such as wind, seismic, and other loads to which the bracing or support may be subject.
      c. Retain a professional engineer, duly licensed and registered in the same jurisdiction as the Site, to design all bracing and supports.

E. Salvage and Ownership:
   1. Materials and equipment to remain Owner's property shall be:
      a. Carefully removed and appropriately handled by Design Builder to avoid damage. Brace motors attached to flexible mountings until reinstallation or delivery to Owner's storage location. Fully remedy to pre-construction condition or replace items damaged during removal or handling by Design Builder.
      b. Removed as functional units, together with all appurtenances required for operation.
      c. Cleaned, listed, and tagged for storage.
      d. Protected from damage.
      e. Delivered to Owner designated storage location indicated in the Contract Documents, or to a place designated by Program Manager or Owner.
   2. Items to be and delivered to Owner are as indicated in Table 02 41 00-A.

Table 02 41 00-A – Items to be Salvaged

EQUIPMENT NAME/ DESIGNATION	EQUIPMENT LOCATION	DELIVER TO OWNER'S LOCATION
Diaphragm Sump Pump	Bio-Building Basement	Warehouse
Polymer Transfer Pumps (2)	Bio-Building Basement	Warehouse
Polymer Transfer Instrumentation (complete)	Bio-Building Basement	Warehouse

3. Preparation of Owner's existing equipment for storage:
   a. Where appropriate, identify each component with markings or tags to indicate its position in the assembly and the assembly of which it is part.
   b. Place small parts in appropriate, durable boxes and clearly mark contents on the outside of box or container.
   c. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
   d. Grease grease-lubricated bearings.
   e. Replace breather plugs with solid plugs.
   f. Megger-test motor windings: Attach report of the test results to the associated motor and submit copy to Program Manager.
   g. Attach unit to suitable crate bottom.
   h. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
   i. Construct crate of wood slats around top and sides of unit.
   j. Attach permanent instruction tag to outside of crate stating "This unit has been prepared for storage. Replace oil, vent plugs, and lubricant in accordance with manufacturer's instructions before start-up."

F. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Program Manager.

3.3 STRUCTURAL REMOVALS

A. Remove structures to lines and grades indicated or necessary, Removals beyond these limits shall be at Design Builder's risk and expense and such excess removals shall be reconstructed to satisfaction of Program Manager without additional cost to Owner.

B. Recycling and Reuse of Demolition Materials:
   1. With or as part of the construction management plan, the Contractor shall submit a construction waste management (CWM) plan in accordance with Specification Section 01 81 13 prior to mobilization that:
      a. Identifies waste materials that will be removed from the site, the process for collecting and storing materials, and locations for disposal
      b. Outlines a plan for materials that will be taken off-site to be recycled. The plan should include what can be recycled, where reclamation facilities are located and how implementation will be documented.
   2. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, in accordance with the CWM plan, unless otherwise approved by Program Manager.
   3. Contractor shall document quantities of non-recycled waste material and recycled materials removed from the site by:
      a. Document waste diversion efforts following the instructions in the provided RA1.4 Reduce Construction Waste Diversion Summary Forms as Attachment D to Specification Section 01 81 13, including, but not limited to:
         1) Waste brought to recycling facilities and landfill with waste tickets for each delivery.

2) Demolition materials housed and prepped for reuse on-site.
3) Waste reduction measures and quantify impact (example – reuse of existing structures that were planned to be demolished and rebuilt).
4) Include manifests, weight tickets, receipts, and invoices, as applicable for recycled and landfilled materials with submittal of forms.

b. Submitting reclamation facility lift tickets
c. Submitting landfill lift tickets
d. Documenting any other off-site material disposal
e. Documentation will be submitted monthly or as coordinated with the Engineer and Envision lead.

4. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.

C. After removing concrete and masonry walls or portions thereof, mats, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 IN below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.

E. Removal of Anchorages and Protruding Metals:
1. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, and where existing metals (and to be removed) protrude from concrete, remove the anchors and other metal to not less than 1.5 IN beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface.
2. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by Program Manager.

F. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.

G. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials as specified in the Contract Documents.

3.4 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing:
1. Piping systems and ductwork systems.
2. Mechanical equipment and appurtenances.
3. Mechanical elements of instrumentation and control systems, such as sensors and transmitters and similar items.
4. Mechanical removals include cutting and capping as required.

5. Mechanical removals as required herein apply to systems exposed to view, hidden from view, and Underground Facilities. Mechanical removals may require work in spaces that may be classified confined spaces.

B. Life-Safety Systems:
   1. Retain existing life-safety systems, including but not limited to fire suppression systems, in place for as long as possible prior to performing associated demolition and removals.
   2. Where demolishing buildings or structures equipped with life-safety systems, remove or deactivate life-safety systems only in the area where active demolition operations are in progress.
   3. Coordinate removal of Life-Safety Systems with Owner and authorities having jurisdiction.

C. Demolition and Removals of Piping, Ductwork, and Similar Items:
   1. Scope:
      a. Safety purge piping and tanks (as applicable) of chemicals, fuel, solids, liquids, and gases (as applicable) and make safe for removal and capping. Discharge contents of existing piping appropriately while avoiding damaging property; restricting access to or use of property; and cresting unsafe, unsanitary, nuisances, and noisome conditions.
      b. To the extent shown or indicated, remove existing piping conveying water (potable and non-potable), waste and vent, fuel (liquids and gases), heating fluids (such as water-glycol solutions), chemicals, solids and slurries, sludge, wastewater, other fluids, and processes gases, and other piping.
      c. Remove piping to the nearest structurally sound (or "solid") piping support, and provide caps on ends of remaining piping.
      d. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
   2. Caps, Closures, Blind Flanges, and Plugs – General (All Piping and Ducts):
      a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
      b. Where used in this Specifications section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
      c. Caps shall be compatible with the piping or ductwork on which the cap is installed, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
      d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Specifications section only when expressly so shown or indicated in the Design Builder Documents or when allowed by Program Manager.
   3. Underground Facilities:
      a. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
   4. Waste and Vent Piping; Ductwork:
      a. Remove waste and vent piping, and ductwork to extent shown and cap as required.
      b. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials as existing, and fully compatible with ensign materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
   5. Potable Water Piping; Plumbing; Fire Suppression Piping and Systems; Heating Piping:
      a. Modifications to potable water piping, fire suppression systems, other plumbing piping, and heating system piping shall comply with Laws and Regulations.
      b. All portions of potable water systems that have been modified or opened shall be hydrostatically tested and disinfected in accordance with AWWA Requirements, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing and fire suppression piping and heating piping systems.

D. Equipment Demolition and Removals:
   1. To the extent shown or indicated and as required for the Work, remove existing mechanical equipment, including (but not limited to):
      a. Facility equipment
      b. Conveying equipment such as elevators, and similar general-use conveying systems.
      c. Fire suppression and plumbing equipment.
      d. Heating, ventilating, and air conditioning equipment.
      e. Security systems equipment.
      f. Flow control gates and valves.
      g. Hoisting equipment.
      h. Bulk materials conveying equipment.
      i. Process heating and cooling equipment.
      j. Blowers, compressors, air filters, air dryers, and similar equipment.
      k. Pumps.
      l. Tanks.
      m. Process equipment, including purification equipment, incineration equipment, pollution control and solid waste equipment, and treatment process equipment.
      n. Appurtenances (including motors, drive systems, controls, cooling water and seal water systems) as shown, indicated, and required for completion of the Work.
   2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly and removal shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
   3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
   4. Tanks and Equipment Containing Process Material:
      a. Purge contents in accordance with Paragraph 3.5.A of this Specifications Section and other requirements of the Contract Documents, as applicable.
      b. Where contents of tank or equipment item may pose a potential hazard, properly dispose of contents in accordance with Laws and Regulations and the Contract Documents.
      c. Where tank or equipment contains wastewater or liquid sludge, and the Site is a wastewater treatment facility, transport and dispose of stored contents on-site at location acceptable to Owner.
      d. Where tank or equipment contains solid or slurry-type material, remove, handle, and transport the contents and appropriately dispose of the materials off-site in accordance with Laws and Regulations, unless otherwise indicated in the Contract Documents.
   5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Specifications section.
   6. Remove small-diameter piping back to header unless otherwise indicated.
   7. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.
   8. Instrumentation and Control Systems Removal:
      a. Remove instrumentation and controls equipment in accordance with this Specifications section's requirements for mechanical removals and electrical removals.

3.5 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing:
   1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
   2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
   3. Switches, panelboards, control stations, and similar items.

4. Transformers, distribution switchboards, control panels, motors, starters, variable speed controllers, and similar items.
5. Lighting fixtures and related items.
6. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.

B. Electrical Removals – General:
1. Comply with Laws and Regulations, including the National Electric Code.
2. Lock Out and Tagging:
   a. Design Builder shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
   b. Upon completion of electrical removals Work, remove the locks and tags and promptly advise Program Manager and Owner that existing facilities are available for use.
3. Remove existing electrical equipment, fixtures, and systems to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
4. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated.
5. Store removed motors, microprocessors and electronics, and other electrical gear to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.

C. Motor Control Centers and Switchgear:
1. Remove or modify motor control centers and switchgear within the demolition areas.
2. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

D. Removal of Cabling, Conduits, Raceways and Similar Items:
1. Verify the function of each cable before disconnecting and removing.
2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Program Manager.
4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
5. Repair all areas of the Work to prevent rusting on exposed surfaces.
6. Underground Electric:
   a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
   b. Where shown or indicated, remove direct-burial cabling. Openings in buildings for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by Program Manager for such purpose, and made watertight.

E. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-site as required in accordance with Laws and Regulations.

3.6 DEMOLITION OF SITE IMPROVEMENTS

A. Pavement, Sidewalks, Curbs, and Gutters:
1. Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
2. To cut pavement, sidewalks, curbs, and gutters, use machinery or tools that provides a smooth-cut edge, appropriate for the required. Where cut edges are not smooth, repair the cut edge to remain to provide a smooth, even appearance.

B. Fencing, Guardrails, and Bollards:
   1. Remove to the limits shown or indicated on the Drawings.
   2. Completely remove below-grade posts and concrete.

C. Manholes, Vaults, Chambers, and Handholes:
   1. Remove to the limits shown or indicated on the Drawings.
   2. If not shown or indicated on the Drawings, remove to not less than 3 FT below finished grade indicated on the Drawings.

D. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes:
   1. Remove to the extent shown or indicated on the Drawings.
   2. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Specifications section.

E. Other Site Improvements: When the Contract Documents require removal of other site improvements not addressed above, copy with Contract requirements for removal of buildings or structures.

3.7 DISPOSAL OF DEMOLITION DEBRIS

A. Disposal – General:
   1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal operations. Promptly upon completion of demolition and removal operations, remove from the Site construction equipment used in demolition Work.
   2. Do not sell at the Site demolition materials or removed equipment. If materials, equipment or debris will be sold by Design Builder, remove the items from the Site and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
   3. Cleaning and Removal of Debris: Comply with the General Conditions and General Requirements.

B. Transportation and Disposal:
   1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
   2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.

C. In accordance with Specification Section 01 81 13, submit to Program Manager information required in this Specification Section on proposed facility(ies) where demolition materials, equipment, and debris will be recycled. Upon request, Program Manager or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Program Manager and Owner.

END OF SECTION

SECTION 03 15 19
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing adhesive anchorage, and post-installed concrete anchors required for the Early Work Implementation but not specified elsewhere in the Contract Documents. Requirements for the remainder of the Work shall be specified by the Design Professional.
   2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
      a. Structural members and accessories.
      b. Metal, wood, and plastic fabrications.
      c. Architectural components.
      d. Mechanical and electrical equipment and components.
      e. Plumbing, piping, and HVAC work.
      f. All other components requiring attachment to concrete.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 07 - Pipe Support Systems.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Structural Concrete and Commentary.
      b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
   2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
      a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
   3. American Institute of Steel Construction (AISC):
      a. 303, Code of Standard Practice for Steel Buildings and Bridges.
   4. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      e. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      f. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      g. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      h. F436, Standard Specification for Hardened Steel Washers.
      i. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
      j. F594, Standard Specification for Stainless Steel Nuts.
      k. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
      l. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

5. ICC Evaluation Service (ICC-ES):
    a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
    b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

B. Qualifications:
1. Anchor designer for Design Builder-designed post-installed anchors and cast in place anchorage shall be a professional engineer licensed in the Commonwealth of Virginia.
2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Program Manager.
3. Installer for adhesive anchors installed in horizontal, upward incline, or overhead applications shall be certified by ACI-CRSI Adhesive Anchor Installation Certification Program.

C. Post-installed anchors and related materials shall be listed by the following agencies:
1. ICC-ES.
2. Program Manager approved equivalent.

1.3 DEFINITIONS

A. Adhesive Anchors:
1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
2. Includes anchors using acrylics, epoxy and other similar adhesives.

B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e., bolt) material.

C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.

D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.

E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM F2329 with minimum coating of 2.0 OZ of zinc per SQFT of metal (average of specimens) unless noted otherwise or dictated by standard.

F. Hardware: As defined in ASTM F2329.

G. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

H. MPII: Manufacturer's printed installation instructions.

I. Mechanical Anchors:
1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
3. Drop-in anchors and other similar anchors are not allowed.

J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
    a. Acknowledgement that submitted products meet requirements of referenced standards.

b. Manufacturer material data sheet for each anchor.
   1) Clearly indicate which products on the data sheet are proposed for use on the Project.
c. Manufacturer's printed installation instructions.
d. Current ICC-ES report for each post-installed anchor system indicating the following:
   1) Certification that anchors meet all requirements indicated in this Specification.
   2) Performance data showing that anchor is approved for use in cracked concrete.
   3) Seismic design categories for which anchor system has been approved.
   4) Required installation procedures.
   5) Special inspection requirements for installation.
e. Anchorage layout drawings and details:
   1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
   2) Drawings showing location, configuration, spacing and edge distance.
f. Design Builder Designed Post-Installed Anchors:
   1) Show diameter and embedment depth of each anchor.
   2) Indicate compliance with ACI 318, Chapter 17 or ACI 350 Appendix D.
   3) Design tension and shear loads used for anchor design.
   4) Engineering design calculations:
      a) Indicate design load to each anchor.
      b) When the design load is not indicated on Drawings, include calculations to develop anchor forces based on Design Criteria listed herein.
      c) Sealed and signed by Design Builder's professional engineer.
      d) Calculations will be submitted for information purposes only.
   5) Type of post-installed anchor system used.
      a) Provide manufacturer's ICC-ES report for the following:
         (1) Mechanical anchorage per ICC-ES AC193.
         (2) Adhesive anchorage per ICC-ES AC308.

B. Samples:
   1. Representative samples of concrete anchors may be requested by Program Manager. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Design Builder.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certification of qualifications for each installer of post-installed anchors.
      a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast-in-place Concrete Anchors:
   1. Building, nonbuilding structures, and equipment, located in dry environment:
      a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized threaded rods.
      b. ASTM A307, Grade A for galvanized headed bolts.
   2. All other cast-in-place concrete anchors:
      a. Stainless steel with matching nut and washer.
      b. Submerged application: ASTM F593, Type 316.
      c. Non-submerged application: ASTM F593, Type 304 or Type 316.

B. Post-Installed Mechanical and Adhesive Concrete Anchors:
   1. Stainless steel with matching nut and washer.
   2. Submerged application: ASTM F593, Type 316.
   3. Non-submerged application: ASTM F593, Type 304 or Type 316.
   4. Zinc coated carbon steel anchors with matching nut and washer where anchoring zinc coated carbon steel members, painted carbon steel members, or specifically noted on the contract drawings.

C. Reinforcement: See Owner Standard Specifications.

D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.

E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.

F. Washers:
   1. ASTM F436 unless noted otherwise.
   2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
   3. Plate washers: Minimum 1/2 IN thick fabricated ASTM A36 (or equal) of matching finish as accompanying bolt, square plates as required.
   4. Follow manufacturer's requirements for all post-installed anchorage.

G. Nuts:
   1. ASTM A563 of matching finish as accompanying bolt, for all cast-in-place anchorage.
   2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
   3. Follow manufacturer's requirements if using post-installed anchorage.

H. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92 PCT in dry film.
   4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

I. Dissimilar Materials Protection: Protect systems from dissimilar materials corrosion as necessary.

2.2 DESIGN BUILDER DESIGNED ANCHORAGE

A. Manufacturers:
   1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Program Manager.
      a. Hilti.
      b. Dewalt.
      c. Simpson Strong-Tie.

B. Design the anchorage when any of the following occur:
   1. Design load for concrete anchorage is shown on the Drawings.
   2. When specifically required by the Contract Documents.
   3. When an anchorage is required but not specified in the Drawings.
   4. When anchorage is shown on Drawings other than Structural Drawings.

C. Anchorage Design Loads:
   1. Determine all of the design loads, including wind and seismic loads, per the building code.
      a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.
      b. Additional support requirements for utilities: See appropriate Specification Section.
      c. Pipe hangers and pipe support steel: See additional requirements listed in Specification Section 40 05 07.

D. When Contract Drawings, other than the Structural Drawings, indicate an anchor diameter or length, the Design Builder design shall incorporate these as “minimums.”

E. Cast-in-Place Concrete Anchors:
   1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the building code including ACI 318or ACI 350, Appendix D.
   2. Design assuming cracked concrete.

F. Post-installed Concrete Anchors:
   1. Provide the manufacturer’s system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified or calculated load based on requirements given in the building code, ACI 318, Chapter 17 ACI 350, Appendix D and current ICC-ES report, for the anchor to be used.
   2. Design assuming cracked concrete.

PART 3 - EXECUTION

3.1 GENERAL

A. Cast-in-Place Anchorage:
   1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Program Manager.
   2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.

B. Adhesive Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Program Manager.
   2. May be used where subjected to vibration or where buried or submerged.
   3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.

4. Contact Program Manager for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

C. Mechanical Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Program Manager.
   2. Do not use where subjected to vibration.
   3. May be used in overhead applications.
   4. Contact Program Manager for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Program Manager or specified in Contract Documents.

3.2 PREPARATION

A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.

B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
   1. Notify Program Manager of conditions detrimental to proper and timely completion of work.
   2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Program Manager.

C. Special Inspection is required in accordance with the building code for all concrete anchorage.
   1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
   2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.

D. Post-installed anchor manufacturer’s representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
   1. Follow such procedures to assure acceptable installation.
   2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.3 INSTALLATION

A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
   1. Tack welding of anchorage is prohibited.
   2. Coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
   3. Anchorage location tolerance shall be in accordance with AISC 303.
   4. Provide steel or durable wood templates for all column and equipment anchorage.
      a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.

B. Unless noted or specified otherwise:
   1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
      a. Provide dissimilar materials protection.
   2. Provide washers for all anchorage.
   3. Where exposed, extend threaded anchorage a maximum of 3/4 IN and a minimum of 1/2 IN above the top of the fully engaged nut.
      a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.

C. Do the following after nuts are snug-tightened down:
   1. If using post-installed anchorage, follow MPII.
   2. Upset threads of anchorage to prevent nuts from backing off.
      a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
   3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn to prevent nuts from backing off.
   4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
   5. If using post-installed anchorage, follow manufacturer’s installation procedures.

D. Assure that embedded items are protected from damage and are not filled in with concrete.

E. Secure architectural components such that it will not be aesthetically distorted nor fasteners overstressed from expansion, contraction or installation.

F. Coat aluminum surfaces in contact with dissimilar materials as needed to protect from dissimilar metal corrosion.

G. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Prepare damaged surfaces by abrasive blasting or power sanding.
   2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.

H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
   1. Use hammer drills to create holes.
   2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

3.4 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01 45 33 and requirements of the VUSBC.

3.5 CLEANING

A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings as necessary.

END OF SECTION

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SECTION 40 05 07
PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe support and anchor systems.
   2. Design of Pipe Support Systems as specified.
   1. Section 03 15 19 - Anchorage to Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B31.1, Power Piping.
      b. B31.2 Fuel Gas Piping.
      c. B31.3, Process Piping.
   2. ANVIL International (ANVIL).
   3. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
      c. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
      e. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
      f. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
      g. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   4. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
      b. D1.6, Structural Welding Code - Stainless Steel.
   5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP-69, Pipe Hangers and Supports - Selection and Application.

B. Responsibility:
   1. Design complete support systems for all piping, as required, and as noted on the Drawings.
   2. Provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.
   3. Incorporate those details with requirements of this Specification Section to provide the piping support system.

C. Each type of pipe hanger or support shall be the product of one manufacturer.

D. Qualifications:
   1. Pipe support designer:
      a. Licensed Professional Engineer registered in the Commonwealth of Virginia.
      b. Minimum of 5 years' experience designing pipe supports for projects of similar size and complexity.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
      d. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
      e. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
      f. Where Contract Documents indicate Design Builder is to design pipe support systems, submit detail design calculations and scaled drawings signed by pipe support designer.
   2. Certifications.
      a. Pipe support designer qualifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 MANUFACTURED UNITS

A. General:
   1. Galvanized components:
      a. Hot-dipped galvanized components.
   2. Dissimilar metals protection:
      a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
      b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.

B. Hanger Rods:
   1. Material:
      a. ASTM A36.
      b. ASTM A575, Grade M1020.
      c. ASTM A576, Grade 1020.
      d. Minimum allowable tensile stress of 12,000 PSI at 650 DEGF per MSS SP-58.
      e. Corrosion resistant: 304 or 316 stainless steel per ASTM A276.
      f. to match material of support attached thereto
   2. Continuously threaded.
   3. Electro-galvanized or cadmium plated after threads are cut.
   4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

C. Hangers:
   1. Materials for corrosive areas: 304 or 316 stainless steel.
   2. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
   3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 IN and less	ANVIL Figure 108 with Figure 114
All except noted	Over 4 IN	ANVIL Figure 590
Steam, condensate and hot water	All	ANVIL Figure 181, Figure 82
Service in chemical storage areas and as indicated on drawings for corrosion resistance	All	CorPro CP - Hanger or equal

D. Concrete Inserts for Hanger Rods:
   1. Continuous slots: Unistrut #P1000.
   2. Individual inserts: ANVIL Figure 281.
   3. See Specification Section 03 15 19, Anchorage to Concrete.

E. Beam Clamps for Hanger Rods:
   1. Standard duty.
   2. ANVIL Figure 133.

F. Trapeze Hangers for Suspended Piping:
   1. General:
      a. Material: Steel.
      b. Galvanized.
      c. Angles, channels, or other structural shapes.
      d. Curved roller surfaces at support point corresponding with type of hanger required.
   2. In chemical storage and feed areas and as indicated on the drawings:
      a. Materials: FRP.
      b. Unistrut fiberglass channel or equal.
   3. Corrosive areas:
      a. Material: 304 or 316 stainless steel.
      b. Angles, channels or other structural shapes.

G. Vertical Pipe Supports:
   1. At base of riser.

H. Expanding Pipe Supports:
   1. Spring hanger type.
   2. MSS SP-58.

I. Pipe Support Saddle:
   1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
   2. ANVIL Figure 264.

J. Pipe Support Risers:
   1. Schedule 40 pipe.
   2. Galvanized.
   3. Size: As recommended by saddle manufacturer.

K. Pipe Support Base Plate:
   1. 4 IN larger than support.
   2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.

3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
4. Collar welded to floor plate.
5. Edges ground smooth.
6. Assembly hot-dipped galvanized after fabrication.

L. Pipe Covering Protection Saddle:
1. For insulated pipe at point of support.
2. ANVIL Figure 167, Type B.

M. Wall Brackets:
1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
2. ANVIL Figure 199.

N. Pipe Anchors:
1. For locations shown on the Drawings.
2. 1/4 IN steel plate construction.
3. Hot-dipped galvanized after fabrication.
4. Designed to prevent movement of pipe at point of attachment.

O. Pipe Guides:
1. For locations on both sides on each expansion joint or loop.
2. To ensure proper alignment of expanding or contracting pipe.
3. ANVIL Figure 256.

2.3 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.
1. Provide 5 to 1 safety factor, against failure.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.3.
2. MSS SP-58 and MSS SP-69.
3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.1.
2. MSS SP-58 and MSS SP-69.

F. Check all physical clearances between piping, support system and structure.
1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser.
1. Support pipes for lateral movement with clamps or brackets.

H. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.

I. Pipe Support Spacing:
1. General:
a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.

c. Provide at least one support for each length of pipe at each change of direction and at each valve.

2. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

3. Support each length and every fitting:
   a. Bell and spigot piping:
      1) At least one hanger.
      2) Applied at bell.
   b. Mechanical coupling joints:
      1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
4. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
5. For PVC, FRP and copper piping:
   a. Provide Unistrut Unicushion wrap of pipe at each support.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
   1. Included in this requirement are movements from:
      a. Trap discharge.
      b. Water hammer.
      c. Similar internal forces.

B. Weld Supports:
   1. AWS D1.1.
   2. Weld anchors to pipe in accordance with ASME B31.3.
   3. AWS D1.6 for stainless steel supports.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect hangers for:
   1. Design offset.
   2. Adequacy of clearance for piping and supports in the hot and cold positions.
   3. Guides to permit movement without binding.
   4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Anchorage to Concrete- reference Section 03 15 19.

G. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
   1. Install concrete inserts as concrete forms are installed.

H. Welding:
   1. Welding rods: ASTM and AWS standards.

2. Integral attachments:
   a. Include welded-on ears, shoes, plates and angle clips.
   b. Ensure material for integral attachments is of good weldable quality.
3. Preheating, welding and postheat treating: ASME B31.3, Chapter V.

I. Field Painting:
   1. Per manufacturer's recommendation and approved by Program Manager.

END OF SECTION

SECTION 40 05 51
VALVES - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valving, actuators, and valving appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Section 40 05 62 - Plug Valves.
   2. Section 40 05 64 - Butterfly Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
      c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      c. D638, Standard Test Method for Tensile Properties of Plastics.
      d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
      e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
      b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
      c. C504, Standard for Rubber-Seated Butterfly Valves.
      d. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      e. C550, Standard for Protective Coatings for Valves and Hydrants.
      f. C606, Standard for Grooved and Shouldered Joints.
   4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
      a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. MG 1, Motors and Generators.
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.

d. Valve material of construction.
e. Special linings.
f. Valve dimensions and weight.
g. Valve flow coefficient.
h. Wiring and control diagrams for electric or cylinder actuators.
i. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70.

2. Test reports.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.2 MATERIALS

A. Refer to individual valve Specification Sections.

2.3 VALVE ACTUATORS

A. Valve Actuators - General:
1. Provide actuators as shown on Drawings or specified.
2. Counter clockwise opening as viewed from the top.
3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 FT-LBS torque on the operating nut.
5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
6. Extension stem:
a. Install where shown or specified.
b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
c. Pin all stem connections.
d. Center in valve box or grating opening band with guide bushing.

B. Buried Manual Valve Actuators:
1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum DIA, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
2. Box base to enclose buried valve gear box or bonnet.
3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
4. Provide at least two tee handle keys with 5 FT extension between key and handle.
5. Extension stem:
a. Provide for buried valves greater than 4 FT below finish grade.
b. Extend to within 6 IN of finish grade.
6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.

C. Exposed Valve Manual Actuators:
   1. Provide for all exposed valves not having electric or cylinder actuators.
   2. Provide handwheels for gate and globe valves.
      a. Size handwheels for valves in accordance with AWWA C500.
   3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
      a. Lever actuators for butterfly valves shall have a minimum of five intermediate lock positions between full open and full close.
      b. Provide at least two levers for each type and size of valve furnished.
   4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
   5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
   6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
   7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
      a. Cadmium-plated chain looped to within 3 FT of finish floor.
      b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
      c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
   8. Provide cast iron floor stands where shown on Drawings.
      a. Stands to be furnished by valve manufacturer with actuator.
      b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.

D. Valve Lockout Devices:
   1. Device manufactured from same material as valve operator, preventing access to valve operator, to accept lock shackle.

2.4 FABRICATION

A. End Connections:
   1. Provide the type of end connections for valves as required as shown on the Drawings.
   2. Comply with the following standards:
      a. Threaded: ASME B1.20.1.
      b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.

B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.

C. Nuts, Bolts, and Washers:
   1. Wetted or internal to be bronze or stainless steel.
      a. Exposed to be zinc or cadmium plated.

D. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Painting Requirements: Comply with manufacturer’s instructions and approved by the Program Manager

C. Setting Buried Valves:
   1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
   2. Set valves and valve boxes plumb.

3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
4. Install in closed position.
5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

E. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

F. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.

G. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

A. Adjust valves, actuators and appurtenant equipment to comply with Section 01 75 00.
   1. Operate valve, open and close at system pressures.

END OF SECTION

SECTION 40 05 62
PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plug valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      b. A536, Standard Specification for Ductile Iron Castings.
      c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C517 Resilient-Seated Cast-Iron Eccentric Plug Valves.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. See Specification Section 40 05 51.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES

A. Manufacturers:
   1. DeZurik.
   2. Henry Pratt.
   3. Millikin.
   4. ValMatic.

B. Materials:
   1. Body: Cast-iron ASTM A126, Class B.
   2. Plug: One or two-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126 Class B.
   3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.

4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
5. Valve seats: Welded-in overlay of 90 percent nickel, (minimum 1/8 IN thick).
6. Stem seal: per AWWA C517, Section 4.4.7.

2.3 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuator.
   1. Furnish actuator integral with valve.

B. Refer to Specification Section 40 05 51 for actuator requirements.

2.4 DESIGN REQUIREMENTS

A. Non-Lubricated Eccentric Plug Valves (Wastewater, Sludge):
   1. Port area:
      a. Valves 4 IN through 20 IN: Equal to or exceed 80 percent of full pipe area.
   2. Valve body: Fitted with bolted bonnet.
   3. End connections: See Specification Section 40 05 51.
   4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
   5. Designed for seating drip tight in any flow direction.
   6. Rating:
      a. 1/2 through 12 IN, 175 PSI working pressure.
      b. 14 through 36 IN, 150 PSI working pressure.
      c. Three-way valves, 125 PSI working pressure.
   7. Actuator:
      a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
      b. Positive identification on actuator indicating valve position.
      c. Adjustable stop to set closing torque.

2.5 FABRICATION

A. See Specification Section 40 05 51.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

C. Install valve with actuator above pipe or plug centerline.

END OF SECTION

SECTION 40 05 64
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Butterfly valves.

B. Related Sections include but are not necessarily limited to:
   1. Section 40 05 51 – Valves – Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
   2. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
      e. A436, Standard Specification for Austenitic Gray Iron Castings.
      f. A536, Standard Specification for Ductile Iron Castings.
   3. American Water Works Association (AWWA):
      a. C504, Standard for Rubber-Seated Butterfly Valves.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-67, Butterfly Valves.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 05 51.
   2. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. DeZurik.
   2. Clow.
   3. Mueller/Lineseal.
   4. Pratt a Mueller Water Company.
   5. Bray.
   6. Pentair/Keystone.

2.2 GENERAL USE BUTTERFLY VALVES

A. For use in all location, except where high performance butterfly valves are required.

B. Comply only with AWWA C504, as noted in this Specification Section.

C. Materials:
   1. Valve bodies:
      a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
      b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
   2. Valve shafts:
      a. One-piece stainless steel, Type 304.
      b. Pins: 304 stainless steel.
      c. Bushings/Packing/O-rings: EPDM, RTFE or TFE.
      d. Bearings: Reinforced TFE or equal.
   3. Valve discs:
      a. Cast iron with welded nickel edge or 304 Stainless Steel disk.
   4. Valve seats:
      a. Water: EPDM or Hycar.
      b. Compressed air: Teflon, PTFE.
      c. Process air: Viton, RTFE, rate for 300 DegF minimum or higher if required by service.
   5. Shaft bearing: Bronze, TFE-coated stainless steel or reinforced TFE.
   6. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.

D. Design Requirements:
   1. Seat type: Resilient.
   2. Body type:
      a. Wafer Lug (laying length may vary from AWWA C504).
      b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5.
   3. Direct buried valves:
      a. All valves: Working pressure rated for 150 PSI (Class 150B per AWWA C504).
   4. Shaft diameter: One-piece constant diameter.

2.3 ACCESSORIES

A. Refer to Drawings and/or valve schedule for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Section 40 05 51 for actuator requirements.

C. Valve Flange Seal Rings:
   1. If Steel Slip-on flanges are being used on the process piping, flange seals will be required for proper installation of valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 40 05 51.

END OF SECTION

SECTION 40 71 00
FLOW INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flow Transmitters:
      a. Magnetic Flow Meters (Inline).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. PTC 19.5, Application of Fluid Meters, Part 2.
   2. ASTM International (ASTM):
   3. American Water Works Association (AWWA).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 FLOW TRANSMITTERS

A. Magnetic Flow Meters (Inline):
   1. Acceptable manufacturers:
      a. Endress + Hauser (ProMag).
      b. Rosemount (8700 Series).
   2. Design and fabrication:
      a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
      b. High input impedance pre-amplifiers.
         1) Minimum impedance: 10^{10} ohms.
      c. Provide wafer body design rated for piping system operating and test conditions. Meter body shall be rated to same pressure as the flanges.
      d. Grounding requirements:
         1) Nonmetallic or lined pipe:
            a) Inlet and outlet grounding rings of same material as electrode or as recommended by manufacturer to meet process requirements.
         2) Conductive piping:
            a) Conductive path between the meter and the piping flanges.
      e. Provide cable between magnetic flow meter and transmitter.
         1) Cable shall be potted and fitted by manufacturer at the factory.

f. Pulsed DC magnetic field excitation.
g. Automatic zero.
h. Adjustable low flow cutoff.
i. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
j. Inaccuracy: ±0.5 percent of rate.
k. 4-20 mA DC isolated output into maximum 800 ohms.
l. Power supply: 120 V ±10 percent, 60 Hz.
m. Indication of flow rate and totalized flow at transmitter.
n. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
o. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.

3. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (GPM)	METER SIZE (IN)	NEMA (IP) RATING
TBD	Polymer Transfer	0-10	3	NA

TAG NUMBER	LINER MATERIAL	ELECTRODE MATERIAL	INTEGRAL, FIELD OR PANEL-MOUNTED TRANSMITTER
TBD	Per Design Builder	Per Design Builder	Field

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 72 00
LEVEL INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Level Transmitters:
      a. Ultrasonic Level Sensor and Transmitter.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings.
   2. ASTM International (ASTM):
      a. A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
      b. A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 LEVEL TRANSMITTERS

A. Ultrasonic Level Sensor and Transmitter:
   1. Manufacturers:
      a. Endress + Hauser (*Prosonic* FMU40).
      b. Magnetrol (*Echotel* Model 335).
   2. Specifications:
      a. General:
         1) Measurement Principle: Ultrasonic, time-of-flight.
            a) Automatic temperature compensation with internal temperature sensor.
            b) Able to ignore false targets.
            c) Maximum Beam Angle: 10 DEG (±5.0 DEG).
         2) Measurement Range: See Schedule.
         3) Level Resolution: 0.10 IN.
         4) Accuracy: ±0.25 percent of measured distance or 0.25 IN.
         5) Blanking Distance: 12 IN.
         6) Update: 200 msec.

b. Process Connection:
   1) Mounting Thread Size: 2 IN NPT, coordinate installation on existing tank.
   2) Optional: Flange connection.
c. Display and Configuration:
   1) Integral Display for live measurement and configuration.
   2) Adjustable zero and span.
   3) Output variables: Level; optional: Volume, Flow (Open Channel Flow).
   4) Output Units: Feet, inches, meters, or millimeters (mm).
d. Electrical:
   1) Signal Power: Either Loop-powered, 2-wire, 24 VDC or Isolated 4-wire, 120 VAC/60Hz.
   2) Current Output: Analog 4-20 Ma into a 400 ohm loop.
   3) High/Low signal alarms: < 4.0 mA and > 20.0 mA.
   4) Optional Communication: HART=.
   5) Configuration: With remote hand-held configurator.
   6) Required Relays: Two SPDT rated at 1A @ 30 VDC or 5A @ 120 VAC.
   7) Cable entry: 1/2 IN NPT connection.
e. Materials of Construction.
   1) Wet-side material: PVDF, PVC, polypropylene, or Kynar.
   2) Body: Polyurethane-covered aluminum or cast aluminum.
f. Environment:
   1) Ambient Temperature: -40 to 158 DegF (-40 to 70 DegC).
   2) Humidity: Up to 95 percent, non-condensing.
   3) Process Temperature: -4 to 158 DegF (-20 to 70 DegC).
   4) Process Pressure: 0 to 35 PSIG.
   5) Protection: NEMA-4X.

3. Schedule (or Instrument List):

TAG NUMBER	SERVICE	RANGE	MAXIMUM DEPTH TO LIQUID SURFACE	MOUNT
TBD	Polymer Tank Level	0-15 ft	14 ft	To be determined by Design Builder

2.3 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
   1. Materials, unless otherwise specified, shall be as follows:
      a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
      b. Mounting brackets:
         1) 316 stainless steel.
      c. Mounting plates, angles:
         1) 316 stainless steel.

B. Provide handheld communicator compatible for all intelligent transmitters furnished.
   1. Handheld communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
   2. If these features are provided with the intelligent transmitter that is accessible, the handheld communicator is not required.

C. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as determined by Design Builder.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Install instrument mounting pipe stands level and plumb.

C. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.

D. Keep foreign matter out of the system.

E. Remove all oil on piping and tubing with solvent before piping and tubing installation.

F. Plug all open ends and connections to keep out contaminants.

G. Threaded Connection Seals:
   1. Use Tite-Seal or acceptable alternate.
   2. Use of lead base pipe dope or Teflon tape is not acceptable.
   3. Do not apply Tite-Seal to tubing threads of compression fittings.

H. Instrument Mounting:
   1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
   2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
   3. Mount instruments level, plumb, and support rigidly.
   4. Mount to provide:
      a. Protect from heat, shock, and vibrations.
      b. Provide accessibility for maintenance.
      c. Free from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 43 23 57
PUMPING EQUIPMENT - PROGRESSIVE CAVITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material, design, fabrication and installation requirements for progressive cavity pumps for polymer transfer.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American National Standards Institute (ANSI).
   3. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Shop Drawings:
   1. Requirements in Specification Section 01 33 00.
   2. Source quality control test reports.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Progressive cavity pumps:
      a. Moyno.
      b. Netzsch.
      c. Seepex.

2.2 MATERIALS

A. Polymer Transfer Pump
   1. Pump body: stainless steel, AISI 316.
   2. RotorAISI 316 stainless steel.
   3. Stator:
      a. Buna-N or nitrile rubber.
   4. Base plate: Fabricated steel.
   5. Stuffing box gland: Ductile iron.
   6. Lantern ring: 316 stainless steel.

2.3 EQUIPMENT

A. Performance and Configuration Requirements:
   1. Polymer Transfer Pump
      a. Design condition: 10 GPM at less than 500 RPM.
      b. Nameplate driver horsepower: per Design Builder.

c. Drive type: Constant speed
d. Suction 3 IN DIA minimum, discharge 3 IN DIA minimum.

2.4 ACCESSORIES

A. Provide run-dry protection for each pump consisting of a temperature probe installed in the pump stator for switching off the pump upon high temperature.

B. Provide protection against run dry or overpressurization by furnishing and installing an adjustable pressure switch at the pump discharge for switching off the pump upon low or overpressurization.

2.5 FABRICATION

A. Pump Body:
1. Provide body containing two inspection ports 180 DEG apart.
2. Cradle mount pump to permit suction port to be rotated at 90 degree increments perpendicular to pump centerline.

B. Rotor:
1. Harden to minimum Rockwell C-57.

C. Stator:
1. Construct by bonding rubber-type material to inside of a steel tube.
2. Minimum 65 durometer hardness (Shore A).

D. Drive Train:
1. Include crown gear-type or pin-type universal joints, seals, connecting rod, driveshaft, and shaft bearings.
2. Connect rotor drive shaft by a connecting rod equipped with two crowned gear-type or pin-type factory grease lubricated and positively sealed universal joints.
   a. Joint unconditionally guaranteed by manufacturer to meet 10,000 HR operation at the required performance conditions.
3. Use universal joints to transmit thrust and torque while allowing the rotor to move through an eccentric path.
4. Joint shall be positively sealed and encased in a series 300 stainless steel cover to protect it from tramp metal and glass.
5. Mount drive shaft in two ball or tapered roller bearings.
6. Bearing ABMA L-10 life: 50,000 HRS at design operating conditions specified.
7. Provide fittings for grease or oil lubrication of bearings.
8. Stuffing box:
   a. Design for either grease lubrication or water seal.
   b. Permit gland adjustment and repacking without dismantling pump.

E. Suction and Discharge:
1. Provide ANSI, Class 150, 125 LB rated flanged.

F. Base Plate: Provide common base plate for pump, drive and motor.

2.6 SOURCE QUALITY CONTROL

A. Testing:
1. Perform Level I test for each pump as defined by HI standards to assure conformance to manufacturer's commercial performance criteria.
2. Perform hydrostatic test for each pump in compliance with HI standards.

2.7 MAINTENANCE MATERIALS

A. Furnish Owner the following extra parts for each pump category:
1. One complete spare pump
2. One rotor.

3. One stator.
4. One connecting rod with bushings.
5. One set of connecting rod joint assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
   5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
   7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
      a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
      b. Realign as necessary, install flange bolts and make equipment connection.
   8. Field paint units per manufacturer’s requirements.
   9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

3.2 FIELD QUALITY CONTROL

1. Inspect equipment covered by this Specification Section.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial start-up of equipment and perform operational checks.
4. Instruct Owner's personnel.

END OF SECTION

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