EXHIBIT "B"
TECHNICAL SPECIFICATIONS
WP-308: LINNWOOD WATER PURIFICATION PLANT
BACKUP POWER GENERATION

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12/6/2013
All Divisions except as Noted

Milwaukee
Water Works

Safe, Abundant Drinking Water.

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12/6/2013
SECTION 13046
PREFABRICATED STEEL BUILDING - GUARDHOUSE AND STRUCTURAL UNLESS OTHERWISE NOTED

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Project Number 172619
December 2013

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EXHIBIT “B”

TECHNICAL SPECIFICATIONS

WP-308: LINNWOOD WATER PURIFICATION PLANT
BACKUP POWER GENERATION

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Section 01070

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Abbreviations for standards and organizations used in the Contract Documents are defined as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ARI	American Refrigeration Institute
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AVATI	See RTI
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association

BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
Fed Spec	Federal Specification
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society
LEED	Leadership in Energy and Environmental Design

MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBHA	National Builders Hardware Association
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBS	See NIST
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly National Sanitation Foundation)
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SDI	Steel Door Institute
SFPA	Southern Forest Products Association
SI	Systéme International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association

SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	SSPC: The Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
USGBC	U.S. Green Building Council
WEF	Water Environment Federation

2. CONSULTING ENGINEER. Consulting Engineer is the firm of Black & Veatch Corporation, 8400 Ward Parkway, P.O. Box 8405, Kansas City, Missouri 64114.

End of Section

Section 01300

SUBMITTALS

1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to City for review, as specified in Section 01010 Summary of Work and herein. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. All deviations from the Contract Documents shall be identified as deviations on each submittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

1.02. City's Review of Submittals. City's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. City's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

1.03. Resubmittal of Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify

that all corrected data and additional information previously requested by City are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by City on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse City for the charges of City for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

2. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention in accordance with Section 01700 Contract Closeout, this section, and as specified in the individual equipment sections.

Hard copies of each manual shall be submitted to City in accordance with Contract Closeout section. With the final hard copy submittal, as described in Contract Closeout section, Contractor shall submit one electronic copy. The electronic copy will be reviewed for content and organization and assigned a review status by the City. When corrections are required, a corrected version of the electronic copy shall be resubmitted. Procedures for submission of the electronic copy will be provided after award of the Contract. When review of the electronic copy by the City is complete, three copies of each electronic O&M manual shall be delivered on CD-ROM to the City. Each CD shall contain only one copy of one manual.

All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.

2.01. Hard Copy Operation and Maintenance Manuals. Hard copies shall be provided in accordance with Contract Closeout section.

2.02. Electronic Operation and Maintenance Manuals. Electronic manuals shall include the content required for the Hard Copy Operation and Maintenance Manuals. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. Files shall be structured and named to follow the file structure of the Hard Copy Operation and Maintenance Manuals.

Documents prepared in PDF format shall be processed as follows:

1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
2. Pages shall be rotated for viewing in proper orientation.
3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
4. Embedded thumbnails shall be generated for each completed PDF file.
5. The opening view for PDF files shall be as follows:
   Initial View: Bookmarks and Page
   Page Number: Title Page (usually Page 1)
   Magnification: Set to Fit in Window
   Page: Single Page
6. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
7. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.
8. Drawings shall be bookmarked individually.
9. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

3. <u>SUPPLEMENTAL OPERATION AND MAINTENANCE MANUAL</u>. In addition to the other operation and maintenance manual requirements of Contract Closeout section, this section, and as specified in individual equipment sections, a supplemental operations and maintenance manual shall be supplied, in Hard Copy and Electronic Copy, as specified herein, to collectively describe the backup power system. The supplemental manual shall be written to a technical level sufficient to inform plant staff, such as operators and electricians, on maintenance and operations and shall include visual aids such as flow diagrams, screenshots, and photos of equipment. The supplemental manual shall include the following sections.

3.01. Design Basis. This section shall include an explanation for plant staff of the design basis for the standby power system. The information shall be presented in laymen's terms and include basic information about all of the major pieces of equipment supplied. Reasons for auxiliary systems such as fuel, exhaust, cooling, starting, load bank, and control shall be explained in a general manner. Additional information describing the design basis will be provided to the Engine-Generator Supplier by the City at a later date.

3.02. Operational Strategies. This section shall include an explanation for plant staff of the power distribution operational strategies for the facility. The water distribution facility has more than one incoming utility feed via main-tie-main configuration. This section shall include a description of the primary source of power, why the facility transfers to the standby secondary power source, and when plant staff would be required to manually transfer to the secondary source. Additional information describing the operational strategies will be provided to the Engine-Generator Supplier by the City at a later date.

3.03. Operating Scenarios. The standby power system can be operated in several different modes or strategies (auto, manual). In this section, each of these scenarios shall be explained in detail using various visual aids such as flow diagrams, actual equipment elevation shots, one-line diagrams and HMI screens.

3.04. Main Equipment and Auxiliary Systems. In this section, main equipment and auxiliary systems, including the engine-generators, switchgear, load bank, fuel, cooling, exhaust, and control systems shall be explained in separate chapters with visual aids. Flow diagrams and detailed descriptions of how to operate the equipment shall be provided to supplement visual aids.

3.05. Functional Sequence of Operation. This section shall describe the operations sequence for the backup power system. A step-by-step list of how to manually operate the system shall be included.

3.06. Equipment Maintenance Program. This section shall consist of a normal preventative maintenance schedule and lubrication schedule for each piece of equipment. A lubricant list and a description of emergency and corrective maintenance shall be included. Trouble shooting information shall also be included in this section.

End of Section

Section 01400

QUALITY CONTROL

1. TESTING SERVICES. Testing services shall be provided in accordance with the General Specifications and as specified herein. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to City. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by City are for the sole benefit of City; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

1.01. Testing Services Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

Concrete materials and design mixtures.

Asphaltic concrete materials and design mixtures.

Embedment, fill, and backfill materials.

All other tests and engineering data required for City's review of materials and equipment proposed to be used in the Work.

Contractor shall obtain City's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

1.02. Testing Services provided by City. Unless otherwise specified, City shall provide for tests made on the following materials and equipment:

Concrete.

Asphaltic concrete.

Moisture-density and relative density tests on embedment, fill, and backfill materials.

In-place field density tests on embedments, fills, and backfill.

Testing, including sampling, will be performed by City or the testing firm's laboratory personnel, in the general manner indicated in the Specifications. City shall determine the exact time, location, and number of tests, including samples.

Arrangements for delivery of samples and test specimens to the testing firm's laboratory will be made by City. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and shall furnish a written report of each test.

Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no Claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by City or laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for City's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings in the Submittals section.

The laboratory retained by City will furnish copies of a written report of each test. One copy of each test report will be transmitted to Contractor, within 3 days after each test is completed.

2. SPECIAL INSPECTIONS. A Special Inspector or Inspector or Inspectors will be provided by City to perform Special Inspections in accordance with the requirements of applicable laws and regulations.

3. OFFSITE INSPECTION. When the Contract Documents require inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, such services will be performed by City or an independent testing firm or inspection organization acceptable to City.

City may send a representative to the factory or shop to review the assembly and witness the factory testing and performance of the Medium-Voltage Metal-Clad Switchgear.

Contractor shall give appropriate written notice to City not less than 10 days before offsite inspection services are required, and shall provide for the producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.

4. MANUFACTURER'S FIELD SERVICES. Manufacturer's field services shall be as specified herein and as specified in Section 01640 Manufacturer's Services except as specifically specified in the respective equipment sections.

4.01. Services Furnished Under This Contract. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the respective equipment section shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of City.

Each manufacturer's representative shall furnish to City a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

Section 01610

GENERAL EQUIPMENT STIPULATIONS

1. SCOPE. When an equipment specification section in these Contract Documents references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.

2. COORDINATION. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

4. WORKMANSHIP AND MATERIALS. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

5. STRUCTURAL DESIGN REQUIREMENTS. All equipment, and other non-structural components and non-building structures as defined in ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Meteorological and Seismic Design Criteria section. Submittals for equipment and other non-structural components and non-building structures shall include a

seal by a professional engineer registered in the state of the project, to confirm that the anchorage design meets the code requirements.

6. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by City. Lubricants for equipment where the lubricants may come in contact with water before or during a potable water treatment process or with potable water, shall be food grade lubricants. This includes lubricants for equipment not normally in contact with water, but where accidental leakage of the lubricants may contaminate the water.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

7. ELEVATION. The elevation of the site shall be as indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

8. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in specific equipment sections.

9. DRIVE UNITS. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

9.01. Gearmotors. The use of gearmotors sharing an integral housing or cutgears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

9.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the

nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L_{10} bearing life shall be 200,000 hours.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L_{10} 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

9.03. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor.

10. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch mesh galvanized expanded metal, or pultrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

11. ANCHOR BOLTS. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolt materials shall comply with the Anchorage in Concrete and Masonry section, and sleeves shall be provided as indicated on the drawings. Unless otherwise specified, anchor bolts shall be at least 3/4 inch in diameter.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

12. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the Grout section.

13. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

14. SHOP PAINTING. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

15. PREPARATION FOR SHIPMENT. Equipment shall be prepared for shipment as specified in the Shipping section.

16. STORAGE. Handling and storage of equipment shall be as specified in the Handling and Storage section.

17. INSTALLATION AND OPERATION. Installation and operation shall be as specified in respective equipment sections and the Startup Requirements section.

18. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of City, initial tests shall be observed or witnessed by City. City shall be reimbursed by Contractor for all costs of subsequent visits by City to witness or observe incomplete tests, retesting, or subsequent tests.

19. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system. A copy of the manufacturer's original operating logic program shall be provided for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

20. REFERENCE STANDARDS. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of opening of Bids (or on the effective date of the Contract or Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of City, Contractor, or Consulting Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to City, Consulting Engineer, or any of Consulting Engineer's Consultants, agents, or employees, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

21. CMMS SYSTEM EQUIPMENT INFORMATION. Provide the following information for each piece of equipment supplied for the project for use in the City's CMMS System.

21-1.01 Equipment Information

1. Equipment Name
2. Model Type
3. Serial Number
4. Vendor
5. Manufacturer
6. Service Contract (Yes or No)
7. Service Vendor Phone #
8. Service Expires
9. Warranty Expires

21-1.02 Motor Information

1. Motor ID
2. RPM
3. HP
4. Description
5. Model #
6. Serial #
7. Manufacturer
8. Amps
9. Voltage
10. Frame
11. Phase
12. Bearing/Coupling Size
13. Motor Lubricant

End of Section

Section 01611

METEOROLOGICAL AND SEISMIC DESIGN CRITERIA

1. SCOPE. Buildings, non-structural components and non-building structures shall be designed in accordance with this section. In the event of conflict with requirements in other sections, the more stringent criteria shall be followed.

2. DESIGN CRITERIA. Non-structure components, non-building structures including anchorage of such items, shall be designed in accordance with the following criteria.

General Design Data:

Building code and references	IBC 2009, ASCE 7-05 "Minimum Design Loads for Buildings and Other Structures",	

Wind Design Data:

Basic wind speed, V	90	mph
Exposure category	C	
Importance factor (wind loads), I	1.15	

Snow Design Data:

Ground snow load, P_g	30	psf
Importance factor (snow loads), I	1.2	
Exposure factor (C_e)	1.0	
Thermal factor (C_t)	1.0	

Seismic Design Data for Non-structural Components:

Design short period spectral response acceleration, S_{DS}	0.112g
Component importance factor, I_P	1.5
Seismic Design Category	C

Seismic Design Data for Non-building Structures

Occupancy Category	IV
Design short period spectral response acceleration, S_{DS}	0.112g

Design one second period spectral response acceleration, S_{D1}	0.071g
Design one second period spectral response acceleration, S_1	0.106g
Importance factor, I	1.5

3. SEISMIC DESIGN.

3-1. General. Structural systems shall provide continuous load paths, with adequate strength and stiffness to transfer all seismic forces from the point of application to the point of final resistance.

3-2. Pre-Engineered Buildings. Not used

3-3. Non-structural Components. Non-structural components are architectural, mechanical, and electrical items that are permanently attached to and supported by a structure but are not part of the structural system, as indicated in Chapter 13 of the ASCE 7.

Non-structural components shall have sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes.

Non-structural components shall be attached so that seismic forces are transferred to the structural system. These attachments shall be bolted, welded, or otherwise positively fastened. Frictional resistance due to gravity shall not be considered in evaluating the required resistance to seismic forces.

Non-structural components shall be designed to be operable during and following a seismic event, without collapsing or breaking away from supports, and remain intact to the extent that they do not create an ignition hazard or release hazardous materials. Components that contain contents that are hazardous (flammable, explosive, corrosive, acidic, caustic, toxic, or that otherwise present a danger to the general public if released) shall maintain containment of those contents following the design earthquake.

"W_p" shall include the total operating weight of the component or system, including, but not limited to, any insulation, fluids, and concentrated loads such as valves, condensate traps, and similar components.

Seismic effects that shall be analyzed in the design of piping systems include the dynamic effects of the piping system, contents, and, when appropriate, supports. The interaction between the piping system and the supporting structures, including other mechanical and electrical equipment, shall also be considered.

3-4. Non-building Structures. Non-building structures are the items described as such in Chapter 15 of ASCE 7.

Non-building structures shall provide sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes.

The seismic design of non-building structures shall provide sufficient stiffness, strength and ductility to resist the effects of seismic ground motions during the design earthquake.

"W" for non-building structures shall include the total dead load and shall also include all normal operating contents of tanks, vessels, bins, and piping.

End of Section

Section 01612

SHIPPING

1. SCOPE. This section covers packaging and shipping of materials and equipment.

2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of City.

Grease and lubricating oil shall be applied to all bearings and similar items.

3. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

End of Section

Section 01614

HANDLING AND STORAGE

1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.

2. DELIVERY. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified in this Contract. These requirements also apply to any subsuppliers making direct shipments to the jobsite.

Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

Delivery of portions of the equipment in several individual shipments shall be subject to review of City before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature

above 60°F. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of City, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

End of Section

Section 01650

STARTUP REQUIREMENTS

1. SCOPE. This section covers startup requirements for all items of equipment and systems including mechanical equipment. Additional requirements may be specified in specific equipment specifications. The requirements of this section shall be satisfactorily completed prior to any field tests specified in the specific equipment sections.

2. GENERAL. Equipment shall not be operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. All items of equipment and systems shall be tested for proper operation, efficiency, and capacity. All required adjustments, tests, operation checks, and other startup activity shall be provided by qualified personnel. Contractor shall be responsible for planning, supervising, and executing the installation of Work.

2.01. Coordination. Contractor shall coordinate all tests related to startup of equipment and systems and shall report the results to City in accordance with the submittals section.

When equipment is ready for a witness test, Contractor shall give written notice to City at least 14 days before any offsite witness testing is performed or any field witnessed performance testing, unless otherwise specified.

3. EQUIPMENT TESTS.

3.01. Factory Tests. When specified in the specific equipment sections, the equipment will be test run at the point of manufacture and the test results will be delivered to City prior to shipment.

3.02. Preliminary Field Tests. All items of mechanical equipment shall be given a preliminary field test by Contractor after installation for proper operation, efficiency, and capacity. The preliminary field test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

Contractor's test operation of each piece of mechanical equipment shall continue for not less than 8 hours without interruption. All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so all parts move freely and function to secure satisfactory operation. All equipment shall be tested continuously under actual or simulated operating conditions. All parts shall operate satisfactorily in all respects, under continuous full load and in

accordance with the specified requirements, for the full duration of the 8 hour test period. If any part of a unit shows evidence of unsatisfactory or improper operation during the 8 hour test period, correction or repairs shall be made and the full 8 hour test operation, as specified, shall be completed after all parts operate satisfactorily.

Tests of all process and pumping equipment, drive motors, including auxiliaries shall be made in accordance with the appropriate and approved test codes such as the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.

Tests shall be conducted after the Work is substantially complete so each item of equipment is ready for integrated operation with other equipment at the plant. Testing, measuring, and calibrating procedures shall be submitted to City for review and acceptance prior to startup and testing of equipment.

The equipment shall be properly filled, by Contractor, with oil and grease, and Contractor shall furnish all power, personnel, water, chemicals, fuels, oil, grease, and auxiliaries necessary for conducting the testing of the equipment for proper operation, efficiency, and capacity except as specified in the Contract Documents.

The period of inspection, initial startup operation, and field adjustment shall be as needed to achieve satisfactory installation and operation of the items furnished. Any period required for instruction of City's personnel shall be as specified in the Contract Documents.

When the specific equipment sections indicate that an installation check is required by the equipment manufacturer, the manufacturer's representative will make all necessary field adjustments and correct defects in materials or workmanship during this test period.

All equipment installed under this Contract, including that furnished by others, shall be placed into successful operation according to the written instructions of the equipment manufacturer and the instructions of the manufacturer's field representative.

3.03. Field System Operation Test. After all equipment is installed and the entire plant or system is ready to operate, Contractor shall conduct a field system operation test. The test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

The test period shall be at least 7 days, and each system shall operate under actual or simulated operating conditions before Final Acceptance of the Work. All defects of material, workmanship, or equipment which appear during this test

period shall be corrected by Contractor. After such corrections are made, the 7 day test shall be repeated before Final Acceptance of Work, unless waived by City.

Contractor shall supply all power, water, oil, grease, auxiliaries, and operating personnel required for this operation test except as specified in the Contract Documents.

When necessary for certain items of equipment, the final adjustments and inspections will be made by factory trained service personnel (other than sales representatives), rather than by Contractor. The service personnel will also supervise the test operation. This requirement will be stated under the detailed specification for the particular piece or pieces of equipment. The manufacturer's service personnel will make adjustments and supervise testing by Contractor until such tests have been accepted by City.

End of Section

Section 02050

DEMOLITION

PART 1 - GENERAL

1-1. SCOPE. This section covers the demolition of existing structures, piping, equipment, and sitework, the cutting and disposing of trees, brush, logs, and other vegetation occurring within the clearing limits, and the removing and disposing of roots, stumps, stubs, logs, and other timber occurring within the grubbing limits as indicated on the Drawings and as specified herein.

1-2. GENERAL. Contractor shall be responsible for all work under this section.

All structures and facilities of the existing Linnwood Purification Plant must remain in continuous operation during the work. Demolition, clearing, and grubbing work shall create minimum interference with City's operations and minimum inconvenience to City. Contractor shall provide protection and safety of all roadways, sidewalks, and all accessible areas during demolition activities.

Blasting will not be permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. DEMOLITION. Removal of equipment or facilities shall include removal of all accessories, piping, wiring, supports, associated electrical starters and devices, baseplates and frames, and all other appurtenances, unless otherwise directed. Existing materials and equipment removed, and not indicated to be reused as a part of the Work, shall become Contractor's property unless otherwise specified, and shall be removed from the Site.

Contractor shall conduct demolition activities in a manner that prevents damage to existing facilities which are indicated to remain and shall provide all necessary protection for existing facilities. Any remaining facilities damaged during demolition shall be repaired by Contractor to a condition equal to or better than the original condition.

Contractor shall provide a sawcut edge for all pavement removals.

All concrete shown in structures and pavements to be demolished is reinforced with steel reinforcing bars. The amounts of reinforcing steel are not shown and the Contractor shall make his own evaluation of the amount of steel reinforcement within the reinforced concrete to be demolished.

Contractor shall use a saw to remove existing electrical substation equipment pad and the associated support columns as shown in the Drawings. Use of heavy machinery to mechanically break the existing substation equipment pad and associated support columns is not an acceptable means of demolition due to the proximity to the buried 84" concrete encased steel water pipe and 24" electrical duct bank. The existing 84" pipe and 24" electrical duct bank must remain in service.

When demolition is complete, all debris shall be removed from the Site and the Site graded to the lines and grades indicated on the Drawings.

3-1.01. Sitework Demolition. Sitework demolition shall include the following:

Removal of existing trees, brush, shrubs, and vegetation as defined in this Section.

Removal of existing electrical substation equipment pad

Removal of existing asphalt pavement

Removal of existing fencing within the limits indicated on the Drawings.

3-2. CLEARING AND GRUBBING.

3-2.01. Construction. Clear and grub all areas within the clearing and grubbing limits as shown on the plans. Cut off and dispose of all trees, brush, shrubs, or other vegetation growing in the clearing limits. Remove all stumps and associated roots, logs, timber, brush, matted roots, and all other debris not suitable for the equipment pad foundation located within the grubbing limits. Grub to a depth of one foot below existing grade.

Do not remove trees and shrubs located beyond the clearing limits unless directed by the City. If clearing where grubbing is not required, cut shrubs and brush to within 3 inches of the ground surface. Cut trees as nearly flush to the ground surface as is practical with tools ordinarily used for falling trees.

Fell trees in such as manner so as to avoid existing structures, utilities, or fences. If feasible, fell trees towards the center of the area being cleared. If required to avoid damage to existing structures, utilities, or fences, cut trees in sections from the top down.

Do not injure or damage trees or shrubs to remain. Symmetrically trim lower limbs or branches of trees left in place and overhanging the equipment pad to at least 30 feet above the finished equipment pad. Trim using generally accepted horticultural practices.

3-2.02. Disposal. Dispose of all material by mechanical chipping, recovering all material as it leaves the chipping machine. Contractor may salvage waste logs and limbs, if desired, and dispose of the material from the site. Contractor owns all material from clearing and grubbing activities. All material shall be removed from the site upon completion of clearing and grubbing activities and before proceeding with grading operations.

End of Section

Section 02200

EARTHWORK

PART 1 - GENERAL

1-1. SCOPE. This section covers earthwork and shall include the necessary preparation of the site; removal and disposal of all debris; excavation; handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of sub-grades; pumping and dewatering as necessary; protection of adjacent property; backfilling; construction of fills and embankments; grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a licensed or registered professional engineer in the state where the earthwork is located, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the Submittals section. Sheeting, shoring, and excavation support systems' submittals shall bear the seal and signature of a Professional Engineer licensed or registered in the State of Wisconsin.

At least 30 days before starting construction on the sheeting and shoring and in accordance with OSHA requirements enumerated above, the Contractor shall ensure that the sheeting and shoring design engineer shall complete and submit to City the Protection System Design Certificate (Figure 1-02200) and the Contractor shall use the sheeting and shoring design. If required by the OSHA requirements enumerated above or to protect existing facilities, then the Contractor is responsible for ensuring that a separate certificate shall be submitted for each unique design. If required for protection of existing facilities or as required by the enumerated OSHA regulations, the certificate shall be signed and sealed by the registered professional engineer that designed the protection system.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted in accordance with the Submittals section. Data submitted shall include:

A 12 inch square sample of fabric.

Manufacturer's descriptive product data.

Installation instructions.

1-3.02 Test Results for Preliminary Review of Materials. Complete test results by an independent commercial laboratory retained by the City for preliminary review of materials proposed for use in fills and embankments, structure backfill, select fill, granular fill, gravel beneath slabs, and any other fill material specified herein.

1-4. BASIS FOR PAYMENT.

1-4.01. Sheeting for Excavation of Structures. No additional payment above the Contract Price will be made for steel sheet piling left in place in excavations for structures.

1-5. INSURANCE. Professional Liability insurance shall be provided as specified in Section 01039.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Filter Fabric. Filter fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the Drawings and as specified herein. Filter fabric Type A shall be a non-woven fabric consisting of only continuous chains of polypropylene filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

Property	Test Method	Unit	Min Roll Value*
Fabric Weight	ASTM D3776	oz/yd^2	6.0
Grab Strength	ASTM D4632	lbs	160
Grab Elongation	ASTM D4632	percent	50
CBR Puncture Strength	ASTM D6241	lbs	410
Trapezoidal Tear	ASTM D4533	lbs	60
UV Resistance at 500 hours	ASTM D4355	% Strength Retained	70

*Minimum average roll value in weakest principal direction.

The apparent opening size (diameter) for the filter fabric Type A shall be no larger than the U.S. Standard Sieve Size 70 per ASTM D4751.

2-1.02. Polyethylene Film. Polyethylene film beneath concrete slabs or slab base course material shall be Product Standard PS17, 6 mil minimum thickness.

2-1.03. General Fill and Embankment Materials. To the maximum extent available, excess suitable material obtained from structure and trench excavation shall be used for the construction of general fills and embankments. Additional material shall be provided from Contractor's off-site source. No borrow pits shall be opened on site unless such pits are specifically indicated on the Drawings.

All material placed in fills and embankments shall be free from rocks or stones larger than the required size in their greatest dimension, brush, stumps, logs, roots, debris, and other organic or deleterious materials. The maximum size of stone in fills and embankment shall be 4 inches. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so that they do not interfere with proper compaction.

2-1.04. Granular Fill. Granular fill material shall be crushed rock or gravel suitable for use as a free draining sub-base beneath slabs and foundations. Granular fill shall be free from dust, clay, and trash; hard, durable, non-friable; and shall be graded 3/4 inch to No. 4 as defined in ASTM C33 for No. 67 coarse

aggregate and indicated below. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate. Only crushed rock with angular particles shall be used when the perimeter of the granular fill is not confined or otherwise subject to raveling, such as on a slope.

Size	Percent Passing
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 - 5

2-1.05. Pavement Subgrade. Dense grade base (1 1/4-inch) shall be placed as a subgrade for asphaltic concrete pavement and beneath concrete pavement. Dense graded base (1 1/4-inch) shall meet the following Wisconsin Department of Transportation gradation requirements:

Size	Percent Passing
1 1/4 inch	95 - 100
3/4 inch	70 – 93
3/8 inch	42 – 80
No. 4	25 – 63
No. 10	16 – 48
No. 40	8 – 28
No. 200	2.0 – 12.0

2-2. MATERIAL TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the Quality Control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of general fill, granular fill, or other specified material, and one additional gradation test shall be made for each additional 500 tons of each material delivered (imported) to the jobsite. In addition, one set of initial Atterberg Limits test shall be made for each fill material containing more than 20 percent by weight pass the No. 200 sieve and for materials specified by Atterberg Limits.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of City. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Field Tests. For planning purposes the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as indicated in the Submittals Procedures section.

Two moisture-density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, select fill, structure backfill, granular fill, or other material proposed.

For area fills and embankments, an in-place field density and moisture test for each 1000 cubic yards of material placed.

One in-place field density and moisture test for every 100 to 200 cubic yards of granular fill.

One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.

At least one test for every full shift of compaction operations on mass earthwork.

Additional gradation, proctor, and relative density tests whenever the source or quality of materials changes.

PART 3 - EXECUTION

3-1. SITE PREPARATION. All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments and sites to be occupied by permanent construction shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of Contractor. See Section 02050 – Demolition.

3-2. EXCAVATION.

3-2.01. General. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Sub-grade surfaces shall be clean and free of loose material of any kind when concrete or asphaltic concrete is placed thereon.

3-2.02. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.03. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by City or indicated in the Drawings. Trees left standing shall be adequately protected from damage by construction operations.

3-2.04. Unauthorized Excavation. Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced with concrete or lean concrete at the expense of Contractor. If structural concrete replacement is chosen, it shall be with concrete placed at the same time and monolithic with the concrete foundation.

3-2.05. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.06. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater and all water, regardless of the source, entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 12 inches, beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit used for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

3-2.07. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported as necessary to prevent caving or sliding.

Steel sheet piling or other excavation support systems shall be furnished and installed as necessary to limit the extent of excavations for the deeper structures and necessary backfill under adjacent shallower structures, and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and install adequate protection systems for prevention of damage to existing facilities.

Excavation support systems and sheeting and shoring shall be all removed after completion of work.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state where the project is located.

3-2.08. Stabilization. Sub-grades for concrete structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in such a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the Drawings.

3-2.09. Roadway Excavation. Excavation for the roadways, drives, and parking areas shall conform to the lines, grades, cross sections, and dimensions indicated on the Drawings. Eight inches of Dense Graded Base shall be installed above the prepared subgrade. After shaping to line, grade, and cross section, the subgrade shall be compacted to a depth of at least 6 inches and shall meet the following:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction and moisture content relative to the optimum.	95%.
Moisture content relative to the optimum.	-3% to +3%

This operation shall include any reshaping and wetting or drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

3-3. GENERAL FILLS AND EMBANKMENTS. Fills and embankments not required or indicated to be designated fills shall be constructed as general fills and embankments. All fills and embankments shall be constructed to the lines and grades indicated on the Drawings. Construction of fills and embankments shall begin from the lowest elevation in a given excavation or area and progress upward. Materials shall be deposited in approximately horizontal layers not to exceed 8 inches in uncompacted thickness. Unless otherwise specified herein, the following governing standards apply:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction.	95%.
Moisture content relative to the optimum.	-3% to +3%

Backfilling of excavations and construction of fills and embankments during freezing weather shall not be done. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-3.01. Sub-grade Preparation. After preparation of the fill or embankment site, the sub-grade shall be scarified and moisture conditioned to a minimum depth of 6 inches, leveled and rolled so that surface materials of the sub-grade will be at a moisture content and as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

Unless otherwise directed by City, the sub-grade shall be proof-rolled by a rubber-tired roller, a loaded dump truck, or other suitable rubber-tired equipment acceptable to City. A minimum of four passes of the proof-rolling equipment shall be provided such that the last two passes are made perpendicular to the first two passes.

All soft, yielding, or otherwise unsuitable material shall be removed and replaced with compacted fill.

3-3.02. Placement and Compaction. All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches in un-compacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried to achieve the moisture content relative to optimum as specified above, and shall be thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to the required degree of compaction at the required moisture content. If the material fails to meet the density specified, compaction methods shall be altered. The changes in compaction methods shall include, but not be limited to, changes in compaction equipment, reduction in uncompacted lift thickness, increase in number of passes, and better moisture control.

Wherever a pipe is to installed within a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench for pipe installation is excavated.

3-3.03. Borrow Pits. Borrow pits are not permitted.

3-4. DESIGNATED FILLS. Designated fills are all fills designated by a name and included as subparagraph under this heading. Fills required or indicated to be designated fills shall be constructed using the specific materials and placement requirements as specified. In addition to the specific requirements specified herein, all requirements for general fills and embankments shall apply. These requirements include, but are not limited to organic or deleterious materials, subgrade preparation, lift thickness, and moisture conditioning requirements. All designated fills shall be constructed to the lines and grades indicated on the Drawings. Backfilling and construction of fills during freezing weather shall not be done except by permission of City. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-4.01. Granular Fill. Granular fills shall be provided where indicated on the Drawings. Granular fills shall be placed on suitably prepared sub-grades in uncompacted lift thickness of 6 inches or less and shall meet the following requirements:

Test method to determine maximum density and moisture.	ASTM D698
Relative compaction.	95%.
Moisture content relative to the optimum.	-3% to +3%

Where granular fills are to be covered with concrete, the top surface shall be graded to the required sub-grade elevation. The completed fill shall be covered by a vapor barrier.

3-4.02. Dense Graded Base. The Dense Graded Base beneath pavement shall be placed in uncompacted lift thickness of 6 inches or less and compacted with a minimum of four passes (round trips) of a self-propelled or walk-behind type vibrating roller. The roller shall be operated in the full vibrating mode and in accordance with the manufacturer's instructions.

3-5. FILTER FABRIC INSTALLATION. Filter fabric shall be placed as specified herein and at the locations specified or otherwise indicated on the Drawings.

Filter fabric shall be protected at all times during construction from contamination by foreign material and damage. Any contaminated or damaged filter fabric shall be replaced with new filter fabric at no additional cost to the City. The work shall be scheduled so that covering of the filter fabric is accomplished within 7 calendar days after placement of the filter fabric.

The subgrade for placement of filter fabric shall be smooth and free of irregularities and undulations. Filter fabric shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. Type A filter fabric shall be overlapped a minimum of 2 feet between adjacent roll ends and adjacent strips.

All filter fabric placed shall be fixed to the subgrade to prevent filter fabric slippage or movement during placement of subsequent materials. Pins or staples shall not be used to fix the filter fabric to the subgrade when a geomembrane is to be placed on top of the filter fabric.

The Contractor shall exercise extreme care during filter fabric installation to prevent damage to the prepared supporting subgrade surface. The Contractor shall exercise care to prevent the entrapment of rocks, clods of earth or other material which could damage the filter fabric, clog the filter fabric or hamper seaming. Any filter fabric surface showing damage from penetration or distress caused by foreign objects shall be repaired or replaced.

No foot traffic will be allowed on the filter fabric except with approved smooth-sole shoes. The Contractor shall not use the filter fabric surface as a work area or storage area for tools and supplies.

Tracked or rubber tired construction equipment shall not be operated directly upon the filter fabric until a minimum thickness of 6 inches of the cover material is placed over the filter fabric. Turning of construction vehicles shall be minimized to avoid distorting or damaging the filter fabric. All damaged filter fabric shall be replaced at Contractor's expense.

3-6. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas

which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth. Any additional topsoil required to provide the required minimum thickness shall be at no additional cost to the City.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 2 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-7. DISPOSAL OF EXCAVATED MATERIALS. All debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, Contractor.

3-8. SETTLEMENT. Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from City.

End of Section

PROTECTIVE SYSTEM
DESIGN CERTIFICATE

I the undersigned professional engineer registered in the state where the earthwork is located, hereby certify that the protection system for the _____(structure name) excavation at _____(location) has been designed by me, is appropriate for the (structure name) as represented to me, and is in compliance with the Contract Documents.

Name: _____ State of Registration: _____

Signature: _____ P.E. Number _____

Date: _____

_____
(Seal)

FIGURE 1-02200

Section 02202

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1-1. SCOPE. This section covers clearing and preparation of the site; removal and disposal of all debris; excavation and trenching for electrical conduit installation; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a licensed or registered professional engineer, to act upon all pertinent matters of the work of this section.

Contractor shall note that existing intersecting and parallel trench and structure backfill of existing utilities shown on the Drawings may run into this Contract's trench. Contractor shall take all measures to protect existing utility lines and pavements, and replace backfill and improvements above backfill disturbed by excavation activities for this contract.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the Submittals section.

At least 30 days before starting construction on the sheeting and shoring, and in accordance with the OSHA requirements identified above, the Contractor shall ensure that the sheeting and shoring design engineer shall complete and submit to City the Protection System Design Certificate (Figure 2-02202) and the Contractor shall use the sheeting and shoring design. If required by the OSHA requirements identified above or to protect existing facilities, the Contractor shall submit a separate certificate for each unique design. If required for protection of existing facilities or as required by the OSHA regulations identified above, the certificate(s) shall be signed and sealed by the registered professional engineer that designed the protection system.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted. Data submitted shall include:

A 12 inch square sample of fabric.

Manufacturer's descriptive product data.

Installation instructions.

1-3.02 Embedment and Backfill Materials. Complete test results covering tests performed by an independent commercial testing laboratory retained by the Contractor for all materials described in the Materials Testing section shall be submitted.

1-4. BASIS FOR PAYMENT.

1-4.01. Trench Sheeting. No additional payment above the Contract Price will be made for trench sheeting left in place.

1-5. INSURANCE. Professional Liability insurance shall be provided as specified in Section 01039.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Filter Fabric. The fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the Drawings and as specified herein. Filter Fabric Type A shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

Property	Test Method	Unit	Minimum Average Roll Value *
Fabric Weight	ASTM D3776	oz/yd2	5.7
Grab Strength	ASTM D4632	lb	155
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi	190
Apparent Opening Size	CW-02215	U.S. Standard Sieve Size	70

* Minimum average roll value in weakest principal direction.

2-1.02. Bedding Materials. Crushed stone chips for electrical conduit package bedding material shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5

The bedding material shall conform to ¾-inch coarse aggregate (ASTM C33 – Size No. 67). The bedding material shall be free from dust, clay, trash, and organic matter; it shall be hard, durable, and non-friable.

2-1.03. Backfill Materials.

Slurry Backfill. Slurry Backfill shall be composed of the following materials:

Fly Ash (Class C)	75 lbs
Concrete Sand (Damp)	1830 lbs
No. 1 Concrete Aggregate	1830 lbs

The material shall be mixed with water to inundate the aggregate sufficiently to provide an approximate 3-inch slump. The material for No. 1 Concrete Aggregate shall conform to ¾-inch coarse aggregate (ASTM C33 – Size No. 67).

2-2. MATERIALS TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the Quality Control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of embedment, fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons of each material delivered to the site. In addition, one set of initial Atterberg Limits test shall be made for each fill materials containing more than 20 percent by weight passing the No. 200 sieve . One additional Atterberg Limits test shall be made for each additional 500 tons of each material delivered to the site.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of City. Contractor shall

provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Tests. For planning purposes, the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as specified in the Submittals Procedures section.

a. Two moisture density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.
b. In-place field density and moisture tests (ASTM D2922 and ASTM D3017) at intervals of 200 feet maximum along the trench.
c. One in-place density and moisture test (ASTM D2922 and ASTM D3017) whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.
d. Additional gradation, Proctor, and relative density tests whenever the source or quality of material changes.

PART 3 - EXECUTION

3-1. CLEARING. All clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

Contractor shall remove, at his own expense, all obstructions at or near the ground surface located within the trench limits. Such obstructions shall be replaced to their condition prior to construction as soon as the work in the vicinity is completed, unless otherwise specified. Comply with all requirements of the City of the removed item for its protection, storage, and replacement.

All concrete and asphalt pavements and concrete bases shall be sawed to full depth prior to removal. The width of the pavement cut shall be at least equal to the anticipated width of the excavation at ground surface.

3-2. EXCAVATION. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when fill is placed thereon.

3-2.01. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.02. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.03. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the material to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 12 inches beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

Contractor shall obtain from the appropriate agencies and authorities, the dewatering and stormwater discharge permits required to remove and dispose of groundwater, surface water, and any other water used in Contractor's operations. The permits shall be obtained prior to start of construction.

3-2.04. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.

Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state where the project is located.

Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by City. Trench sheeting will not be removed, if in the opinion of City, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off 12 inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

A movable trench support may be used, provided care is exercised in placing and moving the trench box or support bracing to prevent movement of the pipe or disturbance of the pipe bedding and backfill. Any voids left in the trench wall or embedment material by support removal shall be carefully filled with granular embedment material compacted as specified herein.

3-2.05. Stabilization. Sub-grades for trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the Drawings.

3-3. TRENCH EXCAVATION. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. One hundred feet shall be the maximum length of open trench on any line under construction.

All trench excavation shall be open cut from the surface.

Prior to excavation, Contractor shall contact local underground alert hotlines, “Digger’s Hotline” and/or individual utility owners for marking underground utilities. Once utilities are marked, Contractor shall hand dig or pothole to expose the existing utilities. A survey shall be made of the utility size, material, location, and elevation prior to trench excavation and information shall be recorded on the record Drawings maintained by the Contractor.

3-3.01. Alignment, Grade, and Minimum Cover. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes.

Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

Where pipe grades or elevations are not definitely fixed by the Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the electrical conduit of 24 inches below paved and graded streets. Greater cover depths may be necessary on vertical curves or to provide adequate clearance beneath existing pipes, electrical conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of cover depth shall be made vertically from the outside top of electrical conduit to finished ground or pavement surface elevation, except where future surface elevations are indicated on the Drawings.

3-3.02. Trench Widths. Trench widths shall be a maximum of 2-1/2 inches greater than the electrical conduit duct bank package widths as shown in the Electrical Drawings. The minimum trench width shall be the width of the electrical conduit duct bank packages as shown in the Electrical Drawings. Except when maximum trench width is required for certain electrical conduits, trenches shall be excavated to the minimum trench. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.

Specified minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required to the trench excavation or the trench protective system.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features.

3-3.03. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that electrical conduit, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

In locations where maximum trench widths are required for designated rigid electrical conduits, mechanical equipment shall be operated so that uniform

trench widths and vertical sidewalls are obtained at least from an elevation 12 inches above the top of the installed pipe to the bottom of the trench.

3-3.04. Cutting Concrete Surface Construction. Cuts in asphalt and concrete pavements and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cuts shall be sawed to full depth prior to removal.

Asphalt and concrete pavement and concrete base pavement over trenches excavated for electrical conduit shall be removed so that a shoulder not less than 6 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3-3.05. Excavation Below Sub-grade. Except where otherwise required, trenches shall be excavated below the underside of the electrical conduit, as indicated in the Drawings, to provide for the installation of Bedding Material.

No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or Bedding Material when the electrical conduit is jointed and spacers installed.

3-3.06. Artificial Foundations in Trenches. Whenever unsuitable or unstable soil conditions are encountered, Contractor shall notify City immediately. When authorized by the City , trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases, adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3-3.07. Over-Excavation. Over-excavation carried below the grade, unless authorized by the City, shall be backfilled to the required grade with material acceptable to the City and compacted to the satisfaction of the City, at no additional cost to the City.

3-5. TRENCH BACKFILL. All trench backfill above electrical conduit package shall conform to the following requirements.

Backfill shall not be placed until the electrical conduit package has been allowed sufficient time to set. Backfill shall not be placed until the electrical conduit package has been inspected, approved and has had sufficient time to set to withstand the load.

The trench backfill shall conform to the requirements for Slurry Backfill as defined in 2-01.03 of this Section. The trench shall be backfilled to the proposed subgrade. The mix shall be deposited in the trench directly from a concrete transit mix truck. Just prior to depositing the Slurry Backfill, the mixer shall be run at mixing speed for one full minute to ensure a consistent mixture.

3-6. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the electrical conduit has been laid. Steel plates and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3-7. SURFACE RESTORATION. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with asphalt pavement as specified in Section 02512 or topsoil to a depth of at least 4 inches where pavement is not specified or shown on the Drawings. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth. Topsoil required to provide the minimum thickness shall be imported and placed at no additional cost to the City.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-8. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Disposal of excess material from other trench excavation sites shall be as follows. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site.

3-9. SETTLEMENT. Contractor shall be responsible for all settlement of trench backfill which may occur within the correction period stipulated in the Contract Documents.

Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the City.

End of Section

PROTECTIVE SYSTEM
DESIGN CERTIFICATE

I, the undersigned professional engineer registered in the state where the Project is located, hereby certify that the protection system for _____(trench location) has been designed by me, is appropriate for the (trench location) as represented to me, and is in compliance with the Contract Documents.

Name: _____ State of Registration: _____

Signature: _____ P.E. Number _____

Date: _____

_____
(Seal)

FIGURE 2-02202

Section 02372

DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the excavation and construction of drilled piers. Setting reinforcing steel, locating embedments, and placing and finishing concrete fill are covered in other sections.

This section is applicable to the following buildings and facilities:

North Courtyard Equipment Pad

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a registered professional engineer in the state of Wisconsin, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed work shall be submitted in accordance with the Submittals section.

1-4. BASIS FOR PAYMENT. Pier excavation payment shall be performed on the following basis:

Excavation will be unclassified to the "bottom of pier" elevation indicated on the Drawings, elevation -25.0. These elevations shall be considered the basis of the Bid.

If suitable bearing is encountered at an elevation above the "bottom of pier" elevations indicated on the Drawings, excavation shall be stopped with the concurrence of the City. A credit shall be given by Contractor for the reduced lengths of piers as stipulated herein.

If suitable bearing is not found at the elevation indicated, excavation shall be continued with the concurrence of the City until suitable bearing is encountered. An extra amount will be due Contractor for the additional lengths of piers as stipulated herein.

An accurate and detailed log shall be kept by Contractor for each pier shaft, indicating the elevation of final bearing. The log shall be filed with the City upon completion of pier work, and adjustment in the Contract Price will be made as

stipulated herein. The lump sum base bid shall be for the total linear feet of piers based on the elevations show on the drawings, including the “base bid” bottom pier elevation. If the actual installed pier bottom elevation as directed by the City varies from the base bid pier bottom elevations indicated on the drawings, procedures for “Extra Work and Credits” as specified in the General Specifications will be used to adjust the final payment to the Contractor. No additional payment will be made to the Contractor for piers installed deeper than that directed by the City. Adjustment will be made on the basis of the net quantities for the overall project, not on an individual pier basis.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials, mixing, and placing of concrete and reinforcing steel within pier excavations shall be as specified in Division 3. Requirements for fabrication and placement of other embedments including anchor bolts, embedded plates, grounding cables, and lightning protection are covered in other sections.

PART 3 - EXECUTION

3-1. DEWATERING. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering the work. Each pier excavation shall be kept dry until the pier is completed.

All excavations which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level at least 12 inches beneath such excavations.

Surface water shall be diverted or otherwise prevented from entering excavations to the greatest extent possible without causing damage to adjacent property.

3-2. PIER EXCAVATION. When indicated on the drawings, portions of the new construction shall be supported on piers carried down to a firm bearing.

Except as otherwise authorized, excavation of cylindrical shaft piers shall be done with a boring machine. The dimensions and location of each pier and the bell at the bottom, when needed, are indicated on the drawings. As an alternative to providing a bell at the bottom of piers, the piers may be constructed cylindrical for their full height, with diameter equal to the bearing diameter at the bottom of the bell.

The excavation for drilled piers may encounter buried remnants of previous construction in the area. If that occurs, the pier excavation shall be advanced

using core barrel or other means as appropriate. Such encounter shall be brought to the City's attention immediately.

Rectangular piers shall be excavated to the dimensions indicated on the drawings. Rectangular piers shall be formed in accordance with the requirements for concrete construction.

Each pier shall be excavated to a final elevation as indicated on the drawings; however, the final elevation shall be suitable to develop the ultimate pier design load. Additional excavation may be required by the City. Piers shall be keyed as indicated on the drawings. At the final elevation, the bottom of each shaft shall be cleaned for examination by the City before concrete is placed. Pier holes shall be cleaned of all loose material and debris and prepared for placing of reinforcing steel, embedments, and the concrete.

3-3. PIER CONSTRUCTION.

3-3.01. Shear Rings. When indicated on the drawings, the pier holes shall be grooved for shear rings to develop side shear. The grooving shall apply to the length of the pier indicated on the drawings. Pier grooves shall be dimensioned as indicated on the drawings.

The grooves shall be horizontal and shall be formed by a tooth on a rotary drill or by other satisfactory methods. Each pier hole for which grooves are indicated shall have a minimum of three grooves. The center of the bottom groove shall be located 12 inches above the bottom of the drilled hole.

3-3.02. Casing. It is anticipated that caving soil and groundwater will be encountered in pier excavations. Contractor shall use full depth temporary casings to maintain stability of the excavation and to exclude ground water. Temporary casing shall be withdrawn only as concrete is poured, the bottom of the casing always being below the top of concrete.

Water shall be removed from pier excavations along with unstable and disturbed soil from the pier bottoms. Concrete placement shall not begin until the pier excavation bottom has been examined and approved by the City. No more than 3 inches of water shall remain in the bottom of the excavation when concrete is placed. If excessive water inflow and accumulation of more than 3 inches of water are experienced and cannot be effectively sealed off by the casing, drilling fluid and tremie concrete placement construction methods shall be used for pier construction. Contractor shall be responsible to provide piers free of defects of any kind.

3-3.03. Tolerances. Allowable tolerances in pier shafts shall be a maximum of 2 inches in horizontal alignment and a maximum of 1.5 percent slope from vertical in length of pier.

These tolerances are separate, but are not cumulative in any one direction. The magnitude of one tolerance only, whichever is the greater, may be applied in any direction within a 90 degrees quadrant. Any shafts exceeding the specified tolerances shall be straightened or shall have suitable reinforcing steel added.

3-3.04. Disposal of Excavated Materials. Suitable excavated materials may be used in fills and embankments as needed. Any excess suitable excavated material shall be disposed of off Site. The material shall be removed from the Site and disposed of by, and at the expense of Contractor.

If on-site disposal of suitable material is permitted, the material shall be disposed.

All debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, Contractor.

End of Section

Section 02512

ASPHALT PAVING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of labor, materials and equipment for the construction of asphaltic concrete base or binding course, bituminous tack coat, and asphaltic concrete surface or wearing course for the roadway, parking, and utility trench restoration areas as indicated on the Drawings.

Subgrade preparation shall be as indicated in Section 02200, unless otherwise specified in the governing standards or herein.

Asphaltic concrete paving shall be constructed to the lines, grades, and cross sections indicated on the drawings. Type of construction shall be as indicated on the Drawings and as specified herein.

1-2. GENERAL.

1-2.01. Governing Standards. Except as otherwise specified or indicated, materials, equipment, details, and construction methods shall comply with the Wisconsin DOT Standard Specifications for Highway and Structure Construction.

1-2.02. Coordination. Contractor shall coordinate the construction of asphaltic concrete paving with the excavation, the construction of concrete curb and gutters, and other construction. Pavement subgrade material is specified in Section 02200.

1-3. SUBMITTALS. All submittals of design mix reports including design mix test results and other data shall be in accordance with the Submittals section.

PART 2 - PRODUCTS

2-1. MATERIALS. The sources of materials shall be acceptable to the the City. Except as modified herein, materials shall conform to the requirements of the governing standards. Delivery tickets for all materials delivered to the site shall be submitted to the City at the end of each day during the progress of the work.

Asphaltic concrete materials shall be as follows:

Base.	
Asphalt concrete mix designation.	E-1, 12.50 mm
Asphalt cement designation.	PG 58-28, 64-22
Surface.	
Asphalt concrete mix designation.	E-1, 12.50 mm
Asphalt cement designation.	PG 64-22
Asphalt binder.	
Type.	MC & SC
Grade.	30 - 3000
Tack coat.	
Designation.	MS-2, SS-1, SS-1h, CSS-1, or CSS-1h
Rate.	0.025 gal/yd^2

PART 3 - EXECUTION

3-1. EQUIPMENT. Equipment and facilities for storage, measuring, mixing, heating, transporting, spreading, compacting, and other operations shall be in accordance with the applicable requirements of the governing standards. Improved or modernized equipment which will produce results equal in quality to those which would result from the specified equipment will be considered for use. All equipment and facilities shall be acceptable to the City.

3-2. SUBGRADE PREPARATION. As a minimum, the top 6 inches of the subgrade shall be compacted to 95 percent of standard proctor density at optimum moisture content as determined by governing standards. In addition, the stability of subgrades shall be such that when materials for construction are deposited on the subgrade no rutting or displacement of the subgrade by material hauling vehicles will occur. No materials shall be placed on subgrades which are muddy, frozen, or have frost, snow, or water thereon. Subgrades shall be thoroughly compacted and properly shaped before any surfacing materials are placed. All subgrade and surfacing shall be sloped toward drains or outer edges.

3-3. PAVEMENTS. Unless otherwise specified, the new pavements to be constructed shall consist of an asphaltic concrete base course (2.25 inches) and an asphaltic concrete surface course (1.75 inches. Asphaltic concrete base course shall be placed in compacted lifts no greater than 2.25 inches. Asphaltic concrete surface course shall be placed in compacted lifts no greater than 2.25 inches.

Grade control shall be maintained by Contractor by means of automatic screed controls on the paving machine and by use of erected and mobile string lines as applicable. The use of the automatically controlled paver may be waived by the City on irregular sections. Finished surfaces shall conform to the lines and grades indicated on the Drawings.

Asphaltic concrete pavements shall be constructed on previously prepared subgrades in accordance with the sections, in compliance with the governing standards.

Asphalt mixtures may be spread and finished by hand methods only where machine methods are impractical as determined by the City. Hand placed mixtures shall not be cast or otherwise manipulated in such manner that segregation occurs.

Minimum temperatures under which asphaltic concrete pavements may be constructed shall be as stipulated in the governing standards.

3-4. REPAIR OF DEFECTS. Contractor shall remove and replace defective areas by cutting to the full depth of the course. Cuts shall be made perpendicular and parallel to the direction of traffic with edges vertical.

A tack coat shall be applied to all exposed surfaces. The area shall be filled with fresh hot asphaltic concrete mix in lifts of the same depths as the adjacent area, then compacted by rolling to specified surface density and smoothness.

3-5. CLEANING. After completion of paving operation, all areas shall be cleaned of excess spilled asphalt materials to the satisfaction of the City.

3-6. PROTECTION. In addition to the requirements for protection stipulated in the governing standards, Contractor shall protect all adjacent concrete and masonry so that no damage will occur as the result of subsequent construction operations. All damage or discoloration shall be repaired to the satisfaction of the City before final acceptance by the City.

Special care shall be taken to prevent tack or other asphalt materials from spraying or splashing. Adjacent construction shall be protected by covering with suitable fabric or paper.

End of Section

Section 02522

CONCRETE SIDEWALK, CURB, AND GUTTER

PART 1 - GENERAL

1-1. SCOPE. This section covers the construction of concrete sidewalks, curb and gutter. This section also covers the reconstruction of concrete sidewalks, curb, and gutter.

Subgrade preparation shall be as indicated in the Earthwork section, unless otherwise specified in the governing standards or herein.

1-2. GENERAL. All existing sidewalks, and curb and gutters disturbed or damaged during construction of new work, or indicated on the Drawings to be demolished and replaced shall be reconstructed to the lines, grades, and cross sections indicated on the Drawings. Damaged curbs, sidewalks and/or gutters shall be to restored to their original locations, cross sections, and style unless indicated otherwise on the Drawings.

Contractor shall be responsible to remove, construct, reconstruct, and adjust as necessary all existing or new manhole tops, curb and gutter, and area drainage structures to match new grades as needed.

1-2.01. Governing Standards. Except as otherwise specified or indicated on the Drawings, materials, equipment, details, and construction methods shall comply with the applicable Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction.

PART 2 - PRODUCTS

2-1. MATERIALS. The sources of materials shall be acceptable to City. Except as otherwise modified herein, materials shall conform to the requirements of the governing standards.

2-1.01. Concrete materials shall be as follows:

Sidewalks

Concrete designation.	A, A-IP, or A-IS
Portland cement designation.	Type I, IP, or IS
Aggregate designation.	Coarse, Size No. 1

Curbs and Gutters.	
Concrete designation.	A,A-IP, or A-IS
Portland cement designation.	Type I, IP, or IS
Aggregate designation.	Coarse, Size No. 1
Membrane curing compound.	Linseed Oil Based Liquid curing compound conforming to AASHTO M 148 or polyethylene sheeting conforming to AASHTO M 171

2-1.02 Expansion Joint Material. Expansion joint materials shall conform to the requirements of AASHTO M 153 or AASHTO M 213 for fiber expansion joints saturated with asphalt. Expansion joints placed within sidewalk shall be ½-inch thick. Expansion joints placed between sidewalk and rigid structures shall be one-inch thick.

2-2. DESIGN MIXTURE DATA. The design mixture shall be as follows:

Water to cement ratio	0.45	
Consistency (slump).		
Non-slip formed	4	in
Slip formed	2.5	in
Compressive strength (28 days).	4000	psi

PART 3 - EXECUTION

3-1. SUBGRADE PREPARATION. As a minimum, the top 6 inches of the subgrade shall be compacted to a 95 percent of standard proctor density at optimum moisture content as determined by governing standards. In addition, the stability of subgrades shall be such that when materials for construction are deposited on the subgrade no rutting or displacement of the subgrade by material hauling vehicles will occur. No materials shall be placed on subgrades which are muddy, frozen, or have frost, snow, or water thereon. Subgrades shall be thoroughly compacted and properly shaped before any surfacing, curb and gutter, or sidewalk materials are placed. All subgrade and surfacing shall be sloped as indicated on the Drawings, and as needed to achieve a uniform slope between new and existing surfaces. Sidewalks shall slope toward one edge.

3-2. CONCRETE SIDEWALKS. Concrete shall be placed, vibrated, and finished as described in the governing standards.

One-half inch expansion joints shall be provided where sidewalks abut a curb, structure, existing sidewalk, at changes in directions, and at intervals of not more than 40 feet. Expansion joints shall be filled to within 3/4 inch of the surface with bituminous expansion joint material, and then filled flush to the surface with self-leveling caulking in accordance with the Caulking section. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.

Concrete sidewalks shall be screeded to the proper elevation and contour. All aggregates shall be completely embedded in mortar. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface. A second floating at the time of initial set shall follow initial floating.

Floated surfaces shall be given a light broom finish, using a horsehair broom, to provide a nonslip surface. Brooming shall be at right angles to the length of the curb, walk, or gutter.

New sidewalks shall be edged to match existing sidewalks.Sidewalks shall be edged using a 3 to 4 inch wide edging tool with a 1/8 inch corner radius. Edger lap marks at corners of each slab shall be carefully removed. False joints shall be provided at right angles to the length of the walk, using a grooving tool with 1/8 inch radius and a depth of 1.2 inch. The finished edge on each side of the joint shall be the same width as the edging tool used. False joints shall divide each sidewalk into square sections.

The finished surface of all sidewalks shall be neat in appearance, shall be sloped to drain, and shall not pond water.

The finished concrete shall be cured and protected as stipulated in the governing standards.

3-3. CONCRETE CURB AND GUTTER. New concrete curb and gutter shall be as indicated on the Drawings and specified herein. Replacement concrete curb and gutter shall match the existing curb and gutter. Unless otherwise authorized by Engineer, adjacent and enclosed curbs, drainage structures, and gutters shall be placed before placement of pavement sections.

Expansion and contraction joints shall be formed at right angles to the alignment of the curb and/or gutter and to the depths as specified, as indicated on the

Drawings, and in conformance with the governing standards. One half inch wide expansion joints shall be placed full depth using a premolded expansion joint material, cut to the configuration of the full size of the section, being secured so that they are not moved by depositing, compacting or finishing the concrete at these joints. The edges of these joints shall be rounded by an edging tool of 1/8 inch radius.

Expansion joints shall be placed at the beginning and end of radii, where curbs and gutters abut structures, and at intervals of approximately 45 feet.

Contraction joints shall be a minimum of 3 inches deep on all sides, shall be spaced at approximately 15 foot intervals, and shall be formed by a 1/8 inch thick steel template, cut to the configuration of the section. These templates shall be secured so they are not moved by depositing, compacting or finishing the concrete.

Unless otherwise indicated on the drawings, and as soon as the concrete has hardened sufficiently, the templates shall be removed from all contraction joints. The edges of the joint shall be rounded with an edging tool having a maximum radius of 3/8 inch .

All expansion and contraction joints shall be filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave and shall not be allowed to overflow the joint.

3-3.01. Forms. Forms shall be in conformance with the governing standards. All forms shall be in good condition, with not more than 1/8 inch variation in horizontal and vertical alignment for each 10 feet in length. Side forms shall have a depth at least equal to the edge thickness of the concrete being formed. The forms shall be set true to line and grade and shall be adequately supported to stay in position while depositing and consolidating the concrete. Forms shall be designed and constructed so as to permit their removal without damage to the concrete.

3-3.02. Joints. Expansion and contraction joints shall be formed at right angles to the alignment of the curb and gutter and to the depths as specified, as indicated on the Drawings, and in conformance with the governing standards.

a. Expansion Joints. One half inch wide expansion joints shall be placed full depth using a premolded expansion joint material, cut to the configuration of the full size of the Curb and Gutter section, being secured so that they are not moved by depositing and compacting the concrete at these joints. The edges of these joints shall be rounded by an edging tool of 1/8 inch radius.

   Expansion joints shall be placed at the beginning and end of radii,

where curbs and gutters abut structures, and at intervals of approximately 45 feet .

b. Contraction Joints. Contraction joints shall be a minimum of 3 inches deep on all sides, shall be spaced at approximately 15 foot intervals, and shall be formed by a 1/8 inch thick steel template, cut to the configuration of the Curb section. These templates shall be secured so that they are not moved by depositing and compacting the concrete.

Unless otherwise indicated on the Drawings, and as soon as the concrete has hardened sufficiently, the templates shall be removed from all contraction joints. The edges of the joint shall be rounded with an edging tool having a maximum radius of 3/8 inch .

All expansion and contraction joints shall be filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave and shall not be allowed to overflow the joint.

3-3.03. Finishing. Curb and gutter shall be finished to the shape indicated on the Drawings. After the forms have been removed, all exposed edges shall be rounded, using an edging tool with a 1/8 inch corner radius. Exposed surfaces shall be float finished and given a light broom finish applied at right angles to the curb at the time of initial set, using a horsehair broom. Mortar or dryer shall not be used to remove imperfections. In all cases, the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed. No plastering of the concrete will be allowed. The finished curb shall have a true surface, free from sags, twists, or warps; shall have a uniform appearance; and shall be true to the original lines, grades, and configurations indicated on the Drawings.

The finished concrete shall be cured and protected as stipulated in the governing standards.

3-4. PROTECTION. In addition to the requirements for protection set forth in the governing standards, Contractor shall protect all adjacent concrete and masonry so that no damage will occur as the result of subsequent construction operations. All damage or discoloration shall be repaired to the satisfaction of City before final acceptance by City.

Special care shall be taken to prevent bituminous materials from spraying or splashing. Adjacent construction shall be protected by covering with suitable fabric or paper.

End of Section

Section 02832

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1-1. SCOPE. This section covers chain link fencing and personnel gates. Fencing shall be provided in the alignment indicated on the Drawings.

1-2. SUBMITTALS. Complete detail drawings that indicate plan layout, grid, spacing of components, accessories, fittings and post anchorage, and specifications for the fence, personnel gates, and accessories shall be submitted in accordance with the Submittals section.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. FENCE TYPES.

2-1.01 Barbed wire fencing shall be installed and located as indicated on the Drawings and unless otherwise specified shall be of the following general types.

Location	Fabric	Height
Ozone Facility Substation	Galvanized Steel.	6 ft
South Perimeter Fence	Galvanized Steel	6 ft

Fence posts shall be cast into 12” diameter, 42” in deep concrete structure with a 36” embedment.

2-2. MATERIALS.

2-2.01. Chain Link Steel Fencing. All steel or malleable iron parts and accessories shall be hot-dip galvanized after fabrication.

Fabric	9 gage thick, 2 inch mesh. Galvanized per ASTM A392, Class 1.

Fabric Finish	Knuckled both edges for fabric widths of 60 inches or less. Knuckled one edge and twisted one edge for fabric widths of 72 inches or more.
Posts, Frames, and Rails	SS 40 or Schedule 40 Steel pipe, ASTM F1043, Group IC, with ASTM F1043, Type B exterior protective coating.
Line Posts	
For 6 foot and 7 foot fencing	2-3/8 inch OD pipe.
Terminal Posts (End, Corner and Pull Posts)	
For 6 foot and 7 foot fencing	2-7/8 inch OD pipe
Gate Posts	
For gate or leaf 6 feet or less	2-7/8 inch OD pipe.
Top Rails	1-5/8 inch OD pipe
Rail Couplings	Sleeve type, 6 inches long, ASTM F626.
Post Tops (with barbed wire)	Pressed steel, malleable iron with pressed steel extension arm, or one-piece aluminum casting, ASTM F626.
Barbed Wire	Each strand shall consist of three 12.5 gage steel wires with four-point barbs; galvanized per ASTM A121, Class 3, or aluminum coated per ASTM A121.
45 degree extension arms	Three strands of barbed wire mounted on extension arms, upper strand of barbed wire approximately 24 inches out from the fence and 24 inches above the top of the fabric.
Stretcher Bars	Steel, ASTM F626, 3/16 by 3/4 inch, or equivalent area.
Fabric Ties	Aluminum bands or wire, ASTM F626, #9 wire or thicker.
Gate Frames	Steel tubing, 1-7/8 inch OD.

Tension Wire	ASTM A824, galvanized or aluminum coated coil spring wire, 7 gage .
Handrail-Setting Cement (posts set into concrete structures)	Minwax "Super Por-Rok Cement" or Master Builders "Set 45".
Hog rings	9 gauge steel wire
Coal tar epoxy paint	In accordance with Protective Coatings section

2-2.03. Padlocks.
Contractor shall provide padlocks compatible with the existing lock system of the City and all padlocks shall be operable with the City's master key.

2-3. PERSONNEL GATES.
Gates shall be swing type, hinged to swing an angle of 180 degrees from closed to open, complete with frames, latches, hinges, braces. Stops, keepers, and padlocks shall be provided where specified.

Gate leaves shall have intermediate members and diagonal truss rods where necessary for rigid construction and shall be free from sag or twist. When adjacent fence is topped with barbed wire, gates shall be fitted with vertical extension arms or shall have frame end members extended to carry barbed wire. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and watertight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be of heavy pattern, with large bearing surfaces, and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than 10 feet wide shall be provided with a forked latch. Latches shall be arranged for padlocking, with the padlock accessible from both sides of the gate unless detailed on Drawings.

Padlocks shall be installed at all gates.

PART 3 - EXECUTION

3-1. INSTALLATION. The installed fence shall conform to the alignment and finished grade indicated. All posts shall be plumb. Unless otherwise indicated on the drawings, posts shall be spaced approximately 10 feet. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence

fabric links. Ground surface irregularities shall be graded to maintain not more than 2 inch clearance below the bottom of the fence fabric.

Where posts are set in earth, concrete foundations 36 inches deep shall be provided. If bedrock is encountered, post excavation shall be continued to the 36 inch depth or 18 inches into the rock, whichever is less. Concrete foundations shall be circular in horizontal section, not less than 10 inches in diameter for line posts, and with a diameter not less than the post OD plus 9 inches for terminal and gate posts, except that foundations in bedrock shall be at least 6 inches larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately 1 inch. Concrete for foundations shall conform to the Cast-in-Place Concrete section using at least a 3000 psi concrete mix. Each foundation shall be cured for at least 72 hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least 18 foot lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately 6 inches above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1,500 feet. A terminal post shall be provided at each change in slope or each change in direction greater than 10 degrees.

Fabric shall be attached to the top rail at 24 inch centers. Fabric shall be attached to the bottom tension wire at 12 inch centers with 9 gauge hog rings. Fabric shall be attached to the line posts at 15 inch centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties. Stretcher bars shall be provided at each gate post and terminal post. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15 inch centers by positive mechanical means.

When necessary, each gate post and terminal post shall be braced by a horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabric shall be stretched taut and anchored so that a pull of 150 lbs at the middle of a panel will not lift the bottom of the fabric more than 6 inches.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

Interior and exterior surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a heavy coat of coal tar paint. The end of each aluminum post to be set in concrete shall be dipped in a container of coal tar paint before installation.

End of Section

Section 02900

MECHANICALLY STABILIZED RETAINING WALL SYSTEMS

PART 1 - GENERAL

1-1. SCOPE. This section covers materials and construction for mechanically stabilized retaining wall systems. Work shall be in accordance with these specifications and with the lines, grades, design, and dimensions as indicated on the Drawings.

1-2. GENERAL. Mechanically stabilized systems shall employ either metallic or polymeric reinforcement within a selected granular backfill mass with wall units that have a discrete modular precast facing and uniform color throughout. Any variations in color uniformity and general appearance of the facing of wall units may be cause for rejection.

The retaining wall system shall be by Anchor Wall Systems, Minnetonka, MN; Keystone Retaining Wall Systems, Minneapolis, MN; or Versa-Lok Retaining Wall Systems, North St. Paul, MN, or approved equal.

1-2.01. Experience. The manufacturer and installation contractor shall be experienced in the design, construction, and installation of the type of the retaining wall system specified as follows:

a. Manufacturer's Experience. The manufacturer of the precast concrete retaining wall system shall be experienced in the manufacture of materials of the type specified and shall submit evidence that the proposed retaining walls have been in satisfactory service for at least 5 years.

b. Installation Contractor's Experience. The installation contractor who installs the precast concrete retaining wall system shall be experienced in the installation of systems of the type specified and shall submit evidence that projects of a similar nature performed by the firm have been in satisfactory service for at least 5 years.

1-2.02. Coordination. Excavation shall remain within the limits indicated on the drawings. The design and construction of the wall shall conform to these limits.

1-3. SUBMITTALS. Completed wall design plans, material specifications, fabrication requirements, and all construction requirements for erecting the wall, complete in place, shall be submitted in accordance with the Submittals section.

Sample wall units shall be submitted to the City for color and texture selection. Samples shall be of sufficient size and shall be submitted in as many textures and colors as may be required for making a proper selection.

1-4. INSURANCE. Professional Liability insurance shall be provided as specified in Section 01039.

PART 2 - PRODUCTS

2-1. MATERIALS. The Contractor shall furnish and install all reinforced concrete units, reinforcing strips and tie-strips, fasteners, joint filler, and all necessary attachments. Contractor may use any combination of reinforcing strips that may be required to remain within the City's property and construction easements.

2-1.01. Backfill Material. The backfill material behind the wall shall be free draining, granular, nonexpansive, noncorrosive material and shall be drained by drains placed at suitable intervals and elevations. Silts and clays shall not be used for the reinforced backfill.

The backfill material shall conform to all of the following additional requirements:

a. The Plasticity Index (PI), as determined by AASHTO T-90, shall not exceed 6.

b. The dry unit weight of the backfill material shall not be less than 100 pounds per cubic foot.

c. The material shall be free of shale or other soft and poor durability particles.

The Contractor shall furnish to the City a Certificate of Compliance certifying the selected granular backfill material complies with this section of the specifications. A copy of all test results performed by the Contractor or his supplier necessary to assure contract compliance shall also be furnished to the City.

Acceptance will be based on the Certificate of Compliance and accompanying test reports.

The frequency of sampling of selected granular backfill, necessary to assure gradation control throughout construction, shall be as specified in the earthwork section and as directed by the City.

2-2. DESIGN. The earth retaining system shall be designed and certified by a professional engineer registered in the State of Wisconsin.

2-2.01. Design Standards. Walls shall be designed in accordance with the AASHTO Standard Specifications for Highway Bridges, Section 5, Retaining Walls. All concrete shall be designed in accordance with ACI 318.

2-2.02. Design Parameters. The following design parameters for the retaining wall systems are minimum values. The computation of seismic load shall be according to the requirements of AASHTO Standard Specifications for Highway Bridges, Division I-A, Seismic Design.

Factor of safety:	
Ultimate bearing capacity	3.0
Pullout resistance	1.5
Factor of safety against overturning	
Static	2.0
Seismic	1.5
Factor of safety against sliding	
Static	1.5
Seismic	1.1

The wall designer is responsible for the internal stability of the wall.

2-2.03. Design Loads. Refer to the geotechnical reports identified in Exhibit “C” for information on the water table, bearing capacity of foundation soils, and properties of backfill material available onsite. The wall designer shall evaluate the information contained in the geotechnical report, verify it if he thinks necessary, and obtain any additional soils information needed for design of the wall.

PART 3 - EXECUTION

3-1. WALL CONSTRUCTION.

3-1.01. Wall Excavation. Excavation shall be in accordance with Section 02200 of these specifications.

3-1.02. Foundation Preparation. The foundation for the structure shall be graded level for a width equal to or exceeding that required for installation of reinforcing strips, or as indicated on the manufacturer's drawings. Unsuitable foundation material shall be removed and replaced with granular fill. The entire foundation area of the wall shall be compacted in accordance with the requirements of the earthwork section. The bottom units shall be supported on an unreinforced concrete leveling pad. The leveling pad shall be cured a minimum of 72 hours before placement of units.

3-1.03. Wall Erection. Precast concrete units shall be placed vertically or to the orientation indicated on the erection drawings. Units shall be placed in successive horizontal lifts in the sequence indicated on the erection drawings. Vertical tolerances (plumbness) or out of plane tolerances and horizontal alignment tolerances shall not exceed 3/4 inch when measured along a 10 foot straightedge. The overall vertical tolerance of the wall (plumbness from top to bottom) or out of plane tolerance shall not exceed 1/2 inch per 10 feet of wall height. Joint tolerance shall be plus or minus 1/4 inch.

3-1.04. Backfill Placement. Where applicable, all backfill placement shall be concurrent with any adjacent embankment fill placement. Backfill placement shall closely follow the erection of each course of units. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the units. Any wall materials which become damaged or disturbed during backfill placement shall be either removed or replaced at the Contractor's expense or corrected, as in a manner acceptable to the City. Any misalignment or distortion of the wall units due to placement of backfill outside the limits of this specification shall be corrected.

Backfill shall be compacted in accordance with Section 02200 of these specifications with the following exceptions:

a. Minimum density shall not be less than 95 percent of maximum dry density in accordance with ASTM D698.

b. For backfills containing more than 30 percent retained on the 3/4 inch sieve, a method of compaction consisting of at least four passes by a heavy roller shall be used. Additional passes shall be made as required to achieve the specified minimum compaction.

c. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content within 2 percent of the optimum moisture content.

d. Compaction within 3 feet of the back face of the wall shall be achieved by a lightweight hand type, mechanical tamper, roller, or vibratory compactor.

e. At the end of each day's operation, the Contractor shall slope the last level of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3-1.05. Construction Field Services. The manufacturer shall furnish the services of one or more field technical advisors. The technical advisor(s) shall be technically competent, experienced in the installation of the structure, and authorized by the manufacturer to perform the work specified.

The field technical advisor(s) shall instruct the Contractor in the proper installation of the structure. The Contractor shall be responsible for informing the advisor(s) prior to the date of installation.

The bid shall include the costs of the field technical advisor(s) to provide all the services stated in this section.

3-1.06. Joints. A filter fabric shall be placed at all wall unit joints in front of the selected granular backfill mass if required by the designer of the wall system. The filter fabric shall be as specified by the wall designer.

The shop drawing submittal shall include the details and specifications for all proposed bearing pads, joint fillers, and filter fabric covers.

3-1.07. Coping and Leveling Pads. The top of retaining walls shall match the elevations indicated on the drawings. The top of the wall shall have a precast or cast-in-place concrete coping. This coping shall be designed by the wall system manufacturer. Concrete leveling pads shall be a minimum 12 inches wide by 6 inches deep.

Concrete for coping and leveling pads shall conform to Section 03301 of these specifications and shall have a minimum 28 day compressive strength of 4,000 psi.

3-2. PRECAST CONCRETE TESTING, INSPECTION, AND ACCEPTANCE. Individual modular units shall consist of precast concrete construction and shall conform to the following:

Concrete wall units shall have a minimum 28 day compressive strength of 3,000 psi in accordance with ASTM C90. The concrete shall have adequate freeze/thaw protection, with a maximum moisture absorption rate, by weight, of 8 percent.

The manufacturer shall demonstrate either by proven field performance, or if required, by laboratory freezing-and-thawing tests that the units have adequate resistance to freezing and thawing. If a laboratory test is used, when tested in accordance with ASTM C67, specimens shall have no breakage and not greater than 3 percent loss in dry weight of any individual unit when subjected to 50 cycles of freezing and thawing. This test shall be conducted not more than 24 months to delivery of units.

Any or all of the following defects shall be sufficient cause for rejection:

Defects that indicate imperfect molding.

Defects indicating honeycombed or open texture concrete.

3-3. TESTING. Laboratory testing required to determine compliance with the requirements of this section for fabrication of units shall be provided by the Contractor. All laboratory testing shall be done by an independent testing laboratory acceptable to the City and retained and paid by the Contractor. Sampling shall be done by the testing laboratory or by a qualified employee of the Contractor in accordance with ASTM D75. Samples shall be tested for compliance with the Materials paragraph.

All field and laboratory testing required to determine compliance with the requirements of this section for backfill, placement, and compaction results will be provided by the City.

Maximum density for compacted materials placed under this section will be determined in accordance with ASTM D698.

End of Section

Section 02930

SEEDING

PART 1 - GENERAL

1-1. SCOPE. This section covers seeding to be performed after backfilling and final grading are complete. All areas disturbed by construction operations shall be treated as specified herein.

All lawn, ditch, and street shoulder areas within street right-of-way and temporary construction easements that are damaged during the Work shall be restored, after completion of construction, to the complete satisfaction of the City. All areas disturbed by Contractor outside the temporary construction easements shall be restored, at Contractor's expense, to the satisfaction of the property owner, except that if the temporary construction easement through the ownership is sodded all disturbed areas outside the construction easement shall also be sodded. Occupying areas outside temporary construction easements, street right-of-way, and utility easements for any purpose shall be done only with the written approval of the property owner.

1-2. GENERAL.

1-2.01. Governing Standard. The governing standard for the seeding Work shall be the Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction (SSHSC).

1-2.02. Experience. All Work shall be performed by a licensed landscaping Contractor who is licensed in the State of Wisconsin.

1-2.03. Completion. Seeding Work shall be completed prior to June 15 or after October 15. Seeding between June 15 and October 15 must be approved by the City. Seeding requirements are as follows:

Locations to be seeded.	As shown on the Drawings
	Any additional site areas disturbed by the Contractor

1-3. SUBMITTALS.

1-3.01. Invoices and Analysis Labels. A copy of supplier's invoices for all seed, mulch, and fertilizer which shows the quantity by weight purchased for the project and representative labels bearing the manufacturer's or vendor's guaranteed

statement of analysis shall be submitted to the City for review and approval to assure compliance with specified requirements for quality and application rates.

1-4. GUARANTEE.

1-4.01. Seeding. Contractor shall guarantee a uniform stand of seeding, free of weeds to the extent practical, and acceptable to the City.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Storage shall be in such a manner that protects the seed from damage by heat, moisture, rodents, or other causes. The seed shall be stored such that its effectiveness will not be impaired. Any previously tested and accepted seed that becomes damaged shall be discarded and replaced by the Contractor. Handling shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. MATERIALS. All materials shall conform to the requirements of the Governing Standard, except where otherwise specified.

2-1.01. Starter Fertilizer. Fertilizer shall be Type A as defined in Section 629.2 of the SSHSC except that the fertilizer shall be a complete pelleted or granulated fertilizer. The analysis in percent by weight shall be as follows:

	Seeded Areas
Nitrogen	16% minimum
Phosphorus	6% minimum
Potassium	6% minimum

The total of nitrogen, phosphorus, and potash shall equal at least 32 percent.

Total nitrogen shall at least equal the sum of the phosphorus and potash.

The fertilizer shall be pre-mixed and packaged in standard size bags, showing weight, analysis, and name of manufacturer.

2-1.02. Seed. The seed mixture shall be Seed Mixture No. 30 as defined in Section 630.2 of the SSHSC. The mixture proportions are as follows:

Species	Purity (minimum %)	Germination (minimum %)	Mixture Proportions (%)
Kentucky Bluegrass	98	85	10
Red Fescue	97	85	30
Hard Fescue	97	85	25
Salt Grass	98	85	10
Improved Fine Perennial Ryegrass	96	85	15
Birdsfoot Trefoil	95	80	10

2-1.03. Topsoil. Topsoil shall be fertile, natural soil, typical of the locality, free from stones, roots, sticks, clay, peat, weeds, and sod, and obtained from naturally well drained areas. It shall not be excessively acidic or alkaline nor contain toxic material harmful to plant growth. Stockpiled topsoil may be used but the Contractor shall furnish additional topsoil at his own expense if required.

2-1.04. Mulch. Mulch shall be a specially processed cellulose fiber containing no growth or germination inhibiting factors, or shall consist of straw from hay and shall include a tackifier. Mulch for hydroseeding operation shall be a wood mulch or combination wood and paper mulch in accordance with the Governing Standard. Mulch shall be free of objectionable foreign matter.

PART 3 - EXECUTION

3-1. GENERAL. Execution of seeding Work shall conform to the Governing Standard, or shall be as specified herein, whichever is the most stringent.

3-1.01. Clearing Prior to finish grading, areas to be seeded shall be cleared to remove stumps, stones larger than 3 inches, roots, cable, wire, debris or other materials that might hinder seeding and future turf maintenance. All debris shall be completely removed from the site.

3-1.02. Finish Grading. Seeding shall not be started until all earthwork has been substantially completed. Backfills and fills shall be allowed to settle, the topsoil spread, and finish grading completed before the Work is started. Finish grading shall result in a surface conforming to the contours indicated on the Drawings.

3-1.03. Application of Fertilizer and pH Adjustment. Prior to application, verify that fertilizer is free of lumps. After finish grading, any fertilizer or chemicals for pH adjustment specified shall be applied uniformly to areas to be seeded.

Fertilizer application rate shall be 7 lbs/1000 ft^2. Chemicals for pH adjustment shall be applied at a rate based on a soil test for pH. The rate shall be adequate to neutralize the soil.

3-1.04 Final Preparation Following application of additives and/or fertilizers the areas to be seeded shall be tilled to a true depth of 6 inches by disking, harrowing, or other accepted methods to thoroughly incorporate the additives and fertilizer, destroy vegetation, and pulverize the soil. After tilling, the bed shall be smoothed by dragging or floating. The surface shall be cleared of all stones, stumps or other objects larger than 1 1/2 inches in thickness or diameter; roots, wire, grade stakes, and other objects that might hinder future turf maintenance operations. All debris shall be completely removed from the site.

When results are not satisfactory because of drought, excessive moisture or other causes, the Work shall be stopped until such conditions have improved or have been corrected.

When possible, operations shall be performed parallel to the contour lines and operations uphill and downhill shall be avoided.

3-2. SEEDING.

3-2.01 Seed Application. Seed shall be applied within 24 hours after preparation of the seedbed. Seed shall be applied with equipment designed to give uniform application. Any method or combination of methods which uniformly distributes the seed directly in contact with the soil, covers the seed, and firms the bed, may be selected. Seed shall be placed approximately 1/4 inch below the surface at a rate of 2 lbs/1000 ft^2.

3-2.02. Mulching. All seeded areas shall be mulched within 24 hours following seed application. Mulch shall be spread uniformly over the seeded area to a loose depth of ½ to 1 ½ inches. Mulch shall be spread by blowing from a machine as specified as Method B in Section 627.3.2.2 of the SSHSC, or by an City approved method. Mulch shall be placed at a rate of 2 tons/acre.

3-3. WATERING.

3-3.01. Seeded Areas.
Seeded areas shall be thoroughly watered after application of seed and mulch. Subsequent water for seeded areas will not be required; however, the Contractor shall guarantee a uniform stand of seeding that is free of weeds to the extent practical, and acceptable to the City.

3-4. REPLANTING. Unacceptably seeded areas shall be overseeded or completely reseeded as instructed by the City. Unless otherwise permitted by City, reseeding shall be performed during the next planting season

3-5. MAINTENANCE. All areas shall be maintained until final acceptance of the project. Maintenance shall include any necessary reseeding, repair of erosion damage, and replacement of displaced mulch until covered with seedlings. In the event erosion occurs from either watering operations or rainfall, such damage shall be repaired.

End of Section

Section 03301

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1-1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work. All concrete shall be air-entrained.

1-2. GENERAL. All cast-in-place concrete shall be accurately formed and properly placed and finished as indicated on the drawings and as specified herein.

1-3. SUBMITTALS. All submittals of drawings and data shall be in accordance with the Submittals section.

1-4. STORAGE AND HANDLING. Cement shall be stored in suitable moistureproof enclosures. Cement which has become caked or lumpy shall not be used.

Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.

Reinforcing steel shall be carefully handled and shall be stored on supports that will prevent the steel from touching the ground.

PART 2 - PRODUCTS

2-1. LIMITING REQUIREMENTS. Unless otherwise specified, concrete shall be controlled within the following limiting requirements.

2-1.01. Cement Content. The quantity of Portland cement in the concrete shall be not less than that indicated in the following table:

Quantity of Cement (lb/yd^3)			
Coarse Aggregate Size from No. 4 Sieve to			
3/8 in.	1/2 in.	3/4 in.	1 in.
600	580	560	535

2-1.02. Maximum Water-Cementitious Ratio. The maximum water-cementitious ratio shall be 0.45 on a weight basis. If fly ash is used, the combined mass of cement plus fly ash shall be used to determine the water-cementitious materials ratio.

2-1.03. Fly Ash Content. At the option of Contractor, fly ash may be substituted for up to 25 percent of the portland cement, but not less than 15 percent, on the basis of 1.0 lbs of fly ash added for each lb of cement reduction.

2-1.04. Coarse Aggregate. The maximum nominal coarse aggregate size shall be not larger than 1 inch.

2-1.05. Slump. Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the City, slump of concrete without a superplasticizer shall not exceed 4 inches . Slump of concrete with a superplasticizer, or a midrange water reducer, shall not exceed 8 inches.

2-1.06. Total Air Content. The total volumetric air content of concrete after placement shall be 6 percent ±1 percent.

2-1.07. Admixtures. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations. A water-reducing admixture and an air-entraining admixture shall be included in all concrete. A midrange water reducer or a superplasticizer may be used at Contractor’s option. No calcium chloride or admixture containing chloride from sources other than impurities in admixture ingredients will be acceptable.

2-1.10. Strength. The minimum acceptable compressive strengths, as determined by ASTM C39 with 6 inch diameter by 12 inch cylinders, shall be:

Age	Minimum Compressive Strength
7 days	3,375 psi
28 days	4,000 psi

2-2. MATERIALS.

Cement	ASTM C150, Type II, low alkali .
Fly Ash	ASTM C618, Class F, except loss on ignition shall not exceed 4 percent.
Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be acceptable.
Coarse Aggregate	Non-reactive crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, class 4S, except that clay and shale particles shall not exceed 1 percent.
Water	Potable.
Admixtures	
Water-Reducing	ASTM C494, Type A or D.
Air-Entraining	ASTM C260.
Superplasticizing	ASTM C494, Type F or G.
Reinforcing Steel	
Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.
Mechanical Connector (Couplers or Form Savers)	Classified Type 2 per ACI 318. Use only where indicated on the drawings.

Water stops	
Metal, at construction joints	Uncoated carbon steel, 12 gage, size as indicated on the drawings.
PVC, at construction joints	Extruded, virgin, elastomeric, polyvinyl chloride (PVC), white (no pigment), flat, ribbed, 3/8 inch thick. Reclaimed material will not be acceptable. Provide hog rings or grommets spaced at 12 inches on center entire length.
For concrete sections less than 12 inches in thickness	6 inches wide, 3/8 inch thick; Greenstreak “679” or Vinylex “R6-38”
For concrete sections 12 inches or more in thickness	9 inches wide, 3/8 inch thick; Greenstreak “646” or Vinylex “R9-38”
Forms	
Plywood Product	Standard PS1, waterproof, resin-bonded, exterior type, Douglas fir.
Lumber	Straight, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.
Form Coating	Nonstaining and nontoxic after 30 days, VOC-compliant; Burke "Form Release (WB)", L&M Chemical "E Z Strip", Nox-Crete "Form Coating", or Symons "Thrift Kote E".
Pre-Cure Finishing Aid	Burke "Finishing Aid Concentrate", Euclid "Eucbar", L&M Chemical "E-Con", Master Builders "Confilm", or Sika "Sikafilm".
Polyethylene Film	Product Standard PS17 or ASTM D 4397, 6 mils or thicker.
Vapor barrier and seam tape	Polyolefin geomembrane, Stego Wrap, 15 mils Vapor Barrier. Stego Wrap Red polyethelene tape.

Membrane Curing Compound and Floor Sealer	
VOC – EPA	ASTM C1315, Type I, Class A, maximum VOC 5.8 lb/gal , minimum 25 percent solids, acrylic, nonyellowing, unit moisture loss 0.40 kg/m^2 maximum in 72 hours.
VOC – Compliant	ASTM C1315, Type I, Class A, water based, VOC-compliant acrylic, maximum VOC 2.9 lb/gal, minimum 30 percent solids, nonyellowing, unit moisture loss 0.40 kg/m^2 in 72 hours maximum.

2-3. PRELIMINARY REVIEW. The source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to the City for review before concrete is placed.

2-4. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment.

Forms for pavement, curbs, or gutters shall be made of steel and shall be supported on thoroughly compacted earth. The top face of pavement forms shall not vary from a true plane more than 1/4 inch in 10 feet.

Forms shall be thoroughly cleaned and oiled before concrete is placed.

Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least 4 inches .

2-4.01. Form Ties. Form ties shall be of the removable end, permanently embedded body type, and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

2-4.02. Edges and Corners. Chamfer strips shall be placed in forms to bevel all salient edges and corners, except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4 inch wide.

2-4.03. Form Removal. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead, live, and construction loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

2-5. REINFORCEMENT. Reinforcement shall be accurately formed and positioned and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise indicated on the drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern. Reinforcement shall be free from dirt, loose rust, scale, and contaminants. Mechanical connections shall be used only as indicated on the drawings.

2-6. BATCHING AND MIXING. Concrete shall conform to ASTM C94 and shall be furnished by an acceptable ready-mixed concrete supplier.

2-6.01. Consistency. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2-6.02. Delivery Tickets. A delivery ticket shall be prepared for each load of ready-mixed concrete and a copy of the ticket shall be handed to the City by the truck operator at the time of delivery. Tickets shall indicate the name and location of the concrete supplier, the project name, the mix identification, the quantity of concrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

PART 3 - EXECUTION

3-1. PLACEMENT. Contractor shall inform the City at least 24 hours in advance of the times and places at which he intends to place concrete.

Methods of conveying concrete to the point of final deposit and of placing shall prevent segregation or loss of ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Concrete shall be compacted by immersion-type vibrators, vibrating screeds, or other suitable mechanical compaction equipment. The use of "jitterbug" tampers to compact concrete flatwork will not be permitted.

3-2. WATER STOPS. Each water stop shall be continuous throughout the length of the joint in which it is installed. Water stops shall be clean, free from

coatings, and shall be maintained in proper position until surrounding concrete has been deposited and compacted.

Junctions between adjacent sections of metal water stops shall be lapped 5 inches and securely bolted, screwed, or spot welded together.

Junctions between adjacent sections of elastomeric (PVC) water stops shall be spliced in strict conformity with the recommendations of the manufacturer. Directional changes and intersections shall be factory fabricated by the water stop manufacturer prior to delivery to the site of the work. Field splices will be acceptable only in straight sections.

3-3. FINISHING. Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall be removed from all formed surfaces, except exterior surfaces that will be in contact with earth backfill.

Unless otherwise specified, unformed surfaces shall be screeded and given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface.

Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color and the completed finish for unformed surfaces unless indicated otherwise.

3-3.01. Troweling. Interior floor surfaces which will be exposed after construction is completed; exposed top surfaces of equipment bases and interior curbs; and other surfaces designated on the drawings shall be steel trowel finished. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks.

3-3.02. Application of Pre-Cure Finishing Aid. Concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight shall be protected with a pre-cure finishing aid. The finishing aid shall form a monomolecular film on the surface of fresh, plastic concrete to retard evaporation.

Immediately following screeding, pre-cure finishing aid shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon , in accordance with the manufacturer's recommendations. The spray equipment shall have sufficient capacity to continuously spray finishing aid at approximately 40 psi with a suitable nozzle as recommended by the manufacturer.

The sprayable solution shall be prepared as recommended by the manufacturer.

Under severe drying conditions, additional applications of finishing aid may be required following each floating or troweling, except the last finishing operation.

3-3.03. Pavement. Following placement and consolidation, and the disappearance of bleed water, the concrete surface shall be broom finished with a broom acceptable to the City. The broom shall be not less than 18 inches wide and made from good quality bass or bassine fibers not more than 5 inches long. The broom finishing shall produce regular corrugations not over 1/8 inch deep. The broom shall be pulled square across the surface, from edge to edge, with adjacent strokes slightly overlapped, and shall not tear the concrete surface.

3-3.04. Sidewalks. Concrete surfaces shall be screeded to the proper elevation and contour. All aggregates shall be completely embedded in mortar. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface. Initial floating shall be followed by a second floating at the time of initial set.

Floated surfaces shall be given a light broom finish, using a horsehair broom, to provide a nonslip surface. Brooming shall be done at right angles to the length of the walk.

Sidewalks shall be edged using a 3 or 4 inch wide edging tool with a 1/8 inch corner radius. Edger lap marks at corners of each slab shall be carefully removed. False joints shall be provided at right angles to the length of the walk, using a grooving tool with 1/8 inch radius. The finished edge on each side of the joint shall be the same width as the edging tool used. False joints shall divide each sidewalk into square sections.

The finished surface of all sidewalks shall be neat in appearance, shall be sloped to drain, and shall not pond water.

3-4. CURING. Concrete shall be protected from loss of moisture by water saturation or by membrane curing for at least 7 days after placement; however, when concrete is also being protected from low temperatures, the period of curing by saturation shall be 1 day less than the duration of the low temperature protection.

Water saturation shall be used on concrete which will be covered later with mortar or additional concrete. Water saturation or membrane curing compound may be used on all other concrete surfaces.

Water saturation of concrete surfaces shall begin as soon as possible after initial set. Unformed surfaces shall be covered with polyethylene film, tarpaulins, or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period. Acceptable methods of water curing are described in ACI 308.

Membrane curing compound shall be sprayed at a coverage rate of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within 30 minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces. Curing compound shall be suitably protected against abrasion during the curing period.

Concrete shall be protected against freezing for at least 8 days after placement.

3-5. REPAIRING DEFECTIVE CONCRETE. Defects in concrete surfaces shall be repaired to the satisfaction of City. All concrete which is honeycombed or otherwise defective shall be cut out and removed to sound concrete, with edges cut square to avoid feathering.

Concrete repair work shall conform to Article 5.3.7 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

3-6. FIELD CONTROL TESTING.

3-6.01. Air Content. An air content test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Contractor shall provide all equipment and supplies necessary for the testing. Air content shall be determined in accordance with ASTM C231.

3-6.02. Slump. A slump test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Slump shall be determined in accordance with ASTM C143.

3-6.03. Test Cylinders. Compression test specimens shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and C39. Compressive strength tests will be evaluated in accordance with ACI 318 and as specified herein.

One set of 6 inch diameter by 12 inch concrete test cylinders shall be cast for each concrete pour. A set of test cylinders shall consist of four cylinders, two to be broken and to have compressive strengths averaged at 7 days, and two to be broken and to have compressive strengths averaged at 28 days. All concrete required for testing shall be furnished by, and at the expense of, Contractor.

The cured cylinders shall be tested by an independent testing laboratory at the expense of the City.

End of Section

Section 03600

GROUTING

PART 1 - GENERAL

1-1. SCOPE. This section covers procurement and installation of grout. Unless otherwise specified, only nonshrink grout shall be furnished.

Epoxy grouting of anchor bolts, threaded rod anchors, and reinforcing bars is covered in the anchorage in concrete and masonry section.

1-2. SUBMITTALS. A letter of certification indicating the types of grout to be supplied and the intended use of each type shall be submitted in accordance with the Submittals section.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage of any kind. Materials shall be protected from moisture.

PART 2 - PRODUCTS

2-1. MATERIALS.

Nonshrink Grout	Precision cementitious grout with demonstrated non-shrinking properties; L&M "Crystex", Master Builders "Masterflow 713" or "Set Grout", Sauereisen "F-100 Level Fill Grout", Sonneborn "Sonogrout 10K", Hilti “CG 200 PC”, or Five Star Products "Five Star Grout".
Water	Clean and free from deleterious substances.

2-2. CEMENTITIOUS GROUT. Cementitious grout shall be furnished factory premixed so that only water is added at the jobsite.

2-3. EPOXY GROUT. Epoxy grout shall be used in lieu of cementitious grout when required by the equipment manufacturer for performance or warranty requirements. Epoxy grout products and installation procedures shall be submitted to City for approval.

PART 3 - EXECUTION

3-1. PREPARATION. The concrete foundation to receive nonshrink grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

3-2. INSTALLATION.

3-2.01. Mixing. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

3-2.02. Placement. Unless otherwise specified or indicated on the Drawings, grout under baseplates shall be 1-1/2 inches thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the baseplates are completely filled without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

3-2.03. Edge Finishing. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate.

3-2.04. Curing. Nonshrink grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least 3 days and then an acceptable membrane curing compound shall be applied.

End of Section

Section 05550

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, adhesive anchors, expansion anchors, undercut anchors, and reinforcing bars to be installed in concrete and masonry.

1-2. GENERAL. Unless otherwise specified or indicated on the Drawings all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated, anchors and anchor bolts in concrete shall have a diameter of at least 3/4 inch, and anchors and anchor bolts in masonry shall have a diameter of at least 1/2 inch.

Unless otherwise indicated on the Drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Anchors and anchor bolts in other locations and applications shall be as indicated on the Drawings.

Cast-In-Place Anchor Bolts.

Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Other interior locations	Carbon steel.

Adhesive, Expansion, and Undercut Anchors.

Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Other interior locations	Carbon steel.

Adhesive, expansion, and undercut anchors may be used instead of cast-in-place anchors where specifically indicated or permitted on the Drawings or with the specific acceptance by City.

1-3. SUBMITTALS. Data, catalog cuts, and ICC ESR reports indicating the manufacturer and types of adhesive anchors, expansion anchors, and undercut anchors to be supplied shall be submitted in accordance with the Submittals section.

If Contractor requests use of products other than those indicated herein, calculations prepared by a registered professional engineer using methods and procedures required by the building code may be required as part of the submittal package.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as indicated below.

Anchor Bolts	
Carbon steel	ASTM F1554, Grade 36 with compatible nuts.
Galvanized steel	ASTM F1554, Grade 36 with compatible nuts; hot-dip galvanized, ASTM F2329.
Stainless steel	Bolts, ASTM F593, Alloy Group 1 or 2; nuts, ASTM F594, Alloy Group 1 or 2.
Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.
Reinforcing Bars	ASTM A615, Grade 60, deformed.
Reinforcing Bars, weldable	ASTM A706, Grade 60, deformed.

Expansion Anchors in Concrete	Products shall be single component anchors tested in accordance with ICC AC193, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). The anchors shall be approved for use in cracked concrete, and for resisting seismic forces. Hilti "Kwik-Bolt TZ", ITW Red Head "Trubolt+", Powers Fasteners “Power-Stud+SD2”, Simpson “Strong-Bolt”.
Expansion Anchors in Grouted Masonry	Products shall be single component anchors tested in accordance with ICC AC01, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). Hilti “Kwik-Bolt 3”, Simpson “Wedge-All”, Powers Fasteners “Power-Stud+ SD1”.
Undercut Anchors in Concrete	Products shall be tested in accordance with ICC AC193, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). Hilti “HDA Undercut Anchor”, USP Structural Connectors “DUC Undercut Anchor”, Powers Fasteners “Atomic+ Undercut Anchor”.
Adhesive Anchors in Concrete	Products shall be tested in accordance with ICC AC308, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). The anchors shall be approved for use in cracked concrete, and for resisting seismic forces.
Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	Hilti “HIT-RE 500-SD” or "HIT-HY 150 MAX-SD", Powers Fasteners “PE1000+”, Simpson “Set-XP”.

Adhesive Anchors in Grouted Masonry	Products shall be tested in accordance with ICC AC58, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition).
Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	Hilti "HIT HY 150 MAX", Simpson “SET Epoxy”.
Adhesive Anchors in Hollow Masonry	Products shall be tested in accordance with ICC AC60, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition).
Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	
Type 1 System	Hilti “HIT HY 20” system.
Type 2 System	Simpson “SET Epoxy” system.
Screen Tubes	As recommended by the manufacturer.

2-2. ANCHORS.

2-2.01. Cast-in-Place Anchor Bolts. Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Unless installed in pipe sleeves, anchor bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts indicated on the Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts.

2-2.02. Adhesive, Expansion, and Undercut Anchors. When adhesive, expansion, or undercut anchors are indicated on the Drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the

Drawings. Alternative anchoring systems may be used only when specifically accepted by the City.

Unless otherwise required, single nuts and washers shall be furnished for adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.

Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. GENERAL. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before tightening of the nuts.

3-1.01. ESR Report Compliance. Anchors shall be installed in accordance with all applicable requirements of the ESR report for the anchoring system. If conflicts are found between the Drawings and the ESR report installation requirements, Contractor shall notify City for resolution.

3-1.02. Special Inspection. Special inspection will be performed by Engineer or City's representative during installation of all anchors covered in this section. Anchorage work shall be performed in a manner that allows the inspections to take place without adversely impacting the schedule.

For cast-in-place anchor bolts, bolts shall be positioned in advance of the concrete placement so that the inspector will have sufficient time to inspect the bolts prior to placing concrete.

For other types of anchors, the minimum frequency and extent of the inspections shall be as indicated in the anchor system's ESR report.

3-2. CAST-IN-PLACE ANCHOR BOLTS. Cast-in-place anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the Drawings and with applicable equipment or structure submittal drawings.

Threads, bolts, and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

3-3. ADHESIVE ANCHORS. The embedment depth for adhesive anchors or reinforcing bars shall be at least 15 rod or bar diameters unless otherwise indicated on the Drawings.

Adhesive shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

Anchors or bars shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 1/16 inch larger than the outside diameter of the rod or bar unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared by removing all dust and debris using procedures recommended by the adhesive manufacturer.

Adhesive anchors and holes shall be clean, dry, and free of grease and other foreign matter at the time of installation. The adhesive shall be placed and the rods or bars shall be set in accordance with the recommendations of the manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.

3-4. EXPANSION AND UNDERCUT ANCHORS. Expansion and undercut anchors shall be installed in accordance with the Drawings, but in no case shall the embedment depth be less than six bolt diameters. The minimum distance between the center of any anchor and an edge or exterior corner of concrete shall be at least six times the diameter of the bolt. Unless otherwise indicated on the Drawings, the distance between the centers of anchors shall be at least 12 times the diameter of the bolt.

End of Section

Section 07900

CAULKING

PART 1 - GENERAL

1-1. SCOPE. This section covers caulking and sealing.

1-2. GENERAL. The terms "caulking" and "sealing", as used on the drawings and in these specifications, are synonymous. Both terms indicate the materials specified herein. Oil-base caulking shall not be used on this project.

1-3. APPROVALS. All caulking shall meet the requirements of the standards specified herein. All caulking and sealing to be used in contact with potable water shall meet the requirements of ANSI/NSF Standard 61.

1-4. SUBMITTALS. Specifications and data covering the materials proposed for use, together with samples or color cards showing the manufacturer's full line of sealant colors, shall be submitted in accordance with the Submittals section.

PART 2 - PRODUCTS

2-1. MATERIALS.

Thiokol Sealants (polysulfides)	Fed Spec TT-S-00227E, Class A or ASTM 920 Type M; polysulfide rubber, two component.
Nonsag	
Nonsubmerged Service	Pecora "Synthacalk GC-2+"; Sonneborn "Sonolastic Polysulfide Sealant"; Polymeric Systems “PSI-350”.
Self-Leveling, nonsubmerged	A.C. Horn "Hornflex Traffic Grade"; Polymeric Systems “PSI-350”.

Urethane Sealants (Polyurethanes)	Fed Spec TT-S-00227E, Class A, Type 2 and ASTM C920, Type M, Grade NS, two component.
Nonsag	
Nonsubmerged Service Exterior Building envelope	ASTM C920, Type S, Grade NS, Class 25, use NT, M, A, O single component gun grade. As manufactured by Pecora "Dynatrol I," Sonneborn "NP-I," Tremco "Dymonic," or City acceptable equal
Nonsubmerged Service	Bostik "Chem-Calk 500"; Tremco "Vulkem 227"; Pecora "Dynatrol II"; Tremco "DYmeric 240"; Sika “Sikaflex-2cNS”.
Self-Leveling, Nonsubmerged Service	Bostik "Chem-Calk 550"; Tremco "Vulkem 245"; Pecora "Urexpan NR-200"; Polymeric Systems “ RC-2SL"; Tremco "THC-900".
Acrylic Sealant	Fed Spec TT-S-230; ASTM C834.
	Bostik “Chem-Calk 600”; Pecora “ AC20”; Tremco “Mono”.
Primer	As recommended by the sealant manufacturer.
Backup Material	Polyethylene or polyurethane foam as recommended by the sealant manufacturer; Dow "Ethafoam SB" or Plateau "Denver Foam".
Bondbreaker Tape	Adhesive-backed polyethylene tape as recommended by the sealant manufacturer.

2-2. COLORS. Colors of sealants shall be as selected by City from the manufacturer's standard line of colors. Different colors may be required for different locations.

2-3. LOCATIONS TO BE CAULKED.

2-3.01. With Thiokol or Urethane Sealant (Nonsag) - Nonsubmerged Service. As indicated on drawings

Entire perimeter of metal louvers.

Entire perimeter of metal dampers and metal shutters.

Joints and sealant beads in metal flashings and penetrations as indicated on the drawings.

Joints between masonry and cast-in-place concrete, where indicated on the drawings.

Other locations where caulking is indicated on the drawings, specified in other sections, or required for weatherproofing.

2-3.02. With Thiokol or Urethane Sealant (Self-Leveling). As indicated on drawings

Horizontal joints in walks or drives.

Horizontal joints in traffic-bearing decks and slabs.

2-3.03. With Acrylic Sealant.

Watertight joints in sheet metal work.

Interior perimeter of frames, hollow metal door frames, aluminum windows, rolling door frames, and other interior location where indicated on drawings.

PART 3 - EXECUTION

3-1. JOINT PREPARATION. All surfaces to receive sealant shall be clean, dry, and free from dust, grease, oil, or wax. Concrete surfaces which have been contaminated by form oil, paint, or other foreign matter which would impair the bond of the sealant to the substrate shall be cleaned by sandblasting. All surfaces shall be wiped with a clean cloth saturated with xylol or other suitable solvent, and shall be primed before the sealant is applied.

Unless otherwise recommended by the sealant manufacturer and permitted by the City, the depth of sealant in a joint shall be equal to the width of the joint, but not more than 1/2 inch. Backup material shall be provided as necessary to control the depth of sealant and shall be of suitable size so that, when compressed 25 to 50 percent, the space will be filled. Backup material shall be rolled or pressed into place in accordance with the manufacturer's installation instructions, avoiding puncturing and lengthwise stretching. If depth of the joint does not permit use of backup material, bondbreaker tape shall be placed at the bottom of the joint to prevent three-sided adhesion.

3-2. SEALING. Sealing work shall be done before any field painting work is started. The air temperature and the temperature of the sealed surfaces shall be above 50°F when sealing work is performed.

Upon completion of the sealing work, each sealed joint shall have a smooth, even, tooled finish, flush with the edges of the sealing recess, and all adjacent surfaces shall be clean. Sealant shall not lap onto adjacent surfaces. Any sealant so applied as to prevent the painting of adjacent surfaces to a clean line, or with an excess of material outside the joint and feathered onto surfaces, shall be removed and the joint resealed.

End of Section

Section 09940

PROTECTIVE COATINGS

PART 1 - GENERAL

1-1. SCOPE. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1-2. GENERAL. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to City, Contractor shall comply with this specification and the coating manufacturer's recommendations.

1-2.01. Governing Standards. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following AWWA, ANSI, NACE, SSPC, NSF, and ASTM.

1-2.02. Delivery and Storage. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1-3. SUBMITTALS. Contractor shall submit color cards for all coatings proposed for use, together with complete descriptive specifications, manufacturer's product data sheet and the completed Coating System Data Sheets, to City for review and color selection. Each product data sheet shall include application temperature limits including recoat time requirements for the ambient conditions at the site, including temperatures up to 130°F. Requests for review submitted directly to City by coating suppliers will not be considered.

Contractor shall submit a Coating System Data Sheet for each separately identified surface in the Coating Schedule that will be used in the project, using the appropriate Coating System Data Sheet forms (Figures 1-09940 and 2-09940) at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer.

Coating System Data Sheets shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Figure
A	Iron and steel (coated entirely in the field)	1
A	Iron and steel (shop primed)	2
C	Concrete and concrete block	1
E	Equipment (nonsubmreged)	2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. Fig.1-09940 shall be submitted for each surface coated entirely in the field.

Each shop-applied coating system that includes one or more field applied coats shall be assigned both a prefix letter and suffix letter "F". Fig.2-09940 shall be submitted for each surface having a shop applied coating and one or more field applied finish coats.

A separate Coating System Data Sheet shall be developed and submitted for each surface scheduled to be coated or variation or change in a coating system. The number identifying the surface and coating system shall be of the form $A1_1$ or $A1_2$-F. The subscript number shall be assigned by the Contractor so that each surface and coating system combination is uniquely identified. For example:

> $A1_1$-F may be assigned to "Epoxy – one coat to metal curbs for skylights and power roof ventilators that have been shop primed."
>
> $A2_1$ may be assigned to "Epoxy – two coats to non-galvanized structural and miscellaneous steel exposed to view inside buildings."
>
> $C2_1$ may be assigned to "Epoxy – two coats to all concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view."
>
> $C2_2$ may be assigned to "Epoxy – two coats to walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment as indicated on the Drawings."

The manufacturer's standard colors will be acceptable for all coatings.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

2-1.01. Alternative Manufacturers. In addition to the coatings listed herein, equivalent products of the following manufacturers will also be acceptable:

Sigma
Rust-Oleum

2-1.02. Equivalent Coatings. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, it shall be understood as establishing the desired type and quality of coating. Other manufacturers' coatings will be accepted, provided that sufficient information is submitted to enable City to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the Submittals section. Requests for review of equivalency will be accepted only from Contractor, and will be considered only after the contract has been awarded.

2-2. MATERIALS. All coatings shall be delivered to the job in original, unopened containers, with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with any previously applied coatings. Coatings used in successive field coats shall be produced by the same manufacturer. The first field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

2-2.01 Primers.

Universal Primer	PPG Amercoat "Amercoat 385 Epoxy", Carboline "Rustbond", ICI Devoe "Devran 224HS", Tnemec "Series 27 F.C. Typoxy", or Sherwin-Williams " Dura Plate 235".

Zinc Primer	PPG Amercoat "Dimetate 9 Series", Carboline "Carbo Zinc II Series", ICI Devoe "Catha-Coat 304V", or Sherwin-Williams "Zinc Clad II Series".
Epoxy Concrete Block Filler	PPG Amercoat "Amerlock 400BF Epoxy Block Filler", Carboline "Sanitile 600", ICI Devoe "Truglaze 4015", Tnemec "Series 54-562", or Sherwin-Williams "Kem Cati-Coat HS".
Epoxy Concrete Filler and Surfacer	Tnemec "Series 218 MortarClad", PPG Amercoat "NuKlad 114A", Carboline "Carboguard 510", or Sherwin-Williams "Steel Seam FT910".

2-2.02. Intermediate and Finish Coatings.

Epoxy Enamel	
Concrete Floors	PPG Amercoat "Amerlock 400", Carboline "Carboguard 890", ICI Devoe "Devran 224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Armorseal 1000HS"; nonskid.
Ferrous Metal Surfaces and Masonry or Concrete Surfaces Other Than Floors	PPG Amercoat "Amercoat 385 Epoxy", Carboline "Carboguard 890", ICI Devoe "Devran 224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Dura Plate 235".
Aliphatic Polyurethane	PPG Amercoat "Amercoat 450H", Carboline "Carbothane 134HG", ICI Devoe "Devthane 379H" Tnemec "Series 1074 Endura-Shield II", or Sherwin-Williams "Acrolon 218HS".

Coal Tar Epoxy	High-build coal tar epoxy; PPG Amercoat "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".
Vinyl Ester	Tnemec "Series 120 Vinester" Carboline "Plasite 4110" or Sherwin-Williams "Magnalux 304FF".
Heat-Resistant	Suitable for temperatures up to 400°F; PPG Amercoat "Amerlock 400", Carboline "Thermaline 450", Tnemec "43-36 Chrome Aluminum", or Sherwin-Williams "Silver-Brite Aluminum".
High Heat-Resistant	Suitable for temperatures up to 1000°F; PPG Amercoat "Amercoat 878", Carboline "Thermaline 4700 VOC", or Sherwin-Williams "Silver-Brite Hi-Heat Silicone Aluminum".

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer, and the edges of the repaired area shall be feathered by sanding or wire brushing to produce a smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

3-1.01. Galvanized Surfaces. Galvanized surfaces shall be prepared for coating according to the instructions of the manufacturer of the epoxy enamel. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

3-1.02. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures as specified: solvents (SSPC-SP1); blasting (SSPC-SP5, -SP6, -SP7, or -SP10); power tools (SSPC-SP3 or -SP11); or hand tools (SSPC-SP2). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

All cut or sheared edges shall be ground smooth to a 1/8 inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard SPO178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of paint.

The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

3-1.02.01. Ferrous Metal Surfaces – Non-immersion Service. Ferrous metal surfaces, including fabricated equipment, in non-immersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy enamel, and heat-resistant coatings, except galvanized surfaces. Blast cleaning to at least SSPC-SP6 shall be used where

recommended by the coating manufacturer, and may be used elsewhere at the option of Contractor, provided that no dust is permitted to settle on adjacent wet coating. Surface profile shall be as recommended by coating manufacturer, but not less than 2 mils.

3-1.02.02. Ferrous Metal Surfaces - Immersion Service. Surface preparation of ferrous metal surfaces in immersion service shall consist of blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of City. Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils.

3-1.03. Concrete Surfaces. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Any other surface preparation recommended by the coating material manufacturer shall be brought to City's attention and may be incorporated into the work if acceptable to City.

All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

New concrete shall have cured for at least 4 weeks before coating is applied as recommended by the material manufacturer. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

All surfaces to be coated shall be cleaned in accordance with ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the Concrete section and as acceptable to the City. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

Except where epoxy enamel is applied as damp-proofing, the concrete surfaces, including those with bug holes less than 1 inch in any dimension, shall be prepared when required and as recommended by the manufacturer, using an epoxy concrete filler and surfacer. Where coating with a vinyl ester the concrete filler and surfacer shall be as recommended by the manufacturer to be compatible with vinyl ester.

3-1.04. Concrete Block Surfaces. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy enamel, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

3-1.05. Copper Tubing. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

3-1.06. Plastic Surfaces. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

3-1.07. Hardware. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

3-1.08. Aluminum. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

3-1.09. Stainless Steel. When a coating system is required, surface preparation shall conform to the coating manufacturer's recommendations.

3-2. MIXING AND THINNING. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3-3. APPLICATION. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. Each coat shall be a different color, if available. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

3-3.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating.

Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

3-3.02. Epoxy Enamel. When used, epoxy enamel shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until top-coated.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

3-3.03. Coal Tar Epoxy. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3-3.04. Vinyl Ester. When used, the application of vinyl ester coating system, including time limits for recoating and temperature requirements of the materials, shall conform to the recommendations of the coating manufacturer.

3-3.05. Film Thickness. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

Type of Coating	Minimum Dry Film Thickness
Medium consistency coal tar	20 mils.

Type of Coating	Minimum Dry Film Thickness
Coal tar epoxy (two coats)	20 mils.
Epoxy enamel	
Floors (two coats)	10 mils.
Surfaces with first coat of epoxy enamel and final coat of aliphatic polyurethane	7 mils (5 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Surfaces with first and second coat of epoxy enamel and final coat of aliphatic polyurethane	12 mils (10 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils.
Immersion service (three coats)	15 mils.
Flake-filled epoxy (two coats)	30 mils.
Vinyl ester	30 mils.
Zinc, epoxy, polyurethane	
Surfaces with first coat of zinc, intermediate coat of epoxy, and final coat of aliphatic polyurethane	10 mils, 3 mils zinc, 5 mils epoxy, plus 2 mils for aliphatic polyurethane.
Heat-resistant (silicone)	3 mils.
High heat-resistant (silicone)	3 mils.
Other (one coat)	5 mils.
Other (two coats)	10 mils.

3-3.06. Weather Conditions. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, Contractor and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35°F to 90°F.

3-4. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces damaged prior to acceptance by City shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of City, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3-5. PROTECTION OF SURFACES. Throughout the work Contractor shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. Contractor shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by City, coated with two coats of masonry coating.

3-6. FIELD QUALITY CONTROL. The following inspection and testing shall be performed: surface profile, visual inspection, and wet and dry film thickness testing. All inspection and testing shall be witnessed by City.

3-6.01. Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

3-6.02. Visual Inspection. The surface of the protective coatings shall be visually inspected.

3.6.03. Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ±0.5 mil. Dry film thickness shall be measured in accordance with SSPC-PA 2.

3-6.04. Spark Testing. Not required.

3-6.05. Adhesion Testing. Not required.

3-7. FIELD PRIMING SCHEDULE. In general, steel and cast iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by City shall be removed and the surfaces shall be field coated, including prime coat (if any). Galvanized, aluminum,

stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

Surface To Be Primed	Material
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.
Epoxy enamel	Same as finish coats.
Coal tar coating	Same as finish coats.
Vinyl ester	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy enamel	Same as finish coats or inorganic zinc.
Coal tar coating	Same as finish coats.
Aluminum	Epoxy enamel.
Galvanized	Epoxy enamel.
Copper	Epoxy enamel.
Stainless steel	Epoxy enamel.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated piping	As recommended by manufacturer of finish coats.
Concrete, surfaces to be coated with epoxy enamel	
For damp-proofing	Epoxy enamel.
For all other surfaces	Epoxy concrete filler and surfacer.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy enamel	Epoxy concrete block filler.

Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with epoxy enamel, coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy enamel shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is damp-proofed with epoxy enamel.

3-8. FINISH COATING SYSTEMS. The following schedule lists coatings systems and coating system designations.

No.	Finish Coating Systems	Coating Surface Designation						
		A	C	E	F	G	H	P
1.	Epoxy – One coat	x			x	x		
2.	Epoxy – Two coats	x	x	x	x	x		x
3.	Epoxy / NSF – Two coats		x	x				
4.	Epoxy – Three coats	x	x	x				
5.	Epoxy / NSF – Three coats	x	x	x				
6.	Epoxy – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy – First and second coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				
10.	Coal tar epoxy – Two coats	x	x	x				
11.	Vinyl ester – Two coats	x	x	x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	
14.	Zinc primer – First coat Epoxy – Intermediate coat Aliphatic polyurethane – Final coat	x		x				
15.	Flake-filled epoxy	x		x				

3-8.01. Surfaces Not To Be Coated. Unless otherwise specified, the following surfaces shall be left uncoated:

Exposed aluminum, except ductwork.
Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.
Nickel or chromium.
Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.
Rubber and plastics, except as specified.
Exterior concrete.
Surfaces specified to be factory finished.
Engine exhaust piping

3-8.02. Shop Finishing. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating manufacturer's recommendations.

a. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
b. Other items as otherwise specified.

3-8.03. Field Coating. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

a. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.
b. All interior ferrous metal surfaces except stainless steel on the digester cover.
c. Other items as otherwise specified.

3-9. METAL SURFACES COATING SCHEDULE.

Surface To Be Coated	Finish Coating System
Non-galvanized structural and miscellaneous steel exposed to view or to the elements in exterior locations.	A6
Non-galvanized structural and miscellaneous steel exposed to view inside buildings.	A2
Steel handrails, steel floor plates, doors, door frames.	A8
Heating and air conditioning units, convector covers, electrical equipment cabinets, and similar Items and equipment (unless factory finished) exposed to view.	E8
Cast Iron and steel piping inside buildings, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A2

Surface To Be Coated	Finish Coating System
Cast Iron and steel piping above grade exposed to the elements and to view outdoors, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A7
Copper pipe and tubing, including fittings and valves	F1
All metal surfaces, unless otherwise specified, which will be submerged or buried, all or in part, including valves, and scum baffles, and sluice gates, but excluding piping laid in the ground.	E4
Aluminum in contact with concrete.	F1
Aluminum and galvanized ductwork and conduit indoors.	F1 or G1
Aluminum and galvanized ductwork and conduit exposed to elements outdoors.	F6 or G6
Aluminum materials exposed to the elements outdoors.	F6

3-10. CONCRETE AND MASONRY SURFACES COATING SCHEDULE.

Surface To Be Coated	Finish Coating System
All concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.	Indoor – C2 Outdoor – C7

3-11. MISCELLANEOUS SURFACES COATING SCHEDULE.

Plastic Surfaces, including PVC and FRP.	Outdoor – P6 Indoor – P2
Piping Insulation	Outdoor – P6 Indoor – P2

3-12. PIPING IDENTIFICATION SCHEDULE. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, marked with flow directional arrows, and color coded.

Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by City.

3-12.01. Location. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every 50 feet in straight runs of pipe. If, in the opinion of City, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

3-12.02. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

3-12.03. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915", Seton "Setmark", or equal. Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch [15 mm] and smaller	Metal tags -1/4 inch
3/4 to 4 inches [20 to 100 mm]	3/4 inch
5 inches [125 mm] and larger	2 inches

3-12.04. Color Coding and Lettering. All piping for the following services shall be color coded. Bands shall be 6 inches wide spaced along the pipe at 5 foot intervals. For services not listed, the color coding and lettering shall be as directed by the City.

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Combustion Air	Dark green	White
Condensate	Light gray with brown bands	Black
Drain	Dark gray	White
Fuel Oil	Black	White

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Nonpotable or Raw Water	Olive green	White
Oil – Hydraulic	Black with white bands	White
Plumbing Vents	Dark gray	White
Potable Water (hot or cold)	Dark blue	Black
Refrigerant	Yellow with white bands	Black
Sewage	Dark gray	Black
Tempered Water	Dark blue	White

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by City. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

Item	Color
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes

Numerals at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

End of Section

SURFACE DESCRIPTION	SYSTEM NO. -

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1
☐ Ferrous Metal Nonimmersion SSPC-SP6
☐ Ferrous Metal Immersion
☐ SSPC-SP10
☐ SSPC-SP-5
☐ Other

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
First Coat (Primer)		
Second Coat		
Third Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 1-09940

SHOP PRIMED SURFACE DESCRIPTION	SYSTEM NO. -	-F

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1 ☐ Other:

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
Shop (Primer)		(Identify Product/Type)
Touchup		
Intermediate Coat		
Finish Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 2-09940

Section 10400

IDENTIFYING DEVICES

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installing of equipment identification nameplates, signs, tags, and identification devices, such as warning signs and symbols, which indicate hazards, identify objects, rooms and devices, provide instruction, and convey information with the intent to eliminate, in so far as possible, accidental injury to workers and the public or damage to the property.

1-2. REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for the reference standards, the latest edition available shall be used.

- Regional Office of the U.S. Dept. of Labor, Occupational Safety and Health Administration 29 CFR 1910
- Wisconsin Administrative Code - Chapter SPS 310 – Flammable, Combustible, and Hazardous Liquids
- Wisconsin Administrative Code - Chapter SPS 314 - Fire Prevention
- Wisconsin Administrative Code - Chapter SPS 316 - Electrical
- Wisconsin Administrative Code - Chapters SPS 361-366 – Wisconsin Commercial Building Code
- 2008 National Electric Code (NEC)
- Americans with Disabilities Act Accessibilities Guidelines (Federal Register)
- NFPA 101 - Life Safety Code
- NFPA 30 – Flammable and Combustible Liquids Code, 2008 Edition
- NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines
- NFPA 704 “Diamond” Hazard Identification systems

- Recommended Standards for Water Works – Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers 2007 Edition

- ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, ANSI Z535.5, ANSI A13.1, ANSI A117.1

1-3. GENERAL. Identifying tags and signs shall be manufactured by firms regularly engaged in the production of high quality signs. Graphics and lettering shall be neatly aligned with sharp, clean edges. Signs displaying ragged edges or other indications of poor workmanship will be rejected.

The identifying tags and signs shall be provided with all of the necessary connectors, supports, fasteners, and adhesives required for complete finished installation. Contractor shall verify all sign graphics and obtain approval from the local Fire Marshall and Building Official with jurisdictional authority before fabrication.

1-4. SUBMITTALS. Contractor shall submit the following items in accordance with the requirements specified in the Submittals section. Items requiring submittals shall include, but not be limited to, the following:

- Manufacturer's information, including manufacturer's specifications and installation instructions.

- Shop drawings consisting of full-size layouts of all signs, including equipment nameplates, incorporating all features, mountings and accessories. Repetitive sign layouts of typical and most restrictive condition shall be submitted. Details of installations shall be submitted showing fasteners and mounting. Style and colors of lettering shall be as selected by the City from manufacturer's standards.

- Samples of all the sign materials and colors proposed for use in the work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions.

1-5. PROJECT CONDITIONS. Contractor shall verify field conditions of the areas of installation, take measurements at the site prior to fabrication, and indicate field dimensions on the shop drawing submittal. Contractor shall coordinate fabrication schedule, delivery and progress schedule with the project manager and project site construction manager to avoid delays.

PART 2 – PRODUCTS

2-1 WALL PLAQUE. Not used.

2-2. INTERIOR SIGNAGE SYSTEM. Not used.

2-3. WARNING SIGNS. Warning signs shall be furnished and installed in the specified location and with the specified wording as indicated below.

Each sign shall be in accordance with the Federal Occupational Safety and Health Act - OSHA Regulations 1910.145. The signs shall be 14 inches by 10 inches, and shall be plastic, semi-rigid "01900 Series" Industrial Safety and Security Co., Lima, Ohio. Signs shall be as follows:

The following sign shall be installed on the exterior of doors leading into electrical rooms, enclosures, and cabinets:

DANGER
HIGH VOLTAGE

The following sign shall be installed on the exterior of all doors leading into the Engine-Generator enclosures:

DANGER
NOISE HAZARD
HEARING PROTECTION REQUIRED

2-3.01. No Smoking Signs. A "No Smoking" sign, combination of words and symbol, shall be mounted on each door to the Engine-Generator enclosures, and to the Switchgear enclosures. Signs shall be 17 inches by 7 inches, and shall be plastic, semi-rigid, Industrial Safety and Security Co. "Catalog No. 03146(2)".

2-4. NAMEPLATES. All equipment, piping, valves, gates, pumps, panels, control equipment, and other equipment denoted by a symbol and an identifying number on the Drawings shall be provided with permanent nameplates or tags. Each nameplate shall bear the equipment identification tag number, manufacturer's name and equipment model, and all other relevant information as required. The equipment tag number designations used shall be as indicated in a table provided to the Contractor during construction. This table shall be a cross reference between the designations provided on the Drawings for construction purposes and the true nameplate information desired by the pumping station facility.
Equipment nameplates shall be located in a conspicuous place as acceptable to the City. All nameplates and tags shall be stainless steel, except that plastic (phenolic) nameplates may be provided for indoor electrical panels.

Colors of the field and lettering shall be selected from the manufacturer's standard colors by the City. Size of the signs or identification tag shall be sufficient to allow for all necessary information but must not interfere with normal operations of the equipment.

Temporary nameplates or tags may be used until such time as the equipment or valve is permanently installed and protected from damage from other construction activities. Temporary nameplates or tags must be removable without causing damage to the equipment.

Plastic nameplates and tags shall be laminated phenolic not less than 1/8-inch thick and shall be black with white core. Number plate symbols and numbers shall be capitalized block letters with a minimum height of 3/4 inch. Number plate height shall be twice the letter height. Metal nameplates and tags shall not be less than 12 gauge thickness with engraved or imprinted symbols and shall be made of stainless steel. Letters shall be painted black after fabrication. Tags shall have smooth edges and shall be a minimum diameter of 2 inches. Nameplates shall be installed with corrosion-resistant mechanical fasteners. Individual equipment and components too small to accommodate the specified nameplates shall be identified with tags. Tags shall be installed with stainless steel chains or straps. Letters and numbers shall be at least 3/16-inch high for tags, 1/2-inch high for equipment nameplates, and 1/4-inch high for nameplates on control panels.

2-6. MISCELLANEOUS SIGNS. All miscellaneous signs shall be stainless steel. Colors of the field and lettering shall be selected from the manufacturer's standard colors by the City. Size of the signs shall be sufficient to allow for all necessary information but must not interfere with normal operations of the equipment.

PART 3 – EXECUTION

3-1. GENERAL. Signs shall conform OSHA Federal Register Part 2, Paragraph 1910.145. Locations, sizes, and colors shall be as reviewed by the City. The lettering sizes shall be three-inch in height unless shown or specified otherwise.

3-2. CLEANING. In accordance with the requirements of the manufacturer’s printed recommendations, all signs shall be thoroughly cleaned and left ready for use.

End of Section

Section 11060

EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers installation of new equipment units that have been purchased by Contractor as part of this Work.

Startup requirements shall be as indicated in the Startup Requirements section.

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by City.

Any existing equipment which is removed shall be handled as indicated in the Demolition section.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer.

Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with the Handling and Storage section until installed in the Work. Equipment shall be protected by Contractor against warping, damage and exposure from the elements. At no time shall the equipment be stored on or come into contact with the ground, grass, or any other type of vegetation. Contractor shall keep the equipment dry at all times.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as follows:

Grout	As specified in the Grouting section.
Anti-Seize thread lubricant for SS bolts	As specified in the Anchorage in Concrete and Masonry section.

PART 3 - EXECUTION

3-1. INSTALLATION.

3-1.01. General.

Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results as specified in the Startup Requirements section.

Each equipment unit shall be leveled, aligned, and shimmed into position. Installation procedures shall be as recommended by the equipment manufacturer and as required herein. Shimming between machined surfaces will not be permitted.

Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Baseplates shall be anchored to the concrete base with required anchor bolts. For equipment with grouted bases, the space beneath shall be filled with grout as specified in the Grout section. The equipment base shall be grouted after initial fitting and alignment.

Anti-seize thread lubricant shall be liberally applied to the threaded portion of all stainless steel bolts during assembly.

When specified in the equipment sections, the equipment manufacturer will provide installation supervision and installation checks. For installation supervision, the manufacturer’s field representative will observe, instruct, guide, and direct Contractor's erection or installation procedures as specified in the equipment specifications. For installation checks, the manufacturer’s field representative will inspect the equipment installation immediately following installation by Contractor, and observe the tests indicated in the Startup Requirements section. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to City.

3-1.02. Engine-Generators and Associated Equipment.

3-1.02.01. Installation. The engine-generator units, including sub-base fuel tanks shall be installed level and plumb. The tanks shall be installed in accordance with the manufacturer's instructions, these specifications, detail drawings, and to the satisfaction of the City.

3-1.02.02. Cleaning. The exposed finish shall be inspected after completing system installation, including pipe connections, fittings, valves, and specialties. Burrs, dirt, and construction debris shall be removed and damaged finishes, including chips, scratches, and abrasions shall be repaired.

3-1.02.03. Protection. The equipment shall be protected after installation, but prior to final acceptance by City. Protection provisions shall be as recommended by the manufacturer and shall include provisions to prevent rust, mechanical damage, and foreign objects entering the equipment.

3-2. STARTUP AND TESTING. Startup requirements, and tests associated with startup shall be as indicated in the Startup Requirements section. Other field tests shall be as indicated in the specific equipment sections. Startup and tests required shall occur in the order listed in the following paragraphs. Tests shall not begin until any installation supervision and installation checks by the equipment manufacturer have been completed, except where noted below.

3-2.01. Preliminary Field Tests. Preliminary field tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's representative will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.02. Field System Operation Tests. Field system operation tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's service personnel will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.03. Field Demonstration Tests. Field demonstration tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.04. Field Performance Tests & Distribution Tests. Field performance tests or distribution tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.05. Field Baseline Performance Tests. Field baseline performance tests shall be conducted by Contractor on the equipment indicated in the equipment sections, and the tests shall be performed as indicated. When indicated in the equipment sections, the equipment manufacturer will participate in these tests. This test shall not be considered an acceptance test, but rather a test to determine initial performance curves and efficiency just prior to the equipment entering service.

End of Section

Section 13046

PREFABRICATED STEEL BUILDING - GUARDHOUSE

PART 1 - GENERAL

1-1. SCOPE. This section covers the design, fabrication, delivery, and erection of the following pre-engineered, Prefabricated Steel Building - Guardhouse, stone walls, and roofing tile.

Building Identification	Linnwood Purification Plant Guardhouse
Location	Linnwood Purification Plant, Entry Way, Milwaukee, Wisconsin

Earthwork, concrete, electrical service connection, and security system work are covered in other sections. Lannon Stone masonry and roofing tile work are covered in this section.

The section will be completed under one of three bid options:

- Base Bid B – B.I.G. Enterprises, Inc. guardhouse with Stainless Steel Wall Framing, Stainless Steel Outside Wall Panels, and Steel Standing Seam Roofing,
- Base Bid B Alternate 1 – B.I.G. Enterprises, Inc. guardhouse with Standard Wall Framing, Galvanized Steel Outside Wall Panels, and Steel Standing Seam Roofing; with Lannon Stone.
- Base Bid B Alternate 2 – B.I.G. Enterprises, Inc. guardhouse with Standard Wall Framing and Galvanized Steel Outside Wall Panels; with Lannon Stone and Roofing Tile.

The fabrication and delivery of the Prefabricated Steel Building shall be provided by the Prefabricated Steel Building Subcontractor. The excavation and structural backfill shall be provided and installed by the Contractor. The concrete foundation and slab shall be provided and installed by the Contractor. The unloading from the delivery truck, placement of the Prefabricated Steel Building on the slab, and anchoring shall be provided and installed by the Contractor. The electrical service connection shall be provided and installed by the Contractor. Connection of the exterior condenser unit, provided by the Prefabricated Steel Building Subcontractor, shall be mounted on the equipment pad and connected to the A/C system by the Contractor. The Lannon Stone wall

shall be provided and installed by the Contractor. The Roofing Tile shall be provided and installed by the Contractor. The security systems and pneumatic tube systems shall be provided and installed by the Contractor.

1-2. GENERAL. Foundation, Prefabricated Steel Building, stone masonry, and roofing tile components and accessories shall be designed and erected in full conformity with the Drawings, specifications, engineering data, instructions, and recommendations of the Prefabricated Steel Building Subcontractor or material manufacturer unless exceptions are noted by City.

The Drawings and specifications have been prepared using the standards, details, and dimensions for a Prefabricated Steel Building manufactured by B.I.G. Enterprises, Inc., 9702 East Rush Street, South El Monte, California 91733-1731, phone: 626 448-1449, http://www.bigbooth.com. If a Prefabricated Steel Building Subcontractor other than B.I.G. is used, then the Contractor is responsible for all needed modifications required to the project as a result of using of the other Prefabricated Steel Building Subcontractor.

The approved Prefabricated Steel Building is B.I.G.'s Entrance Master with nominal dimensions 11'-2" x 16' x 11' high as indicated on the Drawings or approved equal.

Prefabricated Steel Building shall be the product of one manufacturer with a minimum of 10 years documented experience in the design and fabrication of portable steel buildings. Prefabricated Steel Buildings by manufacturers other than the one approved shall submit sufficient data to enable approval to be given. As a minimum: design drawings and/or calculations, applicable certifications, catalog information, and color samples showing equal quality and performance must be submitted for approval.

The Prefabricated Steel Building shall be furnished complete with all primary and secondary structural framing, bracing, connections, metal wall and roof coverings, flashings, closures, metal trim, fasteners, sealants, caulking, and all other accessories needed for a complete weathertight Prefabricated Steel Building, and other miscellaneous components or accessory items when required, as specified or indicated on the Drawings. Other appurtenant items such as conduit, and equipment hangers, etc., shall be provided as indicated on the Drawings and as specified herein. The Prefabricated Steel Building shall include framed openings and flashings for all doors, windows, and other openings as needed. The Prefabricated Steel Building shall include all personnel doors, hardware, windows, and glazing as indicated on the Drawings and as specified herein.

The approved Roofing Subcontractor for the roofing tile is Millen Roofing Company, 8747 North 107th Street, Milwaukee, WI 53224, 414 371-8850. Roofing Subcontractors other than the one approved shall submit sufficient data to enable approval to be given. As a minimum: 25 years of roof tile project experience showing equal quality and performance must be submitted for approval.

1-2.01. Coordination. Prefabricated Steel Building Subcontractor shall provide delivered to site the Prefabricated Steel Building and coordinate with the City and Contractor for the erection and field quality control of the Prefabricated Steel Building and appurtenances.

1-2.02. Governing Standards. The Prefabricated Steel Building design and erection shall comply with the following building codes.

- Wisconsin Administrative Code - Chapter SPS 314 - Fire Prevention
- Wisconsin Administrative Code - Chapter SPS 316 - Electrical
- Wisconsin Administrative Code - Chapters SPS 361-366 – Wisconsin Commercial Building Code
- Wisconsin Administrative Code - Chapters NR 108 - Requirements for Plan and Specifications Submittal
- National Electric Code, 2008 edition
- ASTM Material Standards
- AISC Manual of Steel Construction, 13th Edition.
- ASCE 7-05: Minimum Design Loads for Buildings and Structures.
- American Welding Society (AWS), Structural Welding Code for each type of welded material.

1-3. DELIVERY, STORAGE, AND HANDLING. Prefabricated Steel Building shall be protected for shipment in accordance with accepted packaging standards. Minor damage to finishes shall be touched up before installation using color-matched, air-drying paint furnished by the manufacturer. No other finish will be acceptable. Any significantly damaged components shall be replaced at no cost to City.

1-4. SUBMITTALS. Complete drawings and data showing anchor bolt locations, construction details, cross-sections, insulation, roof and wall panels, fasteners, accessories, locations of all openings, and flashing details shall be furnished prior to fabrication of the Prefabricated Steel Building.

Data shall include design loads, load combinations, and all loads transmitted to the foundations. Structural calculations in conformance with local building codes shall be submitted. Drawings and calculations shall be sealed by a professional engineer registered in the state of Wisconsin.

Drawings shall be accompanied by the manufacturer's erection information indicating standard recommendations and erection details.

Color cards and samples indicating the manufacturers' available colors and the specified color shall be submitted.

Complete details, model numbers, finishes, and installation drawings covering the pedestrian doors, door hardware, windows, electrical fixtures, and HVAC equipment shall be submitted.

Drawings and data shall be submitted in accordance with the Submittals Section.

1-5. WARRANTY. After final acceptance, the completed Prefabricated Steel Building, excluding the Roofing Tile, shall be warranted by the Prefabricated Steel Building Subcontractor to be completely weathertight under all weather conditions for a period of 2 years. Leaks which occur during the correction period, whether through walls, doors, or accessory equipment or materials, shall be repaired at no cost to, and to the satisfaction of, City.

After final acceptance, the completed Roofing Tile shall be warranted by the Roofing Subcontractor to be completely weathertight under all weather conditions for a period of 2 years. Leaks which occur during the correction period through tile roofing or accessory shall be repaired at no cost to, and to the satisfaction of, City.

1-6. INSURANCE. Professional Liability insurance shall be provided as specified in Section 01039.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. Pre-engineered Prefabricated Steel Building shall be as manufactured by B.I.G. Enterprises, Inc., or approved equal.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Minimum design loadings and requirements shall be in accordance with the applicable building code and as specified. Design data for determining wind, snow, ice and seismic loads shall be as indicated in the Meteorological and Seismic Design Criteria section. Load combinations shall be in accordance with the applicable building code.

The building shall be designed in accordance with the following requirements.

Building identification.	Guardhouse	
Minimum roof live load.	30	psf
Minimum roof uplift load.	Per building code	psf
Minimum floor live load.	50	psf
Minimum Basic Wind Speed	90	mph
Wind Exposure Category	C	
Minimum Ground Snow Load	30	psf

2-3. MATERIALS. Materials for the Prefabricated Steel Building shall be new and free from defects, and shall meet the following requirements unless otherwise indicated on the Drawings. All materials are to be provided and installed in the Prefabricated Steel Building by the Prefabricated Steel Building Subcontractor, unless indicated to be provided and installed by other contractors. All materials are to be provided under all three bid options unless indicated to be provided under a specific bid option only.

Standard Wall Framing and Structural Components (Base Bid B Alternate 1, and Base Bid B Alternate 2 only)	3” x 3" x .083 cold drawn electro-welded structural mechanical steel tubing.
Stainless Steel Wall Framing and Structural Components (Base Bid B only)	3” x 3" x .083 Type 304 stainless steel tube.
Standard Floor Framing and Structural Components	2” x 2” x .083 Type 304 stainless steel tube.
Standard Roof Framing and Structural Components	3 x 3" x .083 cold drawn electro-welded structural mechanical steel tubing.

Anchor Bolts and Nuts (By Contractor)	Hilti HVA Adhesive Anchor System, 5/8" diameter Stainless HAS Rod, with washers and nuts, or approved equal.
Roof Sheathing	¾" exterior grade plywood siding.
Lifting Eyes	Guardhouse shall have removable lifting eyes for hoisting by a crane.
Standard Inside Wall Panels	16 Gauge cold rolled galvanized steel.
Galvanized Steel Outside Wall Panels (Base Bid B Alternate 1 and Base Bid B Alternate 2 only)	16 Gauge cold rolled galvanized steel. Upper portion of panel to have B.I.G.'s Entrance Master surface design. Lower portion of panel to be flush to accommodate Lannon Stone.
Stainless Steel Outside Wall Panels (Base Bid B only)	16 Gauge Type 304 stainless steel. Upper and lower portion of panel to have B.I.G.'s Entrance Master surface design.
Floor Panels	11 Gauge Type 304 stainless steel plate.
Floor Covering	Floor covering shall be Nora or approved equal, Norament Hammered surface, 1/8" x 19" x19" square industrial rubber tiles and 4" base cove, color 6172 Fawn or 6192 Pale Brown.
Floor Penetrations	Removable floor covers at locations and sized to accommodate floor penetrations over all floor penetrations for electrical conduits and pneumatic tubes and at anchor bolt locations.
Insulation (Floor)	Insulation board composed of a closed-cell polyisocyanurate foam core bonded to reinforced aluminum foil facers on each side. R value of 10. Complies with ASTM C1289 Type I, Class 1.

Insulation (Roof)	Glasswool insulation with asphalted kraft paper. Vapor transmission (permeance) rating of 1.0 or Less. R value of 28. Complies with the requirements of the applicable ASTM and cancelled federal specifications: ASTM C 665, Type II, Class C; HH-I-521F, Type II, Class C.
Insulation (Walls)	Insulation board composed of a closed-cell polyisocyanurate foam core bonded to reinforced aluminum foil facers on each side. R value of 17. Complies with ASTM C1289 Type I, Class 1.
Gutters and Downspouts	Minimum 26 Gauge galvanized steel conforming to ASTM A653, G-90 coating with factory applied finish.
Flashing and Trim	Steel with factory applied painted finish.
Sealant for Erection of Prefabricated Steel Building (By Contractor)	GE silicone construction sealant, SCS9000 SilPruf NB, with working life of 30-40 minutes, Color clear.
Hollow Metal Personnel Doors and Hardware	
Doors and Frames	ASTM A366 or A569, stretcher leveled, commercial quality sheet steel with smooth, clean surface.
Internal Reinforcing	ASTM A366, cold-rolled steel.
Fillers	Mineral wool or fiberglass.
Glazing	Tempered glass, ANSI Z97.1 or ASTM C1048, 1/4 inch plate or float, 1” dual pane insulating, outside pane tinted bronze, Low-E coating.

Locksets	Schlage D series storeroom feature - must be able to receive primus cylinder (doors will be control by card reader and electronic door strikes).
Door Strikes	Electronic
Hinges	Five knuckle, full mortise ball bearing hinge, ANSI A156.1, ANSI/BHMA A8112.
Closer	Heavy-duty, parallel arm, adjustable, non-sized, nonmetallic cover, ANSI A156.4, Grade 1, BHMA C02061.
Threshold	Polished aluminum diamond plate.
Weather stripping	Prefabricated Steel Building manufacturer standard type; for head, jamb, and sill.
Windows	
Type	Fixed
Frames	Steel frame system with flush mounted corners and welded fastening and painted finish.
Glazing	Tempered glass, ANSI Z97.1 or ASTM C1048, 1/4 inch plate or float, 1” dual pane insulating, outside pane tinted bronze, Low-E coating.
Electrical	U.L. approved fixtures wired to N.E.C. standards. Load Center shall be minimum 125 Amp 120/240 volt, single phase, 3 wire 24 pole with 100 amp main breaker, two duplex outlets on north, south, and east walls and three duplex outlets on west wall all at 18” above finished floor.

Ceiling	Drop ceiling with 16 ga. grid and acoustical tile. Grid to be 2' x 2', 16ga. Galvanized steel formed and welded in place, painted to match the interior color. Drop ceiling at 8' above finished floor.
Lighting (Interior)	Four 1' x 4' dual bulb fluorescent lights, recessed in drop ceiling at 8' above finished floor with wall switch at each door.
Lighting (Exterior)	Six LED flood lights, maxLED Model Number MLFL25LED50, or approved equal. Mount on ½" galvanized and painted pipe mounted near edge of roof as shown on drawings. On/Off switch for all flood lights at each door.
HVAC	Ductless split system with a minimum of 24,000 BTU heating and Cooling with a 3KW heat strip. Exterior condenser unit for mounting on equipment pad.
Lannon Stone (By Contractor) (Base Bid B Alternate 1 and Base Bid B Alternate 2 only)	Lannon Stone shall match as close as possible the size and pattern of stone on plant entry walls. Color of stone shall weather to a color that will match as close as possible the stone on plant entry walls. Mortar joints to match thickness and color of plant entry walls. Provide and install thru wall flashing, caulking, weep holes with bug screens, and other items required to complete Lannon Stone wall.

Steel Standing Seam Roofing (Base Bid B and Base Bid B Alternate 1 only)	Galvanized 24ga. Steel standing seam decking with baked on Kynar 500 finish. Color shall be Cardtex Cocoa.
Roofing Membrane (Base Bid B Alternate 2 only)	The roof system shall satisfy Factory Mutual requirements for Class 1 Fire and I-90 Windstorm Classification Structural Integrity.
Roofing Tile (By Contractor) (Base Bid B Alternate 2 only)	Roofing tiles shall be Ludowici Spanish tile 13 ¼" in length or approved equal. Texture to be Smooth. Colors are to be 50% Santiago Rose and 50% Sunset Red. Hip and ridge are to be straight barrel mission tile. Color fastness included in the 75-year limited warranty. Tile shall meet or exceed requirements of ASTM C 1167 -96 for Grade I clay roof tile; average moisture absorption of less than 1.0. The roof system shall satisfy Factory Mutual requirements for Class 1 Fire and I-90 Windstorm Classification Structural Integrity.
Finish Painting	Rust inhibitive high build epoxy primer and two part polyurethane finish coat. Paint to have minimum 3500 hour salt spray test. Color shall be Cardtex Cocoa.
Touchup Painting (Supplied by Prefabricated Steel Building Subcontractor, applied by Contractor)	As recommended and supplied by the Prefabricated Steel Building manufacturer.

2-4. FABRICATION.

2-4.01. Prefabricated Steel Building. All primary framing shall be shop fabricated welded steel construction. Secondary framing shall have welded connections. Wall panels shall be MIG welded to framing. All exposed welds ground smooth.

2-4.02. Gutters and Downspouts. The gutter apron shall extend under the roofing to provide a positive counterflashing. The outside face of the gutter shall

be supported with at least 16 gauge galvanized steel straps attached to the eave member at a spacing not to exceed 4 feet.

Each downspout shall have elbows at the top of the stone wall and at the base and shall be supported with a minimum of 24 gauge galvanized steel clincher bands attached to the wall covering at a spacing not to exceed 5 feet. The location of downspouts shall be as indicated on the Drawings.

Gutters and downspouts shall be finish coated to match the wall panels.

2-4.03. Hollow Metal Doors and Hardware. Doors including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. All joints at doors shall be sealed to provide weathertight construction and in accordance with the manufacturer's recommendations.

Steel personnel doors and frames shall conform to the applicable sections of Steel Door Institute 100 "Recommended Specifications for Standard Steel Doors and Frames". Personnel doors shall be 1-3/4 inch thick, flush type, steel, with internal steel stiffeners. Doors shall be constructed of minimum thickness 20 gauge steel face sheets and shall be filled with mineral wool or fiberglass fillers. The location of hardware shall be in accordance with the DHI "Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames". Reinforcement for hardware shall be as recommended by Steel Door Institute. Doors shall be weatherstripped at jambs, head, and sill with the manufacturer's standard weatherstripping.

Door frames shall be 2 inch wide, 16 gauge steel, with continuously welded and mitered corners. Frames shall be provided with the reinforcing plates, clips, and extensions necessary for attachment to the Prefabricated Steel Building framing.

Doors and frames shall be cleaned and given a phosphate treatment and a baked or oven-dried rust-inhibitive primer and Finish Painting.

Unless otherwise required, finish hardware for each door shall consist of one key-in-knob cylindrical lockset per opening; electronic strike; 1-1/2 pair full mortise ball bearing hinges per door leaf with nonremovable pin; one parallel arm closer; weatherstripping; and one aluminum threshold. Keying of the locksets shall be as directed by City. Closers shall be mounted on the interior side of the door. Hardware finish shall be US 26D.

Doors shall be glazed with half height window. The glass shall be set in glazing compound with setting blocks as recommended by the glass manufacturer.

2-4.04. Coordination with City's Security Integrator. The scope of work includes electronic door access strikes, locksets and hinge devices and coordination of the specific requirements for these items with the City's Preferred Security Integrator. The Prefabricated Steel Building Subcontractor and the Contractor shall coordinate with the City's Preferred Security Integrator the door, door frame, and finish hardware features to accommodate the requirements of the security system improvements, including the card readers, door alarms, and conduits from the doors and card readers to the control panel and panel boards.

The Prefabricated Steel Building Subcontractor shall coordinate, supply and install conduits, pull boxes, and electronic strikes for the following items to be provided by the City's Preferred Security Integrator per specification section 16725: electrical power and low voltage lines, electrical power wiring, panel-boards, door security hardware, electronic access and other security devices.

2-4.05. Windows. Windows, including frames, shall be securely anchored to the supporting construction, shall be installed plumb and true. All joints at windows shall be sealed to provide weathertight construction and in accordance with the manufacturer's recommendations.

Windows shall be provided at the locations and in the sizes indicated on the Drawings. The window types shall be as specified herein. Windows shall be provided complete with glazing, weatherstripping, and shall meet the applicable portions of AAMA Standard 101. Windows shall be glazed as specified herein. All exposed surfaces of frames shall be finished with manufacturer's standard factory Finish Painting.

2-4.06. HVAC. Prefabricated Steel Building to ship with factory installed interior air distribution unit recessed in the ceiling, all electrical wiring and wall mounted thermostat, 16 Gauge galvanized steel interior chase painted to match the building interior. Chase contains the power, refrigerant & condensate drain. These lines are to be connected on site to the exterior condenser unit that ships loose. The refrigerant lines shall be connected by a licensed Mechanical Subcontractor.

2-4.07. Coatings. The finish on surfaces of wall panels, flashings, appurtenances, and trim shall be the manufacturer's standard finish. Colors for exposed exterior surfaces of all panels, trim, and flashings shall be Cardtex Cocoa. Prefabricated guardhouse to be painted one color inside and out.

All steel parts which are not specified to be factory finished and which are not zinc coated or stainless steel shall be cleaned and shop primed.

Any surfaces abraded or damaged during fabrication shall be touched up or repainted. All welds shall be thoroughly cleaned and touched up with a suitable primer.

A suitable quantity of touchup paint shall be provided with the Prefabricated Steel Building.

The guardhouse coating systems shall be warranted against cracking, fading, peeling, crazing, or chipping failure for a period of 2 years. Any failures which occur during the correction period shall be repaired at no cost to, and to the satisfaction of, City.

2-4.08 Shipping. Prefabricated Steel Building shall ship complete with structural frame, wall surfaces, roof sheathing and membrane roofing, flooring, doors, windows, finish, electrical fixtures, lights, drop ceiling grid and acoustical tiles, HVAC heating cooling air distribution system and thermostat, with weather- tight exterior.

2-4.09. Anchor Bolts. Contractor shall furnish at least six anchor bolts. The number, size, layout, and projection of the building anchor bolts shall be based on information provided by the Prefabricated Steel Building Subcontractor. The Prefabricated Steel Building manufacturer shall provide removable floor covers over the anchor bolt locations to facilitate instillation of the anchor bolts.

2-4.10. Floor Penetrations. Provide removable floor covers at locations and sized to accommodate floor penetrations over all floor penetrations for electrical conduits and pneumatic tubes. Coordinate locations of floor structural members to allow clear passage of electrical conduits and pneumatic tubes through floor.

PART 3 - EXECUTION

3-1. ERECTION. A copy of the Prefabricated Steel Building manufacturer's erection information shall be kept at the erection site at all times, and shall be available for all building trades.

The top surface of the concrete slab shall be flat and level with a maximum deviation from flatness of 1/8” over any measured distance of 10’. Prior to setting the Prefabricated Steel Building, a 1/4 “ diameter bead of caulking shall be applied to the surface of the slab under all building frame members that will contact the slab. While the caulking is pliable, the building shall be set on the slab, with frame members contacting and spreading the caulking. The building shall be set plumb and level. The final position of the building on the slab shall

leave 5” of the slab top surface exposed outside all Prefabricated Steel Building walls.

The Contractor shall be responsible for installing six anchor bolts after the building is set on the slab. The anchor bolts shall be installed through removable floor covers located over the anchor bolt locations.

Any factory finished surfaces abraded or damaged during erection shall be repaired and the coating system touched up or repainted with manufacturer's touchup paint.

If Base Bid B Alternate 1 or Base Bid B Alternate 2 is selected, Lannon Stone walls shall be constructed on all sides of the Prefabricated Steel Building and set on through wall flashing. Caulk top edge of through wall flashing to prevent any moisture for entering space behind flashing. Free draining weepholes with bug screens shall be installed in head joints at base of wall and below cap flashing at 32” centers. Remove mortar from 1” space between stone and outside surface of Prefabricated Steel Building wall panel. Stone size color and shape shall be as specified. Return stone wall to Prefabricated Steel Building at doors and caulk joint.

If Base Bid B Alternate 2 is selected, roof tile shall be place over membrane roofing as received from Prefabricated Steel Building manufacture. Tile shall be placed over roofing felt and secured with copper roofing nails that penetrate the roof deck by a minimum of 5/8 inch. Cut tile to fit at hips and ridge. Cover hips and ridge with tile to shed water.

Downspouts shall be rigidly attached to the Prefabricated Steel Building after the stone walls (if selected) is installed. Gutters shall be installed to provide drainage and shall be jointed with adequate provisions for expansion and contraction.

3-2. FIELD TESTING. The Prefabricated Steel Building shall be leak tested with a garden hose stream prior to acceptance. Any leakage discovered shall be corrected and retested.

3-3. PROTECTION. All portions of the Prefabricated Steel Building shall be protected from damage during site storage and erection. Damaged parts shall be replaced with undamaged units unless field repairs are authorized by City.

3-4. CLEANING. After completion of construction all soiled surfaces shall be cleaned in accordance with the manufacturer's instructions.

End of Section

Section 13200

PNEUMATIC CONVEYANCE SYSTEM

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of a complete pneumatic conveyance system. Each pressure/vacuum pneumatic conveyance unit shall be furnished complete with an indoor powered station, including send/receive station, vacuum and pressure blowers, and console, an outdoor send/receive station, carriers, controls, pneumatic tubing, and all accessories and appurtenances specified, indicated on the Drawings, or otherwise required for a complete and properly operating installation.

1-2. GENERAL. Equipment furnished and installed 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 furnished by the equipment manufacturer unless exceptions are noted by City.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Power Supply. Unless otherwise specified, the power supply to the equipment will be 120 volts, 60 Hz, single-phase.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly and fabrication drawings, together with detailed specifications and data covering all equipment and accessories furnished, shall be submitted in accordance with the Submittals section.

1-3.02. Operation and Maintenance Data and Manuals. Operation and maintenance manuals shall be submitted in accordance with the Contract Closeout and Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. QUALITY ASSURANCE.

1-4.01. Manufacturer Experience. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 10 years, and shall provide a reference list with the names, addresses, and contact phone numbers for a minimum of 20 similar installations.

1-5. COORDINATION. The pneumatic conveyance system shall be furnished by the pneumatic conveyance system manufacturer who shall coordinate the items of equipment, appurtenant systems, interconnecting piping, and controls to ensure the compatibility and proper operation of all items.

The pneumatic conveyance system manufacturer shall prepare system installation drawings, wiring diagrams, and other data required for complete system description and installation. The pneumatic conveyance manufacturer shall verify that each system component is compatible with all other components of the system, that all pipe materials and sizes are appropriate, and that all devices necessary for a properly functioning filtration system have been provided.

1-6. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Each pneumatic conveyance unit will be used to convey documents back and forth from vehicles at an outdoor gate area to inside of the Guardhouse Building. The outdoor equipment shall be suitable for installation outdoors without protection from the elements and the following conditions:

Design ambient temperature	-30 to 113°F
Design wind speed	120 mph

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Each pneumatic conveyance unit shall be designed to transport a 4 inch diameter carrier between the stations indicated on the Drawings.

Number of pneumatic conveyance units	4
Cargo weight limit	3 pounds

Power supply, each unit	120 volts, 60 hertz, single phase, 20 amp branch circuit

2-3. ACCEPTABLE MANUFACTURERS. The pneumatic conveyance system manufacturer and model shall be Eagle Pneumatic, Inc., Pressure/Vacuum Ticket Delivery or City approved equal.

2-4. MATERIALS. Materials of construction shall be as follows:

PVC-1 – Schedule 40 PVC Pipe with Solvent Welded Joints. Pneumatic Conveyance Tubing	Pipe Fittings	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 40. As recommended by the manufacturer.

2-5. CONSTRUCTION. Each pneumatic conveyance unit shall be designed to send and receive carriers between an indoor station in the Guardhouse and an outdoor station located at the gate in the Entry Way area through a single connecting tube and shall be of the “downsend” configuration.

2-5.01. Indoor Power Station. Each indoor powered station shall be furnished with a send/receive station, vacuum and pressure blowers, control system, all housed in a single console. The send/receive station shall be provided with a door and handle. Controls shall operate the blower motors as required for transporting carriers and shall include:

Send/Recall Switch

Door Switch

Indicator Lights

Door Lock

LCD Display

Timer

2-5.02. Outdoor Station. Each outdoor unpowered station shall be provided with a stainless steel housing and “Send” switch, and shall be suitable for outdoor operation without protection.

2-5.03. PVC Tubing. PVC tubing shall be as recommended by the manufacturer and as specified herein. Tubing shall have chamfered ends as recommended by the manufacturer without hubs and shall be joined with couplings that do not protrude into the inner diameter of the tubing.
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PART 3 - EXECUTION

3-1. INSTALLATION. Installation shall be in accordance with the Equipment Installation section and in accordance with the manufacturer's recommendations.

3-2. CLEANING. The exposed finish shall be inspected after completing system installation, including pipe connections, fittings, valves, and specialties. Burrs, dirt, and construction debris shall be removed and damaged finishes, including chips, scratches, and abrasions shall be repaired.

End of Section

Section 16050

ELECTRICAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of all equipment and materials needed for the electrical requirements of this Contract. It also covers conduit, wiring, and terminations for electrical equipment installed under Electrical Equipment Installation section.

This section covers the installation and interconnection of electrical equipment furnished under other sections, except electrical items designated to be installed under those sections.

This section covers installation requirements to comply with NEC Article 708 – Critical Operations Power Systems. All new work, including modifications to existing equipment is defined as a Critical Operations Power Systems (COPS).

1-2. GENERAL. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.

Electrical materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the City.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment provided under this section. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence

1-2.02. Coordination. Electrical work shall conform to the construction schedule and the progress of other trades.

1-2.03. Anchor Bolts and Expansion Anchors. All anchor bolts, nuts, washers, and expansion anchors shall comply with Anchorage in Concrete and Masonry section, except smaller than 3/4 inch will be permitted to match NEMA standard size bolt holes on motors and electrical equipment.

1-2.04. Drawings. Supplementing this section, the Drawings indicate locations of equipment and enclosures and provide one-line and schematic diagrams regarding the connection and interaction with other equipment.

1-3. CODES AND PERMITS. All work shall be performed and materials shall be furnished in accordance with the NEC - National Electrical Code, the NESC - National Electrical Safety Code, and the following standards where applicable:

ANSI	American National Standards Institute.
ASTM	American Society for Testing and Materials.
AWG	American Wire Gauge.
Fed Spec	Federal Specification.
ICEA	Insulated Cable Engineers Association.
IEEE	Institute of Electrical and Electronics Engineers.
IESNA	Illuminating Engineering Society of North America.
NEIS	National Electrical Installation Standards
NEMA	National Electrical Manufacturers Association.
NFPA	National Fire Protection Association.
UL	Underwriters' Laboratories.

Equipment covered by this section shall be listed by UL, or by a nationally recognized third party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. If no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to be used.

1-4. IDENTIFICATION. All new and existing boxes and enclosures (including switchgear, generators, power panels, receptacles, etc.) installed or modified under this contract that are associated with feeder and branch circuit wiring shall be permanently marked so they will be readily identified as a component of the COPS.

Transfer equipment associated with the COPS shall be identified for emergency use.

1-4.01. Conduit. Conduits in manholes, handholes, building entrance pull boxes, junction boxes, and equipment shall be provided with identification tags. Identification tags shall be 19 gage stainless steel, with 1/2 inch stamped letters and numbers as indicated on the Drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.

1-4.02. Conductors. All conductors in power, control, and instrumentation circuits shall be identified and color coded as described herein.

1-4.02.01. Conductor Identification Number. Except for lighting and receptacle circuits, each individual conductor in power, control, and instrumentation circuits shall be provided with wire identification markers at the point of termination.

The wire markers shall be of the heat-shrinkable tube type, with custom typed identification numbers.

The wire numbers shall be as indicated on the equipment manufacturer's drawings.

The wire markers shall be positioned to be readily visible for inspection.

1-4.02.02. Conductor Color Coding. Power conductors shall be color coded as indicated below. For conductors 6 AWG and smaller, the color coding shall be the insulation finish color. For sizes larger than 6 AWG, the color coding may be by marking tape. The equipment grounding conductor shall be green or green with one or more yellow stripes if the conductor is insulated.

The following color coding system shall be used:

120/240V single-phase — black, red, and white
120/208V, three-phase — black, red, blue, and white
120/240V, three-phase — black, orange, blue, and white
277/480V, three-phase — brown, orange, yellow, and gray

Where 120/240 and 120/208 volt systems share the same conduit or enclosure, the neutral for either the 120/240 volt system or the 208 volt system shall be white with a permanent identifiable violet stripe.

Control and instrumentation circuit conductors shall be color coded as indicated in the Cable Data Figures at the end of this section.

1-4.03. Motor Starters. Not used.

1-4.04. Control Stations. ControlControl stations shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the Drawings. Nameplates shall be laminated black-over-white plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the control stations.

1-4.05. Circuit Breakers. Not used.

1-4.06. Disconnect Switches. All switches shall have front cover-mounted permanent nameplates that include switch type, manufacturer's name and catalog number, and horsepower [kW] rating. An additional nameplate, engraved or etched, laminated black-over-white plastic, with 1/8 inch [3 mm] letters, shall

be provided to identify the associated equipment. Both nameplates shall be securely fastened to the enclosure.

1-4.07. Arc Flash Hazard Labels. Lighting panels, power panels, power centers, switchgear and meter socket enclosures shall be provided with permanent labels warning the risk of arc flash and shock hazard. Labels shall be designed in accordance with ANSI Z535.4-1998 and shall include the following:

WARNING
Arc Flash and Shock Hazard

Appropriate personal protection equipment (PPE) required. SEE NFPA 70E.
Equipment must be accessed by qualified personnel only.
Turn off all power sources prior to working on or inside equipment.

Additional information shall be provided on the labels where specified in the Arc Flash Hazard Analysis section of this section.

1-5. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the work performed by the Contractor, shall be submitted in accordance with the Submittals section. The drawings and data shall include, but shall not be limited to, the following:

Drawings and data.
Operating manuals.
Samples.

1-5.01. Submittal Identification. Information covering all materials and equipment shall be submitted for review in accordance with the Submittals section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

a. Lamp fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.

b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.

c. Sheets or drawings covering more than the item being considered shall have all inapplicable information crossed out.

d. A suitable notation shall identify equipment and materials descriptive literature not readily cross-referenced with the Drawings or Specifications.

e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

f. Surge protective device submittals shall include drawings (including unit dimensions, weights, component and connection locations, mounting provisions, and wiring diagrams), equipment manuals that detail the installation, operation and maintenance instructions for the specified unit(s), and manufacturer's descriptive bulletins and product sheets.

g. Manufacture recommended Acceptance Testing Plan for major electrical equipment.

h. Manufacture heat load dissipation information for equipment located in the prefabricated electrical enclosures.

Contractor shall submit the name and qualifications of the Engineering and Testing Services firm proposed to perform the coordination study and the on site testing.

Within 90 days after the Notice to Proceed, Contractor shall furnish a submittal for all types of cable and conduit to be provided. The submittal shall include the cable manufacturer and type, and sufficient data to indicate that the cable and conduit meet the specified requirements.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall include legible and complete surface printing of the cable identification.

1-6. PROTECTION AND STORAGE. During construction, the insulation on all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion by strip heaters, lamps, or other suitable means. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously.

PART 2 - PRODUCTS

2-1. POWER SERVICE ENTRANCE. Not used.

2-2. TELEPHONE SERVICE ENTRANCE. Not used.

2-3. CABLE. All cables of each type (such as lighting cable or 600 volt power cable) shall be from the same manufacturer.

All types of cable shall conform to the Cable Data Figures at the end of this section and as described herein.

2-3.01. Lighting Cable. Lighting cable (Figure 1-16050 THHN-THWN) shall be provided only in lighting and receptacle circuits operating at 277 volts or less. Lighting and receptacle circuits, 8 AWG [10 mm2] or larger, shall be as specified for 600 volt (Figure 2-16050 XHHW) power cable.

2-3.02. 600 Volt Power Cable. Cable in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control, and instrument cables are required, shall be 600 volt (Figure 2-16050 XHHW-2) power cable.

2-3.03. Instrument Cable. Cable for electronic circuits to instrumentation, metering, and other signaling and control equipment shall be two- or three-conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield. Types of instrument cables shall be (Figure 4-16050 single pair).

2.3.04. Multiconductor Control Cable. Not used..

2-3.05. Medium Voltage Power Cable. Cable for circuits rated higher than 600 volts but not above 5,000 volts, and for wet or dry locations in conduit and open air, shall be (Figure 9-16050 8 kV EPR) power cable.

2-3.06. Tray Cable. Not used.

2-3.07. RS-485 Cable. Cable shall be Belden 9841 or equal.

2-4. CONDUIT. Conduit and raceways shall be as described in the following paragraphs:

2-4.01. Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, shall conform to ANSI C80.1, and shall be manufactured in accordance with UL 6.

2-4.02. Intermediate Metal Conduit (IMC). Not used.

2-4.03. Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moistureproof polyvinyl chloride jacket, and shall be UL labeled.

2-4.04. Utility (PVC) Duct. Not used.

2-4.05. Rigid Nonmetallic (PVC) Conduit. PVC conduit shall be heavy wall, Schedule 40, UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL 651.

2-4.06. PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel. Before the PVC coating is applied, the hot-dip galvanized surfaces shall be coated with a primer to obtain a bond between the steel substrate and the coating. The PVC coating shall be bonded to the primed outer surface of the conduit. The bond on conduit and fittings shall be stronger than the tensile strength of the PVC coating. The thickness of the PVC coating shall be at least 40 mils [1000 µm].

A chemically cured two-part urethane coating, at a nominal 2 mil thickness, shall be applied to the interior of all conduit and fittings. The coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking of the coating.

Every female conduit opening shall have a PVC sleeve extending one conduit diameter or 2 inches, whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit before coating. The wall thickness of the sleeve shall be at least 40 mils.

All fittings, condulets, mounting hardware, and accessories shall be PVC-coated. All hollow conduit fittings shall be coated with the interior urethane coating described above. The screw heads on condulets shall be encapsulated by the manufacturer with a corrosion-resistant material.

PVC coated rigid steel conduit shall be manufactured by Ocal, Perma-Cote, or Robroy.

2-4.07. Electrical Metallic Tubing (EMT). Not used.

2-4.08. Rigid Aluminum Conduit (RAC). Not used.

2-5. WIRING DEVICES, BOXES, AND FITTINGS. Concealed conduit systems shall have flush-mounted switches and convenience outlets. Exposed conduit systems shall have surface-mounted switches and convenience outlets.

2-5.01. Conduit Boxes and Fittings.

a. Galvanized or cadmium plated, threaded, malleable iron boxes and fittings shall be manufactured by Crouse-Hinds, Appleton, or O Z Gedney. In applications utilizing aluminum conduit systems, aluminum boxes and fittings manufactured by Crouse-Hinds, Appleton, or O Z Gedney shall be installed.

b. Rigid PVC device boxes and fittings shall be manufactured by Carlon or Cantex.

c. Sheet steel device boxes shall be manufactured by Appleton, Raco, or Steel City.

d. PVC coated device boxes shall be manufactured by Ocal, Perma-Cote, or Robroy Industries.

e. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement to avoid unnecessary bends and fittings.

2-5.02. Device Plates.

a. Galvanized or cadmium-plated device plates shall be used on surface mounted outlet boxes where weatherproof plates are not required.

b. Device plates on flush mounted outlet boxes where weatherproof plates are not required shall be AISI Type 302 stainless steel, Eagle "93nnn series", Hubbell "S series", or Leviton "840nn-40 series"; nylon or polycarbonate, Eagle "513nV series", Hubbell "Pn series", or Leviton "807nn-I series".

c. Device plate mounting hardware shall be countersunk and finished to match the plate.

d. Device plates for switches outdoors or indicated as weatherproof shall have provisions for padlocking switches "On" and "Off", and shall be Appleton "FSK-1VS", Crouse-Hinds "DS185" or O Z Gedney "FS-1-WSCA".

e. Device plates for receptacles indicated as weatherproof shall be Appleton "FSK-WRD", Crouse-Hinds "WLRD1", or O Z Gedney "FS-1-WDCA.

f. Flush-mounted, weatherproof plates shall be provided with adapter plates, Appleton "FSK-SBA" or Crouse-Hinds "FS031".

g. Device plates for ground fault interrupter receptacles indicated to be weatherproof shall be Appleton "FSK-WGFI", Eagle "966", or O Z Gedney "FS-1-GFCA".

h. Receptacle covers outdoors or otherwise indicated to be weatherproof while in-use shall be die cast aluminum and shall include a padlock eye. Covers for standard convenience outlets shall be Hubbell “WP8M” or Thomas and Betts Red Dot “CKMUV”. Covers for ground fault interrupter receptacles shall be Hubbell “WP26M” or Thomas and Betts Red Dot “CKMUV”.

i. Engraved device plates, where required, shall be manufactured by Leviton, or equal.

j. Device plates on PVC conduit fittings shall be Carlon "E98 Series" or Cantex "513300 Series".

2-5.03. Wall Switches.

a. Switches on ac lighting panel load circuits through 277 volts shall be 20 amperes, 120/277 volts, Eagle "2221V" through "2224V", Hubbell "HBL 1221I" through "HBL 1224I", or Leviton "1221-2I" through "1224-2I".

b. Switches for pulse control of lighting contactors shall be 20 amperes, 120/277 volts, momentary, double-throw, center "Off", Eagle "2220V", Hubbell "1557I" or Leviton "1257-I".

c. Switches on ac lighting panel load circuits through 277 volts in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the Drawings shall be 20 ampere, 120/277 volts. Hazardous area switches shall be factory sealed tumbler switches, Appleton “EDS” or Killark “FXS”.

2-5.04. Receptacles.

a. Standard convenience outlets shall be duplex, three-wire, grounding, 20 amperes, 125 volts, Eagle "5362V", Hubbell "5362I" or Leviton "5362-I" for 120 volt circuits, and 250 volts, Eagle "5462V", Hubbell "5462I" or Leviton "5462-I" for 240 volt circuits.

b. Ground fault circuit interrupter receptacles shall be duplex, 20 amperes, 125 volts, Eagle "GF8300V", Hubbell "GF5362I" or Leviton "7899-I".

c. Welding receptacles shall be 30 amperes, 600 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ACRE3034-100", Crouse-Hinds "AR348" plus "ARRC33" and "AR30" or Leviton " 430MI5W". One matching plug, Appleton "ACP3034BC", Crouse-Hinds "APJ3485" or Leviton "430P5W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by Owner.

d. Welding receptacles shall be 60 amperes, 240 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ACRE6035-150", Crouse-Hinds "AREA6485" or Leviton "460MI9W". One matching plug, Appleton "ACP6034BC", Crouse-Hinds "APJ6485" or Leviton "460P9W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by Owner.

2-5.05. Special Outlets. Not used.

2-6. JUNCTION BOXES, PULL BOXES, AND WIRING GUTTERS. Indoor boxes (larger than switch, receptacle, or fixture type) and gutters shall be constructed of sheet steel, shall be galvanized after fabrication, and shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.

Indoor boxes and gutters in corrosive areas indicated on the Drawings and outdoor boxes and gutters shall be NEMA Type 4X, ABS or stainless steel and shall be rigidly supported by PVC-coated or stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

Bolt-on junction box covers 3 feet square or larger, or heavier than 25 lbs, shall have rigid handles. Covers larger than 3 by 4 feet shall be split.

Where indicated on the Drawings, junction and pull boxes with a removable side opposite the underground conduits shall be provided over building ends of underground conduit banks. Boxes shall be sized in accordance with the National Electrical Code, including space for full size continuations of all underground conduits not originally continued. Conduit arrangement shall leave maximum space for future conduits.

2-7. LIGHTING FIXTURES. Lighting fixtures shall be furnished as described in the fixture schedule and as indicated on the Drawings. Lighting fixtures shall be furnished complete with lamps. Pendant fixtures shall have swivel type box covers and threaded conduit pendants unless otherwise specified. Lighting fixtures shall be provided with disconnects in accordance with NEC requirements.

2-7.01. Electronic Ballasts. Electronic ballasts furnished with fluorescent type lighting fixtures shall be CBM certified as meeting requirements of ANSI C82.11 with a THD level of not more than 20 percent.

2-8. LIGHTING PANELS. Each lighting panel shall be a dead-front, 120/240 volt, single phase or 120/208 volt, three phase panelboard with circuit breakers, in accordance with the Drawings and the following:

2-8.01. Cabinet. The panel shall have a flush-mounted or surface-mounted enclosure with a NEMA designation appropriate for the location where it will be installed. The enclosure shall have a hinged trim (cover). Breaker operating handles shall be accessible through a latched, lockable, door. At the completion of the Contract, a neatly printed or typed directory listing the panel and circuit identities shall be mounted inside the door.

2-8.02. Circuit Breakers. Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Breakers indicated as multiple-pole shall be common trip. Breakers shall have interrupting ratings not less than 10,000 amperes. Handle clips to prevent casual operation of breakers shall be provided for 10 percent (at least two) of the breakers and applied to the circuits directed. Breakers and provisions for future breakers shall be provided in the quantities, number of poles, and ampere ratings indicated on the Drawings.

2-8.03. Buses. The panel shall have main and neutral buses insulated from the cabinet, and a ground bus. Buses shall be copper, with ampere ratings and main lugs or breaker as indicated. The ground bus shall be similar to a neutral bus and shall have a good ground connection to the cabinet, a removable bond to the neutral bus, clamp type lugs for the ground cable in each supply conduit, and connections for a ground cable in each load conduit.

2-9. POWER PANELS. Unless otherwise specified, each power panel, without a neutral, shall be dead-front, 3 phase panelboard with circuit breakers, in accordance with the Drawings and the following:

2-9.01. Cabinet. The panel shall have a flush-mounted or surface-mounted enclosure with a NEMA designation appropriate for the location where it will be installed. The enclosure shall have a door with latch and lock. At the completion of the Contract, a neatly printed or typed directory listing the panel and circuit identities shall be mounted inside the door.

2-9.02. Circuit Breakers. Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Breakers indicated as multiple-pole shall be common trip type. Breakers up to 240 volts shall have interrupting ratings not less than 10,000 amperes. Breakers for 277 volts shall have interrupting ratings not less than 14,000 amperes. Breakers for 480 volts shall be rated 600 volts, with interrupting ratings not less than 14,000 amperes at 480 volts. Handle clips to prevent casual operation of breakers shall be provided for 10 percent (at least two) of the breakers and applied to the circuits directed.

2-9.03. Buses. The panel shall have 3 phase buses and a ground bus. Buses shall be copper, with ampere and voltage ratings and main lugs or breakers as indicated. The ground bus shall be similar to a neutral bus and shall have a good ground connection to the cabinet, clamp type lugs for the ground cable in each supply conduit, and connections for a ground cable in each load conduit.

2-10. SURGE PROTECTIVE DEVICES.

2 -10.01. Scope. Surge protective devices (SPD) shall be provided as specified herein and as indicated on the Drawings. Each unit shall be designed for parallel connection to the wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel.

Each SPD shall be furnished and installed for the electrical equipment indicated on the Drawings or as specified herein. All new lighting and power panels shall be furnished with an integral SPD.

Lighting panels shall be rated for the low exposure level capacity unless otherwise noted.

Power panels shall have SPD's rated for a medium-high exposure levels.

2-10.02. Standards. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

ANSI/IEEE C62.41 and C62.45;

ANSI/IEEE C62.1 and C62.11;

National Electrical Manufacturers Association (NEMA LS1 Guidelines);

National Fire Protection Association (NFPA 20, 70 [NEC], 75, and 780);

Underwriters Laboratories UL 1449 Third Edition and 1283

The unit shall be UL 1449 Third Edition Listed as a Type 2 Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference (EMI) Filter.

2-10.03. Environmental Requirements.

a. Operating Temperature: 0°F to +140°F.

b. Relative Humidity: Reliable operation with 5 percent to 95 percent non-condensing.

2-10.04. Electrical Requirements.

a. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as indicated on the Drawings.

b. Maximum Continuous Operating Voltage (MCOV). The SPD shall be designed to withstand a MCOV of not less than 115 percent of nominal RMS voltage.

c. Operating Frequency. Operating frequency range shall be 47 to 63 Hertz.

d. Protection Modes. Four-wire configured systems shall provide, Line-to-Neutral (L-N), Line-to-Ground (L-G), and Neutral-to-Ground (N-G), and Line-to-Line (L-L) protection. Three-wire configured systems shall provide, Line-to-Line (L-L) protection and Line-to-Ground (L-G) protection.

e. Rated Single Pulse Surge Current Capacity. The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be as required and shall be no less than listed in the following table.

	L-N	L-G	N-G	L-L
High Exposure Level	120 kA	120 kA	120 kA	120 kA
Medium-High Exposure Level	100 kA	100 kA	100 kA	100 kA
Medium Exposure Level	80 kA	80 kA	80 kA	80 kA
Low Exposure Level	60 kA	60 kA	40 kA	60 kA

f. UL 1449 Third Edition Voltage Protection Rating (VPR). The maximum VPR per mode for the device (inclusive of disconnect) shall be as required and shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L
120/208 3-phase	800 V	800 V	800 V	1200 V
480 V 3W		1200 V		2000 V

g. Noise Attenuation. The unit shall be capable of a minimum -30 dB attenuation at 100kHz when tested per the 50 ohm insertion loss method as defined by MIL-STD-220A.

h. Nominal Discharge Current. Each SPD shall have a nominal discharge current rating of 20 kA.

i. Overcurrent Protection. At high and medium-high exposure levels, the SPD shall incorporate internal fusing capable of interrupting, at minimum, up to 200 kA symmetrical fault current with 600 volts ac applied.

At medium and low exposure levels, the SPD shall incorporate internal fusing capable of interrupting, at minimum, up to 65kA symmetrical fault current with 600 volts ac applied.

The device shall be capable of allowing passage of the rated maximum surge current for every mode without fuse operation.

j. Unit Status Indicators. The unit shall include long-life, externally visible phase indicators that monitor the on-line status of the unit. When furnished integral to the panelboard, the status indicators shall be viewable through a clear window within the panelboard door, or similar provision made to ensure visibility with the door closed.

2-10.05. Warranty. The manufacturer shall provide a minimum Five Year Limited Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

2-10.06. Installation. Each SPD shall be installed according to the manufacturer's recommendations. If possible for the integral units, provide direct bus connections.

2-10.07. Options. Not used.

2-10.08. Acceptable Manufacturers. Integral SPD's shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, or Square D. External SPD's shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, Square D, or Current Technology. The products of other manufacturers will not be acceptable.

2-11. SEPARATELY ENCLOSED MOTOR STARTERS. Not used.

2-12. SEPARATELY ENCLOSED MANUAL STARTERS. Not used.

2-13. CONTROL STATIONS. Control stations shall be provided as indicated on the one-line diagrams or schematics or as required by the equipment furnished. Pilot devices shall be 30.5 mm heavy-duty, oiltight construction, and shall perform the functions indicated. Pilot lights shall be full voltage type with LED lamps. Indoor control stations shall have NEMA Type 13 enclosures. Control stations outdoors or indicated to be weatherproof shall have NEMA Type 4X stainless steel enclosures with protective caps on the control devices. Control stations in NEC Class I, Division 1 and Division 2, Group D hazardous areas shall have NEMA Type 7 enclosures, or be factory sealed type, Appleton "Contender Series" or Killark "Seal-X Series".

2-14. SEPARATELY ENCLOSED CIRCUIT BREAKERS. Not used.

2-15. DISCONNECT SWITCHES. Unless otherwise specified, each disconnect switch shall be 3 pole, nonfusible, 600 volts, with a continuous current rating as indicated on the Drawings.

Switches located indoors shall have NEMA type enclosure designations as required by the locations where they will be installed. Switches located outdoors shall have NEMA Type 4X enclosures. Switches in chlorine rooms, or in other areas where contact with caustic substances may occur, shall have NEMA Type 4X enclosures of molded reinforced polyester.

Switches shall have high conductivity copper, visible blades; nonteasible, positive, quick-make, quick-break mechanisms; and switch assembly plus operating handle as an integral part of the enclosure base. Each switch shall have a handle whose position is easily recognizable and which can be locked in the "Off" position with three padlocks. The "On" and "Off" positions shall be clearly marked.

All switches shall be UL listed and horsepower [kilowatt] rated, and shall meet the latest edition of NEMA KS1. Switches shall have defeatable door interlocks that prevent the door from being opened while the operating handle is in the "On" position.

2-16. LIGHTING AND AUXILIARY POWER TRANSFORMERS. Separately mounted transformers shall be provided in the phases, kVA, and voltages indicated on the Drawings. Transformers shall be self-air-cooled, dry type, wall- or floor-mounted, and enclosed for wiring in conduit. Transformers installed outdoors shall be weatherproof. Transformers shall have at least two full capacity voltage taps. Transformers shall meet NEMA TP1 guidelines for energy efficiency.

2-17. POWER CENTERS. Not used.

2-18. POWER FACTOR CORRECTION CAPACITORS. Not used.

2-19. LIGHTING CONTACTORS. Not used.

2-20. PHOTOELECTRIC CONTROLS. Photoelectric controls shall be weatherproof, swivel adjustable, with built-in time delay to prevent accidental turnoff by momentary brightness. The photocell shall be rated 1800 VA, 120 volts ac, and shall be field adjustable from 1 ft/c [11 lux] turn-on to 15 ft/c [161 lux] turn-off.

2-21. RELAY ENCLOSURES. Not used.

2-22. ALARM HORN AND BEACON. Not used.

2-23. HEAT-TRACED PIPING. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All material, equipment, and components specified herein shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

3-2. ARC FLASH HAZARD ANALYSIS. Contractor shall commission an Arc Flash Hazard Analysis for each piece of electrical equipment installed or modified under this contract in accordance with OSHA 29 CFR Part 1910, NEC, NFPA 70E, and IEEE 1584 and shall submit an Arc Flash Hazard Analysis report as specified herein.

The Arc Flash Hazard Analysis shall be performed in association with, or as a continuation of, the short circuit study and protective-device coordination study.

Arc Flash Hazard Analysis calculations shall lead to a selection of a level of Personal Protective Equipment (PPE) that is a balance between the calculated incident energy exposure and the work activity being performed, while meeting the following concerns:

Provide adequate protection.

Avoid the need for more protection than is warranted.

Results of the Arc Flash Hazard Analysis shall be used to identify the flash-protection boundary and the incident energy at assigned working distances throughout any position or level in the overall electrical generation, transmission, distribution, or utilization system.

The analysis shall include, but shall not be limited to, the following:

A tabulation of the symmetrical RMS bolted fault current available and X/R ratio at each piece of electrical equipment.

A tabulation of the arc fault current available at each piece of electrical equipment.

A list containing the incident energy and the flash-protection boundary for all electrical equipment.

A list containing each piece of electrical equipment, its corresponding incident energy, hazard rating, and the required Personal Protective Equipment.

An Engineering and Testing Services firm acceptable to the City shall conduct the Arc Flash Hazard Analysis.

3-2.01. Arc Flash Analysis Software. The Arc Flash Hazard Analysis shall be performed using the latest version of SKM Power*Tools for Windows software, without exception. After the final version of the study and analysis are completed and accepted, Contractor shall provide two (2) copies of the SKM electronic file to the City.

3-2.02. Arc Flash Hazard Report.

Contractor shall be responsible for submitting complete and accurate arc flash analysis information in the Arc Flash Hazard Report. The report shall be submitted to the City for review before the final report is prepared. Contractor shall ensure that calculated values for flash-protection boundary, working distance, incident energy, and required Personal Protective Equipment is submitted and provide substantiation that the information will be prominently displayed on electrical equipment.

The Arc Flash Hazard Analysis report shall be bound in a standard 8-1/2 by 11 inch three-ring binder and shall be submitted in accordance with the Submittals section. Final selection of required Personal Protective Equipment shall be subject to review and acceptance by the City.

3-2.03. Arc Flash Labeling. After approval of the Arc Flash Hazard Report, Contractor shall furnish and install arc flash warning labels on the applicable electrical equipment. All electrical equipment shall be provided with the appropriate ANSI compliant arc flash labeling. Labels shall include the flash protection boundary distance, incident energy, and minimum required Personal Protective Equipment.

3-3. COORDINATION STUDY. Contractor shall commission a short circuit study and protective-device coordination study of relays, fuses, circuit breakers, and all other protective devices and shall submit a coordination report as specified herein. The study shall include the entire backup power generation distribution system, back to the ozone and convtional plant switchgears, starting with the smallest – 480 volt, 3 phase, 60 Hz – circuit protective device on the load end, to the nearest protective device on the power company's line side.

Contractor shall be responsible for and shall ensure that all relays and circuit breakers are set according to the study results.

The study shall include, but shall not be limited to, the following:

Color-coded printouts of coordination curves prepared with calculation software.

A tabulation of all protective relay and circuit breaker trip settings and recommended sizes and types of medium-voltage fuses.

Motor starting profiles for all 50 horsepower [37 kW] and larger motors.

Transformer damage curves and protection, evaluated in accordance with ANSI/IEEE C57.109.

Coordination curve(s) from the power company, if available.

Calculated short-circuit values at all nodes in the distribution system included within the scope of the coordination study.

An Engineering and Testing Services firm acceptable to the City shall conduct the coordination study.

Contractor shall be responsible for obtaining the following:

The coordination curves for relays, fuses, and circuit breakers.

Transformer damage curves.

Motor data.

Other applicable information for all new and existing electrical equipment.

Contractor shall coordinate with the power company to obtain the required protective device curves and shall be responsible for all the field work associated with obtaining the necessary data on existing relays, circuit breakers, fuses, and transformers to be included in the coordination study.

The available 3 phase, symmetrical fault current at the point of service shall be obtained from the Power Company.

The coordination report shall be bound in a standard 8-1/2 by 11 inch three-ring binder and shall be submitted in accordance with the Submittals section. Final selection of all protective device settings or sizes shall be subject to review and acceptance by the City.

3-4. POWER AND SERVICE ENTRANCE INSTALLATION. Not used.

3-5. TELEPHONE SERVICE ENTRANCE INSTALLATION. Not used.

3-6. CABLE INSTALLATION.

3-6.01. General. Except as otherwise specified or indicated on the Drawings, cable shall be installed according to the following procedures, taking care to

protect the cable and to avoid kinking the conductors, cutting or puncturing the jacket, contamination by oil or grease, or any other damage. Circuits to supply electric power and control to equipment and devices, communication and signal circuits as indicated on the one-line diagrams shall be installed continuous and may not be spliced unless approved by the the City.

a. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Wrapping stranded cables around screw type terminals is not acceptable.

b. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors may be used for splicing solid cable and for terminations at lighting fixtures.

c. Splices may be made only at readily accessible locations.

d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions. All shielded cable stress cone terminations shall be IEEE Class 1 molded rubber type. Shielded cable splices shall be tape or molded rubber type as required. Shielded cable splices and stress cone terminations shall be made by qualified splicers. Materials shall be by 3M Company, Plymouth/Bishop, or Raychem Electric Power Products.

e. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.

f. Cable-pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone; and shall be Polywater "Type J".

g. Cables operating at more than 2000 volts shall be fireproofed in all cable vaults, manholes, and handholes. Fireproofing shall be applied with a half-lapped layer of 3M "Scotch 77 Arc-Proofing Tape", anchored at each end with a double wrap of 3M "Scotch 69 Glass Cloth Tape" or with equivalent tape by Anixter or Plymouth/Bishop.

h. Where necessary to prevent heavy loading on cable connections, in vertical risers, the cable shall be supported by Kellems, or equal, woven grips.

i. Spare cable ends shall be taped, coiled, and identified.

j. Cables shall not be bent to a radius less than the minimum recommended by the manufacturer. For cables rated higher than 600 volts, the minimum radius shall be 8 diameters for nonshielded cable and 12 diameters for shielded cable.

k. All cables in one conduit, over 1 foot [305 mm] long, or with any bends, shall be pulled in or out simultaneously.

l. Circuits to supply electric power and control to equipment and devices are indicated on the one-line diagrams. Conductors in designated numbers and sizes shall be installed in conduit of designated size. Circuits shall not be combined to reduce conduit requirements unless acceptable to the City.

3-6.02. Underground Cable Pulling Procedure. Care shall be taken to prevent excessive physical stresses that would cause mechanical damage to cables during pulling.

3-6.03. Cable Insulation Test. Conductors with insulation rated 5,000 volts and higher shall be given a field dc insulation test.

The ampacity of direct current testing equipment shall be at least 2,500 microamperes.

Final test voltages and the duration of the test shall be as indicated on the Cable Data Sheets attached to this section. Cable insulation testing shall be recorded on the Cable Test Data Form attached to this section, Figure 16-16050.

Test procedures shall conform to ICEA S-93-639 (NEMA WC 74), 5-46 kV Shielded Power Cable For Use In The Transmission & Distribution of Electric Energy, and the applicable qualification testing standards of AEIC CS-8.

The tests shall be performed by experienced personnel specializing in electrical cable testing. Triplicate copies of test data for each cable shall be submitted to the City. A Cable Test Data Form is included in this section.

3-7. CONDUIT INSTALLATION. Contractor shall be responsible for routing all conduits. This shall include all conduits indicated on the one-lines, riser diagrams, and home-runs shown on the plan Drawings. Conduits shall be routed as defined in these Specifications. Where conduit routing is shown on plans, it shall be considered a general guideline and shall be field verified to avoid interferences.

Except as otherwise specified or indicated on the Drawings, conduit installation and identification shall be completed according to the following procedures.

3-7.01. Installation of Interior and Exposed Exterior Conduit. This section covers the installation of conduit inside structures, above and below grade, and in exposed outdoor locations. In general, conduit inside structures shall be concealed. Large conduit and conduit stubs may be exposed unless otherwise

specified or indicated on the Drawings. No conduit shall be exposed in water chambers unless so indicated on the Drawings.

Unless otherwise indicated on the Drawings, Contractor shall be responsible for routing the conduit to meet the following installation requirements:

a. Conduit installed in all exposed indoor locations, except corrosive areas indicated on the Drawings, and in floor slabs, walls, and ceilings of hazardous (classified) locations, shall be rigid steel. Exposed conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.

b. Conduit installed in floor slabs and walls in non-hazardous locations shall be rigid Schedule 40 PVC.

c. Conduit installed in all exposed outdoor locations shall be PVC-coated rigid steel, rigidly supported by PVC-coated framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

d. Final connections to dry type transformers, to motors without flexible cords, and to other equipment with rotating or moving parts shall be liquidtight flexible metal conduit with watertight connectors installed without sharp bends and in the minimum lengths required for the application, but not longer than 6 feet [1.8 m] unless otherwise acceptable to the City.

e. Terminations and connections of rigid steel and intermediate metal conduit shall be taper threaded. Conduits shall be reamed free of burrs and shall be terminated with conduit bushings.

f. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.

g. Two or more conduits in the same general routing shall be parallel, with symmetrical bends.

h. Conduits shall be at least 6 inches from high temperature piping, ducts, and flues.

i. Conduit installed in corrosive chemical feed and storage areas as indicated by Area Type on the Drawings shall be rigid Schedule 40 PVC.

j. Rigid Schedule 40 PVC conduit shall have supports and provisions for expansion as required by NEC Article 352.

k. Metallic conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.

l. Rigid Schedule 40 PVC conduit shall be secured to sheet metal device boxes using a male terminal adapter with a locknut inside or by using a box adapter inserted through the knockout and cemented into a coupling.

m. Conduits in walls or slabs, which have reinforcement in both faces, shall be installed between the reinforcing steel. In slabs with only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduits larger than 1/3 of the slab thickness shall be concrete encased under the slab.

n. Conduits that cross structural joints where structural movement is allowed shall be fitted with concretetight and watertight expansion/deflection couplings, suitable for use with metallic conduits and rigid Schedule 40 PVC conduits. The couplings shall be Appleton Type DF, Crouse-Hinds Type XD, or O-Z Type DX.

o. Conduit shall be clear of structural openings and indicated future openings.

p. Conduits through roofs or metal walls shall be flashed and sealed watertight.

q. Conduit installed through any openings cut into non-fire rated concrete or masonry structure elements shall be neatly grouted. Conduit penetrations of fire rated structure elements shall be sealed in a manner that maintains the fire rating as indicated on the Architectural Drawings.

r. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.

s. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.

t. Concealed conduit for future use shall be terminated in equipment or fitted with couplings plugged flush with structural surfaces.

u. Where the Drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.

v. Horizontal conduit shall be installed to allow at least 7 feet of headroom, except along structures, piping, and equipment or in other areas where headroom cannot be maintained.

w. Conduit shall not be routed across the surface of a floor, roof, or walkway unless approved by the City.

x. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer's installation procedure using appropriate tools.

y. All conduits that enter enclosures shall be terminated with acceptable fittings that will not affect the NEMA rating of the enclosure.

z. Nonmetallic conduit, which turns out of concrete slabs or walls, shall be connected to a 90 degree elbow of PVC-coated rigid steel conduit before it emerges. Conduits shall have PVC-coated rigid steel coupling embedded a minimum of 3 inches when emerging from slabs or walls and the coupling shall extend 2 inches from the wall.

aa. Power conductors to and from adjustable frequency drives shall be installed in steel conduit.

ab. Conduits for feeders connected to the Critical Operations Power Systems (COPS), as defined by NEC Article 708, which are not embedded in 2 inches of concrete shall be coated with a listed electrical conduit protective system with a minimum 2-hour fire rating. Existing modified feeder conduits connected to the COPS shall also be protected by a 2-hour fire-rated system. System shall be installed in accordance with the manufacturer’s recommendations. Protective system shall be manufactured by 3M or approved equal.

3-7.02. Underground Conduit Installation. All excavation, backfilling, and concrete work shall conform to the respective sections of these Specifications. Underground conduit shall conform to the following requirements:

a. All underground conduits shall be concrete encased unless indicated otherwise on the Drawings. Concrete encasement within 15 feet of building entrances, under and within 5 feet of roadways, and within 10 feet of indicated future excavations shall be reinforced as detailed on the Drawings.

b. Concrete encased conduit shall be schedule 40 PVC. Conduits shall have PVC-coated rigid steel coupling embedded a minimum of 3 inches when emerging from walls and the coupling shall extend 2 inches from the wall. All PVC joints shall be solvent welded in accordance with the recommendations of the manufacturer.

c. Concrete encasement on exposed outdoor conduit risers shall continue to 6 inches above grade, with top crowned and edges chamfered.

d. Conduit and concrete encasement installed underground for future extension shall be terminated flush at the bulkhead with a coupling and a screw plug. The termination of the duct bank shall be reinforced with bars 100 diameters long that shall be terminated 2 inches from the bulkhead. Matching splice bars shall be 50 bar diameters long. Each longitudinal bar shall be provided with a Lenton "Form Saver" coupler and plate or a Dayton "Superior DBR" coupler at the bulkhead. The coupler shall be threaded to accept a dowel of like diameter in the future. Threads shall be protected with screw-in plastic caps. A 1-3/4 by 3/4 inch deep horizontal shear key shall be formed in the concrete encasement above and below the embedded conduits. After concrete placement, conduit and bar connector ends shall be cleaned and coated with two coats of thixotropic coal tar.

e. Underground conduits indicated not to be concrete encased shall be rigid Schedule 40 PVC.

f. Underground conduit bend radius shall be at least 2 feet at vertical risers and at least 3 feet elsewhere.

g. Underground conduits and conduit banks shall have at least 2 feet of earth cover, except where indicated otherwise.

h. Underground conduit banks through building walls shall be cast in place, or concreted into boxouts, with water stops on all sides of the boxout. Water stops are specified in the Cast-In-Place Concrete section.

i. Underground nonmetallic conduits, which turn out of concrete or earth in outdoor locations, shall be connected to 90 degree elbows of PVC-coated rigid steel conduit before they emerge.

j. Conduits not encased in concrete and passing through walls, which have one side in contact with earth, shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.

k. Underground conduits shall be sloped to drain from buildings to manholes.

l. Each 5 kV or higher voltage cable, each 250 kcmil or larger cable, and each conduit group of smaller cables shall be supported from manhole walls by Kindorf "D-990" or Unistrut "P-3259" inserts, with Kindorf "F-721-24" or Unistrut "P-2544" brackets and Unistrut "P1753" or "P1754" fiberglass reinforced polyester cable saddles.

m. Telephone cables shall not be installed in raceways, conduits, boxes, manholes, or handholes containing other types of circuits.

n. Intercommunication and instrument cables shall be separated the maximum possible distance from all power wiring in pull-boxes, manholes, and handholes.

3-7.03. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by forcing nonhardening sealing compound into the conduits to a depth at least equal to the conduit diameter. This method shall be used for sealing all conduits at handholes, manholes, and building entrance junction boxes, and for 1 inch and larger conduit connections to equipment.

3-7.04. Reuse of Existing Conduits. Existing conduits may be reused subject to the concurrence of the City and compliance with the following requirements:

a. A wire brush shall be pulled through the conduit to remove any loose debris.

b. A mandrel shall be pulled through the conduit to remove sharp edges and burrs.

3-8. WIRING DEVICES, BOXES, AND FITTINGS INSTALLATION. Metallic and nonmetallic conduit boxes and fittings shall be installed in the following locations:

3-8.01. Conduit Boxes and Fittings.

a. Galvanized or cadmium plated, threaded, malleable iron boxes and fittings shall be installed in concrete walls, ceilings, and floors; in the outdoor faces of masonry walls; and in all locations where weatherproof device covers are required. These boxes and fittings shall also be installed in exposed rigid steel and intermediate metal conduit systems.

b. Galvanized or cadmium plated sheet steel boxes shall be installed in the indoor faces of masonry walls, in interior partition walls, and in joist supported ceilings.

c. Rigid PVC device boxes shall be installed in exposed nonmetallic conduit systems.

d. PVC coated boxes and fittings shall be installed in PVC coated conduit systems.

3-8.02. Device Plates. Oversized plates shall be installed where standard-sized plates do not fully cover the wall opening.

3-8.03. Wall Switches.

a. Wall switches shall be mounted 3'-6" above floor or grade.

b. After circuits are energized, all wall switches shall be tested for proper operation.

3-8.04. Receptacles.

a. Convenience outlets shall be 18 inches above the floor unless otherwise required.

b. Convenience outlets outdoors and in garages; in basements, shops, storerooms, and rooms where equipment may be hosed down; shall be 4 feet above floor or grade.

c. Welding receptacles shall be surface-mounted 4 feet above the floor.

d. After circuits are energized, each receptacle shall be tested for correct polarity and each GFCI receptacle shall be tested for proper operation.

e. Conduit and wire for convenience outlet installation is not shown on the Drawings and shall be sized, furnished, and installed by Contractor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for convenience outlet installation.

3-9. EQUIPMENT INSTALLATION. Except as otherwise specified or indicated on the Drawings, the following procedures shall be used in performing electrical work.

3-9.01. Setting of Equipment. All equipment, boxes, and gutters shall be installed level and plumb. Boxes, equipment enclosures, metal raceways, and similar items mounted on water- or earth-bearing walls shall be separated from the wall by at least 1/4 inch thick corrosion-resistant spacers. Where boxes, enclosures, and raceways are installed at locations where walls are not suitable or available for mounting, concrete equipment pads, framing material, and associated hardware shall be provided.

3-9.02. Sealing of Equipment. All outdoor substation, switchgear, motor control center, and similar equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed with concrete grout to keep out rodents and insects the size of wasps and mud daubers. Small cracks and openings shall be sealed from inside with silicone sealant, Dow-Corning "795" or General Electric "SCS1200".

3-10. GROUNDING.

3-10.01. General. The electrical system and equipment shall be grounded in compliance with the National Electrical Code and the following requirements:

a. All ground conductors shall be at least 12 AWG soft drawn copper cable or bar, bare or green-insulated in accordance with the National Electrical Code.

b. Ground cable splices and joints, ground rod connections, and equipment bonding connections shall meet the requirements of IEEE 837, and shall be exothermic weld connections or irreversible high-compression connections, Cadweld "Exothermic" or Burndy "Hyground". Mechanical connectors will not be acceptable. Cable connections to bus bars shall be made with high-compression two-hole lugs.

c. Ground cable through exterior building walls shall enter within 3 feet below finished grade and shall be provided with a water stop. Unless otherwise indicated, installation of the water stop shall include filling the space between the strands with solder and soldering a 12 inch copper disc over the cable.

d. Ground cable near the base of a structure shall be installed in earth and as far from the structure as the excavation permits, but not closer than 24 inches.The tops of ground rods and ground cable interconnecting ground rods shall be buried a minimum of 30 inches below grade, or below the frost line, whichever is deeper.

e. All powered equipment, including lighting fixtures and receptacles, shall be grounded by a copper ground conductor in addition to the conduit connection.

f. Ground connections to equipment and ground buses shall be made with copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be made with irreversible high-compression type lugs inserted under permanent assembly bolts or under new bolts drilled and inserted through enclosures, other than explosion proof enclosures, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be acceptable.

g. The grounding system shall be bonded to the station piping by connecting to the first flange inside the building, on either a suction or discharge pipe, with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection.

h. Ground conductors shall be routed as directly as possible, avoiding unnecessary bends. Ground conductor installations for equipment ground connections to the grounding system shall have turns with minimum bend radii of 12 inches.

i. Ground rods not described elsewhere shall be a minimum of 3/4 inch in diameter by 10 feet long, with a copper jacket bonded to a steel core.

j. Test wells and covers for non-traffic areas shall be molded high density polyethylene. Test wells for traffic areas shall be precast concrete construction rated for traffic duty with concrete or cast iron covers.

3-10.02. Grounding System Resistance. The grounding system design depicted on the Contract Drawings is the minimum design required for each building or structure. Each system shall comply with the maximum resistance of 5 ohms to ground. Contractor shall confirm the system grounding resistance with the results of the testing specified herein. Systems exceeding the maximum resistance specified shall be supplemented with additional grounding provisions and retested until the maximum specified resistance is achieved.

3-10.03. Grounding System Testing. The grounding system of each new building or structure and each existing building or structure indicated below, shall be tested to determine the resistance to earth. Testing shall be performed by an independent electrical or grounding system testing organization. Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil.

3-10.03.01. New Grounding Systems. Grounding systems of each new building or structure shall be tested for resistance to earth utilizing the three-point fall of potential test as defined by IEEE 81. Testing shall be completed prior to installation of the electrical distribution equipment to ensure the grounding system is isolated from the utility grounding system and the systems of other structures. The current source probe for the test shall be placed in soil at a distance of 5 to 10 times the distance of the widest measurement across the grounding system ring or grid to ensure adequate measurements outside of the grounding system's sphere of influence. Test probe measurements shall be taken at a distance of one foot from the grounding system reference connection and at each 10 percent increment from the grounding system reference connection to the current source probe location. Test results shall be documented on a graphical plot with resistance in ohms on the vertical axis and distance in feet on the horizontal axis. The results shall clearly indicate a system resistance plateau which confirms a valid test procedure.

3.10.03.02. Existing Grounding Systems. Grounding systems of each existing building or structure indicated shall be tested for resistance to earth.

Existing building(s) or structure(s) to be tested	Ozone Building, North Courtyard Electrical Substation, and Pump Building.

Where existing grounding systems can be isolated from the building power service or utility power service a three-point fall of potential test shall be completed as indicated above. Where isolation of the building grounding system is not practical, a clamp-on resistance test will be an acceptable alternative. Clamp-on resistance testing shall be completed utilizing a ground resistance tester specifically designed for clamp on resistance testing, such as the AEMC "Model 3711". Clamp-on resistance measurements shall be taken at the service side of the service entrance neutral, upstream of the neutral to ground bonding connection to ensure a single path between the grounding system and the utility reference.

3.10.03.03. Grounding System Test Report. A report certified by the testing organization shall be prepared and submitted in accordance with the Submittals section. The final report shall include complete testing results for each building or structure, graphical representation of the test point results for the three-point fall of potential method, and complete observations of all site weather conditions and other environmental conditions that may affect the test results. Final acceptance of the results reported shall be subject to the review and approval of the City.

3-11. LIGHTING FIXTURE INSTALLATION. The Drawings indicate the general locations and arrangements of the lighting fixtures. Fixtures in rows shall be aligned both vertically and horizontally unless otherwise specified. Fixtures shall be clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions.

Conduit and wire for lighting fixture installation is not shown on the Drawings and shall be sized, furnished and installed by Contractor. Circuits to emergency lighting units, exit signs, and fixtures indicated to be night lights shall not be switched. Circuits to fluorescent lighting fixtures indicated to have emergency battery packs shall include an additional un-switched hot conductor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for lighting fixture installation.

3-12. POWER FACTOR CORRECTION CAPACITOR INSTALLATION. Not used.

3-13. MODIFICATIONS TO EXISTING EQUIPMENT. Modifications to existing equipment shall be completed as specified herein and indicated on the Drawings. All existing facilities shall be kept in service during construction. Temporary power or relocation of existing power and control wiring, equipment, and devices shall be provided as required during construction. For the Ozone Facility, one bus of the existing switchgear L-SWG-1 shall remain energized at all times during construction, with all breakers in the appropriate positions throughout the facility distribution, such that only two ozone generators are out of service at any time, while all other facility loads remain uninterrupted. For the Conventional

Plant, one bus of the existing Conventional Plant Switchgear shall remain energized at all times during construction, with all breakers in the appropriate positions throughout the plant distribution, such that only half of the main pumps are out of service at any time, while all other plant loads remain uninterrupted. During times where one switchgear bus is de-energized for planned construction activities, if utility power is lost to the other switchgear bus, Contractor shall restore power to the de-energized bus within 15 minutes. A switchgear bus shall only be allowed to be de-energized during the work day construction period. Buses shall not be allowed to remain de-energized overnight.

3-13.01. Demolition. Unless otherwise specified or indicated on the Drawings, all cable and all exposed conduit for power and control signals of equipment indicated to be removed shall be demolished. Conduit supports and electrical equipment mounting hardware shall be removed, and holes or damage remaining shall be grouted or sealed flush. Conduit partially concealed shall be removed where exposed, and plugged with expanding grout flush with the floor or wall. Repairs shall be refinished to match the existing surrounding surfaces. Demolished equipment shall be discarded or salvaged as indicated on the Drawings and as specified in other sections of these Specifications.

End of Section

STANDARD SPECIFICATIONS

REFERENCE: UL 83, ICEA S-95-658 (NEMA WC70).

CONDUCTOR: Solid, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, UL 83, Type THHN and THWN, ICEA S-95-658.

SHIELD: None.

JACKET: Conductor: Nylon, 4 mils (100 µm) minimum thickness, UL 83.

FACTORY TESTS: Cable shall meet the requirements of UL 83 for Type THHN and THWN.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	**mm²**		**in.**	**µm**	**in.**	**mm**
12	4.0	1	0.015	380	0.17	4.32
10	6.0	1	0.020	510	0.20	5.08

*The average thickness shall be not less than that indicated above. The minimum thickness shall not be less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, THWN or THHN, conductor size, and 600 volt.

600 Volt, Single Conductor Lighting Cable (600-1-PVC-THHN-THWN)

BLACK & VEATCH	Cable Data	Figure 1-16050

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Concentric-lay, uncoated copper; strand Class B. Wet/dry maximum operating temperature 90°C.

INSULATION: Cross-linked thermosetting polyethylene, ICEA S-95-658, Paragraph 3.6.

SHIELD: None.

JACKET: None.

FACTORY TESTS: Cable shall meet the requirements of ICEA S-95-658.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm²		in.	µm	in.	mm
14	2.5	7	0.030	760	0.17	4.32
12	4.0	7	0.030	760	0.19	4.83
10	6.0	7	0.030	760	0.21	5.33
8	10.0	7	0.045	1140	0.27	6.86
6	16.0	7	0.045	1140	0.31	7.87
4	25.0	7	0.045	1140	0.36	9.14
2	35.0	7	0.045	1140	0.42	10.67
1	40.0	19	0.055	1400	0.48	12.19
1/0	50.0	19	0.055	1400	0.52	13.21
2/0	70.0	19	0.055	1400	0.57	14.48
4/0	95.0	19	0.055	1400	0.68	17.27
250	120.0	37	0.065	1650	0.75	19.05
350	185.0	37	0.065	1650	0.85	21.59
500	300.0	37	0.065	1650	0.98	24.89
750	400.0	61	0.080	2030	1.22	31.00
1,000	500.0	61	0.080	2030	1.37	34.80

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, XLP, XHHW-2, conductor size, and voltage class.

600 Volt, Single Conductor Lighting/Power Cable (600-1-XLP-NONE-XHHW-2)

BLACK & VEATCH	Cable Data	Figure 2-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 62, UL 1277.

CONDUCTOR: 16 AWG (1.5 mm^2), 7-strand, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, not less than 15 mils (380 μm) average thickness; 13 mils (330 μm) minimum thickness, UL 62, Type TFN.

LAY: Twisted pair with 1-1/2 inch to 2-1/2 inch (38.10 mm - 63.5 mm) lay.

SHIELD: Cable assembly, combination aluminum-polyester tape and 7-strand, 20 AWG (0.5 mm^2) minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulated conductors.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 62.

Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.

CONDUCTOR IDENTIFICATION: One conductor black, one conductor white.

FACTORY TESTS: Insulated conductors shall meet the requirements of UL 62 for Type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical-tray flame test requirements of UL 1277.

Cable Details

	Assembly Jacket Thickness*		Maximum Outside Diameter	
	in.	μm	in.	mm
Single Pair	0.045	1140	0.34	8.64

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the value indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, Type TC, Type TFN, conductor size, single pair, and voltage class.

600 Volt, Single Pair, Shielded Instrument Cable (600-SINGLE-PAIR-SH-INSTR)

BLACK & VEATCH	Cable Data	Figure 4-16050

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-93-639 (NEMA WC 74), AEIC CS-8, ICEA P-45-482.

CONDUCTOR: Concentric-lay, uncoated or coated copper, strand Class B. Normal maximum operating temperature 90°C.

CONDUCTOR SHIELD: Extruded semiconducting thermosetting material, ICEA S-93-639, Section 3.

INSULATION: Ethylene-propylene rubber, ICEA S-93-639, Section 4, not less than 115 mils (2920 μm) average thickness; 103.5 mils (2630 μm) minimum thickness.

INSULATION SHIELD: Extruded semiconducting thermosetting material, and nonembedded coated copper tape or coated copper wires, ICEA S-93-639, Section 5. Extruded material shall be tested in accordance with ICEA S-93-639 and AEIC CS-8. Shield area shall be not less than that of one helically applied 5 mil (130 μm) copper tape with a 10 percent overlap when calculated according to Formula 3 in ICEA P-45-482.

JACKET: Black polyvinyl chloride, ICEA S-93-639, Paragraph 7.1.9.

FACTORY TEST: Cable shall meet the requirements of ICEA S-93-639 and AEIC No. CS-8.

Cable Details

Size		Number of Strands	*Jacket Thickness		Maximum Outside Diameter	
AWG or kcmil	**mm²**		**in.**	**μm**	**in.**	**mm**
6	16	7	0.060	1520	0.74	18.8
4	25	7	0.060	1520	0.78	19.81
2	35	7	0.060	1520	0.84	21.34
1	40	19	0.060	1520	0.88	22.35
1/0	50	19	0.060	1520	0.92	23.37
2/0	70	19	0.080	2030	1.01	25.65
4/0	95	19	0.080	2030	1.12	28.45
250	120	37	0.080	2030	1.18	29.97
350	185	37	0.080	2030	1.29	32.77
500	300	37	0.080	2030	1.45	36.88
750	400	61	0.080	2030	1.65	41.91
1000	500	61	0.080	2030	1.81	45.97

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the values indicated above.

The conductor shield, insulation, and insulation shield shall be applied in a triple extrusion process with all three components being cured at the same time.

The color of the insulation shall be in contrast to the color of the semiconducting paint. The semiconducting paint shall be readily removable for terminating.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, insulating material, conductor size, and voltage class.

Voltage Test After Installation: DC Test Voltage - 36 kV
Duration of Test - 15 Minutes

8000 Volt, Single Conductor Power Cable
100 Percent Insulation Level (8000-1-EPR-PVC-SH)

BLACK & VEATCH	Cable Data	Figure 9-16050

Project and Location _____ Project No. _____

Circuit Designation _____ Date _____

DC TEST DATA

Time in Minutes After 100% Test Voltage Is Applied	Current, µA		
	Phase A	Phase B	Phase C
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
kV dc after 1 min Decay			

DC Test Voltage _____

Cable Installation: New ____ Used ___ Years____

Cable: Size _____ Length: _____

Oper. kV _____ Grounded _____ Ungrounded _____

Rated Cable Voltage _____

Insulation Wall _____
(Type & Thickness)

Conductor Jacket Wall _____
Type & Thickness)

Shield _____
(Type)

Cable Manufacturer _____

Temperature _____ Humidity_____

Type of Termination _____

Type of Splice & Location_____
_____

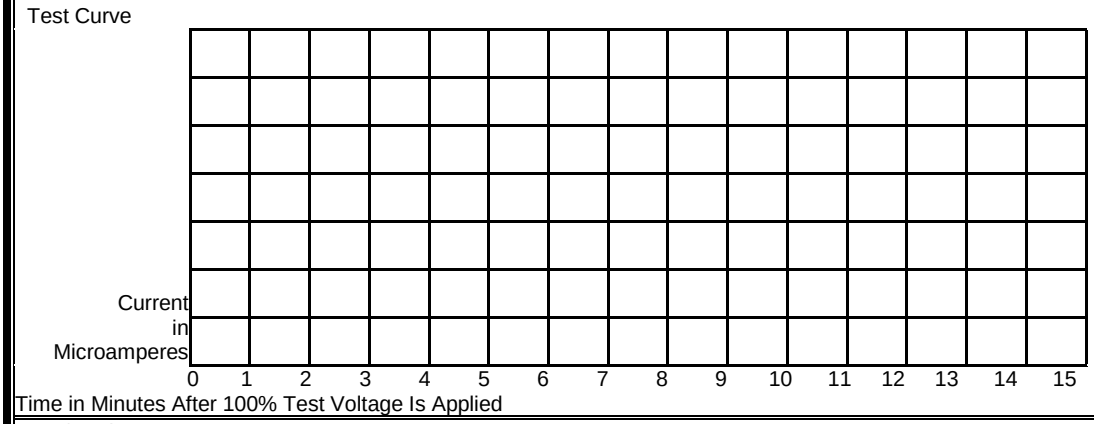
Remarks_____

100 Microamperes (µA) = 0.1 Milliampere

APPLICATION OF TEST VOLTAGE

The initially applied direct-current voltage shall be not greater than 3.0 times the rated alternating-current voltage. The rate of increase from the initially applied voltage to the specified test voltage shall be not over 100 percent in 10 seconds nor less than 100 percent in 60 seconds. The duration of the direct-current voltage test shall be 15 minutes for shielded cables and 5 minutes for nonshielded cables.

Test Curve



NOTES:

1. Plot results of tests on all three phases on this graph.
2. Assign and indicate values for each division on the microamperes scale as required for the circuit being tested.

Cable Test Data Form

BLACK & VEATCH	Cable Data	Figure 16-16050

Section 16100

ELECTRICAL EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of electrical equipment.

1-2. GENERAL. Equipment specified to be installed under this section shall be erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the City.

The electrical equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give the City written notice at least 14 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished under the original procurement contract will be furnished to Contractor upon completion of review by the City. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Delivery. When sills are required for electrical equipment, they shall be shipped ahead of the scheduled equipment delivery to permit installation before concrete is placed.

1-3.02. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Handling and Storage section, and in accordance with manufacturer's written instructions, until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment clean and dry at all times. Openings shall be plugged or capped (or otherwise sealed by packaging) during temporary storage.

1-3.03. Handling. Electrical equipment shall be moved by lifting, jacking, or skidding on rollers as described in the manufacturer's instructions. Special lifting harness or apparatus shall be used when required. Lifting and jacking points shall be used when identified on the equipment. Contractor shall have required unloading equipment on site to perform unloading work on the date of equipment delivery.

1-4. ARC FLASH HAZARD LABELS. Switchgear, switchboards, motor control centers, motor control line-ups, and transfer switches shall be provided with permanent labels warning the risk of arc flash and shock hazard. Labels shall be designed in accordance with ANSI Z535.4-1998 and shall include the following information:

WARNING
Arc Flash and Shock Hazard

Appropriate personal protection equipment (PPE) required. See NFPA 70E.
Equipment must be accessed by qualified personnel only.
Turn off all power sources prior to working on or inside equipment.

Additional information shall be provided on the labels where specified in the Arc Flash Hazard Analysis section of Electrical section.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All installation work shall be in accordance with manufacturer's written instructions.

All material, equipment, and components specified to be installed according to this section shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

Electrical equipment cubicles and vertical sections shall be installed plumb and level. Drawout equipment carriages, circuit breakers, and other removable components shall operate free and easy without binding or distortion.

Unless otherwise indicated or specified, all indoor floor-mounted electrical equipment and control cabinets shall be installed on concrete equipment pads four inches in height.

Indoor metalclad switchgear shall be bolted to steel floor channels which are installed level and flush with the top of the concrete floor or equipment pad.

Outdoor metalclad switchgear and interrupter gear with integral floor channels or beams shall be secured to concrete pads with anchor bolts and clips.

Motor control centers with integral floor sills shall be secured to concrete floors or equipment pads with anchor bolts.

Adequate bracing shall be provided for seismic forces. The bracing shall be designed to meet the requirements of the Meteorological and Seismic Design Criteria section.

3-1.01. Cleaning. All deposits of oil, grease, mud, dirt or debris shall be cleaned from the electrical equipment following installation and field wiring. A detergent water based solution, or other liquid cleaners not harmful to material or equipment finishes, shall be used as recommended by the manufacturer.

End of Section

Section 16491

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1-1. SCOPE. This section covers indoor automatic transfer switches which shall be furnished, and tested as specified and as indicated on the Drawings.

Automatic transfer switch equipment shall meet the design conditions and features.

Automatic transfer switch equipment shall be designated and located as follows:

Tag number(s).	LW-E-ATS-02, LW-E-ATS-03
Location of transfer switch(es).	Conventional Plant HVAC Shop Ozone Building Electrical Room

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the City.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment furnished under this section. If stipulations in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence.

1-2.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. Contractor shall review the Contract Drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by the City.

1-2.03. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

1-2.04. Governing Standards. The equipment furnished under this section shall be designed, constructed, and tested in accordance with UL 1008, Standard for Safety Transfer Switch Equipment; NFPA 110, Standard for Emergency and

Standby Power Systems; and the latest applicable standards of ANSI, NEMA, and IEEE.

The automatic transfer switch shall be UL listed for use in emergency power systems in accordance with Article 700, Emergency Systems.The automatic transfer switch shall be UL listed for use in standby power systems in accordance with Article 701, Legally Required Standby Systems.The automatic transfer switch shall be UL listed for use in standby power systems in accordance with Article 702, Optional Standby Systems, of the National Electrical Code.

1-2.05. Nameplates. Nameplates with designation of each control or indicating device shall be mounted on the switch enclosure. Nameplates shall be black and white laminated phenolic material of suitable size, and shall be engraved with 3/4 inch [19 mm] high letters for section identity and 1/8 inch [3 mm] letters for other information. The engraving shall extend through the black exterior lamination to the white center.

Each control device and each control wire terminal block connection inside the units shall be identified with a permanent nameplate or painted legend to match the identification on the manufacturer's wiring diagram.

1-2.06. System Characteristics. The equipment will be connected to a power system with characteristics as specified below:

Voltage, phase	480, 3-phase V
Frequency	60 Hz
Number of conductors	3-wire

1-3. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the transfer switch, shall be submitted in accordance with the Submittals section. The drawings and data shall include, but shall not be limited to, the following:

Drawings showing front and side views, plan, and weight.
Rating and specifications.
Circuit breaker time-current characteristic curves, if applicable.
Single-line, control schematic, and wiring connection diagrams.
Operation and maintenance and manuals including a list of spare parts.
Seismic certification, when applicable.

1-4. OPERATION AND MAINTENANCE MANUALS. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition

to any instructions or parts lists packed with or attached to the equipment when delivered.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and Storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. The automatic transfer switch shall be a product of a manufacturer who has supplied such equipment for at least 5 years.

The automatic transfer switch shall be manufactured by Automatic Switch Co. (ASCO), GE Zenith Controls, or Russelectric Inc., without exception.

2-2. CONSTRUCTION FEATURES.

2-2.01. Enclosure. The enclosure for the transfer switch shall be as follows:

Type of mounting	Wall mounted
Enclosure rating	Indoor NEMA Type 1

Adequate bracing shall be provided for seismic forces. The bracing shall be designed to meet the requirements of the Meteorological and Seismic Design Criteria section.

2-2.02. Rating. Automatic transfer switches shall be rated for continuous duty in both normal and emergency positions. The switches shall have the number of poles as specified below, and shall be double-throw. Ampere ratings, and 3-cycle closing and withstand ratings shall be as specified below.

Number of poles	3-pole
Ampere rating and 3-cycle closing and withstand rating	260/35,000 A

2-2.03. Space Heaters. Not used.

2-3. PERFORMANCE AND DESIGN REQUIREMENTS.

2-3.01. Equipment Description. The automatic transfer switches shall transfer electric loads from the normal source of electric power to an emergency source of power as indicated on the Drawings. The transfer switches shall automatically transfer the electrical load circuits upon an interruption or a decrease in the

voltage of the normal source of power and shall transfer the loads back to the normal source when it becomes available. The transfer switches shall be furnished without integral overcurrent protection. The switches shall be electrically operated but mechanically held in both the normal and emergency positions. The operating mechanism shall be momentarily energized from the source to which the load is being transferred. All main and arcing contacts and control elements shall be removable from the front of the switches without removing the switch from the enclosure and without removing the power cables. The automatic transfer switches shall be so designed that the load circuits cannot be connected to more than one source of power at a time. The automatic transfer switches shall be magnetic contactor type.

2-3.01.01. Automatic Transfer Switch. The automatic transfer switch shall be an electrically operated double throw switch. Main contacts shall be silver composition. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance. A manual handle shall be provided for maintenance.

Switches composed of molded case breakers, contactors, or similar components not specifically designed for automatic transfer switch applications will not be acceptable.

2-3.01.02. Bypass-Isolation Switch. Not used.

2-3.02. Control System. The control system shall consist of all control devices necessary to operate the switch as described. The system shall incorporate a microprocessor control module connected to the power transfer components by a wire harness and keyed disconnect plugs. The control module shall be completely enclosed with a protective cover and shall be mounted separately from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on plug-in circuit boards. All interface relays shall be identical and shall be control grade, plug-in type, with dust covers.

All control components shall meet or exceed the voltage withstand capability in accordance with IEEE 472 and NEMA ICS 1-109.

2-3.02.01. Performance. The automatic transfer switch shall be designed to function in accordance with the following requirements:

a. The voltage of each phase of the normal source shall be monitored and the pickup voltage shall be adjustable from 85 percent to 100 percent of nominal, and the dropout voltage shall be adjustable from 75 percent to 98 percent of the pickup value. The transfer to emergency will be initiated upon reduction of the normal source to 85 percent of the normal voltage, and retransfer to normal shall occur when the normal source restores to 90 percent of the normal voltage.

b. A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals shall be provided. The time delay shall be field adjustable from 0.5 to 6 seconds and shall be factory set at 1 second.

c. A time delay to retransfer to the normal source shall be provided. The time delay shall be automatically bypassed if the emergency source fails and the normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

d. An in-phase monitor shall be provided to control transfer so motor load inrush currents do not exceed normal starting currents. The monitor shall compare the phase relationship and frequency difference between the normal and emergency sources and shall permit transfer only at acceptable values of voltage, phase relationship, and frequency differential.

2-3.02.02. Indication. The automatic transfer switch shall include indication features in accordance with the following requirements:

a. A detailed step-by-step operating instruction plate shall be provided on the front of the switch.

b. Indicating lights or microprocessor control display indication shall be provided for, but shall not be limited to, the following:

Normal source available.
Emergency source available.
Bypass switch in normal position.
Bypass switch in emergency position.
Automatic transfer switch isolated.
Automatic transfer switch inhibit.
Automatic transfer switch in normal position.
Automatic transfer switch in emergency position.
Automatic transfer switch in test mode.

c. One auxiliary contact shall be provided that is closed when the automatic transfer switch is connected to the normal source and one contact that is closed when the automatic transfer switch is connected to the emergency source.

2-3.03. Shop Painting. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop painted with the manufacturer's standard coating. Finish color shall be ANSI 61. Field painting, other than touchup painting, shall not be required. A sufficient quantity of additional coating material and thinner shall be furnished to permit field touchup of damaged coatings.

2-3.04. Shop Tests. After the equipment has been completely assembled, it shall be shop tested for general operating condition, circuit continuity, high potential, and for compliance with the governing standards. Certified test results shall be submitted to the City before the equipment is shipped.

PART 3 - EXECUTION

3-1. INSTALLATION. The transfer switch will be installed in accordance with Electrical Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of the City.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

Section 16530

SITE LIGHTING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of exterior luminaries and accessories and site lighting poles.

The drawings indicate a general, functional arrangement for the equipment. The Supplier shall review the drawings and supply equipment that meets the functional requirements indicated, and shall furnish and install additional components if required for a properly operating system.

1-2. GENERAL. The Contractor shall furnish all installation drawings, tools, equipment, materials, and supplies and shall coordinate all labor required to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.

The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section.

1-2.02. Governing Standards. All wiring, components and work shall be preformed and materials shall be furnished in accordance with IES RP-8 – Recommended Practice for Roadway Lighting and NFPA 70 – National Electric Code.

1-2.03. Power Requirements. Primary power supply to all components will be 120 volts, 60 Hz, single phase.

1-3. SUBMITTALS. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the Submittals section.

The Contractor shall work in conjunction with the City and the City's Preferred Security Integrator to determine the location of the pole inserts and the required low voltage conduit installation for the camera and power requirements of the lighting units. This information shall be included with all other pertinent structural

pole details in a shop drawing submittal to the City, prior to placing the pole order.

PART 2 - PRODUCTS

2-1. ROADWAY LUMINAIRES AND ACCESSORIES

2-2. LUMINAIRES. Luminaires as indicated on the drawings.

2-3. MOUNTING. Provide pole-mount brackets for roadway units, complete with all appurtenances for mounting luminaires. Units shall be single-bracketed, one luminaire per pole.

2-4. POLES.

2-4.01. Material and Finish. Pre-stressed, spun concrete pole with exposed aggregate finish. Color to match existing roadway lighting units.

2-4.02. Section Shape and Dimensions. Square with beveled corners. The internal wiring raceway shall be 1-1/2” minimum. Pole shall have provision for divider or other means to route 120V power and Cat 5e cables in separate raceways.

2-4.03. Height. Direct embedment type, with above-ground height as indicated on the contract drawings.

2-4.04. Accessories. Two additional holes or inserts to accommodate feedthrough of Cat 5e cables for camera installation by the Preferred Security Integrator. Each light pole shall be furnished handhole, ground lug, and pedestal.

2-4.05. Loading Capacity Ratings. Each pole assembly furnished under this contract, complete with brackets and luminaires, shall be designed to sustain a steady wind of 100 MPH minimum.

2-4.06. Quantities. A total of two (2) concrete poles shall be furnished and installed by the Contractor.

2-4.07. Manufacturer. Traditional Concrete Inc., model no. D525 series or approved equal.

PART 3 - EXECUTION

3-1. GENERAL. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.

3.2. INSTALLATION. All poles shall be directly embedded into the ground plumb, to a depth as recommended by the manufacturer. Luminaires shall be mounted perpendicular to the roadway, unless otherwise indicated on the Contract Drawings.

Bond luminaires, metal accessories, and poles to branch equipment grounding conductor in accordance with NEC requirements.

Contractor shall adjust luminaires to provide optimum illumination levels and distribution.

The Contractor shall work in conjunction with the City and the City's Preferred Security Integrator to determine the location of the pole inserts and the required low voltage conduit installation for the camera and power requirements of the lighting units. This information shall be included with all other pertinent structural pole details in a shop drawing submittal to the City, prior to placing the pole order.

End of Section