



CITY OF MIAMI

TECHNICAL SPECIFICATIONS FOR:

RIVERVIEW STORMSEWER PUMP STATION EMERGENCY GENERATOR, FIRE SUPPRESSANT
SYSTEM AND MAIN SWITCH DISCONNECT PROJECT.

PREPARED BY:



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RJB Project No. 17096

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Reference Documents:

1. Department of Regulatory and Economic Resources, Miami-Dade County Plan Review Summary
2. Department of Regulatory and Economic Resources, Miami-Dade County Storage Tank System Application for Removal

END OF DIRECTORY

SECTION 01010 SUMMARY OF WORK

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION summarizes the WORK of the Project as covered in detail in the complete Contract Documents. This is a general summary and is not intended to be complete and all inclusive of the required WORK items.

1.02 SUBMITTALS:

- A. Submittals shall be in accordance with SECTION 01300.

1.03 PROJECT DESCRIPTION:

- A. Description of Project: The Riverview Pump Station is located at 1301 NW 6th Street, approximately 500 ft east of the Marlin's Baseball Park. The project consist on the replacement of the Riverview Pump Station Generator and The interconnection of the existing Pumps to the New Generator and to the New electrical equipment including a New Main Switch Disconnect from FPL transformer to the existing main switch board. The project also consists in the removal of the existing fire suppressant system and the installation of a New Carbon Dioxide (CO2) Fire Suppressant System including the electrical and mechanical connections.

1.04 RELATED CONTRACT ACTIVITIES:

- A. The CONTRACTOR shall provide adequate disposal of demolition equipment and material.
- B. The CONTRACTOR shall obtain all necessary permits prior to commencing construction activities.
- C. The CONTRACTOR shall refer to all drawing notes.

1.05 WORK PERFORMED BY OTHERS:

- A. N/A

1.06 CONTRACTOR'S USE OF PREMISES:

- A. See General Terms & Conditions.
- B. During construction activities, the CONTRACTOR shall be responsible for maintaining all access roads in good condition, including grading and drainage. See the General Terms & Conditions.
- C. The Contractor shall repair all damages incurred as a result of construction activities such as but not limited to Sidewalks, Pavement, Landscaping, Fencing, Etc. No additional compensation will be given.

1.07 CITY'S USE OF PREMISES:

- A. Partial CITY Occupancy: The CITY reserves the right to occupy and to place and install equipment in areas of the Project, prior to Substantial Completion provided that such occupancy does not interfere with completion of the WORK. Such placing of equipment and partial occupancy shall not constitute acceptance of the WORK.

1.08 WORK SEQUENCE, COORDINATION ACTIVITIES AND SCHEDULED DATES:

- A. General: The CONTRACTOR shall coordinate its WORK with other adjacent contractors, landowners and CITY activities, with specific attention to access and staging areas. Construction sequence shall be

determined by CONTRACTOR subject to the following needs for continuous access and operation by others.

- B. Suggested Construction Sequence: The CONTRACTOR shall submit a construction schedule for CITY evaluation and approval.
- C. Scheduled Events: Schedule the WORK to conform to the following events and dates, and to provide for coordination with the WORK performed by others.
 - 1. One of the existing pumps shall be ready to start from the utility and/or the generator during the construction work.
 - 2. Only one of the two pumps connected to the transfer switches will be able to start from the generator and will require electrical interlocks from transfer switches in the starter control unit.

1.09 LIST OF DRAWINGS:

A. Drawings:

- 1. **Riverview Storm Sewer Pump Station – Emergency Generator, CO2 Fire Suppressant System and Main Switch Disconnect Project.**
- 2. **Sheets ID;**
 - 1.1 C-O Key Sheet
 - 1.2 C-1 General Notes
 - 1.3 C-2 General Notes
 - 1.4 C-3 Demolition Site Plan
 - 1.5 C-4 Site Plan
 - 1.6 E-1 Electrical General Notes
 - 1.7 E-2 Electrical Demolition Plan
 - 1.8 E-3 Electrical Plan
 - 1.9 M-1 Mechanical Floor Plan
 - 1.10 EE-1 Electrical Plan
 - 1.11 EE-2 Electrical Riser and Specifications
 - 1.12 FS-1 Fire Suppression Plan
 - 1.13 FS-2 Fire Suppression Notes and Details

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01015 DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.01 SCOPE:

A. Definitions:

1. A substantial amount of the Technical Specification (specification) language constitutes definitions for terms found in other areas of the Contract Documents including the Drawings, which must be recognized as diagrammatic in nature and not completely descriptive of all requirements necessary.
2. Certain terms used in the Contract Documents are defined in the General Terms & Conditions. Definitions and explanations are not necessarily either complete or exclusive but are general for the WORK.
3. The term "CITY", as defined in the General Terms & Conditions and used in these specifications, is further defined as the City of Miami or City of Miami's authorized representative, which may include, but is not limited to, the Design Engineer, Project Manager or Construction Manager.

B. General Requirements: General requirements are the provisions or requirements of Division 1 SECTIONS which apply to the entire WORK of the Contract.

1.02 FORMAT AND SPECIFICATION EXPLANATIONS:

A. Format Explanation: The format of principal portions of these specifications can be described as follows, although other portions may not fully comply, and no particular significance will be attached to such compliance or noncompliance.

1. SECTIONS and DIVISIONS: For convenience, the basic unit of the specification text is a "SECTION", each unit of which is named and numbered. These are organized into related families of sections, and various families of sections are organized into "DIVISIONS", which are recognized as the present industry consensus on uniform organization and sequencing of specifications. The SECTION title is not intended to limit meaning or content of SECTION, nor to be fully descriptive of requirements specified therein, nor to be an integral part of the text.
2. SECTION Numbering: Used for identification and to facilitate cross-references in the Contract Documents. SECTIONS are placed in numeric sequence; however, the numbering is not sequential, and listing of SECTIONS in Table of Contents at the beginning of the Technical Specifications must be consulted to determine numbers and names of specification SECTIONS in these Contract Documents.
3. Page Numbering: Numbered independently for each SECTION. The SECTION number is shown with the page number at bottom of each page to facilitate location of the text.
4. Parts: Each SECTION of these specifications generally has been subdivided into three (3) basic parts for uniformity and convenience (Part 1 "General", Part 2 "Products", and Part 3 "Execution"). These parts do not limit the meaning of the text within. Some SECTIONS may not contain all three parts when not applicable or may contain more than three parts to add clarity to organization of the SECTION.
5. Imperative Language: Used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the CONTRACTOR. For clarity of reading, at certain locations contrasting subjective language is used to describe responsibilities which must be fulfilled by the CONTRACTOR or, when so noted, by others.

6. Specialists Assignments: In certain instances, specification text requires that specific work be assigned to specialists or expert entities who must be engaged for performance of those units of work. These must be recognized as special requirements over which the CONTRACTOR has no choice or option. These assignments must not be confused with, and are not intended to interfere with, normal application of regulations, union jurisdictions and similar conventions. Nevertheless, final responsibility for fulfillment of the entire set of requirements remains with the CONTRACTOR.
 7. Trades: Except as otherwise specified or indicated, the use of titles such as "carpentry" in specification text, implies neither that the work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor that the specified requirements apply exclusively to work by tradespersons of that corresponding generic name.
- B. Specification Content: Because of methods by which this Project specification has been produced, certain general characteristics of contents and conventions in use of language are explained as follows:
1. Specifying Methods: The techniques or methods of specifying requirements varies throughout the text, and may include "prescriptive", "compliance with standards", "performance", "proprietary", or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.
 2. Overlapping and Conflicting Requirements: Where compliance with two (2) or more industry standards or sets of requirements is specified and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, notify the "CITY" for a decision, as specified in the General Terms & Conditions.
 3. Abbreviations: Throughout the Contract Documents are abbreviations implying words and meanings which will be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology, and in conjunction with coordination of specification requirements, with notations on the Drawings and in schedules. These are normally defined at first instance of use. Organizational and association names and titles of general standards are also abbreviated.

1.03 DRAWING SYMBOLS:

- A. Except as otherwise indicated, graphic symbols used on the Drawings are those symbols generally recognized in the construction industry for the purposes indicated. Refer instances of uncertainty to the CITY for clarification.

1.04 INDUSTRY STANDARDS - APPLICABILITY:

- A. Applicable standards of the construction industry have the same force and effect and are made a part of the Contract Documents by reference, as if copied directly into the Contract Documents, or as if published copies were bound herewith. Referenced standards referenced directly in the Contract Documents or by governing regulations have precedence over non-referenced standards which are recognized in industry for applicability to work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01020 MEASUREMENTS AND PAYMENT

PART 1 - GENERAL

1.01 SCOPE:

A. LUMP SUM CONTRACT: Unless indicated on the Contract Documents, all work indicated on the Contract Drawings and specified in the Bid Documents and Contract shall be included in the Contract Sum indicated on the Bid Form. The following is a description of the WORK listed in the Bid Form and is not intended to be complete and all-inclusive of the required work items. The WORK shall include all miscellaneous and ancillary items necessary to construct a complete and functional Project.

1. New Emergency Generator. The New Generator will increase the capacity and dependability of the pumps systems in case of power outage
2. New CO2 Fire Suppressant System. The Riverview Pump Station old system will be replaced by a CO2 System including all electrical and mechanical appurtenances. As part of this project includes the installation of a main switch disconnect from FP&L transformer to the main switch disconnect.

1.02 BASIS FOR PAYMENTS:

A. The above descriptions generally outline the scope of work required for those elements of the WORK to be paid for under each lump sum item listed in the Bid Form. Those lump sum amounts shall be further distributed in accordance with subvalues identified in the approved Cost Loaded Schedule specified in SECTION 01310 and the GENERAL TERMS & CONDITIONS.

1.03 PAYMENTS:

A. Payments shall be in accordance with the provisions of the GENERAL TERMS & CONDITIONS, Article 14.

END OF SECTION

SECTION 01050 FIELD ENGINEERING AND SURVEYING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work:
 - 1. The CONTRACTOR shall engage a Professional Surveyor and Mapper licensed in the State of Florida to perform all necessary construction layout surveys, horizontal and vertical control, As-Built (Record) Surveys, and Topographic Surveys in accordance with the latest requirements of the CITY OF MIAMI, and all other applicable Local, State and National Codes.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals

1.02 SUBMITTALS:

- A. Submit Professional Surveyor and Mapper Credentials in accordance with SECTION 01300.

PART 2 - CONTRACTOR CONSTRUCTION LAYOUT SURVEY

2.01 DESCRIPTION: In connection with this WORK, the CONTRACTOR shall be responsible for:

- A. Performing all construction layout survey tasks as necessary for construction and satisfactory completion of the WORK.
- B. Verifying benchmark elevations by running a level loop between a minimum of two (2) Project vertical control points prior to the construction layout survey or establishing Project elevation data and/or new benchmarks where necessary.
- C. Completing all leveling under the supervision of a Florida licensed Professional Surveyor and Mapper. The level run shall close to within 0.03 feet $\sqrt{\text{miles}}$ (0.03 feet times the square root of the distance in miles).
- D. Performing a peg test as necessary on all level equipment with needed adjustments to maintain the accuracy of the instruments.
- E. Keeping a record of all survey work in a survey field book in a clear, orderly, and neat manner consistent with standard surveying practices.

2.02 CONSTRUCTION REQUIREMENTS:

- A. The CONTRACTOR's personnel performing the construction layout survey shall work under the direct supervision of a Florida licensed Professional Surveyor and Mapper. Submit the name(s) and address(s) of the survey firms(s) responsible for the Project surveying requirements to the CITY prior to start of survey activities.
- B. The CONTRACTOR shall be solely and completely responsible for the accuracy of the line and grade of all features of the WORK. Any errors or apparent discrepancies found in previous surveys, Drawings, or specifications shall be called to the attention of the CITY by the CONTRACTOR for correction or interpretation prior to proceeding with the WORK.
- C. The CONTRACTOR shall be responsible for the placement, referencing, and preservation of all survey control points, whether set or found on the Project. All boundary corners (i.e. section corners, fractional section corners, similar Project survey monumentation) that may be lost, destroyed or disturbed during construction shall be carefully replaced and referenced by a Florida licensed Professional Surveyor and Mapper.
- D. The supervision of the CONTRACTOR's construction surveying personnel shall be the responsibility of the CONTRACTOR; any deficient surveying layout or construction WORK which may be the result

of inaccuracies in construction layout survey operations or failure to report inaccuracies found in WORK shall be corrected at the expense of the CONTRACTOR.

2.03 SURVEY STANDARDS: If the vertical and horizontal data needs to be established at the Project Site, the CONTRACTOR shall follow the following standards:

- A. Vertical Data:
 - 1. All vertical data shall be collected and displayed in North American Vertical Datum 88 (NAVD 88) All Vertical elevation control level runs shall start and end on National Geodetic Survey (NGS) Second Order or higher CITY approved vertical control monuments. The CONTRACTOR shall use a minimum of two (2) different NGS Second Order or CITY approved published benchmarks that are a minimum of one-half mile apart. The level run(s) between monuments must close on each other.
- B. All Vertical elevation control level runs shall start and end on National Geodetic Survey (NGS) Second Order or higher CITY approved vertical control monuments.
 - 1. The marker for the benchmark can be obtained within the limits of the Project or from the CITY
- C. Horizontal Data (State Plane Coordinates):
 - 1. All horizontal data shall be collected in and based on the North American Datum (NAD 1983/2007) adjustment or higher Horizontal coordinate control shall be established from existing NGS or CITY OF MIAMI DATUM. All horizontal work shall be done in the same horizontal adjustment (no mixing of the adjustments). Once the horizontal datum has been established it shall not change for the life of the project.

2.04 RECORDS AND SUBMITTALS:

- A. Submittals shall be in accordance with SECTION 01300.
- B. Provide to the CITY a copy of the designs described in Paragraph 1.01 signed and sealed by the Florida registered Professional Engineer in charge of the Project.
- C. Provide to the CITY one (1) copy of the Preliminary Surveyor's Report (MS Word 2007), and two (2) copies of the final signed, sealed and certified Surveyor's Report to the CITY.
 - 1. At a minimum, the report shall include: an overall Project description, location sketches, field notes, equipment used, photographs and a horizontal data (NAD 1983/2007 state plane coordinate (RTK)) on each new bench mark (if applicable).
 - 2. A CD containing: Surveyor's firm name and logo, Surveyor's Report, digital photographs, benchmark description sheets and any other associated data.
- D. Records/As-builts:
 - 1. The CONTRACTOR shall provide one (1) set of conventional certified As-Built Survey overlaid on the Drawings.
 - 2. The CONTRACTOR shall provide a single PDF file with all data attached to that file and bookmark the As-Built.
 - 3. The CONTRACTOR shall provide single AutoCAD (version 2010 or later) digital files for each of the certified hard copies.

END OF SECTION

SECTION 01065 PERMITS AND FEES

PART 1 - GENERAL

1.01 SCOPE:

A. Summary of Work:

1. Unless otherwise specified, the CONTRACTOR shall obtain and pay for all permits and licenses related to the WORK as provided for in the General Terms & Conditions.
2. The CONTRACTOR will be issued copies of all permits obtained by the CITY OF MIAMI at the pre-construction conference. A copy of the permits shall be posted at the Site at all times during construction. The CONTRACTOR shall be responsible for familiarizing himself with the permits and shall abide by the permit conditions at all times. The WORK shall be conducted and shall result in construction of the improvements of the Project, in full accordance with the conditions of the permits granted for the Project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01071 STANDARD REFERENCES

Wherever used in the project manual, the following abbreviations will have the meanings listed:

AA	Aluminum Association Incorporated 818 Connecticut Avenue, NW Washington, DC 20006
AABC	Associated Air Balance Council 1518 K Street NW Washington, DC 20005
AAMA	American Architectural Manufacturers Association 2700 River Road, Suite 118 Des Plaines, IL 60018
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, NW, Suite 225 Washington, DC 20001
ABMA	American Bearing Manufacturers Association 2025 M Street, NW Suite 800 Washington, DC 20036
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI, 48331
AEIC	Association of Edison Illuminating Companies 600 18 th Street N Birmingham, AL 35203
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association 400 N. Capital Street, NW Suite 450 Washington, DC 20001
AGMA	American Gear Manufacturer's Association 500 Montgomery Street, Suite 350 Alexandria, VA 22314
AHA	American Hardboard Association 1210 West Northwest Hwy Palatine, IL 60067
AISC	American Institute of Steel Construction One East Wacker Drive, suite 700 Chicago, IL 60601
AISI	American Iron and Steel Institute 1000 16th Street, NW Washington, DC 20036

AITC	American Institute of Timber Construction 333 West Hampden Avenue Englewood, CO 80110
ALSC	American Lumber Standards Committee P. O. Box 210 Germantown, MD 20874
AMCA	Air Movement and Control Association, Inc. 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute, Inc. 25 West 43 rd Street New York NY 10036
APA	American Plywood Association P.O. Box 11700 Tacoma, WA 98411
API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005
AHRI	Air-Conditioning Heating and Refrigeration Institute 1814 North Fort Myer Drive Arlington, VA 22209
ASCE	American Society of Civil Engineers 345 East 47th Street New York, NY 10017
ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASE	American Standard Safety Code for Elevators, Dumbwaiter and Escalators American National Standards Institute/ASMEA17.1/CSA B44 1430 Broadway New York, NY 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers United Engineering Center 1791 Tullie Circle, N.E. Atlanta, GA 30329
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103

AWPA	American Wood Preservers Association P.O. Box 361784 Birmingham, AL 35236
AWPB	American Wood Preservers Bureau 7962 Conell Court P. O. Box 5283 Lorton, VA 22079
AWPI	American Wood Preservers Institute 1945 Old Gallows Road, Suite 150 Vienna, VA 22182
AWI	Architectural Woodwork Institute 46179 Westlake Drive, Suite 120 Potomac Falls, VA 20165
AWS	American Welding Society 550 NW Lejune Road Miami, FL 33126
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 17 th Floor New York, NY 10017
BOCA	Building Officials and Code Administrators 17926 Halstead Homewood, IL 60430
CBMA	Certified Ballast Manufacturers Association 2120 Keith Building Cleveland, OH 44115
CMAA	Crane Manufacturers Association of America (Formerly called: Overhead Electrical Crane Institute) (OECI) 8720 Reds Oak Boulevard, Suite 201 Charlotte, NC 28217
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173
CSA	Canadian Standards Association 155 Queen Street, Suite 1300 Ottawa, Ontario, CA K1P6L1
DEMA	Diesel Engine Manufacturer's Association 122 East 42nd Street New York, NY 10017

DHI	Door Hardware Institute 14150 Newbrook Drive, Suite 200 Chantilly, VA 20151
DIS	Division of Industrial Safety California Department of Industrial Relations 2422 Arden Way Sacramento, CA 95825
EI	Edison Electric Institute 701 Pennsylvania Avenue, NW Washington, DC 20004
EIA	Electronic Industries Alliance 2001 Eye Street, NW Washington, DC 20006
EJMA	Expansion Joint Manufacturer's Association 25 North Broadway Tarrytown, NY 10591
EPA	Environmental Protection Agency Region 4 Sam Nunn Atlanta Federal Center 61 Forsyth Street, SW Atlanta, GA 30303-3104
ESO	Electrical Safety Order, California Administrative Code, Title 8, Chap. 4, Subarticle 5 Office of Procurement, Publications Section P. O. Box 20191 8141 Elder Creek Road Sacramento, CA 95820
FAC	Florida Administrative Code
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Bldg. 197 Washington, DC 20407
FEDSTDS	Federal Standards (see FEDSPECS)
FM	Factory Mutual Research 1151 Boston-Providence Turnpike Norwood, MA 02062
GANNA	Glass Association of North America 800 SW Jackson Street, Suite 1500 Topeka, Kansas 66612
HEI	Heat Exchange Institute 1300 Summer Avenue Cleveland, OH 44115

HI	Hydraulic Institute 1230 Keith Building Cleveland, OH 44115
HPVA	Hardwood Plywood and Veneer Association 1825 Michael Faraday Drive Reston, VA 20190
IAPMO	International Association of Plumbing and Mechanical Officials 5001 E. Philadelphia Street Ontario, CA 91761
ICBO	International Conference of Building Officials 5360 South Workman Mill Road Whittier, CA 90601
ICEA	Insulated Cable Engineers Association P. O. Box P South Yarmouth, MA 02664
ICRI	International Concrete Repair Institute 10600 West Higgins Road, Suite 607 Rosemont, IL 60018
IEEE	Institute of Electrical and Electronics Engineers, Inc. 3 Park Avenue, 17 th Floor New York, NY 10016-5997
IES	Illuminating Engineering Society c/o United Engineering Center 120 Wall Street Floor 17 New York, NY 10005
ISA	Instrument Society of America 67 Alexander Drive Research triangle Park, NC 27709
ISO	International Organization for Standardization 1, ru de Varembe, Case Postale 56 CH-1211 Genna 20, Switzerland
JIC	Joint Industrial Council 7901 Westpark Drive McLean, VA 22101
MFMA	Metal Framing Manufacturers Association 401 Michigan Avenue Chicago, IL 60611
MILSPEC	Military Specifications Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120

MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Avenue, N.E. Vienna, VA 22180
NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt rd bldg C, Suite 312 Glen Ellyn, IL 60137
NACE	National Association of Corrosion Engineers P. O. Box 986 Katy, TX 77450
NEC	National Electrical Code National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814
NELMA	Northeastern Lumber Manufacturers Association, Inc. 272 Turtle Road P. O. Box 87A Cumberland Center, ME 04021
NEMA	National Electrical Manufacturer's Association 1300 N. 17 th Street, Suite 1752 Rosslyn, VA 22209
NESC	National Electric Safety Code American National Standards Institute 1430 Broadway New York, NY 10018
NETA	InterNational Electrical Testing Association 3050 Old Centre Avenue, Suite 102 Portage, MI 49024
NFP	National Forest Products Association (Formerly National Lumber Manufacturer's Association) 1619 Massachusetts Avenue Washington, DC 20036
NFPA	National Fire Protection Association Batterymarch Park Quincy, MA 02269
NHLA	National Hardwood Lumber Association P. O. Box 34518 Memphis, TN 38184-0518
NIST	National Institute of Standards and Technology 100 Bureau Drive, Suite 1070 Gaithersburg, MD 20899-1070

NSF	National Sanitation Foundation P.O. Box 130140 789 N. Dixoboro Road Ann Arbor, MI 48113
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational and Health Administration San Francisco Regional Office 200 Constitution Avenue Washington, DC 20210
PCI	Prestressed Concrete Institute 200 W. Adams Street, Suite 2100 Chicago, IL 60606
PPIC	The Plumbing & Piping Industry Council, Inc. 135 Calle Catalina Place Houston, TX 77007
RIS	Redwood Inspection Service California Redwood Association 818 Grayson Road, Suite 201 Pleasant Hill, CA 94523
RLM	Reflector and Lamp Manufacturers Standard Institute
RMA	Rubber Manufacturers Association 1400 K Street Washington, DC 20005
SAE	Society of Automotive Engineers 400 Commonwealth Drive Warrendale, PA 15096
SBC	Standard Building Code Published by SBCCI
SMC	Standard Mechanical Code Published by SBCCI
SBCCI	Southern Building Code Congress International 1116 Brown-Marx Building Birmingham, AL 35203
SCMA	Southern Cypress Manufacturers Association 805 Sterick Bldg. Memphis, TN 38103

SDI	Steel Door Institute 30200 Detroit road Westlake, OH 44145
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. 4201 Lafayette Center Drive Chantilly, VA 20151
SPC	Society for Protective Coatings 40 24 th Street, 6 th Floor Pittsburgh, PA 15222
SPI	Society of the Plastics Industry, Inc. 1667 K Street, NW Suite 1000 Washington, DC 20006
SPIB	Southern Pine Inspection Bureau P.O. Box 10915 Pensacola, FL 32524
SSPC	The Society for Protective Coatings (formerly called: Steel Structures Painting Council) 40 24 th Street, 6 th Floor Pittsburgh, PA 15222-4656
SSPWC	Standard Specifications for Public Works Construction Building News, Inc. 3055 Overland Avenue Los Angeles, CA 90034
TEMA	Tubular Exchanger Manufacturer's Association 3251 Corte Malpaso, Suite 507 Camarillo, CA 93012
UL	Underwriters Laboratories Inc. 2600 NW Lake Road Camas, WA 98607
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center Denver Federal Center, Building 67 Denver, CO 80225
USACE	United States Army Corps of Engineers Jacksonville District P. O. Box 4970 Jacksonville, FL 32232-0019
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Street P. O. Box 23145 Tigard, OR 97223

WWPA

Western Wood Products Association
(Formerly called: West Coast Lumbermen's Association (WCLA))
522 SW 5th Avenue, Suite 500
Portland, OR 97204

END OF SECTION

SECTION 01200 PROJECT MEETINGS AND REPORTS

PART 1 - GENERAL

1.01 SCOPE

- A. Summary of Work: This SECTION includes the following administrative and procedural requirements:
1. Project Meetings:
 - a. Preconstruction conference
 - b. Progress meetings
 2. Schedules and Reports:
 - a. Initial coordination submittals
 - b. Construction Schedules (See SECTION 01310)
 - c. Special reports
- B. Related Work Specified Elsewhere:
1. SECTION 01300 – Submittals

1.02 SUBMITTALS:

- A. All submittals shall be made in accordance with SECTION 01300.

1.03 PROJECT MEETINGS:

- A. Pre-construction Conference
1. The CITY OF MIAMI will administer a pre-construction conference within ten (10) days after the Effective Date of the Agreement, to review items stated in the following agenda and to establish a working understanding between the parties as to their relationships during conduct of the WORK.
 2. The Preconstruction conference shall be attended by:
 - a. The CONTRACTOR and his Project Superintendent
 - b. Representatives of principal Subcontractors and Suppliers
 - c. Engineer and his Resident Project Representative if any
 - d. The City or its representative
 - e. Other affected parties determined by the CITY OF MIAMI
 3. Agenda:
 - a. Projected Construction Schedules
 - b. Critical Work sequencing
 - c. Designation of responsible personnel
 - d. Project coordination
 - e. Procedures and Processing of:
 - i. Field decisions
 - ii. Substitutions

- iii. Submittals
- iv. Change Orders
- v. Applications for payment
- f. Procedures for testing
- g. Procedures for maintaining record documents
- h. Use of Premises:
 - i. Office, work and storage areas
 - ii. The CITY OF MIAMI's requirements
- i. Construction facilities, controls, and construction aids
- j. Temporary utilities
- k. Safety and first aid
- l. Security
- m. Requirements of any permits obtained by the CITY OF MIAMI and/or the CONTRACTOR

4. Location of Meeting: **ONSITE**

B. Progress Meetings:

1. The CITY OF MIAMI OR IT REPRESENTATIVE will administer a progress meeting a minimum of ONCE WEEKLY (every 1 WEEK) and at other times requested by the CITY. The CONTRACTOR, Engineer and all Subcontractors active on the Site shall be represented at each meeting. The CONTRACTOR may request attendance by representatives of his Suppliers and other Subcontractors, or other entities concerned with the Project or involved with the planning, coordination or performance of future Project activities. All participants in the meeting shall be familiar with the Project and authorized to conclude matters relating to the WORK.
2. The CONTRACTOR and each Subcontractor shall be prepared to report on and discuss the current construction progress, any anticipated future changes to the Construction Schedule, and advise if their current progress, and anticipated future schedules are compatible with the WORK.
3. If one Subcontractor is delaying another, the CONTRACTOR shall direct such changes as are necessary for those involved to mutually agree on the Construction Schedule changes in the best interest of construction progress.
4. Agenda
 - a. Review of construction progress since previous meeting
 - b. Field observations, interface requirements, conflicts
 - c. Issues which may impede the Construction Schedule
 - d. Off-site fabrication
 - e. Delivery schedules
 - f. Submittal schedules and status
 - g. Site utilization
 - h. Temporary facilities and services
 - i. Hours of Work
 - j. Hazards and risks

- k. Housekeeping
 - l. Quality and Work standards
 - m. Change orders
 - n. Documentation of information for payment request
 - o. Corrective measures and procedures to regain projected schedule, if necessary
 - p. Revisions to the Construction Schedule
 - q. Progress and schedule during the succeeding WORK period
 - r. Review proposed changes for:
 - i. Effect on the Construction Schedule and on the Completion Date
 - ii. Effect on the other contracts of the Project
 - s. Other business
- 5. Location of Meetings: **ONSITE**
 - 6. Reporting: After each meeting, minutes of the meeting will be distributed by the CITY to each party present and to parties who should have been present.
- C. Special Reports:
- 1. When an event of an unusual and/or significant nature occurs at the Site, a special report shall be prepared and submitted by the CONTRACTOR to the CITY. List the chain of events, persons participating, and the response by CONTRACTOR's personnel, an evaluation of the results or effects, and similar pertinent information.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01300 SUBMITTALS

PART 1 - GENERAL

1.01 SCOPE:

- A. This SECTION includes definitions, descriptions, transmittal, and review of "Compliance" and "Miscellaneous" Submittals.
- B. Related Work Specified Elsewhere:

1.02 GENERAL INFORMATION:

A. Definitions:

1. Compliance Submittals include Shop Drawings, product data, and samples which are prepared by the CONTRACTOR, Subcontractor, MANUFACTURER, or Supplier and submitted by the CONTRACTOR to the ENGINEER as a basis for approval of the use of Equipment and Materials proposed for incorporation in the WORK or needed to describe installation, operation, maintenance, or technical properties.
 - a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.
 - b. Product data includes standard printed information on materials, products and systems not custom-prepared for this Project, other than the designation of selections from available choices.
 - c. Samples include both fabricated and unfabricated physical examples of materials, products, and WORK; both as complete units and as smaller portions of units of WORK; either for limited visual inspection or (where indicated) for more detailed testing and analysis. Mock-ups are a special form of samples which are too large to be handled in the specified manner for transmittal of sample Submittals.
2. Miscellaneous Submittals are those technical reports, administrative Submittals, certificates, and warranties not defined as Shop Drawings, product data, or samples.
 - a. Technical reports include laboratory reports, tests, technical procedures, technical records, CONTRACTOR's design analysis and CONTRACTOR's survey field notes for construction staking, before cross-sections and after cross-sections, and similar type Submittals.
 - b. Administrative Submittals are those nontechnical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, workmanship bonds, Project photographs, physical work records, statements of applicability, and copies of industry standards, as-constructed data, security/protection/safety data, and similar type Submittals.
 - c. Certificates and warranties are those Submittals on Equipment and Materials where a written certificate or guarantee from the MANUFACTURER or Supplier is called for in the Specifications.
 - d. Reports as required by Contract describing CONTRACTOR's means and methods for items such as dewatering, earth and water retaining, erosion/turbidity control, safety plans, and similar type Submittals.

B. Quality Requirements:

1. Submittals such as Shop Drawings and product data shall be of the quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings such as reproducibles shall be useable for further reproduction to yield legible hard copy.

2. Documents submitted to the ENGINEER that do not conform to these requirements shall be subject to rejection by the ENGINEER, and upon request by ENGINEER, CONTRACTOR shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. CONTRACTOR's (or his Subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve CONTRACTOR (or his Subcontractors) from meeting the required schedule for Submittal of Shop Drawings and product data.
- C. Language and Dimensions:
1. All words and dimensional units shall be in the English language.
 2. Metric dimensional unit equivalents may be stated in addition to the English units.
- D. Submittal Completeness:
1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable the ENGINEER to review the information effectively.
 2. Where standard drawings are furnished which cover a number of variations of the general class of equipment, each such drawing shall be individually annotated to describe exactly which parts of the drawing apply to the equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting" is not an acceptable means of annotating Submittals. Such annotation shall also include proper identification of the Submittal permanently attached to the drawing.
 3. Reproduction or copies of Drawings or portions thereof will not be accepted as complete fabrication or erection drawings. The CONTRACTOR may use a reproduction of the ENGINEER prepared Drawings for erection drawings such as to indicate information on erection or to identify detail drawing references. Where the Drawings are revised to show this additional CONTRACTOR information, the ENGINEER title block shall be replaced with a CONTRACTOR's title block and the ENGINEER professional seal shall be removed from the Drawing. The CONTRACTOR shall revise these erection drawings for subsequent revisions to the Drawings.

1.03 COMPLIANCE SUBMITTALS:

- A. Items shall include, but not be limited to, the following:
1. MANUFACTURER's specifications
 2. Catalogs, or parts thereof, of manufactured equipment
 3. Shop fabrication and erection drawings
 4. General outline drawings of equipment showing overall dimensions, location of major components, weights, and location of required building openings and floor plates
 5. Detailed equipment installation drawings, showing foundation details, anchor bolt sizes and locations, base plate sizes, location of CITY connections, and all clearances required for erection, operation, and disassembly for maintenance
 6. Schematic diagrams for electrical items, showing external connections, terminal block numbers, internal wiring diagrams, and one-line diagrams
 7. Bills of material and spare parts list
 8. Instruction books and operating manuals
 9. Material lists or schedules
 10. Performance tests on equipment by MANUFACTURERS
 11. Concrete mix design information

12. Samples and color charts
13. All drawings, calculations, catalogs or parts thereof, MANUFACTURER's specifications and data, samples, instructions, and other information specified or necessary:
 - a. For ENGINEER to determine that the Equipment and Materials conform with the design concept and comply with the intent of the Contract Documents.
 - b. For the proper erection, installation, operation and maintenance of the Equipment and Materials which the ENGINEER will review for general content but not for substance.
 - c. For the ENGINEER to determine what supports, anchorages, structural details, connections, and services are required for the Equipment and Materials, and the effects on contiguous or related structures and Equipment and Materials.

B. Compliance Submittal Action Stamps:

1. The ENGINEER review action stamp or designation, appropriately completed, will appear on all Compliance Submittals of CONTRACTOR when returned by the ENGINEER. Review status designations listed on ENGINEER action stamp are defined as follows:
 - a. "ACCEPTED AS SUBMITTED": Signifies Equipment or Material represented by the Submittal conforms to the design concept and complies with the intent of the Contract Documents and is acceptable for incorporation in the WORK. CONTRACTOR is to proceed with fabrication or procurement of the items and with related WORK.
 - b. "ACCEPTED AS NOTED": Signifies Equipment and Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is acceptable for incorporation in the WORK subject to the condition that as constructed it shall be in accordance with all notations and/or corrections indicated. CONTRACTOR is to proceed with fabrication or procurement of the items and with related WORK in accordance with ENGINEER notations.
 - c. "RETURNED FOR REVISION": Means that deviation from the requirements of the Contract Documents exist in the Submittal. CONTRACTOR is to resubmit revised information responsive to ENGINEER annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related WORK is not to proceed until the Submittal is approved.
 - d. "NOT ACCEPTABLE (SUBMIT ANEW)": Signifies Equipment and Material represented by the Submittal does not conform to the design concept or comply with the intent of the Contract Documents and is disapproved for use in the WORK. CONTRACTOR is to resubmit Compliance Submittals responsive to the Contract Documents.
 - e. "PRELIMINARY SUBMITTAL": Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. CONTRACTOR is to submit such additional information to permit layout and related activities to proceed.
 - f. "FOR REFERENCE ONLY": Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to the CITY in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. The ENGINEER reviews such Submittals for general content but not for substance.
 - g. "DISTRIBUTION COPY (PREVIOUSLY ACCEPTED)": Signifies Submittals which have been previously accepted and are being distributed to CONTRACTOR, CITY, ENGINEER, Resident Project Representative, and others for coordination and construction purposes.

C. Schedule and Log of Compliance Submittals:

1. Prepare for the CITY, a schedule and log for submission of all Compliance Submittals specified or necessary for ENGINEER review of the use of Equipment and Materials proposed for incorporation in the WORK or needed for proper installation, operation or maintenance. Submit the schedule and log with the procurement schedule and WORK progress schedule. Schedule submission of all Compliance Submittals to permit review, fabrication, and delivery in time so as to not cause a delay in the WORK of CONTRACTOR or his Subcontractors or any other contractors as described herein.
2. In establishing schedule for Compliance Submittals, allow fifteen (15) working days in ENGINEER office for reviewing original Submittals and ten (10) working days for reviewing resubmittals.
3. The schedule shall indicate the anticipated dates of original submission and shall be prepared in accordance with SECTION 01310.
4. Schedule all Compliance Submittals required prior to fabrication or manufacture for submission within **30** days of the Notice to Proceed Schedule Compliance Submittals pertaining to storage, installation and operation at the Site for ENGINEER acceptance prior to delivery of the Equipment and Materials.
5. Resubmit Compliance Submittals the number of times required for ENGINEER "ACCEPTED AS SUBMITTED." However, any need for resubmittals more than the number set forth in the accepted schedule, or any other delay in obtaining acceptance of Submittals, will not be grounds for extension of the Contract Time, provided the ENGINEER completes its reviews within the times stated above.

D. Transmittal of Compliance Submittals:

1. All Compliance Submittals of Equipment and Materials furnished by Subcontractors, MANUFACTURERS, and Suppliers shall be submitted to the ENGINEER by CONTRACTOR in electronic PDF format as indicated below.
2. After checking and verifying all field measurements, transmit all Compliance Submittals to the ENGINEER for acceptance as follows:
 - a. Identify each Compliance Submittal by Submittal Number, Project name and number, Contract title and number, and the Specification SECTION and article number marked thereon or in the letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
 - b. Check and stamp Compliance Submittals of Subcontractors, Suppliers, and MANUFACTURERS with CONTRACTOR's approval prior to transmitting them to the ENGINEER. CONTRACTOR's stamp of approval shall constitute a representation to the ENGINEER that CONTRACTOR has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or he assumes full responsibility for doing so, and that he has coordinated each Compliance Submittal with the requirements of the WORK and the Contract Documents.
 - c. At the time of each submission, call to the attention of ENGINEER in the letter of transmittal any deviations from the requirements of the Contract Documents.
 - d. Provide all Submittals in electronic format, compatible with Adobe Professional, Version 8 (or higher), and submitted as a single file, using PDF bookmarks and/or chapters to identify divisions within the Submittal package.
 - e. Submittals with file sizes greater than ten (10) megabyte (MB) shall be transferred to an approved file sharing system, coupled with an electronic notification to the CITY and ENGINEER of the transfer. The file sharing system, and associated password information, will be provided by the CITY Project Manager.
 - f. Make all modifications noted or indicated by ENGINEER and return revised copies, or samples until accepted. Revised Submittals must be complete and conformed, including all

pages/sheets with the required revisions and any additional or replacement pages/sheets. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by the ENGINEER on previous Submittals. Subsequent review cycles for returned or revised Submittals shall replicate the process described in items d. through e. above.

- g. If the ENGINEER review action is "ACCEPTED AS NOTED", the Submittal will be stamped as such, and electronically transmitted back to the CONTRACTOR. Upon receipt of this notification from the ENGINEER, The CONTRACTOR shall resubmit one (1) conformed electronic copy in PDF file format to the ENGINEER for final distribution. If the Submittal is required to be signed and sealed by a Professional Engineer registered in the State of Florida, it shall be signed and sealed at this time. Submittal will not be considered final until all copies have been received by the ENGINEER. Submittal will be stamped "DISTRIBUTION COPY (PREVIOUSLY ACCEPTED)" by the ENGINEER. Accepted Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the Submittal and resubmit for review.
 - h. Following completion of the WORK and prior to final payment, furnish those drawings necessary to indicate "AS CONSTRUCTED" conditions, including field modifications. Furnish additional copies for insertion in equipment instruction books as required. All such copies shall be clearly marked "AS BUILT DRAWING"
 - i. WORK requiring a Compliance Submittal shall not be commenced or shipped until the Submittal has been stamped "ACCEPTED AS SUBMITTED" or "ACCEPTED AS NOTED" by the ENGINEER
 - j. Keep a legible copy or sample of each Compliance Submittal at the Site.
3. Copies of the equipment CONTRACTOR's erection drawings and other Compliance Submittals required for the installation of equipment furnished by others under separate Contract for installation under this Contract will be transmitted to CONTRACTOR by the CITY in the final distribution of such Submittals.
 4. Information to MANUFACTURER's District Office: MANUFACTURERS and Suppliers of Equipment and Materials shall furnish copies of all agreements, drawings, specifications, operating instructions, correspondence, and other matters associated with this Contract to the MANUFACTURER's district office servicing the CITY. Insofar as practicable, all business matters relative to Equipment and Materials included in this Contract shall be conducted through such local district offices.

E. CITY OF MIAMI Review:

1. The CITY may review and return Compliance Submittals to CONTRACTOR with appropriate notations. Instruction books and similar Submittals will be reviewed by the CITY for general content but not for substance.
2. The CITY acceptance of Compliance Submittals will not relieve CONTRACTOR from his responsibility as stated in the Section 00700 – General Terms and Conditions.

F. Instruction Books / Operation & Maintenance Manuals:

1. Equipment instruction books and manuals shall be prepared by the MANUFACTURER and shall include the following:
 - a. Index and tabs
 - b. Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers
 - c. Applicable drawings
 - d. Name of contact person, phone number, and address of the nearest authorized service facility

- e. Attached to the above shall be a notice of the exact warranty effective dates, beginning and ending.
 - f. All additional data specified
2. Information listed above shall be submitted electronically in a PDF file format.
- a. Instruction Books/Operation & Maintenance Manuals shall contain the following:
 - i. Equipment name
 - ii. MANUFACTURER's name
 - iii. Project name
 - iv. Contract number
 - v. Reference to applicable Drawing No. & Technical Specifications Section
 - b. Format: The overall manual should be constructed around certain types of structures or equipment in the Project, and not merely assembled by technical specification section, so that all pertinent data needed by personnel to operate or maintain the equipment or structure is in one (1) manual (as far as is practical). The CONTRACTOR shall coordinate with the ENGINEER as to how the manuals are to be assembled (Bookmarked).

G. Samples:

- 1. Office samples shall be of sufficient size and quantity to clearly illustrate the following:
 - a. Functional characteristics of the product, with integrally related parts and attachment devices
 - b. Full range of color, texture, and pattern

1.04 MISCELLANEOUS SUBMITTALS:

- A. Miscellaneous Submittals are comprised of technical reports, administrative Submittals, and warranties which relate to the WORK, but do not require ENGINEER approval prior to proceeding with the WORK. Miscellaneous Submittals may include but are not limited to (at ENGINEER discretion):
 - 1. Welder qualification tests
 - 2. Welding procedure qualification tests
 - 3. X-ray and radiographic reports
 - 4. Field test reports
 - 5. Concrete cylinder test reports
 - 6. Certification on Materials:
 - a. Steel mill tests
 - b. Paint lab tests
 - c. Cement tests
 - 7. Soil test reports
 - 8. Temperature records
 - 9. Shipping or packing lists
 - 10. Job progress schedules
 - 11. Equipment and Material delivery schedules
 - 12. Progress photographs
 - 13. Warranties

14. Fire protection and hydraulic calculations
15. Surveying field notes, preliminary and final Surveyor's Reports
16. Pump tests
17. Traffic control plan
18. Technical Reports
19. Written Certificates and Warranties

B. Transmittal of Miscellaneous Submittals:

1. All Miscellaneous Submittals furnished by Subcontractors, MANUFACTURERS, and Suppliers shall be submitted to ENGINEER by CONTRACTOR in an electronic PDF file format, unless otherwise specified.
 - a. Identify each miscellaneous Submittal by Project name and number, Contract title and number, and the specification section and article number marked thereon or in the letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
 - b. Check and stamp Miscellaneous Submittals of Subcontractors, Suppliers, and MANUFACTURERS with CONTRACTOR's approval prior to transmitting them to the ENGINEER. CONTRACTOR's stamp of approval shall constitute a representation to the CITY that CONTRACTOR has either determined and verified all information, or he assumes full responsibility for doing so, and that he has coordinated Miscellaneous Submittal with the requirements of the WORK and the Contract Documents.
 - c. At the time of each submission, call to the attention of the ENGINEER in the letter of transmittal any deviations from the requirements of the Contract Documents.
 - d. Make all modifications noted or indicated by ENGINEER and return revised copies until accepted. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by the ENGINEER on previous Submittals. After Submittals have been accepted, submit copies thereof for final distribution.
 - e. Provide the CITY a copy of the final approved Miscellaneous Submittals package for record keeping.
2. Test Reports:
 - a. Responsibilities of CONTRACTOR and CITY regarding tests and inspections of Equipment and Materials and completed WORK are set forth elsewhere in these Contract Documents.
 - b. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports in an electronic PDF file format to the following parties, unless otherwise specified:
 - i. CITY Resident Project Representative
 - ii. ENGINEER
 - iii. CONTRACTOR
 - iv. MANUFACTURER or supplier

C. CITY OF MIAMI or ENGINEER Review:

1. CITY/ENGINEER will review Miscellaneous Submittals for indications of WORK or material deficiencies within fifteen (15) working days in CITY/ENGINEER office for original Submittals and ten (10) working days for reviewing resubmittals.
2. CITY/ENGINEER will respond to CONTRACTOR on those Miscellaneous Submittals which indicate WORK or material deficiency.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

- 3.01 SUBMITTAL LOG: CONTRACTOR shall maintain an accurate Submittal Log and a Distribution List for the duration of the WORK, showing status of all Submittals and Distributees at all times in a form acceptable to the CITY and ENGINEER. CONTRACTOR shall make the Submittal Log available to the CITY and ENGINEER for its review on request and shall bring a copy of the Submittal Log to all Progress Meetings.

END OF SECTION

SECTION 01310 COST LOADED CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 SCOPE:

- A. COST LOADED CONSTRUCTION SCHEDULE (Construction Schedule): The WORK under this Contract shall be planned, scheduled, executed, and reported by the CONTRACTOR. The CONTRACTOR shall adhere to established technical standards for CPM (Critical Path Method) scheduling using the computerized PDM (Precedence Diagram Method), unless otherwise directed by the CITY. The CONTRACTOR is required to provide all Construction Schedules in electronic format.
- B. The CONTRACTOR shall submit a detailed Cost Loaded Construction Baseline Schedule (Baseline Schedule) showing all WORK required under the Contract and scheduled within the time constraints set forth under the Contract. The CITY will review and comment on the Baseline Schedule submittal as per 2.03. Upon acceptance, the CONTRACTOR shall not change the accepted Baseline Schedule without prior concurrence of the CITY. The Baseline Schedule shall be updated to show actual progress. Any proposed changes in the schedule activities, original duration, logic, activity constraints, other than progress, shall be incorporated into a request for a revision to the accepted Baseline Schedule and submitted for review and acceptance.
- C. The CONTRACTOR shall be responsible for coordinating its own schedules (including subcontractors) as well as the construction activities of others as required to fully execute the WORK.

1.02 SOFTWARE/INTERFACE REQUIREMENTS:

- A. The CONTRACTOR shall use the latest version of Oracle/Primavera P6 Professional Project Management (P6) for creating and updating all Construction Schedules and reports. No other scheduling software programs will be accepted.
- B. To ensure compatibility for CITY asset accounting, the CITY will provide Activity Codes (for all Asset and Non-asset Activities) and assist the CONTRACTOR in developing a Work Breakdown Structure (WBS) to be entered into the scheduling software as referenced in Section 2.02. The Construction Schedule (i.e. the accepted Baseline Schedule and all Schedule Updates) shall be used as the basis for payment.

1.03 QUALITY ASSURANCE:

- A. The CONTRACTOR shall perform the WORK covered by this SECTION with personnel having substantial experience in the use of the latest version of P6 scheduling software on construction projects which required the development and maintenance of the schedule throughout the Project duration.
- B. It is the responsibility of the CONTRACTOR to work with each subcontractor and supplier to obtain information pertinent to the planning and updating of their respective activities in the schedules.

1.04 DEALING WITH SUBSTITUTES:

- A. All versions of the CONTRACTOR's Construction Schedule shall be based solely on the WORK as awarded, and shall exclude any substitute proposals, even if the CONTRACTOR pursues a substitution in accordance with the provisions of the Contract.
- B. The CITY's final determination on any proposed substitutions may not be made until after the CONTRACTOR's Construction Schedule is prepared and accepted. Accepted proposed substitutions shall be identified in the schedule as Change Orders.

1.05 USE OF FLOAT:

- A. Total Float is the amount of time a scheduled activity can be delayed without delaying the completion of the WORK beyond the contractually required end date. Contract Float is the number of days between the CONTRACTOR's anticipated date for early completion of the WORK, or specified part,

and the corresponding Contract Time. Total Float and Contract Float belong to the Project and are not for the exclusive benefit of any party. Contract Float and Total Float shall be available to the CITY's, consultants, or the CONTRACTOR to accommodate changes in the WORK or to mitigate the effect of events which may delay performance or completion. The CITY's will monitor and optimize the use of float for the benefit of the Project.

- B. The CONTRACTOR shall adjust or remove any float suppression techniques (e.g., preferential sequencing, out-of-sequence activity relationships, crew movements, equipment use, form reuse, extended durations, imposed dates, etc.) as a prerequisite to a request for an increase in Contract Price and/or Contract Time. Use of constraints should be minimized and require approval by the CITY's

1.06 EARLY COMPLETION:

- A. An early completion schedule is one which anticipates completion of all or a specified part of the WORK ahead of the corresponding Contract Time. Since Contract and Total Floats belong to the Project, the CONTRACTOR shall not be entitled to any extension in Contract Time or recovery for any delay incurred because of extensions in an early completion date until all Contract Float is used or consumed and performance or completion of the WORK extends beyond the Contract Time. The accepted Baseline Schedule must have a single longest path with zero Total Float. Multiple longest paths are not acceptable.

1.07 NON-COMPLIANCE:

- A. The CITY's may refuse to recommend/authorize a progress payment in the event of the CONTRACTOR's failure, refusal or neglect to provide the required schedule information, since this will preclude the proper evaluation of the CONTRACTOR's progress. Remedies for the CONTRACTOR's failure, neglect or refusal to comply with the requirements of this SECTION are in addition, and not limited to, those provided under other sections of the Contract.

PART 2 - PRODUCTS

2.01 GENERAL CRITERIA:

- A. All Construction Schedules shall be prepared by the CONTRACTOR and reflect the CONTRACTOR's plans, means and methods, techniques and sequences for performing of the WORK.
- B. The Construction Schedules shall break down the WORK into distinct activities with interdependencies to the extent required to clearly depict the planned approach for completion of the WORK and to effectively manage the execution of the WORK.
 - 1. The Construction Schedules shall divide the WORK into manageable and logical segments and specify the progression from the Notice to Proceed (NTP) to Substantial Completion (SC) to Final Completion (FC) within Contract Time.
 - 2. The Construction Schedule is to include, at minimum, appropriate time allowances for submittals, procurement, coordination with others, construction, start-up/check-out (if applicable), operational and performance testing (if applicable), commissioning (if applicable), and Contract Close-Out.
 - 3. Site-related activities shall not reflect a combination of work located in separate structures, work corresponding to different divisions of the specifications, work performed by first and second tier subcontractors or rough-in and finish work of the same trade.
 - 4. The NTP activity shall be the first activity in the schedule and shall be a Start Milestone, with an assigned 7-day, no holiday calendar. The SC and FC activities shall be Finish Milestones, with assigned "Finish on or Before" constraints, with the Contract SC and FC dates assigned to the constraints, with a 7-day, no holiday calendar.
 - 5. Primavera Settings:
 - a. Constraints – Mandatory Starts or Finishes, Start on or Finish on and Late as Possible constraints cannot be used in the Construction Schedules.

- b. Calculation Settings – Default settings must be used, except that Critical activities must be defined as Longest Path activities.
 - c. Activity Types – Resource Dependent & WBS Summary activity types cannot be used except as directed by the CITY's. Most activity types will be set to Task Dependent.
 - d. Percent (%) Complete Type must be set to Duration.
 - e. Duration Type must be set to Fixed Duration & Units.
 - f. There must not be any Curve applied to an activity if the Status % Complete method is going to be used to calculate the actual cost.
6. The CONTRACTOR's Construction Schedule shall include preparation, review and acceptance of Shop Drawings, material fabrication and material deliveries. The first submittal review and acceptance activity durations shall be fifteen (15) working days. Resubmittal review and acceptance cycles shall have activity durations of ten (10) working days. The CONTRACTOR shall include only the first submittal review and acceptance cycle for each submittal in the Construction schedule. If more than one cycle for a submittal occurs, the CONTRACTOR shall add that cycle to the schedule at the time it occurs. Additional submittal, review and acceptance cycles will require a revision to the Baseline Schedule.
- C. The CONTRACTOR shall schedule any requirements (such as submittal reviews) of the CITY's, the DESIGN CONSULTANT and others (performing WORK for the CITY's) indicated in, or required by the Contract Documents. The Construction Schedule shall incorporate appropriate activities and WORK sequences based upon the Contract Documents.

2.02 RESOURCE AND COST LOADING:

- A. Each activity in the Contract Schedule shall be assigned a dollar value in accordance with the physical value of that work in relationship to the Activity Codes/WBS. The total budget value of all activities shall equal the Contract Price. The CONTRACTOR shall also indicate the estimated duration for each construction activity.
- 1. The Major Categories for the WORK being performed shall be broken down by the following Asset Templates and entered as a separate Activity Code: Electric Generator:
 - a. Demolition
 - b. New Generator Concrete Pad
 - c. New Generator Installation
 - 2. Building Pump:
 - a. Electrical Demolition
 - b. New Electrical Equipment
 - c. New Mechanical Equipment
 - 3. New Fire Suppression System
 - 4. FPL Work Coordination
- B. The WBS for the logical construction sequencing, at a minimum shall consist of the following:
- 1. General (e.g., NTP, SC, FC, General Conditions, Bonds & Insurance, Punch list)
 - 2. Submittal Preparation
 - 3. Submittal Review and Acceptance – If there are engineering costs associated with a submittal, those costs must be approved by the CITY before they can be cost loaded in the Construction Schedule. Once approved, a separate activity named "Submittal Accepted" with zero (0) days duration can be added with the cost loading applied. No payment will be made for submittals until the review and acceptance process has been completed for that submittal.

4. Fabrication & Delivery - If there are costs associated with the Fabrication and Delivery, then a separate cost loaded Delivery Activity must be added with one (1) day duration, and assigned to its appropriate Activity Code/WBS. The CITY will only pay for materials once delivered and stored in a manner that complies with all the Contract Documents.
 5. The WBS for the remaining construction related work shall be broken down in sufficient detail for conveying the sequence at which the CONTRACTOR intends to construct the Project.
- C. Schedules where activities are not assigned both an Activity Code and WBS will not be accepted.
- D. Cost Resource Loading:
1. A single unique resource for the cost loading of all activities shall be created in the resource dictionary.
 2. The resource type for costs shall be "No labor".
 3. Cost loading of activities shall be lump sum loading of the Budgeted Cost field or Budgeted Units.
 4. Activity Costs shall be updated using the Actual No labor Cost field or, if "Calculating Costs from Units", change the Duration % Complete or Remaining Duration for each activity. The Duration % Complete must match the Cost % Complete or a specific reason must be given in the narrative for this discrepancy and the CITY will determine if the discrepancy is acceptable.
 5. All costs must be displayed to two (2) decimal places.
 6. The Costs for Mobilization and Demobilization activities must be equal.
- E. Financial Periods and Stored Period Performance:
1. The Financial Periods must be set for the duration of the Project and start on the first day of the month and finish on the last day of the month.
 2. "Stored Period Performance" must be used on a monthly basis in order for the "Actual This Period No labor Cost" to be displayed correctly in the reports.
- F. Stored Material - For those Construction Schedule activities of WORK that will use Stored Materials, the material or equipment delivery activities related to the WORK will be cost loaded with enough money to cover the stored material. The cost loading of activities related to the work-in-place will be reduced by the amount of the stored material costs loaded into the delivery activities. The CONTRACTOR must provide a list of materials and/or equipment that will be paid for under Stored Materials prior to acceptance of the Baseline Schedule so that the CITY can check for proper cost loading.
- G. If the WORK includes items covered by allowances, the CONTRACTOR shall ensure that WORK is completed within the limits of the Contract Time. The Construction Schedule shall incorporate the CONTRACTOR's best estimate of the activities and logic associated with the allowances.

2.03 COST LOADED CONSTRUCTION SCHEDULE SUBMITTAL:

- A. The Construction Schedule submittal, which refers to both the Baseline Schedule and all Schedule Updates, are to consist of the following items:
1. An electronic file containing PDF formats of all required reports and graphics, including a written narrative.
 2. An electronic backup of the Construction Schedule in Primavera P6 XER format.
 3. For Schedule Updates, a copy of the payment application is required. The Period Ending date in the CITY Application for Payment must match the Data Date of the corresponding Schedule Update.
- B. The Schedule Narrative Report for the Construction Schedule shall consist of a written description of how the WORK will be accomplished in accordance with the planned Construction Schedule. The Schedule Narrative accompanying each Schedule Update shall, at a minimum, compare current progress and cost performance to the accepted baseline schedule for all milestones and activities, including longest path activities. If there are potential or actual delays, the narrative shall state the

cause of the delay and impact to the Construction Schedule and define steps that have been taken or intend to be taken to mitigate delay impacts. The CONTRACTOR shall list any proposed changes in network activities and logic that will need to be incorporated into a revision to the Baseline Schedule. The narrative shall provide sufficient detail to allow the CITY to verify the progress of the WORK, compare actual versus planned activities, and identify assumptions made in scheduling work, including Change Order work. The CONTRACTOR shall direct specific attention, in writing, to adjustments or corrections made, either in response to the CITY comments on the previous submittal or otherwise. A Schedule Narrative Report must be provided for all Baseline Schedules and Schedule Updates even if there are no detailed comments for each sub-heading.

1. Schedule Narrative Report
 - a. The Schedule Narrative Report shall show the following sub-headings with detailed comments:
 - i. Progress, issues, delays, and claims
 - ii. Schedule changes, including out-of-sequence work
 - iii. Milestones
 - iv. Critical submittals and Procurement items
 - v. Response to CITY Review comments from previous submittal on an item by item basis.
 - b. It shall be an electronic color PDF – 8 ½ x 11 portrait format file.
- C. Required Schedule Reports and Graphics - Bar Chart reports/P6 (plf) layouts will be provided by the CITY and imported for use by the CONTRACTOR.
 1. Schedule/Leveling Report (Schedlog)
 - a. The report shall indicate software settings and calculations generated by Primavera software.
 - b. Shall be an electronic color PDF - 8 ½ x 11 portrait format file.
 2. WBS with Cash Flow Diagram (Grouped by WBS)
 - a. Bar Chart shall indicate all activities grouped by WBS and sorted by Early Start, Early Finish and Total Float.
 - b. Cash Flow Diagram shall be shown at the end of the Bar Chart, which shows budget and actual monthly bars, and cumulative curves.
 - c. Shall be an electronic color PDF - 11 x 17 landscape format file.
 3. Longest Path Bar Chart (No Grouping)
 - a. Bar Chart shall indicate all longest path activities without grouping and sorted by Early Start, Early Finish and Total Float.
 - b. Bar Chart shall be an electronic color PDF - 11 x 17 landscape format file.
 4. Pay App - Expanded (Grouped by Activity Codes)
 - a. Bar Chart shall indicate all activities grouped by Activity Codes and sorted by Activity ID.
 - b. Bar Chart shall be an electronic color PDF - 11 x 17 landscape format file.
 5. Pay App - Rollup (Grouped by Activity Codes)
 - a. Bar Chart shall indicate all activities grouped by Activity Codes rolled up per each major Activity Code. The application for payment line items must match this layout.
 - b. Bar Chart shall be an electronic color PDF - 11 x 17 landscape format file.
 6. Earned Value Report
 - a. The report shall show Earned Value information comparison between the accepted Baseline and the Current Schedule Update.
 - b. The report shall be an electronic color PDF - 11 x 17 landscape format file.

- D. Draft Schedule Reports – The following reports are to be provided prior to the formal submission of the Schedule Update and application for payment for the purpose of agreeing upon the Duration % Complete and Cost % Complete of each activity.
 - 1. WBS with Cash Flow Diagram
 - 2. Pay App - Expanded
 - 3. Longest Path
- E. Prior to each Schedule Update submittal, the CITY and the CONTRACTOR will agree upon the physical progress of the WORK (Duration % Complete of each activity), and the value (Cost % Complete) of the scheduled work in place. The Duration % Complete must match the Cost % Complete, or a specific reason must be given in the Schedule Narrative Report.
- F. All documents shall show the Project ID and Name. The CITY review shall not extend to the CONTRACTOR's means, methods, or techniques, the correctness of which shall remain the sole responsibility of the CONTRACTOR.
- G. All schedules shall be in accordance with the Contract Time requirements of the Contract. Neither the CITY review of the Construction Schedule, nor the CITY statement of “Accepted As Submitted”, will relieve the CONTRACTOR from responsibility for complying with Contract Time requirements, adhering to those sequences of work indicated in or required by the Contract Documents, or from completing any omitted WORK within the Contract Time.
- H. Acceptance by the CITY of the Baseline Schedule and Schedule Updates shall be a CONDITION PRECEDENT to the processing of Applications for Payment.

2.04 INITIAL AND REVISED COST LOADED CONSTRUCTION BASELINE SCHEDULE:

- A. The CONTRACTOR shall submit their Initial Cost Loaded Construction Baseline Schedule to the CITY for review and acceptance following Contract Execution and prior to NTP. It will be reviewed for conformance to the requirements of the Contract Documents. If the schedule is not accepted and requires revisions, the CONTRACTOR will revise this Initial Construction Baseline Schedule and resubmit it for review and acceptance within ten (10) calendar days.
- B. Schedule Naming Structure: Once the Initial Construction Baseline Schedule is accepted, it becomes the CONTRACTOR's Baseline Schedule Revision 0 and is the basis for monitoring the CONTRACTOR's progress against milestones, Contract Time, and the evaluation and reconciliation of extensions in Contract Time. From then on, all activities, original durations, and their relationships may not be changed, added, or deleted without the prior approval of the CITY the CONTRACTOR's Baseline Schedule Revision 0 must be revised when it is no longer useful as a status and control mechanism as determined by the CITY. All changes must be coordinated with and approved by the CITY. Contract Time (including all contracted milestones) cannot be changed without a formal Change Order approved by the CITY. When a revision to the Baseline Schedule is required, a new revised Baseline Schedule shall be submitted in accordance with change procedures, for review and acceptance by the CITY. Revisions to the Baseline Schedule shall follow the naming sequence listed below: (commas (“,” or ampersands (“&”) cannot be used in the naming structure because they are recognized as commands by Primavera).

Project Name – R0A-U0	1 st Submission of Baseline Schedule.
Project Name – R0B-U0	2 nd Submission of Baseline Schedule, which is accepted.
Project Name – R1A-U0	1 st Submission of Revision to the Accepted Baseline Schedule R0B-U0, which is accepted.
Project Name – R2A-U0	1 st Submission of revised Baseline Schedule R1A-U0, which is accepted.
Project Name – R3A-U0	1 st Submission of revised Baseline Schedule R2A-U0, which is accepted.

- C. Baseline Schedule revisions shall accurately reflect all approved Change Orders including the exact duration and cost. They will be reviewed for conformance to the requirements of the Contract Documents as amended by Change Orders.
- D. Upon execution of a Change Order, a new Activity Code for that Change Order must be created. All activities associated with that Change Order will be assigned to both the new Activity Code and their corresponding WBS. Both the Application for Payment and the layout report, Pay App - Rollup, will have a line item indicating the new Change Order.
- E. The cost loading must not be changed from any Baseline Schedule Activities because of an executed Change Order. Original duration and logic may be changed on the Baseline Schedule Activities, but the dollars amounts can only be changed by adding a new Change Order activity. This is applicable for both additive and deductive Change Orders.
- F. If a particular Scope of Work (SOW) has been deleted in a Change Order, the activity associated with that SOW must have the proper logic that causes both the new deductive Change Order Activity and the Baseline Schedule Activity to progress equally, so the costs calculate correctly for that SOW.
- G. If a Baseline Schedule Activity becomes associated with a Change Order that affects its original duration or logic, then the Activity Name must include the Change Order. (e.g. ***CO#01***).
- H. If a new activity is added because of an executed Change Order both the Activity ID and the Activity Name must reflect the associated Change Order. (E.g. CO#01-A2500, Additional Silt Fence ***CO#01***).
- I. Baseline Schedule Activity ID's must not be changed or deleted.
- J. An executed Change Order may require multiple activities broken down in enough detail to convey the new SOW.

2.05 COST LOADED CONSTRUCTION SCHEDULE UPDATES:

- A. A Schedule Update is a copy of the accepted Baseline Schedule with progress added. Progress is Duration % Complete.
- B. The Schedule Update must be submitted by the CONTRACTOR each month with each pay application or as directed by the CITY. The Schedule Update will indicate actual performed WORK and WORK forecast through Project completion. The actual schedule data shall record when WORK was performed. Forecast data will be calculated by the schedule.
- C. All out of sequence activities that originally had a finish to start relationship but became a Start to Start or Finish to Finish relationship must be corrected in the Schedule Update. For other out of sequence relationships, a revision to the baseline is required.
- D. Each Schedule Update shall be named beginning with the Accepted Baseline Number followed by the Update number beginning with "1A" as follows:

Project Name – R0B-U1A	1 st submitted Update of the accepted Baseline R0B, which was rejected.
Project Name – R0B-U1B	Resubmittal of 1 st Update, which was accepted.
Project Name – R0B-U2A	2 nd submitted Update of the accepted Baseline R0B, which was rejected.
Project Name – R0B-U2B	Resubmittal of 2 nd Update, which was accepted.

PART 3 - EXECUTION

3.01 MONTHLY UPDATE CYCLE:

- A. Schedule Update Submittals are due every 30 days and are to be attached to each Application for Payment. The Schedule Update Total Actual Cost to Date must match the Application for Payment

WORK Completed and Stored to Date amount. The CITY will advise the CONTRACTOR of any change to the due dates.

- B. See Paragraph 2.03.D for the Draft Schedule Reports that are to be provided prior to the formal submission of the Schedule Update and application for payment.

3.02 CHANGES:

- A. Within ten (10) days after a schedule problem is identified by either CONTRACTOR or CITY, or at any time the percentage of the dollar value for completed work is 10 % less than the value of the scheduled WORK, the CONTRACTOR shall submit a Construction Recovery Schedule that identifies the cause of the Change and any actions required by the CONTRACTOR to recover the schedule and complete the WORK within Contract Time. The CONTRACTOR shall promptly undertake appropriate action, at no additional cost to the CITY, to recover the schedule whenever the current schedule shows that the CONTRACTOR did not or cannot achieve a milestone established in the Contract.
- B. Appropriate recovery actions include, but are not limited to, assignment of additional labor, subcontractors, equipment, shift or overtime work, expediting of submittal or deliveries, or any combination of thereof. Overlapping of activities or sequencing changes shall be deemed appropriate only if properly substantiated in the submittal. Recovery plans that are accepted by the CITY that add, delete, or change activities, activity relationships, durations or constraints and cost or resource loading must be submitted as a Revision to the Baseline Schedule with zero Total Float in accordance with this specification. Once the revised baseline is accepted by the CITY, the CONTRACTOR must prepare a Schedule Update of the Baseline Schedule with all actuals to date and submit it for acceptance.
- C. The CONTRACTOR's refusal, failure or neglect to take appropriate recovery action or to submit a written recovery statement shall constitute reasonable evidence that the CONTRACTOR is not prosecuting the WORK, or separable part, with the diligence that will ensure its completion within the Contract Time. Such lack of action shall constitute sufficient basis for the CITY to recommend the withholding of some or all of any payment due and/or shall be considered grounds for termination of the Contract by the CITY in accordance with Article 15 of the General Terms & Conditions.

END OF SECTION

SECTION 01320 CONSTRUCTION VIDEO AND PHOTOGRAPHS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION specifies administrative and procedural requirements for construction photographs.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals

1.02 SUBMITTALS:

- A. Submit photographs electronically as specified in SECTION 01300 and in PART 3, this SECTION.

1.03 QUALITY ASSURANCE:

- A. Photographs and video shall be clear and sufficient to show significant detail, not blurred, or taken in shadow, nor too distant. The CITY may require that the photographs or video be retaken should the quality be insufficient. Costs for such re-takes are the CONTRACTOR's responsibility at no extra cost to the CITY.

PART 2 - PRODUCTS

2.01 PHOTOGRAPHIC REQUIREMENTS:

- A. Specified in PART 3, this SECTION.

PART 3 - EXECUTION

3.01 PROGRESS SITE PHOTOGRAPHS:

- A. The CONTRACTOR shall be responsible for photographs of the Site to show the existing and general progress of the WORK. The CITY will advise as to which views are of interest. Photographs shall be taken of the following areas and at the following times.
 - 1. Existing Site conditions before Site WORK is started. Number of views shall be adequate to cover the Site.
 - 2. Progress of the WORK from beginning and throughout construction. Progress photos must be provided with each pay request. Pay requests will not be considered acceptable until photographs are provided. Number of views shall be adequate to cover the Site.
 - 3. Finished Project after completion of WORK. Number of views shall be adequate to show the finished WORK.
 - 4. If Project is not completed during the Contract Time, or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.
- B. Photographs shall be taken with three (3) megapixel minimum resolution.
- C. Provide a CD containing all photographic images in JPG format. Label CD with the name and Contract number of Project, name of CONTRACTOR, description of view, and date photograph was taken.
- D. Deliver CD to CITY with pay applications.

3.02 ADDITIONAL PHOTOGRAPHS:

- A. From time to time the CITY may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order, and are not included in the Contract Price or an Allowance.
1. The CITY will give the photographer three (3) days' notice, where feasible.
 2. In emergency situations, the photographer shall take additional photographs within 24 hours of the CITY request.
 3. Circumstances that could require additional photographs include, but are not limited to:
 - a. Substantial Completion of a major phase or component of WORK.
 - b. CITY request for special publicity photographs.
 - c. Special events planned at Project Site.
 - d. Immediate follow-up when on-site events result in construction damage or losses.
 - e. Photographs to be taken at fabrication locations away from Project Site.
 - f. Extra record photographs at time of final acceptance.

END OF SECTION

SECTION 01410 TESTING AND QUALITY CONTROL

PART 1 - GENERAL

1.01 SCOPE:

A. Summary of Work:

1. The CONTRACTOR shall provide and maintain an effective Quality Control Program that fulfills the requirements of Article 13 *"Warranty and Guarantee, Tests and Inspections, Correction, Removal or Acceptance of Defective Work"* of the GENERAL TERMS & CONDITIONS.
2. The CONTRACTOR shall establish and implement a Quality Control Plan to perform enough inspection of all items of the WORK, including that of Subcontractors, to insure conformance to the Technical Specifications and the Drawings with respect to the materials, workmanship, construction, equipment performance, and identification.
3. The CONTRACTOR's job supervisory staff may be used for quality control, supplemented as necessary by additional personnel for surveillance or special technicians to provide capability for the controls required by the Technical Specifications. The CONTRACTOR's Quality Control Plan must clearly identify the quality control leader and personnel organizational system. The leader must have the authority to direct the removal and replacement of defective work.
4. After the Contract is awarded and before the construction begins, the CONTRACTOR shall meet with the CITY or its representative to discuss quality control requirements. The meeting shall develop mutual understanding relative to the details of the Quality Control Plan, including the appropriate forms to be used for recording the quality control operations, inspections, administration of the Quality Control Plan, and the interrelationship of the CONTRACTOR and the CITY inspection.
5. The CONTRACTOR shall submit his written Quality Control Plan for review, describing the activities and listing those inspections and testing activities that the CONTRACTOR will perform prior to beginning the WORK. The CONTRACTOR's Quality Control Plan shall describe how he will communicate timely notification to allow for testing and inspection activities performed by the CITY, or its representatives, for on and off-site construction activities
6. All compliance inspections shall be recorded on the appropriate forms, including but not limited to the specific items required in each SECTION of the Technical Specifications. The completed forms, including record of corrective actions taken, shall be furnished to the CITY. The CITY quality control representative will maintain a list of all deficiencies which are not corrected the same day as they are discovered.
7. Should recurring deficiencies in an item or items indicate that the Quality Control Plan is not adequate; the CONTRACTOR shall take corrective actions as directed by the CITY to update the Quality Control Plan, to satisfactorily address and resolve any reoccurring deficiencies.

B. Related Work Specified Elsewhere:

1. SECTION 01300 – Submittals

1.02 TESTING LABORATORY SERVICES:

- A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing laboratory acceptable to the CITY. The laboratory shall be staffed with experienced technicians, and shall be properly equipped, ACI certified, and fully qualified to perform the tests in accordance with the specified standards.

1.03 TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR:

- A. The testing that the CITY will coordinate and pay for is described in paragraph 1.04 below. All other testing required in connection with the performance of the WORK (which are identified as the CONTRACTOR's responsibility in the Contract Documents) shall be performed and paid for by the CONTRACTOR, and a certified copy of the results will be furnished to the CITY within five (5) days of the test.
- B. The CONTRACTOR is also responsible for all testing and inspection services required to achieve an effective Quality Control Program, to assure that the WORK strictly complies with the Contract requirements. The CONTRACTOR shall pay all costs for such services. The CONTRACTOR shall also pay for any tests performed by the CITY which do not meet the requirements of the Technical Specifications and as described below.

1.04 TESTING LABORATORY SERVICES FURNISHED BY CITY:

- A. The CITY will secure the services of a materials testing company, for field and laboratory tests, for certain items of the WORK. The CITY will pay all charges for services on: cast-in-place concrete, moisture density (Proctor) and relative density tests on embankment, fill and backfill materials, in-place field density tests on embankments and fills, and the tests required for the Grouting Beneath Structures. The field sampling and testing will be performed in the general manner indicated in the Technical Specifications, with minimal interference to the construction operations.

While the CONTRACTOR may request testing in order to proceed to a following construction stage, the CITY will determine the exact time and location of the field sampling and testing and may require additional sampling and/or testing as necessary to determine that the materials and equipment conform with the CONTRACTOR-submitted data and to the Contract Documents.

- 1. The CITY shall be reimbursed by the CONTRACTOR for the cost of any CONTRACTOR-requested tests or inspections, or tests on an item purported to be ready, which fail to meet the Technical Specification requirements. The CITY may withhold such amounts from payments otherwise due to the CONTRACTOR.
- B. Arrangements for the delivery of samples and test specimens to the testing laboratory under this paragraph will be made by the CITY. The testing laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and shall furnish a written report of each test.
- C. The CONTRACTOR shall furnish all sample materials and cooperate in the sampling and field testing activities, interrupting the WORK when necessary.
- D. When sampling or testing activities are performed in the field by testing laboratory personnel, the CONTRACTOR shall furnish personnel and facilities to assist in the activities.
- E. The Testing Laboratory contracted by the CITY will not be authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of the Contract Documents.
 - 2. Approve or accept any portion of the WORK.
 - 3. Perform any duties of the CONTRACTOR.
 - 4. The CONTRACTOR shall provide at least 48 hours notice of any work for which he may desire required testing for compliance by the CITY

1.05 TRANSMITTAL OF TEST REPORTS:

- A. Written reports of test and engineering data furnished by the CONTRACTOR shall be submitted as specified in SECTION 01300.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01510 TEMPORARY UTILITIES AND FACILITIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This SECTION includes requirements of a temporary nature not normally incorporated into final WORK. It includes the following:
 - 1. Utility services
 - 2. Construction and support facilities
 - 3. Construction aids
 - 4. Fire protection
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the publications of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. See the various paragraphs for the specified standard. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. American National Standards Association (ANSI):
 - a. A10 Series - Safety Requirements for Construction and Demolition
 - b. ANSI/ASME PTC 19.1-1998 Test Uncertainty, Instrument and Apparatus
 - 2. National Electrical Contractors Association (NECA):
 - a. Electrical Design Library - Temporary Electrical Facilities
 - 3. National Fire Protection Association (NFPA):
 - a. NFPA 10 - Portable Fire Extinguishers
 - b. NFPA 70 - National Electrical Code
 - c. NFPA 241 - Safeguarding Construction, Alterations, and Demolition Operations
 - 4. National Electrical Manufacturers Association (NEMA)
 - 5. Underwriters Laboratories (UL)
 - 6. Florida Department of Transportation Standard Specifications for Road and Bridge Construction
 - 7. Florida Trench Safety Act (90-96, Laws of Florida)

1.03 SUBMITTALS:

- A. Submit in accordance with SECTION 01300.
- B. Site Plan: Submit to the CITY a Site Plan indicating CONTRACTOR's facilities including:
 - 1. Trailers
 - 2. Equipment Yard
 - 3. Parking

4. Traffic Control

1.04 QUALITY ASSURANCE:

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
 - 1. Building Code requirements
 - 2. Utility company regulations
 - 3. Police, Fire Department, and rescue squad rules
 - 4. Environmental protection regulations
- B. Standards:
 - 1. Comply with NFPA 10 and 241, and ANSI A10 Series standards "Temporary Electrical Facilities."
 - 2. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70.
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

- A. Provide new materials and equipment. If acceptable to the CITY, undamaged previously used materials and equipment in serviceable condition may be used. Provide materials and equipment suitable for the use intended, of capacity for required usage, and meeting applicable codes and standards.
- B. Water: Provide potable water approved by local health authorities.
- C. Water Hoses: Provide 3/4-inch (19-mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet (30 m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- D. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- E. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- G. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.01 TEMPORARY UTILITIES:

A. General:

1. Engage the appropriate local utility company to extend temporary electric and phone service to the Project area from nearby existing utilities. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
2. Provide adequate utility capacity at each stage of construction. Prior to availability of temporary utilities at the Site, or in remote areas without services, provide trucked-in services as required for start-up and construction operations.
3. Furnish, install and maintain temporary utilities required for adequate construction, safety and security. Modify, relocate and extend systems as WORK progresses. Repair damage caused by installation or use of temporary facilities. Grade the areas of Site affected by temporary installations to required elevations and grades, and clean the area. Remove on completion of WORK or until service or facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
4. The types of temporary construction utilities and facilities required include, but are not limited to, potable drinking water, wastewater, drainage, dewatering equipment, enclosure of WORK, ventilation, electrical power, lighting, hoisting facilities, stairs, ladders, and roads.
5. Inspect and test each service before placing temporary utilities in use. Arrange for required inspections and tests by governing authorities, and obtain required certifications and permits for use.
6. Materials used for temporary service shall not be used in the permanent system unless so specified or acceptable to the CITY.

3.02 TEMPORARY ELECTRICITY AND LIGHTING:

A. New Service:

1. Arrange with utility company to extend existing electric service to temporary office trailers.
2. Connect temporary service in a manner directed by utility company officials. Provide separate meter for metering of power used by all entities authorized to be at or perform WORK at the Project Site.
3. The electric service shall be of sufficient capacity and characteristics for the various construction tools, machinery, lights, heating and air conditioning, pumps, and other tools required by CONTRACTOR and his Subcontractors. In areas of the Project where permanent or temporary power service from the local utility is not available, the CONTRACTOR shall supply and maintain engine-driven, power-generator sets.
4. Provide weatherproof, grounded, power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating and lighting. Provide overload protection. Supply power for electric welding, if any, from engine-driven, power-generator sets.
5. Provide adequate artificial lighting for all areas of WORK when natural light is not adequate for WORK.
6. Sufficient light shall be provided for general construction areas, with additional sufficient lighting for specific tasks and to meet safety requirements.

B. Use of Permanent System:

1. Prior to use of permanent system to be installed by the power company for construction purposes, obtain written permission of the CITY
 2. Maintain permanent system as specified for temporary facilities.
- C. Costs of Installation and Operation:
1. Pay fees and charges for permits and applications.
 2. Pay costs of installation, maintenance, removal of temporary services, and restoration of any permanent facilities used.
 3. Pay costs of electrical power used (if applicable).
 4. Pay costs of furnishing, operating, and maintaining engine-driven power-generator sets, where applicable.

3.03 TEMPORARY HEAT AND VENTILATION:

- A. General:
1. Provide temporary heat, ventilation and cooling as required to maintain adequate environmental conditions in temporary office trailers and storage sheds and to facilitate progress of the WORK, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage. Protect from adverse affects of low temperatures or high humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
 2. Methods of heating and fuel shall be suitable for particular purposes. Portable heaters shall be standard approved units with controls.
- B. Costs of Installation and Operation:
1. Pay fees and charges for applications, permits, and inspections.
 2. Pay costs of installation, operation, maintenance, removal of equipment, and restoration of existing or permanent facilities if used.
 3. Pay cost of power and fuel used.

3.04 TEMPORARY TELEPHONE SERVICE:

- A. General:
1. Arrange with local telephone Service Company to extend existing direct line telephone service to the CONTRACTOR's and CITY field office site for the use of the CITY and construction personnel and employees.
 2. Telephone Service: Local Provider.
 3. Minimum Service Required: Direct lines for voice and data communication for the CITY field office as specified in SECTION 01590.
 - a. One direct line instrument in superintendent's field office.
 - b. Adequate number of service lines and instruments for needs of trades.
 - c. Other instruments and pay telephone station(s) at the option of the CONTRACTOR, or as required by regulations.
 - d. Provide a dedicated telephone line for a fax machine in the Superintendent's field office.
 4. CONTRACTOR shall arrange with local cellular/mobile telephone Service Company to provide mobile telephone service for use by CONTRACTOR and so CONTRACTOR can be reached throughout the entire Project area during normal working hours.

B. Costs of Installation and Operation:

1. Pay all costs for installation, maintenance and removal, and service charges for local calls. Toll charges shall be paid by the party who places the call.

3.05 TEMPORARY SANITARY FACILITIES:

A. CONTRACTOR-Furnished Facilities:

1. Furnish, install and maintain temporary sanitary facilities for use through construction period. Remove on completion of WORK.
2. Provide for all construction workers under this Contract and representatives at the Site.
3. Toilet facilities shall be of the chemical-aerated recirculation or combustion type, properly vented and fully enclosed with a glass- fiber-reinforced polyester shell or similar nonabsorbent material.

3.06 TEMPORARY CONSTRUCTION AIDS:

A. General:

1. Provide construction aids and equipment required by personnel, available for CITY observers' use, and to facilitate the execution of the WORK; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, and other such facilities and equipment.
2. Materials may be new or used, must be suitable for the intended purpose and meet the requirements of applicable codes, regulations and standards.
3. When platform stair framing is in place, provide temporary treads, platforms, and railings for use by construction personnel.

3.07 TEMPORARY BYPASS FLOW:

- A. The CONTRACTOR shall furnish a bypass system as specified in specification SECTION 02402.

3.08 INSTALLATION AND REMOVAL:

- A. Relocation: Relocate construction aids as required by progress of construction, by storage or WORK requirements, and to accommodate requirements of CITY and other CONTRACTORS at the Site.
- B. Removal: Remove temporary materials, equipment and services when construction needs can be met and allowed by use of permanent construction, or at completion of the Project.
- C. Repair: Clean and repair damage caused by installation or by use of temporary facilities.
1. Remove foundations and underground installations for construction aids.
 2. Grade the areas of the Site affected by temporary installations to required elevations and clean the area.

END OF SECTION

SECTION 01530 TEMPORARY BARRIERS AND CONTROLS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes General Requirements for:
 - 1. Protection of the WORK
 - 2. Protection of existing property
 - 3. Barriers
 - 4. Security
 - 5. Environmental controls
 - 6. Access roads and parking areas
 - 7. Traffic control and use of roadways
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 01590 – Field Offices and Sheds
 - 3. SECTION 01700 - Contract Closeout

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the publications of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 SAFETY AND PROTECTION OF WORK AND PROPERTY:

- A. General:
 - 1. The CONTRACTOR shall provide for the protection of the WORK as set forth in the GENERAL TERMS & CONDITIONS. Always Provide protection against rain, wind, storms, frost, freezing, condensation, or heat so as to maintain all WORK and Equipment and Materials free from injury or damage. At the end of each day all new WORK likely to be damaged shall be appropriately protected.
 - 2. The CONTRACTOR shall notify the CITY immediately if at any time, operations are stopped due to conditions which make it impossible to continue or to obtain proper results.
 - 3. The CONTRACTOR shall construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, pits, and trenches dewatered sufficiently to permit continuous construction.

4. The CONTRACTOR shall protect floors from damage by proper covering and care when handling heavy equipment, painting, or handling mortar or other such materials. Use proper cribbing and shoring to prevent overloading of floors while moving heavy equipment. Provide metal pans under pipe-threading machines and other machines that may leak oil and clean such pans daily, keeping oil off the floors. Restore floors to former condition where damaged or stained.
 5. The CONTRACTOR shall not load concrete floors less than 28-days old without the written permission from the CITY
 6. The CONTRACTOR shall restrict access to roofs except as required by the WORK. Where access is required, provide protection with plywood, boards, or other suitable materials.
- B. Property Other than CITY:
1. The CONTRACTOR shall provide for the protection of property as set forth in the GENERAL TERMS & CONDITIONS. Report immediately to the owners thereof and promptly repair damage to existing facilities resulting from construction operations.
 2. Names and telephone numbers of representatives of the power company having jurisdiction over power lines in the WORK area can be obtained from the CITY. The CONTRACTOR shall contact the power company a minimum of seven (7) calendar days prior to performing WORK within 500' of power transmission line property, right-of-way or easement lines.
 3. The applicable requirements specified for protection of the WORK shall also apply to the protection of existing property of others.
 4. The CONTRACTOR shall restore all property affected by the CONTRACTOR's operations to the original or better condition, to the satisfaction of the CITY

3.02 BARRIERS:

A. General:

1. The CONTRACTOR shall furnish, install, and maintain suitable barriers as required to prevent public entry, protect the public, and to protect the WORK, existing facilities, trees, and plants from construction operations. Remove the barriers when no longer needed or at completion of the WORK.
2. The CONTRACTOR may use new or used materials, suitable for the intended purpose, but must not violate requirements of applicable codes and standards or of regulatory agencies.
3. Barriers shall be of a neat and reasonably uniform appearance, structurally adequate for the required purposes.
4. The CONTRACTOR shall maintain barriers in good repair and a clean condition for adequate visibility.
5. The CONTRACTOR shall relocate barriers as required by progress of the WORK.
6. The CONTRACTOR shall repair damage caused by the installation of barriers and restore damaged areas to original or better condition, to the satisfaction of the CITY.

3.03 ENVIRONMENTAL CONTROLS:

A. Dust Control:

1. If appropriate and at the discretion of the CITY, the CONTRACTOR shall provide and apply methods of positive dust control to minimize raising dust from construction operations.
2. The CONTRACTOR shall clean interior spaces and surfaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

3. The CONTRACTOR shall schedule operations so that dust and other contaminants will not fall on wet or newly-coated surfaces.
 4. The CONTRACTOR shall cover materials transported to and from Site as necessary to prevent depositing material on offsite roadways or creating dust.
- B. Water and Erosion Control:
1. The CONTRACTOR shall provide methods necessary to control surface water to prevent damage to the WORK, the Site, or adjoining properties as specified in SECTION 02436.
 2. The CONTRACTOR shall control fill, grading, and ditching to direct surface water away from excavations and other construction areas, and to direct surface water to proper storage and/or conveyance facilities.
 3. The CONTRACTOR shall control surface water and ground water as necessary to prevent flooding, erosion, or other damage to any portion of the Site and/or to adjoining areas.
- C. Debris Control and Clean-Up:
1. The CONTRACTOR shall always keep the premises free from accumulations of debris, waste materials, and rubbish. The CONTRACTOR's responsibilities shall include, but not be limited to the following:
 - a. Adequate trash receptacles at the Site emptied promptly when filled.
 - b. Periodic cleanup to avoid hazards or interference with operations at the Site and to maintain the Site in a reasonably neat condition.
 - c. The keeping of construction materials such as forms and scaffolding neatly stacked.
 - d. Immediate cleanup to protect the WORK by removing splattered concrete, oil, paint, corrosive liquids, and cleaning solutions from walls, floors, and other surfaces before the surfaces are marred.
 2. The CONTRACTOR shall prohibit overloading of trucks to prevent spillages on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.
 3. Final cleanup is specified in SECTION 01700.
- D. Pollution Control:
1. The CONTRACTOR shall provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations.
 2. The CONTRACTOR shall provide equipment and personnel and perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site in approved locations and replace with suitable compacted fill and topsoil.
 3. The CONTRACTOR shall take special measures to prevent harmful substances from entering public waters, sanitary sewers, or storm sewers.
 4. If hazardous materials are discharged, report to authorities as required by applicable law or regulations and notify the CITY, immediately.

3.04 TRAFFIC CONTROL AND USE OF ROADWAYS:

- A. Traffic Control:
1. The CONTRACTOR shall provide, operate, and maintain equipment, services, and personnel, with traffic control and protective devices, as required to expedite safe vehicular traffic flow on haul routes, at Site entrances, onsite access roads, and parking areas. This includes barricades

and other devices or personnel as necessary to adequately protect the public. Prepare and submit a Traffic Control Plan to CITY for review.

2. The CONTRACTOR shall remove temporary equipment and facilities when no longer required. Restore grounds to original, better, or specified conditions.
 3. The CONTRACTOR shall provide and maintain suitable detours or other temporary expedients if necessary.
 4. Bridge over open trenches where necessary to maintain traffic.
 5. The CONTRACTOR shall consult with applicable governing authorities to establish public thoroughfares which will be used for Site access. All operations shall meet the approval of owners or agencies having jurisdiction.
- B. Maintenance of Roadways:
1. The CONTRACTOR shall repair off-site roads, water control and CITY structures and levees damaged by operations. Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.
 2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.

3.05 SECURITY:

- A. The CONTRACTOR is solely responsible for initiating and maintaining security at the construction Site. CONTRACTOR shall take all necessary precautions for the security of, and shall provide the necessary protection to:
1. Materials and equipment incorporated into the WORK or stored on-site prior to incorporation into the WORK.
 2. Temporary field offices and sheds, and their contents including those listed in SECTION 01590.
 3. Plant and equipment including any equipment furnished for use by the CITY.
- B. The CONTRACTOR shall replace, in kind, any materials or equipment lost, damaged or destroyed at no cost to the CITY.

END OF SECTION

SECTION 01580 PROJECT IDENTIFICATION AND INFORMATIONAL SIGNS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes basic requirements for temporary Project Identification and Informational signs required during construction.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 1300 Submittals

1.02 SUBMITTALS:

- A. Submit as specified in SECTION 01300.
- B. Includes, but not limited to, the following:
 - 1. Shop Drawings, sign materials, sign proofs and product data as applicable.
 - 2. Show content, layout, lettering, colors, and structure.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENTS:

- A. The CONTRACTOR shall design sign(s) and structure(s) to withstand wind and environmental conditions in accordance with all applicable laws and regulations. Provide with a finish adequate to withstand weathering, fading, chipping, and peeling for duration of construction.

2.02 IDENTIFICATION SIGNS:

- A. Project Identification:
 - 1. The CONTRACTOR shall construct sign mounting structure(s) and framing of wood or metal, structurally adequate to meet the requirements of Paragraph 2.01 above and/or as shown on the Contract Documents.
 - 2. The Project Identification sign panel shall be constructed of minimum 3/4-inch thickness B/C exterior grade plywood. Panels shall be one sheet with an overall size of 48 inches by 96 inches.
 - 3. Rough hardware shall be galvanized steel or aluminum.
 - 4. Coating: Paint shall be suitable for outdoor applications and shall be resistant to weathering, peeling, chipping and fading. Sign colors shall be approved by the CITY.
 - 5. Information Content:
 - a. Project title/name, location, CITY logo and name as shown on the Contract Documents
 - b. Names and titles of authorities (i.e. CITY COMMISSION, MAYOR, D1 COMMISSIONERS AND CITY MANAGER, ETC.
 - c. Name of prime CONTRACTOR and major Subcontractors
- B. CONTRACTOR Identification: If not a part of the Project identification sign, provide and install the CONTRACTOR's standard sign.

2.03 INFORMATIONAL SIGNS:

A. Construction:

1. This includes signs for traffic, construction workers, and general public in regards to directions, warnings, hazards, locations of areas, facilities, equipment, and others of a similar nature.
2. The CONTRACTOR shall provide signs of design, size, color, and lettering as required by regulatory agencies and/or as shown on the Contract Documents. Signs shall be painted metal, plastic, or fiberglass. Materials shall be suitable for the conditions in which signs are to be placed, such as weathering and fading.
3. The CONTRACTOR shall construct sign mounting structure(s) and framing of wood or metal, structurally adequate to meet the requirements of Paragraph 2.01 above and/or as shown on the Contract Documents.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Project and Contractor Identification Signs: The CONTRACTOR shall

1. Install all required signs in locations acceptable to the CITY. Install so as not to obstruct traffic or construction operations.
2. Erect on framing or foundation, and rigidly brace.
3. Maintain signs in good repair, in a neat, clean and readable condition.
4. Remove all signs, framing, supports, and foundations upon completion of the Project.

B. Informational Signs: The CONTRACTOR shall

1. Install at appropriate locations and in enough quantities to assure visibility. Relocate as required by progress of the WORK.
2. Maintain signs in good repair, in a neat, clean, and readable condition.
3. Remove all signs, framing, supports, and foundations upon completion of the Project.

END OF SECTION

SECTION 01590 FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary: This SECTION includes requirements for temporary field offices and other structures for office and storage space required by CONTRACTOR and the
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01510 - Temporary Utilities and Facilities
 - 2. SECTION 01600 - Equipment and Materials
- C. Use of Existing Facilities: Existing facilities at the Site shall not be used for field offices.
- D. Use of Permanent Facilities: Permanent facilities, when substantially completed, shall not be used for field offices or for storage.

PART 2 - PRODUCTS

2.01 FIELD OFFICES:

- A. General:
 - 1. Provide trailers, mobile buildings, or buildings constructed with floors raised aboveground, with steps and landings at entrance doors.
 - 2. Buildings shall be structurally sound, secure, and weathertight.
 - 3. Provide four (4) appropriate portable type fire extinguishers at each office and storage area.
 - 4. Maintain offices for duration of Contract.
 - 5. Install office spaces ready for occupancy within 7 days of the Notice to Proceed.
 - 6. Obtain any required building permits for installation of temporary field offices and sheds.
- B. CONTRACTOR's Office:
 - 1. Provide a field office for CONTRACTOR's superintendent on the Site.
 - 2. Field office shall be of size required for general use, with lights, heat and air conditioning, furnishings, telephone service, and other necessary facilities and utilities required by CONTRACTOR's operations.

2.02 STORAGE SHEDS AND TRAILERS:

- A. On-Site:
 - 1. The CONTRACTOR shall provide temporary buildings or trailers needed for storage of Equipment and Materials installed under this Contract (and those furnished by CITY or others under separate Contract).
 - 2. Provide ventilation and heating as required by Equipment and Material stored or as per MANUFACTURER's requirements.
 - 3. The CONTRACTOR shall be solely responsible for temporary buildings and trailers located on site.
- B. Off-Site:
 - 1. The CONTRACTOR shall advise the CITY of any arrangements made for storage of Equipment and Materials in a place other than CITY Site. The CONTRACTOR shall furnish evidence of insurance coverage with Application for Payment in conformance with General Terms & Conditions.

PART 3 - EXECUTION

3.01 LOCATION, INSTALLATION AND MAINTENANCE:

A. General:

1. Place temporary buildings, trailers, and stored materials in locations acceptable to CITY
2. Installed field offices and sheds to resist winds and elements of the locality where installed.
3. Remove when no longer needed at the Site or when WORK is completed.
4. Keep approach walks free of leaves, mud, water, or ice.
5. At completion of WORK, remove temporary buildings and trailers, foundations (if any), utility services, and debris.
6. Prepare ground or paved areas as specified in applicable SECTIONS.

END OF SECTION

SECTION 01600 EQUIPMENT AND MATERIALS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes general requirements for transportation, handling, delivery, storage, and protection of CONTRACTOR and CITY- furnished Equipment and Materials.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 01630 - Product Options and Substitutions
 - 3. SECTION 01640 - Start Up/Check Out/Manufacturer's Field Services for Contractor Furnished Equipment
 - 4. SECTION 01641 – Start-Up/Check-Out Manufacture's Field Services for Owner Furnished Equipment
 - 5. SECTION 01660 - Equipment and System Performance and Operational Testing
 - 6. SECTION 01662 - Commissioning

1.02 DEFINITIONS: Definitions used in this Paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

- A. Products: Items purchased for incorporation in the WORK, regardless of whether they were specifically purchased for the Project or taken from the previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and other terms of similar intent.
- B. Equipment: A product with operational or non-operational parts, regardless of whether motorized, manually operated, or fixed. Equipment may require service connections such as wiring or piping.
- C. Materials: Products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form part of the WORK.

1.03 QUALITY CONTROL:

- A. Equipment and Material Incorporated into the WORK: Provide products that comply with the requirements of the Contract Documents, are undamaged, and unless otherwise indicated, are unused at the time of installation. The CONTRACTOR shall provide products that are complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.
- B. Standard Products: Where they are available and comply with the Technical Specifications, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- C. Continued Availability: Where, because of the nature of its application, the CITY is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard products for which the MANUFACTURER has published assurances that the products and its parts are likely to be available to the CITY at a later date.
 - 1. Conform to applicable Technical Specifications, codes, standards, and regulatory agency requirements.

2. Comply with size, make, type, and quality specified, or as specifically approved in writing by the CITY.
 3. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Equipment and Materials shall be suitable for service conditions intended.
 - d. Equipment capacities, sizes, and dimensions indicated or specified shall be adhered to unless variations are specifically approved in writing.
 - e. Provide labels and nameplates where required by regulatory agencies or to state identification and essential operating data.
 - f. Two (2) or more items of the same kind shall be identical, supplied by the same MANUFACTURER.
 4. Do not use equipment and material for any purpose other than that for which it is designed or is specified.
- D. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
- E. Identification: Each item of equipment shall have permanently affixed to it a label or tag with its equipment number designated in this Contract. The label or tag shall be stainless steel and shall be located so as to be easily visible.

1.04 TRANSPORTATION AND SHIPMENT:

- A. Shipment Preparation: The CONTRACTOR shall require MANUFACTURERS and suppliers to prepare Equipment and Materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage, for CONTRACTOR supplied equipment. Provisions for protection shall include the following:
1. Crates or other suitable packaging materials
 2. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery
 3. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel
 4. Grease packing or oil lubrication in all bearings and similar items
 5. Precast concrete components shall be transported, lifted and stored as specified by the precast supplier. Precast supplier shall provide written instructions to the CONTRACTOR as to the above. The CONTRACTOR shall provide a copy to the CITY.
- B. Marking: Each item of Equipment and Material shall be tagged or marked as identified in the delivery schedule or on Submittals, submitted in accordance with SECTION 01300. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together, and the packages or bundles are properly tagged or marked.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Delivery – The CONTRACTOR shall:

1. Arrange deliveries of Equipment and Materials in accordance with cost loaded construction schedules, in ample time to facilitate inspection prior to installation, and to avoid delay of the WORK.
 2. Deliver, store, and handle Equipment and Materials in accordance with the MANUFACTURER's recommendations using means and methods that will prevent damage, deterioration, and loss, including theft.
 3. Control delivery schedules to minimize long term storage at the Site and to prevent overcrowding of construction areas. Coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss.
 4. Avoid conflict with Work of CITY or other contractors.
 5. Deliver Equipment and Materials to the Site in MANUFACTURER's sealed containers or other packaging system with identifying labels and instructions for handling, storing, unpacking, protecting, and installing.
 6. Mark deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.
 7. Immediately upon delivery, inspect shipment to assure:
 - a. That each product complies with requirements of Contract Documents and reviewed Submittals.
 - b. Quantities are correct.
 - c. Containers and packages are intact, labels are legible.
 - d. Equipment and Materials are properly protected and undamaged.
- B. Storage – The CONTRACTOR shall:
1. Store Equipment and Materials immediately after delivery and protect it as necessary until completion of the WORK. Store in accordance with MANUFACTURER's instructions with seals and labels intact and legible.
 2. Store Equipment and Materials in a manner that will not endanger the supporting construction and/or existing structures and facilities.
 3. Store Equipment and Materials that are subject to damage by elements in weathertight enclosures.
 4. Maintain temperature and humidity within ranges required by the MANUFACTURER.
 5. Protect motors, electrical equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
 6. Protect exposed-machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
 7. Protect bearings and similar items with grease packing or oil lubrication.
 8. Handle and store steelplate, sheet metal, and similar items in a manner to prevent deformation.
 9. Exterior Storage – The CONTRACTOR shall:
 - a. Provide platforms, blocking, or skids to support fabricated products aboveground; and to prevent soiling, staining and damage. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation.

- b. Store loose granular materials on solid surface areas to prevent mixing with foreign matter.
 - c. Provide surface drainage to prevent flow or ponding of rainwater.
10. Equipment and Materials shall not show any pitting, rust, decay, or other deleterious effects of storage prior to final acceptance of WORK.
11. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions and are free from damage or deterioration.
- C. Handling – The CONTRACTOR shall:
- 1. Provide equipment and personnel necessary, to properly unload and handle Equipment and Materials, by methods to prevent damage, soiling and /or staining of the Equipment and Materials, or packaging.
 - 2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
 - 3. Provide additional protection to surrounding surfaces as necessary to prevent damage.
- D. Maintenance of Storage – The CONTRACTOR shall:
- 1. Inspect stored Equipment and Materials on a regularly scheduled basis.
 - 2. Verify that storage facilities comply with the MANUFACTURER's product storage requirements, including environmental conditions continually maintained.
 - 3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
 - 4. For mechanical and electrical equipment in long-term storage, provide the MANUFACTURER's service instructions to accompany each item, with notice of enclosed instructions on the exterior of the package. Service the Equipment, as necessary on a regularly scheduled basis.
- E. Protection after installation – The CONTRACTOR shall:
- 1. Provide substantial coverings as necessary to protect all installed Equipment and Materials from damage from subsequent construction operations. Remove the protective coverings when no longer needed or as specified.

1.06 EXISTING EQUIPMENT AND MATERIALS:

- A. Equipment and Materials to be reused:
- 1. For Equipment and Materials specifically indicated or specified to be reused in the WORK, use special care in removal, handling, storage, and reinstallation to assure proper function in the completed WORK.
 - 2. Arrange for transportation, storage and handling of products which require off-site storage, restoration, or renovation and pay all costs for such work.
 - 3. The CONTRACTOR may at his option, furnish and install new items in lieu of those specified to be reused.
 - 4. Remove, relocate and reinstall the following Equipment and Materials:
 - a. Rain Gauge
- B. Equipment and Materials not to be reused:

1. The following Equipment and Materials to be removed shall remain CITY property and are not to be reused in the WORK. The CONTRACTOR shall Remove from its location, prepare for handling and storage, and deliver to CITY
 - a. Gates, hoist framing, cables, construction blocks, and all equipment and materials associated with the hoist lifting system.
- C. Equipment and Materials designated to be removed but not reused or delivered to CITY, shall become the property of the CONTRACTOR and shall be removed from the Site.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS:

- A. Specified in each applicable SECTION of the Technical Specifications and/or Drawings.

2.02 PRODUCT SELECTION AND SUBSTITUTIONS:

- A. Specified in the Instructions to Bidders and General Terms & Conditions

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS:

- A. Installation:
 1. When Contract Documents require that installation of WORK shall comply with MANUFACTURER's printed instructions, the CONTRACTOR shall:
 - a. Obtain and distribute copies of such instructions if not a part of Submittals, containers, or packaging to all parties involved in the installation, including a copy to the CITY
 - b. Maintain one complete set of instructions at the Site during installation and until Final Acceptance.
 - c. Handle, install, connect, clean, condition, and adjust all products in accordance with such instructions and in conformance with the specified requirements. Should job conditions or specified requirements conflict with the MANUFACTURER's instructions, consult with the CITY for further instructions.
 - d. Not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents or approved in writing by the MANUFACTURER and the CITY.
 - e. Accurately locate and align with other work and anchor all Equipment and Materials securely in place except as required for proper movement and performance.
 - f. Clean and protect all exposed surfaces as necessary to ensure freedom from damage and deterioration until Final Acceptance.

END OF SECTION

SECTION 01630 PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 SCOPE:

- A. This SECTION covers the CITY review procedures for CONTRACTOR's requests of acceptable substitute items of material and equipment. All requests for substitution shall be made no earlier than the Effective Date of the Contract. See Article 22 of the Instructions to the Bidders of this Contract Document. A determination of acceptability or rejection of the substitution request will be made in accordance with paragraph 6.05 of Section 00700 - General Terms and Conditions.
- B. Requests received prior to the date established above will not be considered.
- C. Substitutions may be approved at the CITY sole discretion where one or more of the following conditions apply:
 - 1. The substitution must be required for compliance with final interpretation of code requirements or regulations.
 - 2. The substitution must be due to the unavailability of the specified products, through no fault of the CONTRACTOR.
 - 3. The substitution may be requested when subsequent information discloses the inability of the specified products to perform properly or to fit in the designated space.
 - 4. The substitution may be requested when in the judgment of the CITY a substitution would be substantially to the CITY best interests in terms of cost, time or other considerations.
- D. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals

1.02 SUBSTITUTION REQUEST:

- A. Submit as required in SECTION 01300:
 - 1. Complete data substantiating compliance of the proposed substitution with the Contract Document
 - a. Product identification including MANUFACTURER's name and address
 - b. MANUFACTURER's literature including product description, performance and test data, and reference standards
 - c. Name and address of similar projects on which product was used and dates of installation
 - 2. Itemized comparison of proposed substitution with product or method specified
 - 3. Data relating to changes in the construction schedule
 - 4. Accurate cost data on proposed substitution in comparison with product or method specified
- B. In submitting the request for substitution, the CONTRACTOR makes the following representations:
 - 1. The CONTRACTOR has investigated the proposed product and has determined that it is equal or superior in all respects to that specified.
 - 2. The CONTRACTOR will provide the same warranty or guarantee for the substitution as for the product specified.
 - 3. The CONTRACTOR will coordinate installation of the accepted substitution into the WORK, making such changes as may be required for the WORK to be completed in all respects.
 - 4. The CONTRACTOR waives all claims for additional costs related to substitution that subsequently becomes apparent.
 - 5. Cost data is complete and includes all related costs under the Contract.

1.03 CITY ENGINEER'S REVIEW:

- A. The CITY, in evaluating the request for substitution, will consider all variations of the proposed substitute from that specified to determine the acceptability of the proposal. The CITY may require the CONTRACTOR to furnish additional data about the proposed substitute necessary to make such a determination. The CITY will be the sole judge of acceptability, and no substitute will be ordered or installed without the CITY prior written acceptance. The CITY may require the CONTRACTOR to furnish, at the CONTRACTOR's expense, a special performance guarantee or other surety with respect to any substitute. Substitutions will not be considered if:
1. Substitutions are indicated or implied on Shop Drawings or product data submittals without a request submitted in accordance with this SECTION.
 2. Acceptance will require substantial revision to the Contract Documents.

END OF SECTION

SECTION 01640 START-UP/CHECK-OUT/MANUFACTURER'S FIELD SERVICES FOR CONTRACTOR
FURNISHED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes requirements of the CONTRACTOR in relation to services to be performed at the Site by the MANUFACTURERs and Suppliers of CONTRACTOR Furnished equipment, regarding the erection, start-up, and testing of CONTRACTOR Furnished equipment.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 01641 – Start-Up/Check-Out/Manufacturers Field Testing for Owner Furnished Equipment
 - 3. SECTION 01660 - Equipment and System Performance and Operational Testing
 - 4. SECTION 01662 – Commissioning

1.02 SUBMITTALS:

- A. All submittals shall be in accordance with SECTION 01300.

1.03 SERVICES REQUIRED:

- A. The following services are to be provided for all CONTRACTOR Furnished Equipment and Materials under this Contract:
 - 1. Provide the services of Qualified Field personnel from the MANUFACTURER(s) or Supplier(s) of Equipment and Materials furnished by the CONTRACTOR and installed under this Contract, and perform all required MANUFACTURER's Field Services. Qualified field personnel shall be certified by the MANUFACTURER of the specific product or system as having the necessary knowledge and experience to perform the required Field Services.
 - 2. Where such services are specified, the CONTRACTOR shall not perform any WORK related to the installation or operation of the Equipment and Materials furnished and installed under this Contract without direct supervision and guidance from the MANUFACTURER's or Supplier's Qualified Field personnel unless the CITY concurs otherwise, in writing.
 - 3. Where required, the MANUFACTURER's or Supplier's Qualified Field personnel shall perform the following:
 - a. Observe the erection, installation, start-up and testing of equipment.
 - b. Instruct and guide the CONTRACTOR in proper equipment installation, start-up, testing and operation procedures.
 - c. Supervise the initial start-up, operational check, and any required adjustments of the equipment.
 - d. Instruct the CITY designated personnel in proper operation and maintenance of all CONTRACTOR Furnished equipment.
 - e. Furnish a written report, in accordance with SECTION 01300, to the CITY covering all WORK done at least once each week and when WORK on each item of equipment or systems completed.

4. The CONTRACTOR shall provide at least five (5) working days advance notice prior to the arrival of any MANUFACTURER's and/or Supplier's Qualified Field personnel at the Site.
- B. The CONTRACTOR shall submit an equipment start-up/check-out plan (Plan) to the CITY for review. The Plan at a minimum shall include the equipment and components to be started/checked-out/tested, start-up/check-out/testing duration, personnel required, and details of procedures to be used.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 OPERATION AND TESTING:

- A. Placing Equipment in Operation:
1. The CONTRACTOR shall place all Equipment and Materials installed under this Contract into successful operation according to instructions of the Supplier, MANUFACTURER, or their Qualified Field personnel, including making all required adjustments, tests, operation checks, plus the following:
 - a. Cleaning, sounding, blowing-out, and flushing of lubricating oil and water systems, and other pipelines.
 - b. All required lubrication, fuels, supplies, power, consumables, water, and labor for the duration of start-up and testing, and until Substantial Completion of the WORK.
 - c. Tests of lubrication system safety interlocks and system performance.
 - d. Final alignment checks and measurements made under observation of the CITY Alignment checks shall include opening connections, if required, to ensure there are no abnormal stresses on equipment from pipes, ducts, or other attachments. Alignment shall be within tolerances specified by the MANUFACTURER, and the measurements shall be recorded and furnished to the CITY.
 - e. Motor rotation checks before connecting couplings.
 - f. Inspection of sleeve bearings for adequate contact.
 - g. Checking of anchor-bolt tensions, grout and shims. Tighten all anchor bolts with calibrated torque wrenches using care not to over stress the bolts.
 2. After "run-in" and acceptance of alignment, and where specified, affix major equipment in place using standard tapered dowels with jack-out nuts at the head ends to facilitate equipment removal.
 3. Record and submit all of the above operations on forms acceptable to the CITY.
 4. Provide all necessary attendants and personnel as part of the WORK to accomplish the above operations until such time as individual items, systems, equipment, or sections of the Project are acceptable for operation by the CITY.
 5. Provide attendants on a continuous basis, as required, to complete the start-up/check-out/testing procedures without interruption once they have been started.
- B. Performance Tests:
1. Equipment and Materials Furnished by the CONTRACTOR:
 - a. The CITY may conduct acceptance tests after installation to determine if the Equipment and Materials installed as part of the WORK perform in accordance with Contract Documents. Final acceptance of Equipment and Materials will be based on the acceptable results of such tests.

- b. No tests will be conducted on Equipment and Materials for which MANUFACTURER's Field Service is specified unless the MANUFACTURER's Field Representative is present and declares in writing that the Equipment and Materials are ready for testing.
- c. The tests will be made as set forth in the Contract Documents unless the interested parties mutually agree upon some other manner of testing.

END OF SECTION

SECTION 01641 START UP/CHECK OUT/MANUFACTURER'S FIELD SERVICES FOR OWNER FURNISHED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes requirements of the CONTRACTOR in relation to services to be performed at the Site by the MANUFACTURERS of Owner Furnished Equipment, about installation, erection, start-up, and testing of Owner Furnished equipment. In general, for the equipment identified in the Supplemental Conditions that the Owner (CITY) is providing, the CONTRACTOR must coordinate and integrate delivery, installation, testing and Commissioning into the Project as though it were CONTRACTOR supplied.
- B. Where any field service is provided by the MANUFACTURERS of Owner Furnished equipment, as identified in the Supplementary Conditions, the CONTRACTOR shall not perform any WORK related to the installation or operation of such Equipment and Materials without direct observation and guidance of the MANUFACTURER's or Supplier's field personnel unless CITY concurs otherwise.
- C. The CONTRACTOR is required to coordinate the receipt of this material and equipment with his overall construction schedule.
- D. The CONTRACTOR will be responsible for off-loading upon delivery to the Site, assembly, installation, storage (in accordance with MANUFACTURER's recommendations), staging, security, scheduling, handling, start up, testing and Commissioning of Owner Furnished Equipment. The Supplemental Conditions include an additional responsibility for the CONTRACTOR to load, pickup and transport some owner furnished equipment.
- E. The CONTRACTOR will assume responsible custody upon delivery, as if it were CONTRACTOR furnished materials and equipment.
- F. The CONTRACTOR will be responsible for requesting data on Owner Furnished equipment in a timely manner to comply with test plan requirements in SECTION 01660.
- G. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 01660 - Equipment and System Performance and Operational Testing
 - 3. SECTION 01640 – Start-up/Check-out/Manufacturers Field Testing For Contractor Furnished Equipment SECTION 01662 Commissioning

1.02 SERVICES REQUIRED:

- A. The CONTRACTOR shall coordinate with the MANUFACTURER's representatives on Owner Furnished equipment to create a viable test plan for the system in which each component or piece of equipment is to be installed. Submittal of a testing plan shall be included as a milestone in the construction schedule per SECTION 01660. The testing plan at a minimum shall include components to be started/checked out, personnel required, details of procedures to be used, and safeguards to be employed.

PART 2 - PRODUCTS (Specified in applicable Sections)

PART 3 - EXECUTION

3.01 OPERATION AND TESTING:

A. Placing Equipment in Operation:

1. Place all Owner Furnished Equipment and Materials installed under this Contract into successful operation according to instructions of the Supplier, MANUFACTURER, or field representative, including making all required adjustments, tests, operation checks, and the following:
 - a. Cleaning, sounding, blowing-out, and flushing of lubricating oil and water systems, and other pipelines.
 - b. Lubrication, fuels, supplies, power, consumables, water, and labor to be supplied by the CONTRACTOR for the duration of start-up and testing, and until substantial completion of the WORK.
 - c. Tests of lubrication system safety interlocks and system performance.
 - d. Final alignment checks and measurements made under observation of the CITY. Alignment checks shall include opening connections, if required, to ensure there are no abnormal stresses on equipment from pipes, ducts, or other attachments. Alignment shall be within tolerances specified by the MANUFACTURER, and measurements shall be recorded and furnished to the CITY
 - e. Motor rotation checks before connecting couplings.
 - f. Inspection of sleeve bearings for adequate contact.
 - g. Checking of anchor-bolt tensions, grout and shims. Tighten anchor bolts with calibrated torque wrenches using care not to over stress bolts.
2. After "run-in" and acceptance of alignment, affix major equipment as specified and allowed for in Contract Documents.
3. Record all above operations on forms acceptable to the CITY.
4. Furnish all necessary attendants and personnel as part of the WORK to accomplish the above operations until such time as individual items, systems, equipment, or sections of the plant are acceptable for operation by CITY.
5. Provide attendants on a continuous basis as required to complete events without interruption once they have been started.
6. The CONTRACTOR shall provide labor, lubricants and fuels and other consumables sufficient for testing and placing equipment in operation.

B. Performance Tests:

1. Equipment and Materials Furnished by the Owner:
 - a. The CITY may conduct acceptance tests after installation to determine if the Equipment and Materials installed as part of the WORK perform in accordance with Contract Documents. Final acceptance of Equipment and Materials or services rendered by the CONTRACTOR will be based on acceptable results of such tests and certification, by the MANUFACTURER, that the equipment is installed and operating in accordance with their recommendations.
 - b. No tests will be conducted on Equipment and Materials for which the MANUFACTURER's Field Service is specified unless the MANUFACTURER's Field Representative is present and declares in writing that the Equipment and Materials are ready for such test.
 - c. The tests will be made as set forth in the Contract Documents unless the interested parties mutually agree upon some other manner of testing.
 - d. The CONTRACTOR must be aware of pre-operation procedures and required testing of Owner Furnished Equipment, to comply with SECTION 01660.

END OF SECTION

SECTION 01660 EQUIPMENT AND SYSTEM PERFORMANCE AND OPERATIONAL TESTING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION contains requirements for the CONTRACTOR in documenting testing work required under this Contract. In addition, this SECTION contains requirements for the CONTRACTOR during installed performance testing of all mechanical, electrical, instrumentation, and Heating, Ventilation, and Air Conditioning (HVAC) equipment and systems, including structures for watertight construction, provided under this Contract and all equipment furnished by the CITY. This SECTION supplements but does not supersede specific testing requirements found elsewhere in this Contract.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 1. SECTION 01310 – Cost Loaded Construction Schedule
 - 2. SECTION 01640 - Start-up/Check-out/Manufacturer’s Field Services for Contractor Furnished Equipment
 - 3. SECTION 01641 – Start-Up/Check-Out/Manufacturers Field Testing for Owner Furnished Equipment
 - 4. SECTION 01662 – Commissioning
 - 5. SECTION 01700 – Contract Closeout

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B40.1 – Standard for Pressure Gauges and Gauge Attachments
 - 2. American Society of Testing Materials (ASTM):
 - a. E77 - Standard Test Method for Inspection and Verification of Thermometers
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - a. E 41.8 - Standard Methods of Measurement of Flow of Gas
- B. Dye Dilution: Flow Measurement in Open Channels and Closed Conduits
- C. U.S. Department of Commerce
 - 1. National Bureau of Standards: Calibration Method, Vol. 1
- D. U.S. Geological Survey (USGS)
 - 1. Techniques of Water-Resources Investigations of the United States Geological Survey: Measurement of Discharge Using Tracers

1.03 QUALITY CONTROL:

- A. CONTRACTOR's Quality Control Manager: The CONTRACTOR shall a qualified operations specialist as Quality Control Manager to manage, coordinate, and supervise the CONTRACTOR's quality control program. The Quality Control Manager shall have at least five (5) years of total experience, or experience on at least five (5) separate projects, in managing the start-up commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems. Operations specialists shall have equivalent experience in the operation and maintenance of diesel engines, right-angle gear reducers, large drainage pumps, and standby engine generators. The quality control program may include, but not be limited to the following:
1. A testing plan setting forth the sequence in which all testing work required under this Contract will be implemented
 2. A documentation program to record the results of all equipment and system tests
 3. An installed performance testing program for all mechanical, electrical, instrumentation, and HVAC equipment and systems installed under this Contract
 4. A calibration program for all instruments, meters, monitors, gages, and thermometers installed under this Contract
 5. A calibration program for all instruments, gages, meters, and thermometers used for determining the performance of equipment and systems installed under this Contract
 6. A testing schedule conforming to the requirements specified in paragraph 01660-2.02 C
- B. For the purposes of this SECTION, a system shall include all items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others. The CONTRACTOR's Quality Control Manager shall coordinate the activities of all Subcontractors and suppliers for equipment and materials supplied by both the CONTRACTOR and the CITY to implement the requirements of this SECTION.

1.04 CALIBRATION:

1. All test equipment (gages, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this Contract shall be calibrated to within plus or minus two (2) percent of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale. Pressure gages shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve.
2. Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than two (2) inches shall be calibrated in situ using either the total count or dye dilution methods. Gas flow meters installed in piping systems with diameters greater than six (6) inches shall be calibrated in situ using the pitot tube velocity averaging method. Flow meter calibration work shall be performed by individuals skilled in the techniques to be employed. Calibration tests for flow metering systems shall be performed over a range of not less than ten (10) percent to at least 75 percent of system full scale. At least five (5) confirmed valid data points shall be obtained within this range. Confirmed data points shall be validated by not less than three (3) test runs with results which agree within plus or minus two (2) percent.

1.05 SUBMITTALS:

- A. Submittal material, to be submitted in accordance with SECTION 01300, shall consist of the following:
1. The CONTRACTOR's plan for documenting the results from the test program in conformance with the requirements of paragraph 01660-2.02 A, provided eight (8) weeks before testing is to begin, including:

- a. Proposed plan for documenting the calibration of all test instruments
 - b. Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems
 - c. Sample forms for documenting the results of field pressure and performance tests
2. The credentials and certification of the testing laboratory proposed by the CONTRACTOR for calibration of all test equipment
 3. Pre-operational check-out procedures, reviewed and approved by the respective equipment MANUFACTURERS
 4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the CONTRACTOR for the systematic testing of all equipment and systems installed under this Contract
 5. A schedule and subsequent updates, whenever schedule changes occur, presenting the CONTRACTOR's plan for testing the equipment and systems installed under this Contract
 6. A schedule establishing the expected time period (calendar dates) when the CONTRACTOR plans to commence operational testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place
 7. A summary of the Quality Control Manager's qualifications, showing conformance to paragraph 01660-1.03 A requirements

PART 2 - PRODUCTS

2.01 GENERAL:

- A. The CONTRACTOR shall prepare test plans and documentation plans as specified in the following paragraphs. The CITY will not witness any test work for the purpose of acceptance until all test documentation and calibration plans and the specified system or equipment test plans have been submitted and accepted.

2.02 DOCUMENTATION:

- A. Documentation Plans: The CONTRACTOR shall develop a records keeping system to document compliance with the requirements of this SECTION. Calibration documentation shall include identification (by make, MANUFACTURER, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.

Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the CITY witness and the CONTRACTOR's Quality Control Manager. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:

1. Metallurgical tests
2. Factory performance tests
3. Accelerometer recordings made during shipment
4. Field calibration tests
5. Field pressure tests
6. Field performance tests
7. Field operational tests

The CONTRACTOR shall develop test documentation forms specific to each item of equipment and system installed under this Contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the CITY.

B. Test Plans: The CONTRACTOR shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, Subcontractors' and MANUFACTURERS' representatives to be present and expected test duration.

1. As a minimum, the test plans shall include the following features:
 - a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device
 - b. Calibration of all analysis instruments and control sensors
 - c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract.
 - d. System tests designed to duplicate, as closely as possible, operating conditions described in the Contract
2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
3. The importance of the test plan submittals is represented by the requirement to provide it as a milestone on the construction progress schedule, and as a line item in the Schedule of Values. Delivery of all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract shall be made eight (8) weeks in advance of the date the CONTRACTOR wishes to begin such testing. Once the CITY has reviewed and taken no exception to the CONTRACTOR's test plans, the CONTRACTOR shall reproduce the plans in sufficient number for the CONTRACTOR's purposes and an additional ten copies for delivery to the CITY. No test work shall begin until the CONTRACTOR has delivered the specified number of final test plans to the CITY.

C. Testing Schedule:

1. The CONTRACTOR shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the CONTRACTOR's construction schedule specified in SECTION 01310. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The CITY will not witness any testing work for the purpose of acceptance until the CONTRACTOR has submitted a schedule to which the CITY takes no exception. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of this Contract.
2. All performance and operational testing required under this SECTION shall be completed prior to the start of commissioning.

2.03 SYSTEM AND EQUIPMENT PERFORMANCE TESTS:

A. Each item of mechanical, electrical, instrumentation and HVAC equipment installed under this Contract shall be tested to demonstrate compliance with the performance requirements of this Contract.

- B. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this contract shall be tested in accordance with the requirements of this Contract.

2.04 OPERATIONAL TESTS:

- A. Once all equipment and systems have been tested individually, the CONTRACTOR shall fill all systems with the intended process fluids sufficient to satisfy all individual component and system tests. The CONTRACTOR shall then operate all systems for a continuous period of not less than five (5) days or as specified by the CITY, simulating actual operating conditions to the greatest extent possible. The CONTRACTOR shall install temporary connections, bulkheads and make other provisions to recirculate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, the CONTRACTOR's Quality Control Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the CITY.

2.05 PRODUCT DATA:

- A. Records produced during the testing program shall be considered as Product Data, to be provided in accordance with SECTION 01300.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The CONTRACTOR's Quality Control Manager shall organize teams made up of qualified representatives of equipment suppliers (for both CONTRACTOR and CITY supplied equipment and materials), Subcontractors, the CONTRACTOR's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract. The objective of the testing program shall be to demonstrate, to the CITY complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meet all performance requirements and the facility is ready for the commissioning process to commence. In addition, the testing program shall produce baseline operating conditions for the CITY to use in a preventive maintenance program.

3.02 CALIBRATION OF FIXED INSTRUMENTS:

- A. Calibration of analysis instruments, sensors, gages, and meters installed under this Contract shall proceed on a system-by-system basis. No equipment or system performance acceptance tests shall be performed until instruments, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the CITY.
- B. All analysis instruments, sensors, gages, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gages, and meters installed under this Contract shall be subject to recalibration as a condition precedent to commissioning under the provisions of SECTION 01662.

3.03 PERFORMANCE TESTS:

- A. General: Performance tests shall consist of the following:
 1. Pressure and/or leakage tests
 2. Electrical testing as specified in DIVISION 16
 3. Wiring and piping, individual component, loop, loop commissioning and tuning testing as described in DIVISION 13 and 16
 4. Pre-operational checkout for all mechanical and HVAC equipment. Pre-operational check-out procedures shall be reviewed and approved by the respective equipment MANUFACTURERS.

5. Initial operation tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems to demonstrate compliance with the performance requirements of this Contract

In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the CITY after receipt of a written request, complete with justification of the need for the change in sequence.

- B. Pressure and Leakage Tests: Pressure and leakage tests shall be conducted in accordance with applicable portions of the Specifications. All acceptance tests shall be witnessed by the CITY. Evidence of successful completion of the pressure and leakage tests shall be the CITY representative's signature on the test forms prepared by the CONTRACTOR.
- C. Functional Checkout: Prior to energization (in the case of electrical systems and equipment), all circuits shall be run out and tested for continuity and shielding in accordance with the procedures required in DIVISION 16.
- D. Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested in accordance with the procedures required in DIVISIONS 13 and 16.
- E. Electrical Resistance: Electrical resistance testing shall be in accordance with DIVISION 16.
- F. Pre-Operational Tests: Pre-operational tests shall include the following:
 1. Alignment of equipment using reverse dial indicator method
 2. Pre-operation lubrication
 3. Tests per the MANUFACTURERS' recommendations for prestart preparation and pre-operational check-out procedures
- G. Functional Tests:
 1. General:
 - a. Once all affected equipment has been subjected to the required pre-operational check-out procedures and the CITY has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications. If available, canal water may be employed for the testing of all liquid systems except gaseous, oil, or chemical systems. If not available, potable water shall be employed as the test medium. Test media for these systems shall either be the intended fluid or a compatible substitute. The equipment shall be operated enough period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the CONTRACTOR shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the CITY. Disposal methods for test media shall be subject to review by the CITY. During the functional test period, the CONTRACTOR shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the CITY to enter in a preventive maintenance system.
 - b. Test results shall be within the tolerances set forth in the detailed specification sections of this Contract. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the CITY and the CONTRACTOR regarding the test results or the methods or

equipment used in the performance of such test, the CITY may order the test to be repeated.

- c. If the repeat test, using such modified methods or equipment as the CITY may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the CITY. Otherwise, the costs shall be borne by the CONTRACTOR. Where the results of any functional test fail to comply with the Contract requirements for such test, then such repeat tests as may be necessary to achieve the Contract requirements shall be made by the CONTRACTOR at his expense. The CONTRACTOR shall provide, at no expense to the CITY, all power, fuel, compressed air supplies, water, chemicals, and any other necessary consumable item, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work, required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.
2. Retesting: If under test, any portion of the work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the CITY, be repeated within reasonable time and in accordance with the specified conditions. The CONTRACTOR shall pay to the CITY all reasonable expenses incurred by the CITY, including the costs of the Engineer if applicable, as a result of repeating such tests.
3. Post-Test Inspection: Once functional testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the CITY. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the CITY at no cost to the CITY.

END OF SECTION

SECTION 01662 COMMISSIONING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION contains requirements for the CONTRACTOR's performance prior to (i.e. operational testing period) and during the commissioning of the structures, equipment and systems constructed and installed during this Contract. All WORK during the operational testing period and prior to commissioning shall be done by the CONTRACTOR.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals

1.02 QUALITY ASSURANCE:

- A. Cleanup: Following completion of the operational testing period, the CONTRACTOR shall remove, clean, and replace all permanent and temporary filters and strainers in all pipeline systems; replace all HVAC (heating, ventilation and air conditioning) filters; dewater and clean all sumps; and dewater all process units for final inspection as a condition precedent to commissioning.
- B. Commissioning team: The CONTRACTOR shall assemble a commissioning team under the direction of an individual duly authorized to commit the CONTRACTOR's personnel and resources to respond to requests from the CITY. The commissioning team shall consist of representatives of the CONTRACTOR's mechanical, electrical, and instrumentation subcontractors, and others as appropriate. The commissioning team shall be available at the Site of the WORK when needed. The commissioning team shall always be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this Contract.

1.03 SUBMITTALS: The following information shall be submitted to the CITY in accordance with the provisions of SECTION 01300:

- A. Detailed plans for commissioning each process unit and each system constructed or modified as a part of the WORK performed under this Contract.
- B. The CONTRACTOR's commissioning team shall include a staffing plan with names, qualifications, and telephone numbers of those assigned with both daytime and off-hour standby duty.

PART 2 - PRODUCTS

- A. Working with representatives of the CITY, the Engineer, and the MANUFACTURERS and suppliers of CITY or CONTRACTOR Furnished Equipment and Materials, the CONTRACTOR shall develop and produce a detailed, written plan for the start-up and initial operation, under actual operating conditions, of the equipment and systems installed and constructed under this Contract. The document, after acceptance by the CITY, shall serve as the guidance manual for the commissioning process.

PART 3 - EXECUTION

- A. After completion of the equipment and system performance and operational testing, where required, and agreement on the part of the CITY that the systems did meet all test requirements, commissioning will begin.
- B. The CONTRACTOR shall remove all temporary piping, bulkheads, controls and other alterations to the permanent systems that may have been needed during the performance and operational testing and shall perform the tasks necessary to make the improvements constructed under this Contract fully

operational. The CITY shall confirm in writing the date(s) that the system is ready for commissioning and on which actual commissioning activities commence. Activities conducted prior to such written confirmation shall not constitute commissioning.

- C. The CITY operation and maintenance personnel will be responsible for operation of the systems to be commissioned, with guidance and support by the Commissioning Team. The portion of the WORK to be commissioned shall be fully operational, performing all functions for which it was designed.
- D. The CONTRACTOR shall always be available during commissioning periods to provide immediate assistance in case of failure of any portion of the system being constructed.
- E. During the commissioning period, the CITY shall be responsible for all normal operational costs and the CONTRACTOR shall bear the costs of all necessary repairs or replacements, including labor and materials, required to keep the portion of the plant being commissioned, operational.

END OF SECTION

SECTION 01700 CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: This SECTION includes administrative and procedural requirements for Contract Closeout including, but not limited to, the following:
 - 1. Inspection procedures
 - 2. Project record document submittal
 - 3. Operation and maintenance manual submittal
 - 4. Submittal of Warranties of All Equipment
 - 5. Final cleaning
 - 6. CONTRACTOR's Certification
- B. Closeout requirements for specific construction activities are included in the appropriate SECTIONS in DIVISIONS 1 through 16.
- C. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 01050 - Field Engineering and Surveying
 - 3. SECTION 01530 - Temporary Barriers and Controls
 - 4. SECTION 01640 - Start-up/Check-out/Manufacturer's Field Services for Contractor Furnished Equipment
 - 5. SECTION 01641 - Start-up/Check-out/Manufacturer's Field Services for Owner Furnished Equipment
 - 6. SECTION 01660 - Equipment and System Performance and Operational Testing
 - 7. SECTION 01662 - Commissioning

1.02 SUBSTANTIAL COMPLETION:

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, the CONTRACTOR shall satisfy the following:
 - 1. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents. Submit in accordance with SECTION 01300.
 - 2. Obtain and submit releases enabling the CITY unrestricted use of the WORK and access to services and utilities. Include Certificates of Occupancy (C.O.), operating certificates, and similar releases, as required.
 - 3. Submit Record Documents, including but not limited to, maintenance manuals, Project photographs, damage or settlement surveys, Boundary surveys, all As-Built and Topographic Surveys as per SECTION 01050 and similar record information as specified in Paragraph 1.04. All drawings shall be scanned and submitted in accordance with SECTION 01300, and in hard copy form, 24 inch by 36 inch plan size. All other documents shall also be scanned and submitted in accordance with SECTION 01300.
 - 4. Complete final cleanup requirements, including touch up painting.
 - 5. Touch up and otherwise repair and restore marred, exposed finishes.
 - 6. Provide all services and testing in accordance with SECTIONS 01640, 01641 and 01660, if applicable.
- B. Inspection Procedures: On receipt of a request for inspection, the CITY will either proceed with inspection or advise the CONTRACTOR of unfilled requirements. The CITY will prepare the Certificate of Substantial Completion following inspection or advise the CONTRACTOR of WORK that must be completed or corrected before the certificate will be issued.

1. The CITY will reschedule the inspection when in its opinion, the WORK is substantially complete.

1.03 FINAL ACCEPTANCE:

- A. Preliminary Procedures: Submit certification by CONTRACTOR that WORK has been completed in accordance with the Contract Documents to the knowledge of the CONTRACTOR. Before requesting final inspection, complete the following:
 1. Submit the final payment request with releases and supporting documentation. Include insurance certificates for products and completed operations where required.
 2. Submit a letter certifying that all items listed as part of the Certification of Substantial Completion have been completed or corrected.
 3. Submit consent of surety to final payment.
 4. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 5. Submit Release of Liens (from the Prime, and all Subcontractors, Vendors and Suppliers).
 6. Submit Maintenance Bond (if applicable).
 7. The above shall be submitted in accordance with SECTION 01300.
- B. Reinspection Procedure: The CITY will reinspect the WORK upon receipt of notice that the WORK, including inspection list items from earlier inspections, has been completed.
 1. Upon completion of reinspection, the CITY will advise the CONTRACTOR of WORK that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, the reinspection will be repeated.
- C. Return all keys furnished by the CITY. The CONTRACTOR shall forfeit his key deposit for keys that are not returned.

1.04 RECORD DOCUMENT SUBMITTALS:

- A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure location. Provide access to record documents for the CITY reference during normal working hours.
- B. As-Built Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Drawings and Shop Drawings. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set. Mark the set to show the actual installation where the installation varies substantially from the WORK as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Call attention to each entry by drawing a "cloud" around the areas affected.
- C. The CITY will make electronic copies of whatever electronic versions of the Drawings exist, available to the CONTRACTOR for As-Built purposes. The CONTRACTOR must obtain concurrence from the CITY as to form and content of record information provided in electronic format prior to proceeding, but in general, information similar to that noted below needs to be provided.
 1. Record information concurrently with construction progress.
 2. Mark record sets with red erasable pencil. Mark each document "AS-BUILT DRAWINGS" in neat, large, printed letters.
 3. Mark As-Built invert elevations for all water control structures, culverts, etc. Refer to SECTION 01050 for structures which require a permanent benchmark.
 4. Mark new information that is important to the CITY that is not shown on Drawings or Shop Drawings.
 5. Note related Change-Order numbers where applicable.

6. Include the following:
 - a. Where Submittals (like Shop Drawings) are used for mark-up, record a cross-reference at corresponding location on Drawings.
 - b. Field changes of dimension and detail.
 - c. Changes made by Change Order or other Modifications.
 - d. Details not on original Drawings.
 - e. As-Builts shall also include a plot of the actual excavation cross-sections plotted at the same station as overlaid on top of the design cross-sections.
 - f. As-Builts shall include a plot of the actual levee and embankment cross-sections plotted at the same station as overlaid on top of the design cross-sections. Refer to SECTION 01050.
 - g. Give particular attention to concealed elements that would be difficult or expensive to locate at a later date.
 - h. GPS (global positioning system) coordinates of major structures using the format lat/long DD (decimal/degree) NAD83/2007 (North American Datum).
 7. Record Specifications: Maintain one (1) complete copy of the Contract Documents including addenda. Include with the Contract Documents one (1) copy of other written construction documents, such as Requests for Information (RFIs), Change Orders and modifications issued in printed form during construction.
 8. Mark these documents to show substantial variations in actual WORK performed in comparison with the text of the Specifications and modifications.
 9. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 10. Note related As-Built information and Product Data.
 11. Upon completion of the WORK, submit Record Specifications to the CITY for the CITY records on CD in PDF format.
 12. Include the following:
 - a. MANUFACTURER, trade name, catalog number, and Supplier of each product and item of equipment actually installed, including optional and substitute items
 - b. Changes made by Addendum, Change Order, or other Modifications
 - c. Related Submittals
 13. Affix the CONTRACTOR's corporate seal on the cover sheet indicating the documents within are representative of the as-built condition of the Project. The seal shall be signed by an officer of the company.
- D. Record Product Data: Provide one (1) copy of each Product Data submittal. Note related Change Orders and markup of Record Documents.
1. Mark these documents to show significant variations in actual WORK performed in comparison with information submitted. Include variations in products delivered to the Site and from the MANUFACTURER's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the WORK that cannot otherwise be readily discerned later by direct observation.
- E. Record Sample Submitted: Immediately prior to Substantial Completion, the CONTRACTOR shall meet with the CITY personnel at the Project Site to determine which Samples are to be transmitted to the CITY for record purposes. Comply with the CITY instructions regarding packaging, identification, and delivery to the CITY.
- F. Miscellaneous Record Submittals: Refer to other Specification SECTIONS for requirements of miscellaneous record keeping and submittals in connection with actual performance of the WORK. Immediately prior to the date or dates of Substantial Completion (unless otherwise specified), complete

miscellaneous records and place in good order. Identify miscellaneous records properly, bind or file, and submit to the CITY for the CITY records.

- G. Warranties and Bonds: Submit original documents as specified in Section 00700 - General Terms & Conditions, Supplemental Conditions, SECTION 01300, and technical specifications.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 FINAL CLEANING:

- A. General: The General Terms & Conditions require general cleaning during construction. Regular Site cleaning is included in SECTION 01530.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with MANUFACTURER's instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - a. Clean the Site of rubbish, litter, and other foreign substances. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
 - b. Remove temporary structures, tools, equipment, supplies, and surplus materials.
 - c. Remove temporary protection devices and facilities which were installed to protect previously completed WORK.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the WORK during construction.
- D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the CITY property. Do not discharge volatile, harmful, or dangerous materials into drainage systems, surface waters or wetlands. Remove waste materials from the Site and dispose of lawfully.
 - 1. Where extra materials of value remain after completion of associated WORK, they become the CITY property. Dispose of materials of no value to the CITY as directed by the CITY.
- E. Repairs:
 - 1. Repair damaged protective coated surfaces.
 - 2. Repair roads and other items damaged or deteriorated because of construction operations, including those which have been damaged, but are not located within the Project limits.
 - 3. Restore all ground areas affected by construction operations.

END OF SECTION

PART 1 - GENERAL

1.01 **SCOPE:** Operation and Maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.

A. O&M instructions must be submitted and accepted before on-site training may start.

1.02 **TYPES OF INFORMATION REQUIRED:**

A. **General:** O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. See SECTION 01300 for details on how to prepare and submit this data. In addition, one or more of the following items of information shall be provided as applicable.

B. **Operating Instructions:** Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:

1. **Safety Precautions:** List personnel hazards for equipment and list safety precautions for all operating conditions.
2. **Operator Prestart:** Provide requirements to set up and prepare each system for use.
3. **Start-Up, Shutdown, and Post Shutdown Procedures:** Provide a control sequence for each of these operations.
4. **Normal Operations:** Provide control diagrams with data to explain operation and control of systems and specific equipment.
5. **Emergency Operations:** Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
6. **Operator Service Requirements:** Provide instructions for services to be performed by the operator such as lubrication, adjustments and inspection.
7. **Environmental Conditions:** Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or each piece of equipment and describe conditions under which equipment should not be allowed to run.

C. **Preventive Maintenance:** The following information shall be provided for preventive and scheduled maintenance and repair:

1. **Lubrication Data:** Provide the following lubrication data, other than instructions for lubrication in accordance with paragraph 2.B.6.
 - a. A table showing recommended lubricants for specific temperature ranges and applications
 - b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities
 - c. A lubrication schedule showing service interval frequency
2. **Preventive Maintenance Plan and Schedule:** Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and

economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

- D. Corrective Maintenance: Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.
1. Troubleshooting Guides and Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or requires replacement.
 2. Wiring Diagrams and Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits, including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.
 3. Maintenance and Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.
 4. Removal and Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test illustrations.
 5. Spare Parts and Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
 6. Corrective Maintenance Man-Hours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.
- E. Appendices: The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance of the product or equipment.
1. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
 2. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
 3. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
 4. Testing Equipment and Special Tool Information: Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.03 TRANSMITTAL PROCEDURE:

- A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with SECTION 01300. Only complete sets of O&M instructions will be reviewed for acceptance.
- B. Three copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment numbers it appears in the project manual. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information. Binders shall be 3-inch, D-ring, presentation type with locking mechanism and clear view vinyl cover for insertion of graphic identifying contents of binder.
- C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.04 PAYMENT:

- A. Acceptable O&M information for the project must be delivered to the CITY prior to the project being **85** percent complete. Progress payments for work more than **85** percent completion may be reduced until the specified acceptable O&M information has been delivered to the CITY.

1.05 FIELD CHANGES:

- A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the CONTRACTOR to reflect any field changes or information requiring field date.

END OF SECTION

SECTION 02050 DEMOLITION

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall include the removal of existing construction to limits indicated on drawings where earthwork or other construction operations are to be performed as specified herein. The CITY shall not be responsible for the condition of any items to be removed or salvaged. **The CONTRACTOR shall notify the CITY of any unique and/or hazardous waste materials that will be, or may be, encountered.**
- B. Related Work Specified Elsewhere:
 - 1. Section 021110 Clearing and Land Preparation
 - 2. Section 02215 Protection of Existing Structures
 - 3. Section 02220 Excavation and Backfilling
 - 4. Section 02436 Environmental Protection

1.02 APPLICABLE PUBLICATIONS: (Not Used)

1.03 DEFINITIONS: (Not Used)

1.04 SUBMITTALS:

- A. Schedule of Demolition:
 - 1. Submit proposed methods and operations of demolition for review and approval by the CITY prior to the start of WORK.
- B. Permits:
 - 1. The CONTRACTOR shall be responsible for acquiring appropriate necessary permits for the work. Copies of the permits shall be submitted to the CITY prior to commencement of demolition.

1.05 QUALIFICATIONS: (Not Used)

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall not commence demolition of structure(s) prior to written permission of the CITY.
- B. Condition of structures to be demolished:
 - 1. The CITY assumes no responsibility for actual condition of structures to be demolished.
 - 2. Conditions existing at time of inspection for bidding purposes will be maintained by CITY insofar as practicable.
- C. The CONTRACTOR shall remove all such foundations to one foot below the proposed sub-grades.
- D. Explosives: The use of explosives will not be permitted. The CONTRACTOR may use a non-explosive, expanding agent in drilled holes for the demolition of concrete, and shall conform to all manufacturers' recommendations, including safety precautions for mixing and placing the agent.

- E. The CONTRACTOR shall ensure the safe passage of persons around the area of demolition and clearing. The CONTRACTOR shall conduct operations to prevent injury to adjacent structures, other facilities, and any persons.
 - 1. The CONTRACTOR shall protect existing finish work that is to remain in place from damage due to demolition operations.
- F. Traffic:
 - 1. The CONTRACTOR shall conduct operations and the removal of debris to ensure minimum interference with existing access roads and other adjacent, occupied or used facilities.
 - 2. Do not close, block or otherwise obstruct access roads or other occupied or used facilities without permission from the CITY.
- G. The CONTRACTOR shall promptly repair damages caused to adjacent facilities by demolition operations at no cost to the CITY.
- H. Utilities Disconnection:
 - 1. The CONTRACTOR shall perform all necessary coordination to locate, disconnect, relocate, and/or protect as needed all existing underground, aboveground, and overhead utilities within the limits of demolition prior to commencement of demolition operations. All expenses incurred for the coordination with utility companies and agencies, shall be at no cost to the CITY.
 - 2. The CONTRACTOR shall promptly repair damages to existing utilities that are to remain, at no cost to the CITY.

1.07 CERTIFICATIONS AND TESTING: (Not Used)

1.08 INSPECTION COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours' notice of its intention to begin new WORK activities.

1.09 WARRANTY: (Not Used)

PART 2 - PRODUCTS

2.01 SALVAGE MATERIALS:

- A. The CONTRACTOR shall salvage and store the following material for the City's use:
 - 1. **Old Generator** as directed by the CITY. The CONTRACTOR shall use extreme care not to damage the equipment and material during their removal and replacement.
 - 2. Salvage material shall be transferred to **a location as directed by the CITY**.
- B. Road and building rubble free of contaminants and rebar and no greater than 12" in any direction may be used to fill existing canals up to an elevation matching adjacent grades. The CITY is to review and approve the material being used prior to placement in existing canals.

PART 3 - EXECUTION

3.01 DEMOLITION:

- A. The CONTRACTOR shall provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
- B. If hazardous materials are found, the CONTRACTOR shall notify the CITY immediately.

- C. The CONTRACTOR shall completely backfill below-grade areas and voids resulting from demolition work. The CONTRACTOR shall provide fill consisting of approved soil, gravel or sand (free of trash and debris) and compact fill to approximate density of surrounding native soil.

3.02 DISPOSAL OF DEMOLISHED MATERIALS:

- A. The CONTRACTOR shall remove debris, rubbish, and other materials resulting from demolition operations.
- B. If hazardous materials are encountered during demolition operations, the CONTRACTOR shall comply with all applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
- C. The CONTRACTOR shall transport materials removed from demolished structures and properly dispose of them at an approved site according to the State, Federal, and local regulations.

3.03 CONNECTIONS TO EXISTING CONSTRUCTION:

- A. The CONTRACTOR shall cut and remove portions of existing construction as required to allow proper installation of new construction.
- B. The CONTRACTOR shall shore, brace and maintain existing structure(s) in a safe condition until permanent supports are completed.
- C. The CONTRACTOR shall repair all damage because of installation of shoring and bracing.

3.04 CLEANUP AND REPAIR:

- A. Upon completion of demolition work, the CONTRACTOR shall remove all tools, equipment, and demolished materials from site; see SECTION 1.01 and SECTION 3.02 of this specification.
- B. The CONTRACTOR shall repair demolition performed more than that required and return structures and surfaces to conditions existing prior to commencement of demolition work. The CONTRACTOR shall repair adjacent construction or surfaces soiled or damaged by demolition work to the satisfaction of the CITY.
- C. The CONTRACTOR shall remove or modify as indicated all existing construction within the construction limits to the extent necessary to permit construction of the work. The CONTRACTOR shall properly dispose of the material at an approved site according to the State, Federal, and local regulations.

END OF SECTION

SECTION 02110 CLEARING AND LAND PREPARATION

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall include the removal of trees and other vegetation from areas where earthwork or other construction operations specified herein are to be performed. This section also includes land preparation activities for excavation and fill areas.
- B. Related Works Specified Elsewhere
 - 1. SECTION 1300 - Submittals
 - 2. SECTION 02050 - Demolition
 - 3. SECTION 02200 - Earthwork
 - 4. SECTION 02221 - Trenching, Backfilling and Compacting

1.02 APPLICABLE PUBLICATIONS:

- A. Florida Department of Transportation (FDOT)
 - 1. 104 – Specification Prevention, Control, and Abatement of Erosion and Water Pollution

1.03 DEFINITIONS: (Not Applicable)

1.04 SUBMITTALS:

- A. Prior to beginning the WORK, CONTRACTOR shall submit a detailed plan for clearing and land preparation in conformance with SECTION 01300. The plan shall detail the sequence of WORK and describe the CONTRACTOR's planned method of clearing and land preparation activities.

1.05 QUALIFICATIONS: (Not Applicable)

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall ensure the safe passage of persons around areas of clearing and land preparation. The CONTRACTOR shall conduct its operations to prevent injury to adjacent structures, vegetation designated to remain, other facilities and persons.
- B. Traffic:
 - 1. The CONTRACTOR shall conduct its operations and the removal of cleared materials to ensure minimum interference with existing access roads and other adjacent occupied or used facilities.
 - 2. The CONTRACTOR shall not block or otherwise obstruct access roads or other occupied or used facilities without permission from the CITY. Where blockage is allowed, the CONTRACTOR shall provide alternate routes around closed or obstructed traffic ways.
- C. The CONTRACTOR may commence clearing or land preparation within portions of the project falling within the limits of temporary construction easements or utility Right-of-Way only with specific permission from the CITY for each activity and location. All requirements under A and B above apply within these limits.

1.07 CERTIFICATIONS AND TESTING: (Not Applicable)

1.08 INSPECTION COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 advance hours notice of its intention to begin new WORK activities.

1.09 WARRANTY: (Not Applicable)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 GENERAL CLEARING:

- A. The CONTRACTOR shall remove most of the above grade non-native vegetative matter in the areas indicated on the plans. The CONTRACTOR shall complete the work of Clearing and Land Preparation as outlined below.
1. Mowing or the use of a bush-hog may be required in areas of heavy grass, weeds, or woody-stalked vegetation.
 2. Completely remove all designated exotic/hazardous trees within the designated project boundaries.
 3. All woody debris that measures over three-quarters inch in diameter and longer than 18-inches shall be removed.
 4. All stumps shall be ground level to six inches below the surrounding ground level. Stumps on the slopes shall be cut flush with the natural angle of the existing grade and treated immediately with an herbicide approved by the CITY. All seedlings within the project site shall be treated with the herbicide.
 5. All plant material (whole or chipped) will be removed from the project area and stockpiled at a location authorized by the CITY. Disposal of the stockpile shall be accomplished at a maximum of every fifteen (15) workdays.
 6. Remove any garbage or other waste debris recovered during clearing.
 7. On completion of the clearing, remove all sticks, rubbish and other extraneous material and rake the ground surface to leave a smooth and clean appearance.
 8. Clearing and land preparation shall proceed sufficiently ahead of earthwork activities to minimize disruption and allow time for determination of the adequacy of the clearing procedure.
 9. All WORK shall be performed in accordance with approved principles of modern arboricultural methods.
 10. All trees to remain in the project area, as designated by the CITY, shall be protected from damage by tree barricades.
 11. All WORK shall be performed without damage to existing amenities, including trees and shrubs. The CONTRACTOR shall be responsible for repair and replacement of existing amenities to the satisfaction of the CITY. The CONTRACTOR shall protect all vegetation, habitats, or amenities on the project location as indicated on the plans.
- B. The CONTRACTOR shall clear adjacent to cut or fill sections to a minimum distance of ten (10) feet outside of slope lines unless lesser distances are specified. Clearing in areas of native vegetation for levee construction or removal and canal excavation shall be limited to 10 feet outside of slope lines.

3.02 EROSION CONTROL:

- A. The CONTRACTOR shall prevent and control erosion and water pollution as per FDOT Specification Sections 104 -1, 2, 3, 4, 6 and 7 and Florida Department of Environmental Protection (FDEP) regulations and permit conditions.

END OF SECTION

SECTION 02200 EARTHWORKS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, equipment, and materials for all excavating, trenching, filling, construction of embankment, backfilling, compacting, grading, and all related items of earthwork necessary to complete the WORK indicated or specified.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 01410 – Testing and Quality Control
 - 3. SECTION 01050 – Field Engineering and Surveying
 - 4. SECTION 02050 - Demolition
 - 5. SECTION 02110 - Clearing and Land Preparation
 - 6. SECTION 02215 – Protection of Existing Structures
 - 7. SECTION 02220 - Excavation and Backfilling
 - 8. SECTION 02221 - Trenching, Backfilling and Compacting
 - 9. SECTION 02920 - Sodding

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. American Society of Testing Materials (ASTM):
 - a. C33 - Standard Specification for Concrete Aggregates
 - b. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using the Standard Effort (12,400 ft-lbf/ ft³ (600 kN-m/m³)).
 - c. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using the Modified Effort (56,000 ft-lbf/ ft³ (2,700 kN-m/m³))
 - d. D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - e. D3740 – Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - f. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - h. D4564 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sleeve Method.
 - i. D4914 – Standard Test Methods for Density and Unit Weight of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
 - j. D5030 – Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.

- k. D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Method Shallow Depth
- l. E329 – Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
- 2. Florida Department of Transportation (FDOT):
 - a. Standard Specifications for Road and Bridge Construction
- 3. American Association of State Highway Transportation Officials (AASHTO):
 - a. T 27 – Sieve Analysis of Fine and Course Aggregates
 - b. T 99 - Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - c. T 180 – Standard Method for Moisture-Density Relations of Soils using a 10 lb (4.54 kg) Rammer and 18 in (457 mm) Drop
- B. Florida Method (FM) of Test:
 - 1. FM T-1 011 – Florida Method of Test for Sampling Aggregates
- C. Miscellaneous Project Data:
 - 1. Subsurface soil data logs are provided for the CONTRACTOR's reference (N/A)

1.03 DEFINITIONS:

- A. Select Fill:
 - 1. Select Fill shall be clean, well-graded material free from debris, peat, roots, seeds of nuisance or exotic species, organic material, clods, and stones with a diameter greater than three (3) inches (76 mm) in any direction. Select Fill shall have an average organic content of not more than 2% or have an individual test value of not more than 4%. Select Fill shall be placed where indicated on the Drawings.
 - 2. Select Fill may be material excavated for the WORK (native) or may be imported. The CONTRACTOR may blend native materials to achieve a material that meets the requirements for Select Fill.
 - 3. Select Fill shall meet one of the following Unified Soil Classification System (ASTM D2487) designations: SW, SM or SP-SM. Materials classified as SP may be used only where the existing excavated and surrounding materials are confirmed by laboratory testing to be SP. .
- B. Random Fill:
 - 1. Random Fill shall be clean, well-graded material, meeting one of the following Unified Soil Classification System (ASTM D2487) designations: SW, SP, SM, SC, SW-SM, SW-SC, SP-SM, and SP-SC, that is thoroughly mixed and free from debris, clods, seeds of nuisance or exotic species, and stones with a diameter in any direction greater than those specified in the below table. Random Fill shall have an organic content of less than 5% by weight. Tighter restrictions on stone size are considered in the top layer of fill, as per subsection 3.05 Final Dressing of Slopes, if the area is to be seeded, sodded, or landscaped. Random Fill shall be placed where indicated on the Drawings.
 - 2. Random Fill may be material excavated for the WORK (native) or may be imported. The CONTRACTOR may blend native materials to achieve a material that meets the requirements for Random Fill.

- C. Unified Soil Classification System (USCS): USCS is a two-letter classification system used to describe the texture and grain size of a soil. In the USCS system, letters are representative as follows: G stands for gravel, S stands for sand, M stands for silt, C stands for clay, O stands for organic, P stands for poorly graded, W stands for well graded, H stands for high plasticity, and L stands for low plasticity.
- D. Excavation: Excavation shall be the removal of all materials within the defined configuration to the limits of excavation shown on the Drawings, excluding stripping material.
- E. Unsuitable Fill: Soil that does not meet the requirements for fill (or backfill) addressed thus far in this SECTION shall be considered Unsuitable Fill soil.
- F. **Cohesionless materials: These materials include gravels, gravel-sand mixtures, sands, and gravelly sands and are generally exclusive of clayey and silty materials.**
- G. **Cohesive materials: These materials include silts and clays and are generally exclusive of sands and gravel**

1.04 SUBMITTALS:

- A. Submittals shall be in accordance with SECTION 01300.
- B. The CONTRACTOR shall submit laboratory test results on the materials proposed to be used (whether native or imported) as Select Fill, Random Fill and Silica Filter Sand, Type 1 Graded Gravel and Type 2 Graded Gravel. At a minimum the laboratory testing shall include sieve analysis, organic content, USCS classification and modified proctor per ASTM D1557, as applicable. Prior to construction, the CONTRACTOR shall provide the source of each material proposed to be used.
- C. The CONTRACTOR shall submit two (2) copies of field measured cross-sections at each design cross-section for record purposes for canal excavations and levee embankments as described in this SECTION. The submittal of the field measured cross-sections shall be signed and sealed by a Professional Surveyor and Mapper licensed in the State of Florida.

1.05 QUALIFICATIONS:

- A. Geotechnical Testing Agency Qualifications: The CONTRACTOR shall furnish at his own expense an independent testing agency qualified according to ASTM E329 to perform all testing required to establish and maintain his Quality Control. This Quality Control involves conducting soil materials and rock-definition testing during earthwork operations, as documented according to ASTM D 3740.
- B. Earthwork Contractor Qualifications: The CONTRACTOR shall use an adequate number of skilled laborers and installers who are thoroughly trained and have a minimum of five (5) years of successful experience in the necessary crafts and are completely familiar with the methods needed for the proper performance of the WORK of this SECTION. The CONTRACTOR shall employ the adequate resources and equipment necessary to successfully perform the WORK of this SECTION on schedule.

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall excavate any material encountered to the depth and grades required, shall backfill such excavations as required, and shall dispose of excess or unsuitable materials from excavation as approved by the CITY. The CONTRACTOR shall provide and place necessary borrow material to properly backfill excavations as indicated on the Drawings, specified herein, or as directed by the CITY.
- B. Excavation, dewatering, sheeting, and bracing required shall be carried out so as to prevent any possibility of undermining or disturbing the foundations of any existing structure or WORK, and so that all WORK may be accomplished and inspected in the dry, except as directed by the CITY.

Aqueous construction may be performed only with prior written approval of the CITY. Excavation and backfilling shall be in accordance with SECTION 02220.

- C. The CONTRACTOR shall furnish, at his expense, the services of a Professional Surveyor and Mapper licensed in the State of Florida for the field layout of all WORK indicated or specified in this SECTION. The CONTRACTOR's licensed surveyor shall perform all initial Site layouts and shall provide follow-up verification of all WORK underway as necessary.

1.07 CERTIFICATIONS AND TESTING:

- A. The responsibility to retain the services of an independent testing laboratory shall be as defined in SECTION 01410.
- B. The CONTRACTOR shall furnish, at his own expense, all testing required to establish and maintain his Quality Control (QC) processes required or specified in this SECTION. Field density tests shall be in accordance with all applicable ASTM Standards appropriate to each type of material used in the earthwork. Failure to meet the specified density will require the CONTRACTOR to recompact and retest, at his own expense, those areas directed by the CITY.

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide at least 48 hours advanced notice of its his intention to begin new WORK activities.

1.09 WARRANTY:

- A. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 MATERIALS ENCOUNTERED:

- A. The CONTRACTOR shall consider all materials encountered in excavations as suitable for use in Random Fill, provided that they consist of two (2) or more well-graded soils and achieve the required compaction as specified in this SECTION.
- B. The CONTRACTOR shall consider all materials encountered, regardless of type, character, composition and condition thereof unclassified other than as indicated in Article 1.03 Definitions. The CONTRACTOR shall estimate the quantity of various materials included prior to submitting the Bid Form. Rock encountered shall be handled by the CONTRACTOR at no additional cost to the CITY.

PART 3 - EXECUTION:

3.01 SITE PREPARATION:

- A. Clearing and Demolition: The CONTRACTOR shall perform clearing and demolition as specified in SECTIONS 02110 and 02050.
- B. Stripping: The CONTRACTOR shall remove topsoil from areas within limits of excavation and areas designated to receive compaction as shown on the Drawings, required and as provided below:
 - 1. Scrape area clean of all brush, grass, weeds, roots, and other material.

2. Strip to a minimum depth of approximately six (6) inches or to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required segregating topsoil. All roots and branches 1/2 inch in diameter or greater shall be removed.
 3. Stockpile topsoil in areas where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, debris and stones larger than two inches in diameter.
- 3.02 DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL: The CONTRACTOR shall dispose of all excess or unsuitable material off-site or in areas otherwise approved by the CITY.
- 3.03 STOCKPILE OF EXCAVATED MATERIAL: The CONTRACTOR shall stockpile excavated materials in areas shown on the Drawings or in areas otherwise approved by the CITY.
- 3.04 EXCAVATION AND TRENCHING:
- A. Trenching for Pipes: The CONTRACTOR shall perform trenching for pipes as shown on the Drawings, required, and specified in accordance with SECTION 02221.
 - B. Sheeting and Bracing: The CONTRACTOR shall provide sheeting and bracing shown on the Drawings or as required in accordance with the following provisions.
 1. Use when required by the specifications or Drawings and where resulting slopes from excavation or trenching might endanger the structural integrity of in-place or proposed structures.
 2. Provide materials on-site prior to start of excavation. Adjust spacing and arrangement as required by conditions encountered.
 3. Remove sheeting and bracing as backfill progresses. Fill voids left after withdrawal with sand or other CITY approved material.
 4. In-place structures damaged by sheeting and bracing activities shall be repaired by the CONTRACTOR at no additional cost to the CITY.
 5. Comply with all applicable Sections of Occupational Safety and Health Administration (OSHA).
 6. Comply with all requirements of the Florida Trench Safety Law as specified in the General Terms and Conditions.
 - C. Blasting: If required and approved by the CITY, the CONTRACTOR shall perform blasting in accordance with the SECTION 02211.
 - D. Excavation for Structures: The CONTRACTOR shall perform excavation for structures as shown, required and specified below:
 1. Excavate area adequate to permit efficient erection and removal of forms.
 2. Trim to neat lines where details call for concrete to be deposited against earth.
 3. Excavate by hand in areas where confined space and access restricts the use of machines.
 4. Notify the CITY immediately when excavation has reached the depth indicated on plans.
 5. Restore bottom of excavation to proper elevation with concrete in areas that are over excavated.
 6. Conform to the requirements of SECTION 02221.
 - E. Demucking: The CONTRACTOR shall remove all organic soils from areas below structures, piping, and road subgrades to the lines and grades as shown in the Drawings. Materials excavated shall not be

used for backfill of structures or pipes and shall be placed in Random Fill zones only. Organic soils (including peat) shall be used in Random Fill in the top layer of the final dressing of the levee.

- F. Cross-Sections: For pay quantities and record purposes, the CONTRACTOR shall submit field measured cross-sections as required by the CITY

3.05 BACKFILLING:

- A. Pipe Backfill: The CONTRACTOR shall perform pipe backfill as required, shown, and specified in accordance with SECTION 02221.
- B. Structure Backfill: The CONTRACTOR shall place structural backfill in accordance with the lines, grades, and cross-sections shown in the Drawings or as ordered by the CITY. The CONTRACTOR shall backfill using Select Fill. Stones or rocks greater than two (2) inches (51 mm) in any dimension shall not be placed within twelve (12) inches of the structure. Lifts shall not exceed eight (8) inches. The following procedures shall be adhered to:
1. Structure backfill shall be compacted to not less than 95% maximum dry density as measured by ASTM D1557.
 2. Backfill shall not be placed against fresh concrete without the approval of the CITY. Once approved, backfill only after concrete has attained at least 70% design strength. Backfill adjacent to structures only after a sufficient portion of the structure has been built to resist the imposed load.
 3. Remove all debris from excavation prior to placement of material.
 4. Place backfill in level layers of thickness within the compacting ability of equipment used.
 5. Perform backfilling simultaneously on all sides of structures. For walls, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.
- C. Unclassified Backfill: The CONTRACTOR shall ensure that unclassified backfill be placed in twelve (12) inch loose lifts to the lines and grades shown on the Drawings or as approved by the CITY. The CONTRACTOR shall compact unclassified backfill to a density approximating the density of surrounding native material and in a manner that will prevent settlement of the completed area.

3.06 GRADING: The CONTRACTOR shall perform grading as shown on the Drawings, required, and provided for below:

- A. Grade and compact all areas within the project area, including excavated and filled sections and adjacent transition areas, reasonably smooth, and free from irregular surface changes.
- B. Degree of finish shall be that ordinarily obtained from blade grader or scraper operations except as otherwise specified.
- C. Finished rough grades shall generally be not more than one quarter foot above or below those indicated with due allowances for topsoil.
- D. Finish all ditches, swales, and gutters to drain readily.
- E. Provide roundings at top and bottom of banks and at other breaks in grade.

3.07 RESTORATION:

- A. The CONTRACTOR shall restore all areas disturbed by construction activities to equal or better condition and to the satisfaction of the CITY. Seed and mulch all other disturbed areas.

3.08 MAINTENANCE:

- A. The CONTRACTOR shall protect newly graded areas from actions of the elements.
- B. The CONTRACTOR shall fill, repair, and re-establish grades to the required elevations and slopes for any area that shows settling or erosion occurring prior to seeding.
- C. The CONTRACTOR shall maintain grassed and sodded areas in accordance with SECTIONS 02486 and 02920, respectively.

END OF SECTION

SECTION 02215 PROTECTION OF EXISTING STRUCTURES

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, equipment, and materials for protecting existing structures during construction, and for monitoring and documenting the effectiveness of said protection.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 02050 - Demolition
 - 3. SECTION 02110 - Clearing and Land Preparation
 - 4. SECTION 02200 - Earthwork
 - 5. SECTION 02221 - Trenching, Backfilling, and Compacting

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. See the various paragraphs for the specified standard. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. All applicable local (City, County, Village, Town, Tribe, etc.) codes, regulations, ordinances, and standards.
 - 2. Florida Department of Transportation (FDOT)
 - a. Standard Specifications for Road and Bridge Construction.

1.03 DEFINITIONS:

- A. Existing Nearby Facilities at Risk (ENFAR): the collective name of any and all nearby buildings, structures, facilities, utilities, property, access roads, levees, etc. located within or adjacent to the Site that could receive seismic motion greater than one-half inch per /second (or a more stringent velocity required by a permit or agency) and could be at risk for being damaged from ground vibrations due to construction.

1.04 SUBMITTALS: The CONTRACTOR shall provide the following Compliance Submittals in accordance with SECTION 01300, which are required:

- A. A complete list of all applicable rules and regulations with which they must comply.
- B. Pre-Construction Condition Survey and Vibration Monitoring and Control:
 - 1. The CONTRACTOR shall submit a Pre-Construction Condition survey in accordance with SECTION 01300, not less than ten (10) days prior to commencing construction operations.
 - 2. The CONTRACTOR shall schedule and conduct a pre-construction condition survey. The CONTRACTOR shall provide one (1) person from its organization and its specialist on vibration control who meets the qualifications of Article 1.05 to organize and lead a team, with the DISTRICT and a representative of each ENFAR, in making a pre-construction condition survey. At a minimum, each ENFAR shall be inspected and its condition documented. The following is a list of each ENFAR specific to this Project for which a pre-construction inspection and report is mandatory whether the ENFAR criteria are met or not:

- C. The Pre-construction condition survey document shall include at a minimum:
- a. A map of the Project Site with areas of concern highlighted.
 - b. Photographically documented existing conditions, and instances of pre-existing cracks or other defects. The documentation shall clearly identify each item. Documentation shall describe the location, the direction from which the photo was taken, and dates. Documentation shall include a narrative of each issue. CONTRACTOR shall note the condition of the existing structures and shall locate and identify any areas where bulging, sloughing, cracking, or existing damage is observed.
 - c. Actual measured horizontal and vertical dimensions (not estimated dimensions) from the nearest operations to surveyed properties, structures, levees, utilities or facilities. The CONTRACTOR is required to have a Professional Land Surveyor registered in the State of Florida supervise the measurements and recording of this information.
 - d. Pertinent diaries or logs of conversations with owners related to the pre-construction condition of the inspected ENFAR's.
 - e. The CONTRACTOR shall clearly document existing conditions.
- D. Seismic Monitoring Records:
1. The records shall be clearly tied to specific construction events and include instrument identification, locations, dates, and times with tabulated and summarized results.
- E. Damage Investigation Survey Document:
1. Within seven (7) calendar days of any WORK event causing damage to any property a survey shall be conducted. Such survey shall include as a minimum:
 - a. Detailed description of the damage, including videotape or photographic documentation.
 - b. Name, address and telephone number of the Owner of the damaged property, structures, levees, utilities or facilities. The CITY will supply a master list of adjacent property owner information.
 - c. Evaluation of the cause of the damage and measures taken or to be taken to prevent recurrence.
 2. The CONTRACTOR shall supplement this report on a bi-weekly basis (or other time period as determined by the CITY) until the damage is repaired or otherwise made whole.
 3. The CONTRACTOR shall submit an overview of the damage survey results including the status of any damage events, within 30 calendar days of the completion of all construction operations.
- F. Damage Inspection Survey:
1. The CONTRACTOR shall perform Damage Inspection surveys to detect any effects resulting from construction operations.
 2. The CONTRACTOR shall submit Damage Inspection survey, photographs, and other finalized data to the CITY
 3. The CITY shall inspect the properties, levees, structures, facilities and utilities after receipt of the report to verify the accuracy of the survey. Florida Department of Transportation (FDOT), Florida Power & Light (FPL) or other property or utility owners may inspect their structures, facilities, levees or utilities. Any damaged areas, which were not specifically identified in the pre-construction survey narrative and photographs, shall be deemed to have been caused by the

construction operations. The CONTRACTOR shall be responsible for required repairs at no additional cost to the CITY.

1.05 QUALIFICATIONS: N/A

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall include in its bid consideration in its progress schedule for time it takes to obtain permits, permit revisions and inspections from the issuing entities.
- B. The CONTRACTOR shall obtain copies of all applicable codes, regulations, laws and ordinances and keep them in its on-site project file.

1.07 CERTIFICATIONS AND TESTING: (Not Used)

1.08 INSPECTION COORDINATION: (Not Used)

PART 2 - PRODUCTS

2.01 MATERIALS ENCOUNTERED:

- A. Materials to be encountered include geologic formations for which the CONTRACTOR has determined appropriate methods for achieving required grades, loosening material, and fragmenting according to gradation requirements. The CONTRACTOR shall ensure in its bid that it has considered all the potential expenses related to the construction required to comply with the industry regulations and with requirements of the plans and specifications.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The CONTRACTOR shall be responsible for any damage to existing properties, utilities, structures, facilities, levees or access roads due to construction activities. The CONTRACTOR shall expediently repair (within 30 days or as directed by the CITY) at no additional expense. Upon the circumstance of damage:
 - 1. The CONTRACTOR shall stop construction operations.
 - 2. The CONTRACTOR shall provide the required damage survey.
 - 3. The CONTRACTOR shall undertake to rectify the damage.
 - 4. The CONTRACTOR shall revise, resubmit, and obtain the CITY acceptance, and any required third-party acceptance, on the appropriate construction methods before any further WORK is undertaken.
- B. The CONTRACTOR shall have the sole responsibility for the safety of all WORK activities including labor, materials handling, shipment, storage, and equipment.
- C. No time extensions will be made, nor will additional compensation be made for delays or other circumstances related to unacceptable WORK.
- D. The CONTRACTOR shall take precautions to preserve the materials outside the lines of excavation in an undisturbed condition.

3.02 COORDINATION WITH THIRD PARTIES WITH RESPECT TO CONSTRUCTION:

- A. Critical properties, public utilities, levees, structures or facilities may lie close to construction areas associated with this Project. During Project development agreements may have been made between

the DISTRICT and relevant third parties. Some of these agreements will guide, restrict and affect the CONTRACTOR's activities. The following list includes the affected parties, and conditions, restrictions, timeframes, issues and consequences that the CONTRACTOR must consider in his bid for both costs and scheduling. The CONTRACTOR shall be responsible for plan implementation and effectiveness while accommodating such agreements. There will be no extra compensation for activities the CONTRACTOR must pursue to satisfy the conditions.

1. [

3.03 SITE PREPARATION:

- A. The CONTRACTOR shall demolish structures and other items as shown on the Drawing and in accordance with SECTION 02050.
- B. The CONTRACTOR shall clear the Site in accordance with SECTION 02110.
- C. The CONTRACTOR shall strip the Site in accordance SECTION 02200.
- D. Vibration Control: The CONTRACTOR shall provide a minimum of three (3) seismographs sufficient to measure and record ground movements caused by construction. The seismographs shall be placed at locations to include, but not limited to, the nearest properties, buildings, structures, levees, or utilities and such locations are to be approved by the CITY:
 - 1. Seismograph operators shall be qualified personnel capable of setting up instruments at designated locations and efficiently recording the construction. Construction shall be controlled in such a manner that the maximum ground vibration level at any structure which is vulnerable to damage shall not exceed a zero-to-peak particle velocity of one-half inch per /second or any more stringent permit or regulatory agency requirement.
 - 2. The instrumentation shall record three (3) orthogonal components (vertical, radial, and transverse with respect to the location of the construction) of particle velocity direct (or shall have sufficient resolution of acceleration or displacement such that particle velocity can be readily and accurately determined from the records). The instantaneous vector sum of the three (3) directional components of vibration will be used to compute the maximum vibration level. A written memorandum of vibration intensity shall be submitted within 24 hours when specifically requested by the CITY, or without request when such intensity exceeds a peak particle velocity of one and one-half inch per second.

END OF SECTION

SECTION 02220 EXCAVATIONS AND BACKFILLING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, materials, and equipment to perform the excavation and backfilling as shown on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 02110 Clearing and Land Preparation
 - 2. SECTION 02221 Trenching, Backfilling & Compaction
 - 3. SECTION 02200 Earthwork

1.02 APPLICABLE PUBLICATIONS:

- A. American Society of Testing Materials (ASTM)
 - 1. D698 Standard Test Methods for Laboratory compaction Characteristics of Soil Using the Standard Effort (56,000 ft-lbf/cu. ft.)
 - 2. D1557 Standard Test Methods for Laboratory compaction Characteristics of Soil Using the Modified Effort (12,400 ft-lbf/cu. ft.)
 - 3. D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 - 4. D4254 Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- B. Florida Department of Transportation
 - 1. Standard Specifications for Road and Bridge Construction, latest edition, (FDOT)

1.03 DEFINITIONS: (Not Applicable)

1.04 SUBMITTALS: The CONTRACTOR shall submit, prior to the start of work, the planned method of construction works for the CITY review. This plan shall also indicate the intended construction sequence for backfilling operation.

1.05 QUALIFICATIONS: (Not Applicable)

1.06 RESPONSIBILITIES: (Not Applicable)

1.07 CERTIFICATIONS AND TESTING: Field density tests in accordance with ASTM Standards, for each type of material used in backfilling may be required. Failure to meet the specified density will require the CONTRACTOR to compact again and retest, at its own expense, those areas directed by the CITY

1.08 INSPECTION COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide the CITY at least 48 hours advance notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS, and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of SECTION 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of SECTION 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

- 2.01 STRUCTURAL BACKFILL: The CONTRACTOR shall provide satisfactory structural backfill material which shall consist of material free of muck, stumps, rocks, or other material considered unacceptable by the CITY. The general requirements for fill shall be in accordance with SECTION 02200 Earthwork and FDOT 120-7.1 and 7.2.
- 2.02 EMBANKMENT FILL: The CONTRACTOR shall provide embankment fill free of muck, stumps, roots, brush, vegetation or other material considered undesirable by. The general requirements of embankment fill shall be in accordance with SECTION 02200 Earthwork and FDOT 120-7.1 and 7.2.

PART 3 - EXECUTION

3.01 SITE PREPARATION:

- A. Clearing and Grubbing: The CONTRACTOR shall perform clearing and grubbing in accordance with SECTION 02110 Clearing and Land Preparation and with the following provisions:
1. Perform only in areas where earthwork or other construction operations are to be performed or otherwise shown on Drawings.
 2. Protect tops, trunks, and roots of existing trees that are to remain on the site.
 3. Clear areas and dispose of other trees, brush and vegetation before starting construction.
 4. Remove tree stumps and roots larger than three inches in diameter and backfill resulting excavations with approved material.
- B. Stripping: The CONTRACTOR shall remove topsoil from areas within limits of excavation and areas designated to receive compaction as shown on the Drawings, required and as provided below:
1. Scrape area clean of all brush, grass, weeds, roots, and other material.
 2. Strip to depth of approximately six inches or to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required segregating topsoil.
 3. Stockpile topsoil in areas where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, debris and stones larger than two inches in diameter.

- 3.02 DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL: The CONTRACTOR shall dispose of all excess or unsuitable material off-site or in areas otherwise approved by the CITY.
- 3.03 STOCKPILE OF EXCAVATED MATERIAL: The CONTRACTOR shall stockpile excavated materials in areas shown on the Drawings or in areas otherwise approved by the CITY.
- 3.04 PLACEMENT OF STRUCTURAL FILL: The CONTRACTOR shall place structural backfill true to the lines, grades and, cross sections shown in the Drawings or as ordered by the CITY. Structural backfill shall be deposited by the CONTRACTOR in horizontal layers not exceeding eight inches in depth measured loose, and shall be compacted to a density of not less than 95 percent of the maximum density at optimum soil moisture content +/- 2% as determined by ASTM D1557 Standards. Backfill shall not be placed against fresh concrete without the approval of the CITY.
- 3.05 PLACEMENT OF EMBANKMENT FILL: The CONTRACTOR shall construct embankments true to the lines, grades, and cross sections shown on the Drawings or as directed by the CITY. Fill for embankments shall be placed by the CONTRACTOR in successive layers of not more than twelve inches in thickness, measured loose, for the full width of the embankment. Each layer of the material used in the formation of the embankments shall be compacted by the CONTRACTOR to a density of at least 95 percent of the maximum density as determined by ASTM D1557 Standards. Unreasonable roughness of the surface shall be dressed out. Rocks and boulders shall not project above the finished surfaces. All areas disturbed shall be graded by the CONTRACTOR so that water drains freely at all points after construction.
- 3.06 COMPACTION EQUIPMENT: When placing fill adjacent to foundations or retaining walls, heavy equipment for spreading and compacting fill shall not be operated closer than a distance equal to the height of backfill

above the top of the footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the materials being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

- 3.07 GRADING: The CONTRACTOR shall perform grading as shown on the Drawings, required, and provided for below:
- A. Grade and compact all areas within the project area, including excavated and filled sections and adjacent transition areas, reasonably smooth, and free from irregular surface changes.
 - B. Degree of finish shall be that ordinarily obtained from blade grader or scraper operations except as otherwise specified.
 - C. Finished rough grades shall generally be not more than one quarter foot above or below those indicated with due allowances for topsoil.
 - D. Finish all ditches, swales, and gutters to drain readily.
 - E. Provide roundings at top and bottom of banks and at other breaks in grade.
- 3.08 CLEANUP: The CONTRACTOR shall cleanup the site as required and provided for below, to the satisfaction of the CITY:
- A. Clear surfaces of all stones, roots, grading stakes, and other objectionable materials.
 - B. Keep paved areas clean and promptly remove rock or dirt dropped upon surfaces.
- 3.09 PROTECTION AND MAINTENANCE: The CONTRACTOR shall maintain the embankments until final acceptance of all work. The maintenance shall include repairs of any erosion, slides, or other damages.

END OF SECTION

SECTION 02221 TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, materials and equipment necessary for complete and proper trenching, backfilling and compacting as specified herein.
 - 1. SECTION 02200 Earthwork

1.02 APPLICABLE PUBLICATIONS:

- A. American Society of Testing Materials (ASTM):
 - 1. D698 - Standard Test Methods for Laboratory compaction Characteristics of Soil Using the Standard Effort (12,400 ft-lbf/ ft³ (600 kN-m/m³))
 - 2. D1557 - Standard Test Methods for Laboratory compaction Characteristics of Soil Using the Modified Effort (56,000 ft-lbf/ ft³ (2,700 kN-m/m³))
 - 3. D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 - 4. D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- B. Florida Department of Transportation (FDOT):
 - 1. Standard Specifications for Road and Bridge Construction, latest edition, (FDOT)
- C. Miscellaneous Project Data: N/A

1.03 DEFINITIONS: (Not Applicable)

1.04 SUBMITTALS: (Not Applicable)

1.05 QUALIFICATIONS: (Not Applicable)

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall make all excavations for piping and appurtenant structures in any material encountered to the depth and grades required, shall backfill such excavations and dispose of excess or unsuitable materials from excavation, and shall provide and place necessary borrow material to properly backfill excavations, all as indicated on the drawings, specified herein, or as directed by the CITY.
- B. Excavation, dewatering, sheeting and bracing required shall be carried out to prevent any possibility of undermining or disturbing the foundations of any existing structure or work, and so that all work may be accomplished and inspected in the dry, except as directed by the CITY. Aqueous construction may be performed only with prior approval of the CITY.

1.07 CERTIFICATIONS AND TESTINGS: (Not Applicable)

1.08 INSPECTION COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

- 2.01 MATERIALS: The CONTRACTOR shall furnish materials as required to complete the Work under this Section.

PART 3 - EXECUTION

- 3.01 EXTENT OF OPEN EXCAVATION: The CONTRACTOR shall perform the excavation such that at any time the amount of excavation open will be held to a minimum consistent with normal and orderly prosecution of the work, or as restricted by permit conditions.
- 3.02 CUTTING PAVEMENT: When excavations are required in paved areas the CONTRACTOR shall conform to the following.
 - A. When excavations are to be made in paved surfaces, the pavement shall be cut ahead of the excavation by means of suitable sharp tools to provide a uniform sharp edge with minimum disturbance of remaining materials.
 - B. Asphalt paving and other improvements in the right-of-way and on other private property affected by this construction shall be duly protected and, where disturbed, shall be restored or replaced to meet original conditions.
- 3.03 TRENCH EXCAVATION: The CONTRACTOR shall perform trench excavation in accordance with the following.
 - A. All excavation for piping shall be open cut. Trench sides shall be approximately vertical between an elevation of one foot above the top of the pipe and the centerline of the pipe; otherwise, trench sides shall be as vertical as possible or as required. Trenches may be excavated by machinery to a depth that will not disturb the finish grade.
 - B. Trench width shall be as narrow as practical and shall not be widened by scraping or loosening material from the sides.
- 3.04 EXCAVATION BELOW NORMAL GRADE:
 - A. In the event the CONTRACTOR through error or carelessness excavates below the elevation required, the CONTRACTOR shall at his own expense backfill with selected gravel and compact to obtain a suitable pipe bedding all as directed and to the satisfaction of the CITY
 - B. In the event unstable or unsuitable bedding material is encountered at or below the pipe bedding level, the CONTRACTOR shall remove such material and replace it with suitable compacted material.
- 3.05 BACKFILLING TRENCHES:
 - A. The CONTRACTOR shall be responsible for obtaining the necessary inspections before, during and after backfilling and shall re-excavate, refill and perform all such related work to obtain satisfactory test results.

- B. The CONTRACTOR shall use excavated materials classified as embankment fill for backfilling and such grading on the site as is required. The CONTRACTOR shall dispose of any excess fill or unstable material in areas approved by the CITY. Pipe trenches shall be backfilled with fine, loose embankment fill (see SECTION 02220, paragraph 2.02), free from large stones, carefully deposited on both sides of pipe and thoroughly and carefully rammed until enough fill has been placed to provide a cover of at least one foot above the pipe. The remainder of the backfill material may then be thrown in and tamped. Water settling may be permitted. The CONTRACTOR shall submit written request detailing the need to perform water settling and reasons why work in the dry is not possible. The CONTRACTOR shall also submit detailed procedures for the review and approval of the CITY. Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally, made to conform to the surface of the ground. Backfilling shall be carefully performed, and the surface restored to the elevation shown on the plans. In unpaved areas the surface of trenches shall conform and be equal to quality, character and material of the surface immediately prior to making the excavation.
- C. Place earth embedment as follows:
1. With level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length.
 2. Form shallow depression under each joint to facilitate jointing.
 3. Add second layer simultaneously to both sides of the pipe with care to avoid displacement of the pipe.
 4. Place material in maximum 12-inch lifts.

3.06 BACKFILLING OF TRENCH UNDER ROADWAY AND AREAS TO BE PAVED: The CONTRACTOR shall place material in 12-inch maximum layers after filling one foot above pipe as previously described. Each layer shall be compacted to 95 percent maximum dry density as measured by ASTM D1557 so that pavement can be placed promptly. Any pavement cut, or area disturbed by this work shall be replaced to match existing.

3.07 BACKFILLING OF TRENCH OPEN AREAS: The CONTRACTOR shall place material in 12-inch maximum lifts after filling one foot above pipe as previously described. The top one-foot layer shall be compacted to **90** percent maximum dry density as measured by ASTM D1557. Each layer shall be compacted to the density of adjacent soils. Restore the surface to original grade and place sod or seed as required by the contract documents.

END OF SECTION

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall provide all labor, equipment and materials necessary for the prevention of environmental damage as the result of construction operations under this Contract and for those measures set forth in other requirements of the Technical Specifications.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 02050 – Demolition
 - 3. SECTION 02110 – Clearing and Land Preparation
 - 4. SECTION 02200 – Earthwork

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards or codes of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. The CONTRACTOR shall comply with all applicable environmental laws and regulations.
 - 1. Environmental Protection Agency (EPA)
 - a. Clean Air Act (CAA)
 - b. Clean Water Act (CWA)
 - c. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
 - d. Executive Orders and EPA requirements, as appropriate; and all general and specific Federal Permit Conditions as applicable.
 - e. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
 - f. National Environmental Laboratory Accreditation Conference (NELAC)
 - g. National Environmental Policy Act (NEPA)
 - h. National Pollution Discharge Elimination System (NPDES)
 - i. Resource Conservation and Recovery Act (RCRA)
 - j. Safe Drinking Water Act
 - k. Toxic Substance Control Act (TSCA)
 - 2. Code of Federal Regulations (CFR)
 - a. 40 CFR - Parts 109, 261.10, 260-268, 273, 279
 - 3. Florida Department of Environmental Protection (FDEP)
 - a. Florida Administrative Code (FAC)
 - i. 62-770, 62-780
 - b. Florida Stormwater, Erosion and Sedimentation Control Inspector's Manual
 - 4. Florida Department of Transportation (FDOT)
 - a. Standard Specification for Road and Bridge Construction - Sections 104-1, 2, 3, 4, 6 and 7
 - 5. Florida Statutes
 - a. Chapter 403
 - 6. National Oceanic and Atmospheric Administration (NOAA)
 - a. Coastal Zone Management Act (CZMA)
 - 7. National Park Service (NPS)
 - a. Native American Graves Protection and Repatriation Act (NAGPRA)
 - b. National Historic Preservation Act (NHPA)
 - 8. U.S. Army Corps of Engineer (USACE)

9. U.S. Fish & Wildlife Service (FWS)
 - a. Endangered Species Act (ESA)
 - b. Fish and Wildlife Coordination Act (FWCA)
 - c. Migratory Bird Treaty Act (MBTA)
- B. State and local codes, permits, regulations and ordinances as applicable.

1.03 DEFINITIONS:

- A. For the purpose of this SECTION, environmental damage is defined as the presence of hazardous, physical, or biological elements or agents which alter the physical, chemical or biological integrity of the environment in such a way that it represents an unacceptable risk to public health, safety or welfare; unfavorably alter ecological balances; affect other species, biological communities, or ecosystems; or degrade the quality of the environment for aesthetic, cultural, and/or historical purposes. The control of environmental damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid waste, radiant energy and radioactive materials, as well as other pollutants.

1.04 SUBMITTALS: Within 20 calendar days after the Notice to Proceed (NTP), the CONTRACTOR shall submit an Environmental Protection Plan (Plan) for review and acceptance by the CITY in accordance with SECTION 01300. Approval of the Plan shall not relieve the CONTRACTOR of its responsibility for adequate and continuing control of pollutants and appropriate environmental protection measures. Approval of the Plan is conditional and predicated on satisfactory performance during construction. The CITY reserves the right to require the CONTRACTOR to modify the Plan if it is determined that environmental protection requirements are not being met. No physical WORK at the Site shall begin prior to acceptance of the Plan. The Plan shall include, but not be limited to the following:

- A. A list of the Federal, State and Local laws, regulation and permits concerning environmental protection, pollution control and abatement that are applicable to the CONTRACTOR's proposed operations and the requirements imposed.
- B. Methods for protection of features to be preserved within the authorized WORK areas: The CONTRACTOR shall prepare a listing of methods to protect resources needing protection (trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil and historical, archeological and cultural resources).
- C. Procedures to be implemented are to provide all necessary environmental protection and to comply with applicable laws and regulations: The CONTRACTOR shall provide written assurance that immediate corrective action will be taken to correct any environment damage due to accident, natural causes or failure to follow the procedures set out in accordance with the Plan.
- D. Environmental monitoring plans, if applicable.
- E. Traffic control plan, if applicable.
- F. Drawings showing locations of proposed temporary activities, such as material storage areas or stockpiles of excess spoil or materials.
- G. Erosion and sediment control methods, for protecting surface waters, wetlands, and groundwater during construction. All stormwater and erosion control methods shall be in accordance with the FDEP Florida Stormwater, Erosion and Sedimentation Control Inspector's Manual. The CONTRACTOR shall prevent and control erosion and water pollution as per FDOT Specification Sections 104-1, 2, 3, 4, 6 and 7 and all applicable FDEP regulations and permit conditions.
- H. Spill Prevention Methods: The CONTRACTOR shall identify any hazardous or potentially hazardous substances to be used on the Site and indicate intended actions to prevent accidental or intentional introduction of these materials into the air, ground, water, wetlands or drainage areas. The Plan shall specify the actions that will be taken to meet the federal, state and local laws regarding labeling, storage, removal, transport and disposal of all hazardous or potentially hazardous substances.
- I. Spill Contingency Plan for hazardous, toxic or petroleum material.
- J. A WORK area plan, showing proposed activities and identifying areas of limited use or non-use, and including measures that will be taken for field identification of these areas.

- K. Identification of the person who shall be responsible for implementation of the Plan. This person shall have authority to respond for the CONTRACTOR in all environmental protection matters.
- L. A recycling and waste management plan. The CONTRACTOR shall include waste minimization efforts in the Plan.

1.05 QUALIFICATIONS:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide at least 48 hours advance notice of its intention to begin new WORK activities.
- B. When the Eastern Indigo Snake is identified as a species of concern in the environmental permits the CONTRACTOR shall supply qualified eastern indigo snake observers during ground clearing activities. Qualified Observers are defined as individuals who have been instructed by the CITY on proper techniques and protocols for protection of the Eastern Indigo Snake during site activities. The observer's names and documentation showing completion of the CITY instruction shall be provided to the CITY at least two (2) weeks prior to the commencement of ground clearing activities.

1.06 RESPONSIBILITIES:

- A. Quality Control: The CONTRACTOR shall establish and maintain quality control for the environmental protection of all items set forth herein. The CONTRACTOR shall record on daily quality control reports or attachments thereto, any problems in complying with applicable laws, regulations and ordinances, and corrective action(s) taken.
- B. Permits and Authorizations: The CONTRACTOR shall apply for and obtain all necessary permits or licenses unless the CITY has already acquired them. The CONTRACTOR shall be responsible for implementing and complying with all terms, conditions and requirements of all permits issued for construction of the Project. The CONTRACTOR shall install speed limit signs for off-road and improved road travel for construction equipment and employee vehicles that identify speeds protective of wildlife. The CONTRACTOR shall also provide all necessary signage describing all Threatened and/or Endangered species which are identified in applicable environmental permits.
- C. Training: Prior to the onset of construction activities the CONTRACTOR and all personnel shall be trained on how to identify and implement the Standard Protection Measures and Guidelines for the Threatened and Endangered Species and ground-nesting birds. The Standard Protection Measures for the Eastern Indigo Snake dated August 12, 2013, is attached in Appendix C.

1.07 CERTIFICATIONS AND TESTINGS:

- A. All physical, chemical, and biological measurements and analyses that are necessary to comply with the monitoring requirements in all applicable permits or in this Contract must be performed according to approved methods and procedures by a commercial laboratory that is certified to perform the required analyses according to the approved methods and procedures by the National Environmental Laboratory Accreditation Conference (NELAC).

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide to the CITY at least 48 hours advance notice of its intention to begin new WORK activities.

PART 2 - PRODUCT (ENVIRONMENTAL PROTECTION PLAN)

2.01 NOTIFICATION:

- A. In the event that the CITY notifies the CONTRACTOR of any non-compliance with federal, state or local laws, permits or other elements of the CONTRACTOR's Environmental Protection Plan, the CONTRACTOR shall without delay inform the CITY of the proposed correction action and take such action as approved.
- A. The CONTRACTOR shall notify the CITY immediately of any warnings or notices of noncompliance, fines, citations or tickets issued directly to the CONTRACTOR by any federal, state, or local environmental protection, waste management, code enforcement, or fire, police, or public health agency.

- B. If the CONTRACTOR fails to comply, the CITY may order all WORK to cease until corrective action has been taken. No time extensions shall be granted or damages allowed for the suspension of WORK under this circumstance.
- C. A Notice of Termination (NOT) shall be sent to the applicable federal, state, and local permit-issuing authorities with a copy to the CITY within fourteen (14) days of final stabilization

2.02 SUMMARY:

- A. The CONTRACTOR shall submit a written report within 30 days of completion of the Project. This report shall delineate the absence, or occurrence, of reported or unreported environmental incidents during the course of the Project.

2.03 TRAINING:

- A. The CONTRACTOR shall train its personnel in relevant phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, and careful installation and monitoring of the Project to ensure continuous environmental pollution control.

PART 3 - EXECUTION (PROTECTION OF ENVIRONMENTAL RESOURCES)

3.01 GENERAL:

- A. During the entire period of the Contract, the CONTRACTOR shall protect environmental resources within the Project boundaries and those affected outside the limits of construction. The CONTRACTOR shall confine its activities to the areas defined by the Drawings and specifications. Any deviations from the Drawings including, but not limited to borrow areas, disposal areas, staging areas, and alternate access routes will require additional review by the CITY to ensure compliance with applicable environmental rules and regulations prior to implementation/or commencement of those deviations.

3.02 PROTECTION OF LAND RESOURCES:

- A. Prior to the beginning of any construction the CONTRACTOR shall delineate, install protection and be responsible for preservation of all land resources that are to be preserved or avoided within the WORK area. The CONTRACTOR shall not remove, cut, deface, injure, or destroy any land resources (trees, shrubs, vines, grasses, topsoil, or land forms) unless indicated in the Drawings or specifically authorized by the CITY All damaged areas shall be restored to original or better condition, to the satisfaction to the CITY

3.03 DISTURBED AREAS:

- A. The CONTRACTOR shall effectively prevent erosion and control sedimentation through approved materials and methods as identified in the Environmental Protection Plan. Disturbed areas will include areas of ingress and egress, construction materials storage, staging, washdown areas, and toxic, hazardous, and solid materials/waste storage areas. Disturbed areas shall be temporarily stabilized within seven (7) days of cessation of phased construction activity and permanently stabilized within fourteen (14) days of cessation of all phases of construction activity. Temporary Best Management Practices (BMPs) shall remain in place and in effect until the final Site inspection is complete and Site is certified as stabilized.

3.04 PROTECTION OF WATER RESOURCES:

- A. The CONTRACTOR shall conduct all activities in a manner to avoid pollution of surface water, ground water and wetlands. The CONTRACTOR's construction methods shall protect wetland and surface water areas from damage due to mechanical grading, erosion, sedimentation and turbid discharges. No storage or stockpiling of equipment shall be allowed within any wetland area unless specifically authorized under a permit for the Project.
- B. Water directly derived from construction activities shall not be allowed to directly discharge to water areas, but shall be collected in retention areas to allow settling of suspended materials. The CONTRACTOR shall monitor water quality of dewatering discharge into water bodies or leaving the Site in accordance with applicable environmental permits. All monitoring of any water areas that are affected by construction activities shall be the responsibility of the CONTRACTOR.

3.05 OIL, FUEL AND HAZARDOUS SUBSTANCE SPILL PREVENTION:

- A. The CONTRACTOR shall prepare a spill contingency plan in accordance with 40CFR, Part 109. The CONTRACTOR shall prevent oil, fuel or other hazardous substances from entering the air, ground, drainage, and local bodies of water or wetlands. In the event that a spill occurs, despite design and procedural controls, the CONTRACTOR shall take immediate action to contain and clean up the spill and report the spill immediately to the CITY and to other appropriate federal, state, and local agency contacts. Reportable quantities (greater than 25 gallons) of petroleum-based fluids must be reported within 1 hour to the National Response Center (800-424-8802) and State Warning Point (800-320-0519) if it reaches the waters of the state or, if not, within 24 hrs to State Warning Point. Toxic and hazardous substance spills directly into waters of the state, in any quantity, must be reported immediately to the CITY and those federal and state points of contact listed above.
- B. The CONTRACTOR shall submit a written report to the CITY and to the State of Florida Bureau of Emergency Response providing certification of commitment of manpower, equipment and materials necessary to prevent the spread and effect expeditious cleanup and disposal. This report shall be submitted within 48 hours of the spill event.

3.06 MATERIALS AND WASTE MANAGEMENT:

- A. For sanitary waste management, the CONTRACTOR shall ensure that portable restrooms will be anchored on level ground with at least a 15-foot set-back from water bodies or banks or slopes thereto. For solid waste management, dumpster(s) will either be outfitted with a water-tight cover or be covered with a tarpaulin when not in use to minimize infiltration and leaching of rain with at least a 15-foot set-back from water bodies, conveyances thereto, or banks or slopes thereto. Hazardous materials storage areas and liquid refuse and hazardous waste collection and storage areas shall be denoted on the Plan.
- B. The CONTRACTOR shall ensure toxic substances and hazardous materials are stored in a locked, blast-resistant shed anchored to a bermed concrete or asphalt pad on level ground with at least a 15-foot setback from any water bodies, conveyances thereto, or banks or slopes thereto.
- C. For solid and/or hazardous waste disposal involving lead-based paint, the CONTRACTOR shall ensure containers with Toxicity Characteristic Leaching Procedure – Tetraphenylborate (TCLP TPb) concentrations in excess of the Resource Conservation and Recovery Act (RCRA) action level will be transported by a licensed hazardous waste hauler to a licensed hazardous waste disposal facility within the time limit appropriate to the generation rate and accumulated volume of hazardous waste material. Containers with TCLP TPb concentrations less than the RCRA action level shall be transported by a licensed solid waste hauler to a licensed Class I solid waste disposal facility. In either case, the CONTRACTOR shall obtain and transmit signed and dated copies of the transport and disposal manifests to the CITY for records retention.
- D. The CONTRACTOR is prohibited from the on-site burning of hazardous wastes (aerosol cans, oil filters, etc.). All hazardous wastes shall be disposed of as required by law. Copies of relevant Material Safety Data Sheets (MSDSs) shall be appended to the Environmental Protection Plan, Safety Plan, Spill Prevention Plan, and Stormwater Pollution Prevention Plan (SWPPP).
- E. The CONTRACTOR is responsible for the materials and processes where wastes may be generated under the contracted activities. The CONTRACTOR is responsible for providing the materials in order to implement the Contract and is responsible for operating and maintaining any processes from which waste material may be generated.
- F. The CONTRACTOR is deemed to be the “generator” as defined in 40 CFR 261.10 for any hazardous wastes or spill residue that is generated during the activities encompassed in this Contract. It is recognized that it is the CONTRACTOR’s or a subcontractor of the CONTRACTOR whose act first causes a hazardous waste to become subject to regulation. The CONTRACTOR is a different legal entity from the owner/operator of the physical location/property where the contracted activities will be conducted. CONTRACTOR is a “person” within the meaning of Section 403.031(5), Florida Statutes.
- G. The CONTRACTOR is responsible for compliance with applicable standards of 40 CFR 260-268 and 40 CFR 273 and 279 and state regulations which adopt or reference these federal standards.
- H. The CONTRACTOR is responsible for the generation and retention of records associated with waste management practices and disposition. All records shall be maintained for a minimum of three (3) years from the date of generation. All records will be made available to the CITY or regulatory agencies upon request.

- I. In the event of any chemical discharges associated with CONTRACTOR's or subcontractor's activities, CONTRACTOR shall be responsible for reporting, assessment and remediation of such discharges in accordance with applicable federal, state or local regulations and/or guidelines including, but not limited to, 40 CFR 264/265, Chapter 62-770, Florida Administrative Code (F.A.C.) and Chapter 62-780, F.A.C.

3.07 FISH AND WILDLIFE RESOURCE PROTECTION: The CONTRACTOR shall control and minimize interference with, disturbance to, and damage of fish and wildlife resources.

- A. If adverse impacts occur to fish and wildlife species of concern, including but not limited to Threatened and/or Endangered Species and Protected Migratory Bird Species, the CONTRACTOR shall immediately notify the CITY and provide details of adverse impacts for determination of further action that may be required. Adverse impact is defined as any harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such activity. Threatened and/or Endangered Species that require specific protection measures as identified in the environmental permits shall be listed in the Environmental Protection Plan.
- B. In the event that the CITY determines that an adverse impact to species of concern, including but not limited to Threatened and/or Endangered Species and Protected Migratory Bird Species occur as a result of the construction activities, the CITY shall notify the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service for determination of further action and possibly to determine if seasonal or daily timing restrictions on construction activities is needed.
- C. The CONTRACTOR and all personnel shall be familiar with the Plan shall be able to identify the threatened and endangered species listed in the Plan. Any activity observed by the CONTRACTOR that may result in adverse impact to threatened or endangered species shall be reported immediately to the CITY, who shall have sole authority for any WORK stoppages, creation of a buffer area, or restart of construction activities.
- D. Any Threatened and/or Endangered Species and species of concern observed at the Site will be recorded and logged. The logs shall be provided to the CITY on a bi-weekly basis. See attached Wildlife Log, Appendix A. If nesting activity is detected within and/or adjacent to the Site, the CONTRACTOR shall immediately contact the CITY for determination of further action and possibly to determine if seasonal or daily timing restrictions on construction activities is needed.
- E. The CONTRACTOR shall keep construction activities under surveillance, management, and control to prevent impacts to migratory birds and their nests. The CONTRACTOR may be held responsible for harming or harassing the birds, their eggs or their nests as a result of the construction. Any nesting activity observed by the CONTRACTOR shall be reported immediately to the CITY Construction Manager who shall have sole authority for any work stoppages, creation of the buffer area, or restart of construction activities.

3.08 ENVIRONMENTAL PROTECTION RETENTION RECORD RETENTION:

- A. The CONTRACTOR shall retain a copy of all required permits, the Plan, the SWPPP, the Spill Prevention Plan, and all associated reports, records and documentation required by these permits or the Contract at the construction Site or an appropriate alternative location as specified in the Notice of Intent (NOI) from NTP through Notice of Termination (NOT). Such documentation includes but is not limited to soil disturbance and stabilization logs, inspection and corrective action logs, turbidity monitoring logs, wildlife observation logs and reports, TCLP and Synthetic Precipitation Leaching Procedure (SPLP) assay results, sanitary, solid, and hazardous waste transport and disposal manifests, spill reports, material safety data sheets, and any warnings, citations or notices of noncompliance, or fees, levies, fines or penalties. A copy of all such records shall be submitted to the CITY at the time of Contract close-out.

3.09 PROTECTION OF AIR RESOURCES:

- A. The CONTRACTOR shall minimize pollution of air resources. All activities, equipment, processes and work operated or performed in accomplishing the specified construction shall be in strict accordance with the applicable air pollution standards of the State of Florida (F.S. Chapter 403 – Environmental Control and F.A.C. Section 200 – Recirculation Chiller) and all Federal emission and performance laws and standards as applicable. This includes, but is not limited to, control of particulates, dust generated by or incidental to construction activities, burning and odors.

3.10 PRESERVATION AND RECOVERY OF HISTORIC, ARCHEOLOGICAL, AND CULTURAL RESOURCES: If applicable, known historic, archeological and cultural resources within the CONTRACTOR's WORK area(s) will be designated as a "Sensitive Environmental Area" on the Drawings or other documents. If so designated, the

CONTRACTOR shall install protection for these resources and shall be responsible for their preservation during the Contract's duration. The CONTRACTOR shall not distribute maps or other information on these resource locations except for distribution among the CONTRACTOR's staff with a "need to know" technical responsibility for protecting the resources.

- A. Inadvertent Discoveries: If, during construction or other activities, the CONTRACTOR observes items that may have historic or archeological value, such observations shall be reported immediately to the CITY so that the appropriate staff may be notified, and a determination made for what, if any, additional action is needed. Examples of historic, archeological and cultural resources are bones, remains, artifacts, shell, midden, charcoal or other deposits, rocks or coral, evidences of agricultural or other human activity, alignments, and constructed features. The CONTRACTOR shall cease all activities that may result in the destruction of these resources and shall prevent his employees from further removing, or otherwise damaging, such resources.
- B. Claims for Downtime due to Inadvertent Discoveries: Upon discovery and subsequent reporting of a possible inadvertent discovery of cultural resources, the CONTRACTOR shall seek to continue WORK well away from, or otherwise protectively avoiding, the area of interest, or in some other manner that strives to continue productive activities in keeping with the Contract. Should an Inadvertent Discovery be of the nature that substantial impact(s) to the WORK schedule are evident; such delays shall be coordinated with the CITY

END OF SECTION

SECTION 02510 CONCRETE WALKWAYS, CURBS AND GUTTERS, RAMPS, MISCELLANEOUS
CONCRETE SLABS AND WHEEL STOPS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, materials and equipment necessary for the construction for concrete walkways, curbs and gutters, ramps, miscellaneous concrete slabs and wheel stops, as shown on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 03200 - Concrete Reinforcement
 - 3. SECTION 03300 - Cast-In-Place Concrete

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction (FDOT)
 - a. 346 – Standard Specifications for Portland Cement Concrete
 - b. 350 – Cement Concrete Pavement
 - c. 520 – Standard Specifications for Concrete Gutter, Curb Elements, and Traffic Separators
 - d. 522 – Standard Specifications for Concrete Sidewalk
 - e. 931 - Standard Specifications for Metal Accessory Materials for Concrete Pavement and Concrete Structures

1.03 DEFINITIONS: (Not Used)

1.04 SUBMITTALS:

- A. Submit the following for review in accordance with SECTION 01300.
 - 1. Copies of proposed concrete mix design and compression strength tests.

1.05 QUALIFICATIONS: (Not Used)

1.06 RESPONSIBILITIES: (Not Used)

1.07 CERTIFICATIONS AND TESTING:

- A. Perform tests in accordance with standards hereinafter specified.

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide at least 48 hours advance notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the MATERIALS and PRODUCTS specified in this SECTION against defective materials and workmanship with the MANUFACTURER's standard warranty, but for no less than one (1) year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. The CONTRACTOR shall provide concrete for sidewalks, curbs and gutters, ramps and miscellaneous concrete slabs as specified in FDOT Specifications Section 346. For miscellaneous concrete slabs Class I concrete shall have a minimum strength of 3000 psi.

2.02 METAL ACCESSORY MATERIALS:

- A. The CONTRACTOR shall provide metal accessory materials for miscellaneous concrete slabs as indicated on the Drawings and as specified in FDOT Specification Section 931.

2.03 PRE-CAST CONCRETE WHEEL STOPS:

- A. The CONTRACTOR shall furnish pre-cast concrete wheel stops that are nominally six (6) inches high by six (6) inches wide by six (6) feet long or accepted equivalent. One wheel stop shall be furnished per parking space or as shown on the Drawings. Wheel stops shall be reinforced with two (2), #4 bars.

2.04 FORMS: The CONTRACTOR shall furnish forms for the forming of the concrete curb in accordance with the following:

- A. The forms shall be wood or metal.
- B. The forms shall be straight and strong enough to resist springing during placement of concrete.
- C. The forms shall have sufficient bearing surface to prevent tipping.
- D. The height of the forms shall be equal to full depth of section to be constructed.
- E. Slip form.

PART 3 - EXECUTION

3.01 CONCRETE WALKS AND RAMPS:

- A. The CONTRACTOR shall construct concrete sidewalks and ramps as specified in FDOT Specifications Section 522 where shown on the Drawings.

3.02 CURBS AND GUTTERS:

- A. The CONTRACTOR shall construct concrete curbs and gutters as specified in FDOT Specifications Section 520 where shown on the Drawings.

3.03 MISCELLANEOUS CONCRETE SLABS:

- A. The CONTRACTOR shall construct miscellaneous concrete slabs for mechanical equipment as indicated on the Drawings and as specified in FDOT Specifications Section 350.

3.04 PRE-CAST CONCRETE WHEEL STOPS:

- A. The CONTRACTOR shall install pre-cast concrete wheel stops by anchoring them with at least two (2) one-half inch (#4) round reinforcing bars driven a minimum of twelve (12) inches into the pavement. Wheel stops damaged when driving rods shall be replaced with new wheel stops.

3.05 FORMS: The CONTRACTOR shall install the forms in accordance with the following:

- A. Use flexible forms for all curved form lines except:
 - 1. Curves having a radius of 200 feet or greater may be formed in ten (10) foot or shorter chords.
 - 2. Curves having a radius of 100 feet or greater may be formed in five (5) foot or shorter chords.
- B. Thoroughly clean, oil, securely stake, brace, and hold forms to line and grade.
- C. Remove forms from front face of curb section at the time necessary to permit finishing concrete. Leave other forms in place not less than twelve (12) hours after placement of concrete.

3.06 JOINTS: The CONTRACTOR shall install joints in the curbs as follows:

- A. Contraction Joints:
 - 1. Construct at locations indicated and as follows:
 - a. Divide concrete curb into monolithic sections not greater than ten (10) feet in length.
 - 2. Form contraction joints by any of the following methods:
 - a. Place one half inch thick steel separators after concrete has taken its initial set, but before final finishing.
 - b. Cut a groove in the fresh concrete to a depth of at one quarter the section thickness by use of a jointer having a radius of one-half inch and thickness not exceeding one-half inch.
 - c. Saw the hardened concrete before shrinkage cracking occurs. Depth of cut not less than one quarter the section thickness and width of key not to exceed three sixteenths inch.
- B. Expansion Joints:
 - 1. Construct at the following locations:
 - a. Locations as indicated on the Drawings.
 - b. All points of curvature and points of tangency of curves having a radius of 100 inches or less and at intervals not exceeding 60 inches in tangent section.
 - c. Locations where curb abuts other structures and slabs.
 - 2. Stake, support, and secure preformed joint filler in position to prevent displacement during and finishing operations.
 - 3. Round edges of joints with an edging tool of one quarter inch radius.
- C. Construction Joints:
 - 1. Locate to coincide with contraction, expansion or key joints.
 - 2. When concrete placement is interrupted between joint locations for enough time for the concrete to take its initial set, remove concrete to the nearest joint location before resuming placement.

END OF SECTION

SECTION 02821 SECURITY FENCING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish and install all chain-link fabric security fencing and warning signage as shown on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 02221 - Trenching, Backfilling and Compacting

1.02 APPLICABLE PUBLICATIONS: The most current revision of the following standard specifications shall apply to the WORK of this SECTION as indicated.

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - 5. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
 - 6. ASTM F567 - Standard Practice for Installation of Chain-Link Fence
 - 7. ASTM F626 – Standard Specification for Fence Fittings
 - 8. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric
 - 9. ASTM A780 - Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 10. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates
 - 11. ASTM F1043 – Standard Specification for Strength and Protective Coating on Metal Industrial Chain-Link Fence Framework [Replaced F669]
 - 12. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
 - 13. Florida Building Code Section 2224

1.03 DEFINITIONS: (Not Used)

1.04 SUBMITTALS:

- A. Submit as specified in SECTION 01300.
- B. The CONTRACTOR shall make submittals for security fencing to include but not limited to, the following:
 - 1. Product data

2. Plan layout
 3. Details illustrating fence height, sizes of posts, rails, braces, and hardware list
 4. Erection procedures
 5. Mill certification that materials meet specifications of member size, strength, wall thickness and coatings
 6. Fence mounted warning signage
- 1.05 QUALIFICATIONS: Provide chain link fence as complete units controlled by a single source, including necessary erection accessories, fittings, and fastenings.
- 1.06 RESPONSIBILITIES: (Not Used)
- 1.07 CERTIFICATIONS AND TESTING: (Not Used)
- 1.08 INSPECTION COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours advanced notice of its intention to begin new WORK activities.
- 1.09 WARRANTY:
- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this SECTION against defective materials and workmanship with the MANUFACTURER's standard warranty, but for no less than one (1) year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
 - B. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

- 2.01 The CONTRACTOR shall provide materials in accordance with the following:
- A. The CONTRACTOR shall provide security fencing to the height as indicated on the Drawings or as specified herein.
 - B. The CONTRACTOR shall provide posts, rails and supports of the dimension indicated on the Drawings, as specified herein, or as required. Dimensions of posts, rails, and supports shall be outside dimensions exclusive of coatings.
 - C. The CONTRACTOR shall provide steel fabric as required, shown on the Drawings and as specified below:
 1. No. 9-gauge, 2-inch diamond mesh steel chain-link fabric with Class 1 zinc coating meeting ASTM A392. Furnish 1-piece fabric widths.
 2. Knuckled selvage on top, twisted selvage on bottom.
 - D. The CONTRACTOR shall provide steel framework as required, shown, or specified below.
 1. General: Galvanized steel, ASTM A53, with no less than 1.8-ounce zinc per square foot (oz/sf) of surface, or steel conforming to ASTM A1011 externally triple coated with hot dip galvanizing at 1.0 oz/sf, chromatic conversion coating and clear acrylic polyurethane and coated internally with zinc rich coating.
 2. Fittings and Accessories: Galvanized, ASTM A153 with zinc weights per Table I.

E. The CONTRACTOR shall provide steel posts, tension wire and braces as required, shown and specified below.

1. Posts, Security Fence Per ASTM F1083 for Regular Strength Pipe:
 - a. End, Angle, Corner or Pull Posts: 2.375 inches O.D. with 0.154-inch wall thickness
 - b. Line Posts: 2.375 inches O.D. with 0.154-inch wall thickness
 - c. In lieu of pipe specified above, steel pipe conforming to ASTM A1011 or greater strength, but less wall thickness, will be acceptable.

2. Posts, Standard Railings: One and a one-half inch diameter extra strong pipe at 3.6 pounds per foot.

3. Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

<u>Gate Type</u>	<u>Gate Post</u>	<u>lbs./in. ft.</u>
Double Swing	4.000" O.D.	9.11
Personnel	2.875" O.D.	5.79
Single Swing Vehicle	4.000" O.D.	9.11

4. Top and Bottom Rail: The structure security fence shall have one and five eighths inch diameter standard pipe at 2.72 pounds per foot for top and bottom rails. The standard railing shall consist of one and one-half inch diameter standard pipe for top and bottom rail as well as additional framing.

5. Tension Wire: No. 7 gauge coiled spring wire, metal and finish to match fabric, conforming to ASTM A824. Locate at bottom of security fence.

6. Wire Ties: 11-gauge galvanized steel (to match fabric core material). Spacing on top rail shall be five (5) ties between posts, evenly spaced. Spacing on line posts shall be one (1) less than the height of the fence in feet, evenly spaced.

7. Post Bracing:

- a. Diagonal adjustable rods three-eighths inch in diameter equipped with adjustable tightener
- b. Horizontal Braces: 1.660 inches O.D. at 2.27 pounds per foot

8. Post Tops:

- a. Designed as a weathertight closure cap for tubular posts
- b. Malleable iron or pressed steel or aluminum alloy

9. Stretcher Bars:

- a. One-piece, full height of fabric
- b. 3/16-inch by three-quarters inch, galvanized
- c. Bands of galvanized steel or malleable iron

10. Tension Bands:

- a. Use one (1) less than the height of the fence in feet, evenly spaced.

F. Barbed Wire and Supporting Arms:

1. Barbed Wire Supporting Arms: One for each post as indicated. Extend vertical pipes to connect barbed wire.

- a. Single arm at 45 degrees with vertical, sloping to outside of fence

- b. Constructed for attaching three rows of barbed wire to each arm and designed as a weathertight closure cap
 - c. Designed for 250-pound minimum pull-down load
 - d. Attached to steel posts or integral with post top
 - e. Provided with openings to receive top rail
 - f. Pressed steel galvanized
2. Barbed Wire:
- a. Two-strand, 12-gauge wire with 14-gauge, 4-point barbs 5 inches O.C.
 - b. Metal and finish to match fabric
 - c. Three rows required
- G. Gates - Manual-Swing: The CONTRACTOR shall furnish manual swing gates meeting ASTM F900, and as follows:
1. Framing:
- a. Fabricate perimeter frames of gates from metal and finish to match fence framework.
 - b. Provide intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware and accessories. Space so that frame members are not more than eight feet apart unless otherwise indicated.
 - c. Frames assembled by welding or watertight galvanized steel rigid fittings.
 - d. Fabric to match that of fence. Install fabric with stretcher bars at vertical and top and bottom edges.
 - e. Diagonal cross bracing of three-eighths inch diameter adjustable truss rods to ensure frame rigidity without sag or twist.
 - f. Where barbed wire is indicated or specified, extend gate end members one foot above top members to receive barbed wire.
2. Hardware:
- a. Hinges of pressed or forged steel or malleable iron, non-lift-off type, offset to permit 180-degree (outward) gate opening, one and one-half inch pair per leaf.
 - b. Latches and Gate Stops: Double leaf
 - i. Plunger-bar type latch, full gate height, designed to engage gate stop of flush-plate type, with anchors
 - ii. Locking device and padlock eyes an integral part of latch
 - iii. Keeper to automatically engage gate leaf and secure free end of gate in open position
 - c. Latches: Single leaf
 - i. Forked type to permit operation from either side of gate
 - ii. Padlock eye as integral part of latch
3. Coating: Hot-dip galvanized conforming to ASTM A153.

PART 3 - EXECUTION

3.01 **INSTALLATION:** The CONTRACTOR shall install security fence as required, shown and specified below.

- A. Fence and Standard Railing:
1. Install framework, fabric, and accessories in accordance with ASTM F567.
 2. Posts: Posts shall be set in concrete with minimum hole diameters equal to sixteen (16) inches and with a minimum depth of 42 inches (for fence heights of 6-8 feet). Set post in a vertical position, plumb and in line. Place 2,500 psi concrete into hole and extend two (2) inches above grade. Crown the concrete top and extend the bottom of the footing a minimum of six (6) inches below the bottom of the post.
 - a. For the portion of the post embedded in concrete or below finished grade, coat with coal tar epoxy to two inches above grade.
 - b. When solid rock or concrete is encountered, without overburden of soil, set posts to a depth of four times the diameter of the post with a hole size a half-inch larger than the post diameter. The post shall set in non-shrink grout with a crown to shed water. When rock or concrete is encountered with an overburden of soil the posts shall be set to the full depth as specified above. Space posts as indicated.
 3. Place corner or terminal posts every 50' and at all bends. Equally space line posts between terminal posts or corner posts, at intervals not exceeding ten (10) feet.
 4. Post Bracing:
 - a. Install horizontal center brace rail and diagonal truss rod at each corner post, terminal post, and gate post. Install bottom brace rail on gate leaves.
 - b. Install so posts are plumb when diagonal rod is undertension.
 5. Provide top rail continuous through line posts. Splice top rail with top rail sleeves.
 6. Tension Wire: Weave through the fabric and tie to each post with minimum 7-gauge wire to match fabric finish.
 7. Fabric: Stretch taut with equal tension on each side of line posts.
 - a. Install fabric on the outside face of the fence enclosure, and anchor to framework so that fabric remains in tension after pulling force is released.
 - b. Position bottom of fabric at finished grade. Do not allow finished grade to encroach onto fabric.
 - c. Use U-shaped wire, conforming to diameter of pipe to that attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - d. Fasten fabric to steel line posts with wire ties spaced twelve (12) inches O.C. maximum.
 - e. Fasten fabric to tension wire using 11-gauge galvanized steel hog rings spaced at 24 inches O.C.
 8. Stretcher Bars:
 - a. Thread through or clamp to fabric four inches O.C.
 - b. Secure to posts with galvanized steel tension bands spaced twelve (12) inches O.C. maximum.
 - c. Install at each end post and each side of corner post.
 9. Post Tops: Install on each post.
 10. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. (Peen ends of bolts or score threads to prevent removal of nuts).
 11. Gates:

- a. Field verify gate opening dimensions for gate frame fabrication. Install gates in accordance with ASTM F567. Proposed grades: Check cross slopes and grades along fence lines to position gates. Maintain four (4) inches maximum clearance beneath gate frames to finished grade.
 - b. Install gates with fabric to match fence. Install three hinges per leaf, latch, catches, drop bolt foot bolts and sockets, torsion spring, retainer, and locking clamp. Install a center stop in concrete for swing gate drop rods. Install gate catcher with post at full gate openings.
 - c.
12. Field welds will not be allowed, except for attachment of posts to anchor plates on structure walls, without prior written authorization from the CITY.
- B. Repairing Damaged Coatings:
1. Repair damaged galvanized surfaces because of welding with paint containing zinc dust in accordance with ASTM A780. Prior to painting, the damaged surface shall be prepared using mechanical means to remove all flux residues and weld spatter. Paint to minimum eight (8) mil dry thickness.
 2. Apply per MANUFACTURER's recommendations.

END OF SECTION

SECTION 02920 SODDING

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall provide all labor, equipment and materials necessary to establish a stand of grass within the specified areas by furnishing and placing sod, and rolling, fertilizing, watering and maintaining the sodded areas to ensure a healthy stand of grass.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 01600 – Equipment and Materials

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. Florida Department of Transportation (FDOT)
 - a. Standard Specifications for Road and Bridge, latest edition

1.03 SUBMITTALS:

- A. Submittals shall be in accordance with SECTION 01300 and the General Terms and Conditions of the Contract.
- B. Sod certification for grass species and location of sod source.

1.04 QUALITY ASSURANCE:

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five (5) years experience, and certified by the State of Florida.
- B. Installer: Company approved by the sod producer.
- C. Sod: Minimum age of eighteen (18) months, with root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.
- D. The CITY reserves the right to test, reject or approve all materials before application.

1.05 REGULATORY REQUIREMENTS:

- A. Comply with regulatory agencies for fertilizer.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver products to Site in accordance with the provisions of SECTION 01600.
- B. Store and protect products in accordance with the provisions of SECTION 01600.
- C. Deliver sod on pallets. Protect exposed roots from dehydration.
- D. Do not deliver more sod than can be laid within 48 hours.

- E. Deliver fertilizer in water proof bags showing weight, chemical analysis, and name of MANUFACTURER.
- F. The CONTRACTOR shall furnish the CITY with the MANUFACTURER's application/installation instruction for all materials received in order that the minimum application rate of materials may be determined.

1.07 MAINTENANCE SERVICE:

- A. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

1.08 WARRANTY:

- A. The MANUFACTURER shall warrant the MATERIALS and PRODUCTS specified in this section against defective materials and workmanship for not less than sixty days from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Sod:
 - 1. The sod shall be closely match existing as directed, with well matted roots.
 - 2. The sod shall be commercial size rectangular measuring twelve (12) inches by 24 inches or larger.
 - 3. The sod shall be sufficiently thick to secure a dense stand of live grass, with a minimum thickness of two (2) inches.
 - 4. The sod shall be live, fresh and uninjured at the time of planting.
 - 5. The sod shall have a soil matt of sufficient thickness adhering firmly to the roots to withstand all necessary handling and be reasonably free of weeds and other grasses.
 - 6. The sod shall be planted as soon as possible after being harvested, and shall be shaded and kept moist from the time of harvesting until it is planted.
 - 7. The source of the sod may be inspected for approval by the CITY prior to construction.
- B. Topsoil:
 - 1. Excavated from Site and free of weeds.
- C. Fertilizer:
 - 1. Commercial fertilizer shall be Ammonium Sulfate (21-0-0-24S) containing 21 percent nitrogen and 24 percent sulfur.
 - a. Fertilizer containing phosphorus is not acceptable.
- D. Water:
 - 1. Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 - EXECUTION

3.01 SOIL PREPARATION:

- A. Any growth, rocks, or other obstructions which might interfere with maintenance operations shall be removed and disposed of properly. Remove stones over two (2) inches in any dimension and sticks, roots, rubbish and other extraneous matter.
- B. Areas to be sodded are to be graded to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions, to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
- C. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting.
- D. If prepared areas are eroded or otherwise disturbed after fine grading and prior to planting they shall be restored to specified condition prior to planting.
- E. Immediately upon completion of construction, sod shall be planted in all disturbed areas and as designated in the Drawings.

3.02 FERTILIZING:

- A. Apply fertilizer in accordance with MANUFACTURER's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper two (2) inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.03 LAYING SOD:

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod tight with no open joints visible. Do not overlap. Stagger end joints twelve (12) inches minimum. Do not stretch or overlap sod pieces.
- C. Do not use sod which has been cut for more than 48 hours
- D. Peg sod at locations where sod may slide, as directed by the CITY.
- E. Roll sod using a lightweight turf roller to provide a true and even surface.

3.04 MAINTENANCE:

- A. Water all newly grassed areas at least once a week, at a rate equivalent to ½" to ¾" per week, to prevent grass and soil from drying out.
- B. Immediately replace sod in areas which show deterioration or bare spots.
- C. The CONTRACTOR shall include in pricing, water and equipment to insure adequate survival of the sod and such maintenance as filling, leveling and repairing of any washed or eroded areas as may be necessary, for sixty days after Substantial Completion.

END OF SECTION

SECTION 03100 CONCRETE FORMWORK AND ACCESSORIES

PART 1 - GENERAL

1.01 SCOPE:

- A. The CONTRACTOR shall provide all labor, materials and equipment for the following:
 - 1. Design and construction of all necessary formwork including the required bracing, supports, scaffolding, shoring, and other falsework to produce cast-in-place concrete in the finished structure within the required tolerances for line, grade dimension and detail.
 - 2. Joints in concrete, complete and in place, in accordance with the Contract Documents. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the CITY.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 03300 - Cast-in-Place Concrete
 - 3. SECTION 07920 - Sealants and Caulking

1.02 APPLICABLE PUBLICATIONS: The following standard specifications shall apply to the WORK of this SECTION:

- A. American Concrete Institute (ACI)
 - 1. ACI 347 - Recommended Practice for Concrete Formwork
 - 2. ACI 117 - Standard Tolerances for Concrete Construction and Materials
- B. American Society of Testing and Materials (ASTM)
 - 1. A775 - Epoxy Coated Reinforcing Steel Bars
 - 2. C920 - Elastomeric Joint Sealant
 - 3. D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 - 4. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
 - 5. D638 - Standard Test Method for Tensile Properties of Plastics
 - 6. D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
 - 7. D747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
 - 8. D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber
 - 9. D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - 10. D2000 - Standard Classification System for Rubber Products in Automotive Applications
 - 11. D2240 - Standard Test Method for Rubber Property - Durometer Hardness
 - 12. D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- C. US Product Standards (PS)
 - 1. PS-1 - Construction and Industrial Plywood for Concrete Forms

- 2. PS-20 - American Softwood Lumber Standard
- D. NSF International
 - 1. NSF 61 - Drinking Water System Components - Health Effects
- E. United States Army Corps of Engineers (USACE)
 - 1. CRD-C572 - PVC Waterstops
- F. Federal Specifications
 - 1. TT-S-0227 E(3) - Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures
- G. Occupational Safety and Health Association (OSHA)
 - 1. CFR Title 29 Part 1926 - Safety and Health Regulations for Construction

1.03 DEFINITIONS:

- A. Construction Joints:
 - 1. When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. If indicated on the drawings, joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.
- B. Contraction Joints:
 - 1. Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the earlier pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint, which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the later pour. Waterstop and/or sealant groove shall also be provided when indicated.
- C. Expansion Joints:
 - 1. To allow the concrete to expand freely, a space is provided between the two pours, and the joint shall be formed as indicated. The space is obtained by placing a filler joint material against the earlier pour, to act as a form for the later pour. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop as indicated.
 - 2. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
 - 3. The space so formed shall be filled with a joint sealant material as indicated herein. In order to keep the two walls or slab elements in line the joint shall also be provided with a sleeve-type dowel as indicated.
- D. Control Joints:
 - 1. The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material.

1.04 SUBMITTALS:

- A. Falsework Calculations and Drawings: The CONTRACTOR shall submit calculations and drawings prepared and sealed by a Professional Civil Engineer registered in the State of Florida, which indicate

the falsework complies with the requirements of OSHA Title 29, Part 1926.703. The submission of design details and calculations for falsework is for information only.

- B. The plans of falsework proposed to be used shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions.
- C. The CONTRACTOR shall submit placement drawings showing the location and type of all joints for each structure.
- D. Prior to production of the waterstop materials required under this SECTION, qualification samples of waterstops shall be submitted which represent in all respects the material proposed. Such samples shall consist of extruded or molded sections of each size or shape to be used. The balance of the material to be used shall not be produced until after the CITY has reviewed the qualification samples.
- E. Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. These samples shall be prefabricated (shop made fitting) so that the material and workmanship represent in all respects the fittings to be provided. Field samples of prefabricated (shop made fitting) fittings (crosses, tees, etc.) may also be selected at random by the CITY for testing by a laboratory at the CITY expense. When tested, tensile strength across the joints shall be at least 1120 psi.
- F. The CONTRACTOR shall submit MANUFACTURER's information demonstrating compliance with requirements for the following:
 - 1. Form ties and related accessories, including taper tie plugs, if taper ties are used
 - 2. Form gaskets
 - 3. Form release agent, including NSF certification if not using mineral oil
 - 4. List of form materials and locations for use
 - 5. Bearing Pads
 - 6. Neoprene Sponge
 - 7. Preformed Joint Filler
 - 8. Backing Rod
 - 9. Bond Breaker
 - 10. Waterstops
 - 11. Slip Dowels
 - 12. PVC Tubing

1.05 QUALIFICATIONS:

- A. Every person responsible for waterstop installation is required to have a current individual Certification from the waterstop MANUFACTURER on file with the CITY, which states said individuals are certified and trained to install waterstop per MANUFACTURER's recommendations and specifications.

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR is fully responsible for the design and construction of all forms and falsework to be in compliance with all applicable OSHA requirements, and the requirements of all agencies having jurisdiction on the project. The submission of design details and calculations for falsework is for information only.

- B. The CONTRACTOR shall prepare adhesion and cohesion test specimens for construction joint sealant as required herein, at intervals of 5 working days while sealants are being installed.
- C. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
 - 1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.
 - 2. Sealant shall be cast and cured according to MANUFACTURER's recommendations except that curing period shall be not less than 24 hours.
 - 3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.07 CERTIFICATIONS:

- A. Form materials, which may remain or leave residues on or in the concrete, shall be certified as compliant with NSF 61.
- B. Joint materials shall be certified as compliant with NSF 61.
- C. The CONTRACTOR shall submit certified test reports from the sealant MANUFACTURER on the actual batch of material being supplied indicating compliance with requirements herein before the sealant is used on the job.
- D. The CONTRACTOR shall provide copies of the Waterstop Welding Certifications provided by MANUFACTURER or authorized agent of MANUFACTURER for every person who is to be involved with waterstop installation.

1.08 INSPECTIONS:

- A. Falsework shall be inspected for conformance with the accepted submittal. No workers will be allowed to use falsework for access and no concrete placement to related forms will be permitted until the falsework is inspected by the CONTRACTOR for conformance with the submittals and appropriately tagged. No variations or alterations to falsework, as compared to the reference submittal, will be allowed without certification of the variation by the original Professional Engineer.
- B. All waterstop field joints shall be subject to rigid inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the CITY for the required inspections. Not less than 24 hours advance notice shall be given for scheduling such inspections.
- C. Field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects, which would reduce the potential resistance of the material to water pressure at any point. Defective joints shall be replaced with material, which passes inspection; faulty material shall be removed from the site and properly disposed of.
- D. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
 - 1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less
 - 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less
 - 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less

4. Misalignment of joint which results in misalignment of the waterstop in excess of 1/2-inch in 10 feet
5. Porosity in the welded joint as evidenced by visual inspection
6. Bubbles or inadequate bonding which can be detected with a penknife test (If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle
8. Any evidence of burned material

1.09 WARRANTY:

- A. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 FORM AND FALSEWORK MATERIALS:

- A. Except as otherwise expressly accepted by the CITY, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:
 - Walls - Steel, fiberglass, or plywood panel
 - Columns - Steel, plywood, PVC, fiberglass, or spiral wound fiber forms
 - Roof and floor - Plywood
 - All other work - Steel panels, fiberglass, or plywood
- B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 1. Plywood shall be new, waterproof, synthetic resin bonded, exterior type, manufactured especially for concrete formwork and shall conform to Plyform Class I, B-B EXT, of PS-1, and shall be edge sealed.
 2. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with PS 20.
 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO EXT Grade.
- C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to 1/2-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- D. Forms and falsework to support the roof and floor slabs shall be designed in accordance with ACI 347.

2.02 FORM TIES:

- A. Ties shall be standard crimped snap ties with one-inch (1") snapback. Ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so that they cannot be moved from mid-point of the tie.

- B. Removable taper ties may be used when approved by the CITY. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

2.03 FORM RELEASING AGENT:

- A. Form release agent shall be non-staining and shall leave no residues on or in the concrete unless certified as compliant with NSF 61 and shall not adversely affect the adhesion of paint or other coatings.

2.04 WATERSTOPS:

A. PVC Waterstops:

1. PVC Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of this SECTION. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop MANUFACTURER and shall furnish to the CITY for review, current test reports and a written certification of the MANUFACTURER that the material to be shipped to the job meets the physical requirements as outlined in the USACE CRD-C572, and those listed herein.
2. Flatstrip and Center-Bulb Waterstops: The thickness of waterstops, including the center bulb, shall not be less than 3/8-inch. Waterstop shall be provided with factory installed hog rings at 12 inches on centers along the waterstop.
3. Multi-Rib Waterstops: Multi-rib waterstops where required shall have prefabricated (shop made fitting) joint fittings at all intersections of the ribbed-type waterstops.
4. Retrofit Waterstops: Retrofit waterstops and batten bars shall be manufactured as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.
5. Waterstop Testing Requirements: When tested in accordance with the test standards, the waterstop material shall meet or exceed the following requirements:

Property	Value	ASTM Standard
<u>Physical Property, Sheet Material</u>		
Tensile Strength-min (psi)	2000	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	600	D 747
<u>Accelerated Extraction (CRD-C572)</u>		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
<u>Effect of Alkalies (CRD-C572)</u>		
Change in Weight (percent)	+ 0.25/- 0.10	-----
Change in Durometer, Shore A	+/- 5	D 2240
<u>Finish Waterstop</u>		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

B. Pre-formed Hydrophilic Waterstops:

1. Hydrophilic (bentonite-free) waterstops shall be the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

2. Waterstop shall be manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties. Waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. The minimum expansion ratio of modified chloroprene shall be not less than 2 to 1 volumetric change in distilled water at 70 degrees F (21 degrees C).
3. Hydrophilic Waterstop shall meet the following minimum requirements:

Property	Value	ASTM Standard
<u>Physical Property, Chloroprene</u>		
Tensile Strength-min (psi)	1275	D 412
Ultimate Elongation-min (percent)	350	D 412
Hardness, Shore A	55 +/- 5	D 2240
<u>Physical Property, Modified Chloroprene</u>		
Tensile Strength-min (psi)	300	D 412
Ultimate Elongation-min (percent)	600	D 412
Hardness, Shore A	55 +/- 5	D 2240

4. Bonding agent for hydrophilic waterstop shall be the MANUFACTURER's recommended adhesive for wet, rough concrete.

C. Other Types of Waterstops:

1. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed herein.

2.05 JOINT SEALANT FOR WATER BEARING JOINTS:

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete, which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements (73 degrees F and 5percent R.H.):

Requirement	Value	ASTM Standard
Work Life (minutes)	45 - 180	-----
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)- max (hours)	24	-----
Ultimate Hardness	20 - 45 Shore "A"	D 2240
Tensile Strength - min (psi)	175	D 412
Ultimate Elongation - min (percent)	400	D 412
Tear Resistance - min (pounds per inch of thickness)	75	D 624 (Die C)
Color	Light Gray	-----

- C. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
 1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ASTM C 920, or TT-S-0227 E(3) for 2-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ASTM C 920 Class 25, Grade NS, or TT-S-0227 E(3), Type II, Class A.
 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ASTM C 920 Class 25, Grade P, or TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant MANUFACTURER, shall conform to the printed recommendations of the MANUFACTURER.

D. Sealants for non-waterstop joints in concrete shall conform to SECTION 07920.

2.06 JOINT MATERIALS:

- A. Bearing Pad: Bearing pad shall be neoprene conforming to ASTM D 2000, BC 420, 40 durometer hardness unless otherwise indicated.
- B. Neoprene Sponge: Sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056, Type 2C5-E1.
- C. Joint Filler
 1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D1056, Type 2C5-E1.
 2. Joint filler material in other locations shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752, for Type I, except as otherwise indicated.

2.07 BACKING ROD:

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at eight (8) psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.08 BOND BREAKER:

- A. Bond breaker shall contain a fugitive dye so that areas of application will be readily distinguishable.
- B. Bonding agent for hydrophilic waterstop shall be the MANUFACTURER's recommended adhesive for wet, rough concrete.

2.09 SLIP DOWELS:

- A. Slip dowels in joints shall be smooth epoxy-coated bars, conforming to ASTM A 775.

2.10 PVC TUBING:

- A. PVC tubing in joints shall be Schedule SDR 13.5, conforming to ASTM D 2241.

2.11 CHAMFER STRIP:

- A. Provide three quarter inch triangular fillets, milled clear straight grained wood, surfaced each side, or extruded vinyl type, with or without nail flange to form all exposed concrete edges such as columns, pilasters, beams, curbs, equipment pads, tops of walls, and as indicated. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4" chamfers. Re-entrant corners in concrete members shall not have fillets, unless otherwise indicated.

PART 3 - EXECUTION

3.01 FORMS:

- A. Forms shall conform to the shape, lines, and dimensions as shown on the Drawings and shall be substantial and sufficiently tight to prevent leakage. Forms shall be properly braced or tied so as to maintain position and shape. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the CITY and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. The CONTRACTOR shall be fully responsible for the adequacy of the formwork in its entirety and any forms that are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced. The CONTRACTOR shall provide worker protection from protruding reinforcement bars in accordance with applicable safety codes.
- C. The CONTRACTOR may reuse forms only if in good condition and only if acceptable to the CITY. Reused forms shall be thoroughly cleaned and may require light sanding between uses to obtain a uniform surface texture on all exposed concrete surfaces. Forms shall not be reused if they have developed defects that would affect the surface texture of exposed concrete. Exposed concrete surfaces are defined as surfaces, which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CITY.
- D. Forms shall be sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- E. Immediately before the placing of reinforcing, faces of all forms in contact with concrete shall receive a thorough coating of form release agent. Any excess agent shall be satisfactorily removed before placing concrete. If using mineral oil, the CONTRACTOR shall oil the forms at least two weeks in advance of their use. Care shall be exercised to keep oil/release agent off the surfaces of steel reinforcement and other items to be embedded in concrete.
- F. The CONTRACTOR shall supply sufficient number of forms of each kind to permit the required rate of progress to be maintained.
- G. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations.

3.02 WATERSTOPS:

- A. Waterstops shall be embedded in the concrete across joints as indicated. Waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of MANUFACTURER of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the WORK and shall repair or replace at its own expense any waterstops damaged during the progress of the WORK. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.03 SPLICES IN PVC WATERSTOPS:

- A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the MANUFACTURER's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.

2. The splices have a tensile strength of not less than 80 percent of the unspliced material tensile strength.
 3. The continuity of the waterstop ribs and of its tubular center axis be maintained. No edge welding is allowed.
- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated (shop made fitting) prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated (shop made fitting) waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.04 FORM DESIGN:

- A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.
- B. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form.
- C. The CONTRACTOR shall provide adequate clean-out holes at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the CITY. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of SECTION 03300. The size, number, and location of such form windows shall be as acceptable to the CITY.

3.05 FORM CONSTRUCTION:

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member, where concrete is permitted to be placed against trimmed ground, in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the CITY. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties, which cause spalling of the concrete upon form stripping or tie removal, will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls, which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout, which shall match the color and texture of the surrounding wall surface.

3.06 JOINT CONSTRUCTION:

A. Setting Waterstops:

1. In order to eliminate faulty installation that may result in joint leakage, the CONTRACTOR shall be particularly careful to get the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the WORK and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
2. In placing PVC waterstops in the forms, the CONTRACTOR shall provide means to prevent the waterstop from being folded over by the concrete as it is placed. Waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, the CONTRACTOR shall work concrete under the waterstops by hand so as to avoid the formation of air and rock pockets.
3. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
4. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

B. Joint Location:

1. Construction joints and other types of joints shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction. Where joints are indicated spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the CITY.

C. Joint Preparation:

1. The CONTRACTOR shall take special care in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of SECTION 03300. Except on horizontal wall construction joints, wall to slab joints, or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as indicated herein.

D. Retrofit Joint Preparation:

1. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material. Surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to application of epoxy and waterstop.

E. Construction Joint Sealant:

1. Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sandblasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer shall be furnished by the sealant MANUFACTURER. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
2. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the MANUFACTURER, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. Sealant shall achieve final cure at least 7 days before the structure is filled with water.
3. Sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations.
4. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew doing the WORK carefully instructed on the proper method of mixing and application by a representative of the sealant MANUFACTURER.
5. Any joint sealant which fails to fully and properly cure after the MANUFACTURER's recommended curing time for the conditions of the WORK hereunder shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the indicated joint sealant. Costs of such removal, joint treatment, re-sealing, and appurtenant WORK shall be the CONTRACTOR's responsibility.

F. Hydrophilic Waterstop

1. Where a hydrophilic waterstop is called for in the Contract Documents, it shall be installed with the MANUFACTURER's instructions and recommendations except as modified herein.
2. When requested by the CITY, the CONTRACTOR shall arrange for the MANUFACTURER to furnish technical assistance in the field.
3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided. Hydrophilic waterstop shall not be used in expansion or contraction joints or in the first 6 inches of any non-intersecting joint.

4. The hydrophilic waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
 5. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.
 6. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop with single component water-swelling sealant as recommended by MANUFACTURER.
 7. The hydrophilic waterstop shall not be installed where the air temperature falls outside the MANUFACTURER's recommended range.
 8. The concrete surface under the hydrophilic waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
 9. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive recommended by the MANUFACTURER
- G. Retrofit Waterstop:
1. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on center, staggered, and in accordance with the MANUFACTURER's written recommendations.

3.07 REMOVAL OF FORMS:

- A. Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete or workers. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength (0.75f_c) in SECTION 03300. No forms shall be disturbed or removed under an individual panel or unit before the concrete in all the adjacent panels or units have attained 0.75f_c strength and have been in place for a minimum of 7 days. The time required to establish said strength shall be determined by the CITY, who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for vertical walls of waterholding structures shall remain in place at least 36 hours after the concrete has been placed.
- B. Forms for parts of the WORK not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347.

3.08 FALSEWORK:

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements herein.

- B. The CONTRACTOR shall design and construct falsework to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- C. The CONTRACTOR shall place falsework upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall be as recommended by the CONTRACTOR's geotechnical engineer and shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

3.09 TOLERANCES:

- A. The variation from plumb, level and required lines shall not exceed 1/4-inch in any ten feet (10') of length, non cumulative, and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117 - Standard Tolerances for Concrete Construction and Materials.

END OF SECTION

SECTION 03200 CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SCOPE:

- A. The CONTRACTOR shall furnish all labor, materials and equipment to provide and properly place all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in the reinforced concrete and masonry construction and all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories as shown on the drawings and as specified herein.
 - 1. SECTION 03100 - Concrete Formwork and Accessories
 - 2. SECTION 03300 - Cast-In-Place Concrete

1.02 APPLICABLE PUBLICATIONS: The most recent revision of the following standard specifications shall apply to the WORK of this SECTION:

- A. American Concrete Institute (ACI):
 - 1. ACI 318 - Building Code Requirements for Reinforced Concrete
 - 2. ACI SP-66 - Detailing Manual
- B. American Society of Testing and Materials (ASTM):
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 2. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - 3. ASTM A555 – Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
 - 4. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 5. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars
 - 6. ASTM A955/A955M – Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement
- C. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Recommended Practice for Placing Reinforcing Bars
- D. Florida Building Code, Latest Edition

1.03 DEFINITIONS: (Not Used)

1.04 SUBMITTALS: The CONTRACTOR shall submit the following:

- A. Mill Certifications of Grade 60 reinforcing steel or stainless steel, as required
- B. Complete bar schedule, bar details and erection drawings in conformance with ACI SP-66
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and Shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. Mill certificates shall be delivered with each shipment of reinforcing bars.

1.05 QUALIFICATIONS: (Not Used)

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall perform Pull tests to 50 percent of five percent of drilled dowels, randomly selected by the CITY. If any tested dowels slip or yield, an additional five percent of drilled dowels shall be tested until an entire five percent sample is tested without slipping or yielding.

1.07 FACTORY TESTING:

- A. If requested by the CITY, the CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in adequate quantity for testing. The CONTRACTOR shall pay costs of additional tests due to material failing tests.

1.08 CERTIFICATIONS:

- A. International Code Council Evaluation Service (ICC-ES) Certifications for mechanical couplers, if allowed
- B. Mill Certifications of Grade 60 reinforcing steel

1.09 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide sufficient notice and opportunity to the CITY to review the placement of the reinforcing steel before the concrete is placed. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours advance notice of its intention to begin new WORK activities.

1.10 WARRANTY:

- A. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 REINFORCING BARS:

- A. Metal reinforcement shall be deformed type bars conforming to ASTM A615, Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 60, unless otherwise specified. Reinforcing steel shall be fabricated for the shapes and dimensions indicated on the Drawings and in compliance with ACI 318. All bars shall be bent cold.
- B. Replace all reinforcement with bends and kinks not shown on fabrication Shop Drawings. Remove from job site all such reinforcing and replace with new fabricated steel. Field bending of reinforcement at the work site is prohibited.
- C. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185, and the details indicated. Do not use fabric that has been rolled. Install flat sheets only.
- D. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.
- E. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A775.
- F. Mechanical couplers shall be provided where indicated and where approved by the CITY. The couplers shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be provided. This shall apply

to all mechanical splices, including those splices intended for future connections. Reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

- G. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in SECTION 03600.

PART 3 - EXECUTION

3.01 PLACEMENT AND ANCHORAGE:

- A. Bar supports shall be spaced in accordance with CRSI.
 - 1. Reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.
 - 2. Limitations on the use of bar support materials shall be as follows.
 - a. Concrete Dobies: permitted at all locations except where architectural finish is required.
 - b. Wire Bar Supports: permitted only at slabs over dry areas, interior non-hydraulic wall surfaces, and exterior wall surfaces.
 - c. Plastic Bar Supports: permitted at all locations except on grade.
- B. Reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position with not less than 16-gauge annealed wire. The placement tolerances shall be in accordance with ACI 318, paragraph 7.5, Placing Reinforcement and the CRSI Manual of Standard Practices.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
- D. Bars additional to those indicated which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.
- E. Additional reinforcement around openings:
 - 1. Place an equivalent area of steel around pipe or opening and extend on each side and top and bottom sufficiently to develop bond in each bar.
 - 2. Refer to details on Drawings for bar extension length on each side of opening.
 - 3. Where welded wire fabrics are used, provide extra reinforcing using fabric or deformed bars.
- F. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- G. Bars may be moved as necessary to avoid interference with other reinforcement steel continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.

- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than three (3) feet on centers in any direction. Welded wire fabric shall not be placed on the ground and hooked into place in the freshly placed concrete.
- I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. Chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the CITY.
- J. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on center. The construction practice of placing welded wire fabric on the ground and hooking it into place in the freshly placed concrete shall not be used.
- K. Stainless steel reinforcing bar shall be shipped, handled, and placed such that it does not come into direct contact with carbon steel. Tie wires and bar chairs shall be stainless steel or non-metallic. Nylon, PVC, or polyethylene spacers shall be used where stainless steel bar must be attached to carbon steel, to maintain a minimum 1 inch clearance.

3.02 CONCRETE COVER:

- A. The concrete cover over reinforcement shall conform to ACI 318, paragraph 7.7, Concrete Protection for Reinforcement, unless otherwise indicated. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

3.03 SPLICING:

- A. All lap splices of bar reinforcement shall be as indicated and conform to Chapter 12 of ACI 318 or as otherwise approved by the CITY. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.
- B. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each two running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- C. Splices in column spiral reinforcement, when necessary, shall be made by a lap of 1-1/2 turns.
- D. Reinforcing shall not be straightened or rebend in a manner which will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold, unless otherwise permitted by the CITY. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the CITY.
- E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as indicated. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged.

3.04 CLEANING AND PROTECTION:

- A. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing indicated for the adjacent section.
- B. Reinforcement shall be free of all materials that will reduce bond.

- C. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be re-inspected and, if necessary, re-cleaned or sandblasted.
- E. Properly cap all vertical reinforcement steel if area is subject to having workers above the reinforcement area.

3.05 INSTALLATION OF DRILLED REINFORCING STEEL DOWELS:

- A. For drilling and grouting information see SECTION 03600.

END OF SECTION

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE:

- A. The WORK of this SECTION consists of furnishing all labor, equipment, supplies, and materials necessary for the proper placement, curing, finishing, protection, and repair of the cast-in-place concrete required by the Contract Documents.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 2. SECTION 01410 – Testing and Quality Control
 - 3. SECTION 02200 – Earthwork
 - 4. SECTION 03100 - Concrete Formwork and Accessories
 - 5. SECTION 03200 - Concrete Reinforcement

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. American Concrete Institute (ACI)
 - a. 117 - Standard Tolerance for Concrete Construction and Materials
 - b. 301 - Structural Concrete for Buildings
 - c. 304.2R - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
 - d. 305 - Committee Report on Hot-Weather Concreting
 - e. 306 - Committee Report on Cold-Weather Concreting
 - f. 308 - Standard Specification for Curing Concrete
 - g. 309 - Consolidation of Concrete
 - h. 318 - Building Code Requirements for Reinforced Concrete
 - i. 350 – Code Requirements for Environmental Engineering Concrete Structures
 - 2. American Society for Testing and Materials (ASTM):
 - a. C31 - Making and Curing Concrete compression and Flexure Test Specimens in the Field
 - b. C33 – Standard Specification for Concrete Aggregates
 - c. C39 - Compressive Strength of Cylindrical Concrete Specimens
 - d. C94 - Standard Specification for Ready-Mixed Concrete
 - e. C127 - Test Method for Specific Gravity and Absorption of Coarse Aggregate
 - f. C128 - Test Method for Specific Gravity and Absorption of Fine Aggregate
 - g. C136 - Method for Sieve Analysis of Fine and Coarse Aggregates
 - h. C143 - Test Method for Slump of Hydraulic Cement Concrete

- i. C150 – Standard Specification for Portland Cement
 - j. C156 - Test Method for Water Retention by Concrete Curing Materials
 - k. C157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
 - l. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - m. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - n. C260 - Specification for Air Entraining Admixtures for Concrete
 - o. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - p. C494 - Standard Specification for Chemical Admixtures for Concrete
 - q. C566 - Test Method for Total Moisture Content of Aggregate by Drying
 - r. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
 - s. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - t. C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation
 - u. C1157 – Performance Specification for Hydraulic Cements
 - v. C1240 - Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
 - w. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - x. D2419 - Test Methods for Sand Equivalent Value of Soils and Fine Aggregate
 - y. E96 - Standard Specification for Water Vapor Transmission of Materials
 - z. E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- 3. Federal Specifications
 - a. UU-B-790A - Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant)
 - 4. Florida Building Code and Local Building Codes as appropriate
 - 5. Florida Department of Transportation (FDOT)
 - a. Standard Specifications for Road and Bridge Construction, latest edition.

1.03 DEFINITIONS:

- A. Structural Concrete: Concrete to be used in all cases except where indicated otherwise in the Contract Documents.
- B. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground pipe encasement, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise indicated.

- C. Lean Concrete: Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles that are indicated on the Drawings as unreinforced. Lean concrete shall be used as protective cover for dowels intended for future connection.
- D. Hydraulic Structure: A concrete structure for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.

1.04 SUBMITTALS:

A. Mix Designs:

- 1. Prior to beginning the WORK and within **14** days after issuance of the Notice to Proceed, the CONTRACTOR shall submit preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete. Mix designs shall be tested by an independent testing laboratory acceptable to the CITY. All costs related to such testing shall be CONTRACTOR'S responsibility.
- 2. Test data relating to the cement, aggregate, and admixtures shall be less than six months old. Furnish the submittals in accordance with ACI 301 for the following:
 - a. Mill tests for cement
 - b. Admixture certification. Chloride ion content shall be included.
 - c. Aggregate gradation test results and certification
- 3. Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

B. Other

- 1. The CONTRACTOR shall submit materials and methods for curing.
- 2. The CONTRACTOR shall submit product specifications, data, and installation instructions for all miscellaneous products called for in this specification.

1.05 QUALIFICATIONS:

- A. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

1.06 RESPONSIBILITIES: (not used)

1.07 CERTIFICATIONS AND TESTING:

A. General

- 1. Concrete and other materials for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the CITY in obtaining samples, and disposal and cleanup of excess material.
- 2. The testing laboratory will meet or exceed the requirements of ASTM C1077.

3. The cost of trial batch, laboratory, and shrinkage tests on cement, aggregates, and concrete, will be the CONTRACTOR'S responsibility.

B. Trial Batch and Laboratory Tests

1. Tests for determining slump shall be in accordance with the requirements of ASTM C143.
2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C33.
3. A testing laboratory approved by the CITY shall prepare a trial batch of each class of concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to the CONTRACTOR. Concrete shall conform to the requirements of this SECTION, whether the aggregate proportions are from the CONTRACTOR'S preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement, and admixture proposed for the Project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch.
4. The determination of compressive strength shall be made in accordance with ACI 318, Section 5.3.
5. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C136. Values shall be given for percent passing each sieve.
- 6.

C. Field Tests

1. The responsibility to retain the services of an independent testing laboratory shall be as defined in SECTION 01410.
2. The CONTRACTOR shall pay the cost of any additional tests and investigation on WORK that does not meet the specifications.
3. Tests on pumped concrete shall be taken at the point of final placement.
4. Compressive Test: Compressive test specimens shall be taken during construction from the first placement of each class of concrete placed each day and for each 150 cubic yards or fraction thereof each day.
 - a. Each set of test specimens shall consist of five (5) cylinders. Specimens shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
 - b. Compression tests shall be performed in accordance with ASTM C39. Two (2) cylinders shall be broken at seven (7) days and two (2) at 28 days, and the remaining cylinder shall be held to verify test results, if needed.
 - c. The acceptance of the test results shall be the average of the strengths of the two specimens tested at 28 days as per ACI 318. Evaluation and acceptance of the concrete shall be per ACI 318, Chapter 5.
5. Slump Tests: One (1) slump test shall be taken per truckload in accordance with ASTM C143.
6. Air Content: Air content shall be determined for each compressive test taken in accordance with ASTM C231 or by ASTM C173.

7. Aggregate testing shall be made every twelve (12) months during construction to insure continued compliance with these Specifications.
8. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement.
9. Temperature: Concrete temperature shall be recorded in accordance with ASTM C1064.
- 10.

1.08 CONCRETE CONFERENCE:

- A. A meeting to review the detailed requirements of the CONTRACTOR'S proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 14 days after the Notice to Proceed.
- B. All parties involved in the concrete WORK shall attend the conference, including the following at a minimum:
 1. CONTRACTOR'S representative
 2. Testing laboratory representative
 3. Concrete subcontractor
 4. Reinforcing steel subcontractor and detailer
 5. Concrete supplier
 6. Admixture MANUFACTURER's representative
- C. The conference shall be held at a mutually agreed upon time and place. The CITY shall be notified no less than 5 days prior to the date of the conference]

1.09 WARRANTY:

- A. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.
- A.

PART 2 - MATERIALS

2.01 GENERAL:

- A. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.
- B. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.
- C. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments.
- D. Materials shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- E. Storage of materials shall conform to the requirements of Section 205 of ACI 301.

2.02 CEMENT:

- A. Cement shall be standard Portland Cement Type II conforming to ASTM C150 and C1157

- B. A minimum of 85 percent of cement by weight shall pass a 325 screen.
- C. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the CITY
- D. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CITY, if requested, regarding compliance with these Specifications.

2.03 AGGREGATES:

- A. Aggregates shall be obtained from pits acceptable to the CITY, shall be non-reactive, and shall conform to the requirements of ASTM C33.
- B. When tested in accordance with ASTM C33, the loss resulting after five (5) cycles of the soundness test, shall not exceed ten (10) percent for fine aggregate and twelve (12) percent for coarse aggregate, when using sodium sulfate.
- C. When tested in accordance with ASTM C33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
- D. Coarse Aggregates:
 - 1. Coarse aggregates shall be crushed stone, gravel or other approved inert material having clean, hard, durable, uncoated particles conforming to ASTM C33.
 - 2. The coarse aggregates shall be prepared and handled in two (2) or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined.
 - 3. When tested in accordance with ASTM C33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
- E. Fine Aggregates:
 - 1. Fine aggregates shall be clean sand conforming to ASTM C33.
 - 2. When tested in accordance with ASTM D2419, the sand equivalency shall not be less than 75 percent for an average of three (3) samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C33 when tested in accordance with ASTM C136 for the fineness modulus of the sand used, including the optional grading in Section 6.2. The fineness modulus of sand used shall not be over 3.1.
 - 3. When tested in accordance with ASTM C33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

2.04 WATER:

- A. The water used in the concrete mix and for curing shall be clean, potable, and in accordance with ACI 318. Water shall be free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.
- B. The water shall be considered potable, for the purposes of this SECTION only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

2.05 ADMIXTURES:

- A. General: All admixtures shall be compatible and be furnished by a single MANUFACTURER capable of providing qualified field service representation. Admixtures shall be used in accordance with MANUFACTURER's recommendations. If the use of an admixture is producing an inferior end result,

the CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates or more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

B. Air Entraining Admixtures:

1. Air entraining admixture shall conform to ASTM C260. Air content shall be tested at the point of placement.
2. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
3. Sufficient air-entraining agent shall be used to provide a total air content of 3 percent. Concrete floors to receive a shake-on floor hardener shall have an air content not to exceed three (3) percent or as recommended by the hardener MANUFACTURER.

C. Set Controlling and Water Reducing Admixtures:

1. Admixtures may be added at the CONTRACTOR'S option, subject to the CITY approval, to control the set, effect water reduction, and increase workability. The cost of adding an admixture shall be the CONTRACTOR'S responsibility. Concrete containing an admixture shall be first placed at a location determined by the CITY. Admixtures shall conform to the requirements of ASTM C494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
2. Concrete shall not contain more than one water-reducing admixture.
3. Set retarding admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently greater than 80 degrees F, a set retarding admixture shall be used. Set retarding admixture shall conform to ASTM C494 Type B or D.
4. Set accelerating admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently less than 40 degrees F, a non-corrosive set accelerating admixture shall be used. Set accelerating admixture shall conform to ASTM C494 Type C or E.
5. Normal range water reducer shall conform to ASTM C494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the MANUFACTURER's instructions and recommendations.
6. High range water reducer shall conform to ASTM C494, Type F or G High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than fourteen (14) ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating the water/cement ratio.
 - a. If the high range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of three (3) inches plus or minus 1/2-inch prior to adding the high range water reducing admixture at the Site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the primary system.
 - b. Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or five (5) minutes after the addition of the high range water reducer, unless recommended otherwise by the MANUFACTURER.

F. CURING MATERIALS:

- D. Curing compound shall conform to ASTM C309, Type I. Curing compound shall be white pigmented, resin based and compliant with local VOC requirements. When curing compound must be removed for finishes or grouting, it shall be of a dissipating type. Sodium silicate compounds shall not be allowed.
- E. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.
- F. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a minimum thickness of two (2) mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
- G. Polyethylene-coated burlap for use as concrete curing blanket shall be minimum 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.
- H. Curing mats for use in Curing Method 6 below, shall be heavy shag rugs or carpets or cotton mats quilted at 4-inches on center. Curing mats shall weigh a minimum of twelve (12) ounces per square yard when dry.

2.06 MISCELLANEOUS MATERIALS:

- A. Damp proofing agent shall be an asphalt emulsion conforming to ASTM D1227, Type III, Class 1.
- B. Evaporation retardant shall create a monomolecular film on the concrete. The retardant shall have no effect on cement hydration and shall meet local VOC requirements. Evaporation retardant shall not affect adhesion of curing compounds or other treatments and shall not affect the color of the concrete.
- C. Reinforcement shall be per SECTION 03200.
- D. Water Stops shall be per SECTION 03100.
- E. Damp proofing agent shall be a waterborne emulsified-asphalt. Damp proofing shall be suitable for "green" or slightly damp surfaces and shall withstand normal expansion and contraction of the concrete. Damp proofing agent shall breath to allow vapors to escape. Damp proofing agent shall meet local VOC requirements.
- F. Bonding agents shall be 100% solids, epoxy adhesives conforming to the following:
1. For bonding freshly-mixed, plastic concrete to hardened concrete, bonding agent shall be a medium viscosity adhesive conforming to ASTM C881 Type II, Grade 2, Class C,
 2. For bonding hardened concrete or masonry to steel, bonding agent shall be a non-sagging gel adhesive conforming to ASTM C881 Type I or IV, Grade 3, Class C.
- G. Vapor Barrier:
1. of 10 mil Polyethylene with 6 in min. wide Z-Lock Type Lapping. Visqueen or approved equal. Vapor Barrier shall be installed under concrete slabs of all habitable spaces. Barrier shall be installed per the MANUFACTURER recommendations and per ASTM E1643.
- H. Non-Waterstop Joint Material:
1. Preformed Joint Material: Preformed asphalt-impregnated fiber conforming to ASTM D1751.

2. Bond Breaker: All bond breakers shall be roofing felt or 15 mils minimum dry film thickness of bituminous paint as indicated.

2.07 CONCRETE DESIGN REQUIREMENTS:

A. General: Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. The exact proportions in which these materials are to be used for different parts of the WORK will be determined during the trial batch process. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results. All changes shall be subject to review by the CITY.

B. Fine Aggregate Composition:

1. In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table.

Fine Aggregate	
Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

2. For other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

C. Duct bank concrete shall contain an integral red-oxide coloring pigment. Concrete shall be dyed red throughout. Surface treatment to color duct banks will not be acceptable.

D. Water/Cement Ratio and Compressive Strength:

1. Water/cement ratio is given for aggregates in saturated-surface dry condition, and total moisture of all aggregates, calculated by ASTM C566, less the absorption of the aggregate as calculated by ASTM C127 and C128, shall represent total free moisture in the aggregate to determine the water/cement ratio. Total free moisture of aggregates shall be added to batch water to estimate water content of concrete. Concrete shall have the following minimum properties:

E. Concrete Proportions:

Type of Work	Min 28-Day Compressive Strength (psi)	Maximum Size Aggregate (in)	* Cement Content per cubic yd (lbs)	* Maximum W/C Ratio (by weight)
Structural Concrete				
Roof, floor slabs, columns, walls, and all other concrete items not indicated elsewhere.	4500	1	564 to 600	0.45

Sitework concrete	3,000	1	470 (min)	0.50
Lean concrete	2,000	1	376 (min)	0.60

* The cement content and water cement ratio are based on total cementitious material including silica fume, slag or fly ash.

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR'S construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability and strength.

- F. Adjustments to Mix Design: The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional compensation because of such changes. Any changes to the accepted concrete mix design shall be submitted to the CITY for review and shall be tested again in accordance with these Specifications.
- G. When using a floor hardener, the water/cement ratio shall not be greater than specified by the hardener MANUFACTURER.

2.08 CONSISTENCY:

- A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C143. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless indicated otherwise	3-inches plus or minus 1-inch
With high range water reducer added	7-inches plus or minus 2-inches

2.09 MEASUREMENT:

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the CITY.
- B. Weighing tolerances:

Material	Percent of Total Weight
Cement	1

Aggregates	3
Admixtures	3

- C. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the CITY and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any required amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism shall prevent leakage when the valves are closed.

PART 3 - EXECUTION

3.01 PROPORTIONING AND MIXING:

- A. Proportioning of the mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. Mixing shall conform to the requirements of Chapter 7 of ACI 301.
- C. Slumps shall be as indicated herein.
- D. Retendering of concrete or mortar that has partially hardened shall not be permitted.

3.02 PREPARATION OF SURFACES FOR CONCRETING:

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Vapor Barrier
 - 1. Vapor Barrier shall be installed under on-grade building floor slabs of non-hydraulic structures and at other locations indicated.
 - 2. Base shall be leveled, compacted, and tamped per SECTION 02200. Remove sharp edges, projection materials and roughness that might penetrate vapor barrier. Install barrier with width parallel with the direction of the pour of the concrete.
 - 3. Place, protect, and repair defects in sheet according to ASTM E1643, and the MANUFACTURER's written instructions. Seams shall be lapped and sealed in accordance with ASTM E1643.
 - 4. The CONTRACTOR shall exercise care to avoid puncturing or tearing the vapor barrier during installation. Patch punctures and tears as they occur.
- C. Joints in Concrete:
 - 1. All joints shall be installed where indicated on the Drawings or where otherwise approved by the CITY. The surface of the construction joint shall be rough and prior to placement shall be cleaned and moistened with water.
 - 2. Concrete surfaces upon or against which new concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CITY, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydro blasting, sandblasting or chipping (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.

3. After the surfaces have been prepared, all approximately horizontal construction joints shall be covered with a 6-inch lift of a pea gravel mix. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix. If high range water reducer is used in the wall concrete, then the pea gravel joint topping does not need to be used.
- D. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the CITY.
- E. Embedded Items:
1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the CITY at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.
 2. Inserts or other embedded items shall conform to the requirements herein.
 3. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated on the Drawings or shown by Shop Drawings and shall be acceptable to the CITY before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- F. Placing New Concrete Against Old: Where new concrete is to be placed against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro blasting, sandblasting or chipping to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CITY.
- G. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the WORK. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the CONTRACTOR's responsibility and shall be subject to the review of the CITY.
- H. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- I. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided during the placing of concrete.
- J. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.
- K. Cleaning: The surfaces of metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 CONVEYING:

- A. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation or loss of material.
- B. No aluminum materials shall be used in conveying any concrete.
- C. Ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the CITY. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.
- D. Pumping:
 - 1. If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
 - 2. The pumping equipment shall have two (2) cylinders and be designed to operate with one cylinder in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.
 - 3. The minimum diameter of the hose conduits shall be in accordance with ACI 304.
 - 4. Pumping equipment and hose conduits that are not functioning properly shall be replaced.
 - 5. Aluminum conduits for conveying the concrete shall not be permitted.
 - 6. Concrete samples for slump, air content, and test cylinders will be taken at the placement end of the hose.

3.04 DELIVERY:

- A. Ready-mixed concrete shall be batched, mixed, transported and delivered in accordance with these specifications and ASTM C94 including the following supplementary requirements.
 - 1. Concrete shall be discharged within **1-1/2** hours from the time concrete was mixed, if centrally mixed, or from the time the original water was added, if transit-mixed, or before the drum has been revolved **300** revolutions, whichever is first.
 - 2. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one-inch when the required slump is 3-inches or less, or if they differ by more than 2-inches when the required slump is more than 3-inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
 - 3. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CITY.
 - 4. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the MANUFACTURER of equipment. Additional mixing, if any, shall be at the speed designated by the MANUFACTURER of the

equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

3.05 PLACING:

- A. Non-Conforming Work or Materials: Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the WORK. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced.
- B. Unauthorized Placement: No concrete shall be placed except in the presence of a duly authorized representative of the CITY. The CONTRACTOR shall notify the CITY in writing at least 24 hours in advance of placement of any concrete.
- C. Concrete shall not be dropped more than four feet (4') without use of chutes or tremies. Concreting shall be a continuous operation until placement of the section is complete. All concrete shall be worked around reinforcement and embedded items. If vibrators are used, care shall be taken not to segregate concrete. Vibrators will not be allowed to move concrete within the form. All forms and subgrade shall be dampened prior to placement and excess water removed.
- D. Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this SECTION.
- E. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the WORK progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- F. Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6-feet in horizontal direction. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2-feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5-feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- G. Concrete with hardener shall be placed per the hardener MANUFACTURERs written recommendations.
- H. Placing New Concrete Against Old: Epoxy adhesive bonding agent shall be applied to the old surfaces according to the MANUFACTURER's written recommendations. This provision shall not apply to joints where waterstop is provided, see SECTION 03100.
- I. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F or less than 55 degrees F for sections less than 12-inches thick, nor less than 50 degrees for all other sections. The CONTRACTOR shall be entitled to no additional compensation on account of the temperature requirements.
- J. Hot Weather Placement
 1. Placement of concrete in hot weather shall conform to ACI 305 and the following:
 2. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed [60] minutes.

3. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as pre-cooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed.

K. Cold Weather Placement

1. Placement of concrete in cold weather shall conform to ACI 306.1, and the following:
2. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the minimum temperature.
3. Remove all ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6-inches. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.
4. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.

L. Order of Placing Concrete

1. The order of placing concrete in all parts of the WORK shall be acceptable to the CITY. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least five (5) days for hydraulic structures and two (2) days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least ten (10) days for hydraulic structures and 4 days for all other structures.
2. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.06 TAMPING AND VIBRATING:

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete. Vibrators shall be Group 3 per ACI 309, high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required. Group 2 vibrators may be used only at specific locations when accepted by the CITY.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall

not contact the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

- 3.07 **CURING AND DAMPPROOFING:** Concrete shall be cured for a minimum of five (5) days after placement in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement and duct bank concrete and thrust blocks	3
All concrete surfaces not specifically indicated in this Paragraph	4
Floor slabs on grade in hydraulic structures	5
Slabs on grade to receive an adhered floor finish	6 (Omit curing compound)
Slabs not on grade	6

- A. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 7 days of placing the concrete, curing shall be continued in accordance with Method 6 below.
- B. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- C. Method 3: The surface shall be covered with moist earth not less than 4 hours or more than 24 hours after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- D. Method 4: The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the MANUFACTURER's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7-day curing period. If the seal is damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 3. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
 4. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within two (2) hours after removal of forms. Repairs to formed surfaces shall be made within the two (2) hour period; provided, however, that any such repairs which cannot be made within the said two (2) hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

5. At locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6-feet of the joint and to any other location where the curing membrane has been disturbed.
6. Prior to final acceptance of the WORK, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage the surface finish.

E. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4 above. Not less than one hour or more than four (4) hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting, or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3-inches and fastened together with a waterproof cement to form a continuous watertight joint.
2. The curing blankets shall be left in place during the 7-day curing period and shall not be removed until after concrete for adjacent work has been placed. If the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections. During the first three (3) days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

F. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least seven (7) consecutive days beginning immediately after the concrete has reached final set or forms have been removed.
2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent being dislodged by wind or any other causes. Edges shall be continuously held in place.
4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, the entire concrete surface shall be wetted, and curing compound shall be immediately applied to the entire surface in accordance with Method 4 above.
6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the WORK.

G. Damp proofing

1. The exterior surfaces of backfilled dry well walls and buried roof slabs shall be damp proofed as follows.
2. Immediately after completion of curing the surface shall be sprayed with a damp proofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to one-half strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the undiluted material, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Damp proofing material shall be as indicated above.
3. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used if it produces a uniformly coated white surface and remains until placing of the backfill. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

3.08 CONCRETE FINISHES:

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces:
 1. No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as indicated.
- C. Unformed Surfaces:

After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each WORK operation as necessary to prevent drying shrinkage cracks. The classes of finish for unformed concrete surfaces are designated and defined as follows: Unformed Surface Finish Schedule	
Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Water bearing slabs with slopes 10 percent and less	U3
Water bearing slabs with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls subject to foot traffic	U4
Top surface of walls not subject to foot traffic	U3
Floors to receive surface hardener	U5

1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
2. Finish U2 - (Float Finish)

- a. Compact, accurately screed and float to a true uniform surface.
 - b. Surfaces shall be floated with wood or metal floats or a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted.
 - c. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Test surface with straightedge and eliminate high and low spots of more than 1/8 inch in ten (10) feet. Surface irregularities shall not exceed 1/4-inch.
 - d. Joints and edges shall be tooled where indicated or as determined by the CITY.
3. Finish U3 - (Hand-Troweled Finish)
- a. Finish surface as in Finish U2 - Float Finish and after the surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, trowel with steel trowel to obtain a smooth dense finish after concrete has hardened to ring under the trowel.
 - b. The finish shall produce a smooth dense uniform surface free of all irregularities, blemishes, ripples, and trowel marks.
4. Finish U4 - (Nonskid Finish)
- a. Trowel the Finish U3 - Hand-trowel Finish surface to remove local depressions or high points. In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated.
 - b. The resulting surface shall be rough enough to provide a nonskid finish.
5. Finish U5 - (Surface hardener)
- a. Immediately after screeding, shake on hardener shall be applied per the MANUFACTURER's written recommendations.
 - b. Surface shall receive a minimum of two coats of a liquid hardener per the MANUFACTURER's written recommendations.
 - c. CONTRACTOR shall notify hardener MANUFACTURER three (3) working days prior to hardened concrete floor being placed.
 - d. Hardener MANUFACTURER shall provide continuous supervision of concrete and hardener placements, supplying CITY with a report of each day's placement. Cost of supervision is to be borne by CONTRACTOR.

3.09 ARCHITECTURAL FINISH:

- A. General: Architectural finishes shall be provided only where specifically indicated below. In all other locations, the paragraph entitled Concrete Finishes shall apply.

Location	Finish
All formed and unformed surfaces above grade and exposed to view - Electrical Concrete Pad	U4

- B. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and form-tie holes filled as indicated herein.
- C. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
- D. Architecturally treated concrete surfaces shall conform to the accepted sample in texture, color, and quality. It shall be the CONTRACTOR'S responsibility to maintain and protect the concrete finish.

3.10 PROTECTION:

- A. The CONTRACTOR shall protect concrete against damage until final acceptance.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.11 DEFECTIVE SURFACE TREATMENTS:

A. Patching Concrete:

- 1. Patch all tie holes, honeycombs or other defects with a Portland Cement and sand grout.
- 2. Defective surfaces to be repaired shall be cut back from true line a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, plus not less than 1/32-inch depth of the surface film from all hard portions by means of an efficient sandblast.
- 3. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends.
- 4. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. Holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- 5. The grout shall not be richer than one (1) part cement and three (3) parts sand with the amount of mixing water enough to produce a workable mix. For exposed walls, the cement shall contain such a proportion of white Portland cement as is required to make the color of the patch match the color of the surrounding concrete. The patch shall be finished in such a manner as to match the adjoining surfaces.
- 6. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

B. Defective Concrete:

- 1. Any concrete which is not formed as shown on the Drawings or does not conform to the Contract tolerances or shows defects which reduce its structural adequacy, shall be removed from the job by the CONTRACTOR at his expense unless the CITY grants written permission to patch the defective area.

C. Exposed Concrete Surfaces:

- 1. As soon as forms are removed, exposed surfaces shall be carefully examined and all ridges, ribs and other imperfections shall be rubbed with an abrasive stone or ground in a satisfactory manner in order to secure a smooth, uniform and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted
- 2. No repairs shall be made until after inspection by the CITY
- 3. In no case will extensive patching of honeycombed concrete be permitted
- 4. Concrete containing minor voids, pinholes, honeycombing, or similar depression defects shall be repaired as indicated below.
- 5. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. Repairs and replacements shall be performed promptly.

6.

3.12 REINFORCEMENT:

- A. Reinforcement shall be in accordance with SECTION 03200, of these Specifications. Concrete protection for the reinforcement shall conform to the requirements ACI 318, paragraph 7.7.1.

3.13 CONSTRUCTION TOLERANCES:

- A. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.
- B. The following non-cumulative construction tolerances apply to finished walls and slab unless otherwise indicated:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation from the level or from the grades indicated.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation from plumb	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

3.14 CARE AND REPAIR OF CONCRETE:

- A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

END OF SECTION

SECTION 06100 ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The Work of this Section shall consist of furnishing all labor, materials, and equipment necessary for all rough carpentry as shown on the drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 03100 Concrete Formwork and Accessories

1.02 APPLICABLE PUBLICATIONS:

The following standard specifications shall apply to the work of this section as indicated:

- A. American Society for Testing Materials (ASTM).
- B. Southern Pine Inspection Bureau, Standard Grading Rules, latest edition, (SPIB).
- C. American Wood Preservers Institute (AWPI).

1.03 SUBMITTALS:

- A. Submit for review, properly identified product data on wood preservative treatments proposed.
- B. Furnish certificates from wood treating plant or material supplier that all rough lumber supplied conforms to referenced specifications. Certificates shall include grade, species and moisture.

1.04 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS:

- A. General Requirements:
 - 1. Sizes: Lumber sizes to conform to Prod. Std. PS 20 and unless otherwise specified to be surfaced on four sides. Sizes for materials other than lumber to conform to requirements of the rules or standards under which they are produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes to be within manufacturing tolerances allowed by standard under which product is produced.
 - 2. Preservative Treatment:
 - a. Wood members and plywood specified in this section to be preservative treated by pressure methods and so marked, in accordance with American Wood Preservers Institute Standards.
 - b. Treatment shall be selected from one of the following:

- i. DOT Sodium Borate (SBX)
 - ii. Alkaline Copper Quaternary (ACQ-C and ACQ-D with carbonate)
 - iii. Copper Azole (CBA-A and CA-B)
- c. Treatment of wood to be painted or to make contact with painted parts, and wood to which finishing materials will be fastened to be in accordance with AWPI Standards LP-2 or LP-4. Wood treated with oil-borne preservative to be clean, free from surface oil, and properly seasoned for use in building construction. Wood treated with water-borne preservatives to be air-dried or kiln dried to moisture content specified for lumber and marked with word "Dry." Treated wood that is cut to be brush-coated with preservative used in original treatment.

B. Performance Requirement:

1. Grading and Marking: Lumber and plywood to bear grade mark, stamp, or other identifying marks indicating grades of material and rules of standards under which they are produced. Such identifying marks on a material to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of inspection organization, usage of authorized identification, and information included in identification.
 - a. Inspection agency for lumber shall be certified by Board of Review, American Lumber Standards Committee, to grade species used. Except for plywood and lumber, bundle marking or certificates will be permitted in lieu of marking each individual piece.
2. Moisture Content: Moisture content shall conform to the rules for the lumber association or the inspection bureau under which the lumber is graded but shall not exceed 15 percent for boards and dimensional lumber 2 inches or less in thickness.
 - a. At time lumber is delivered and installed in work the moisture content is to be as follows:
 - i. Treated lumber 2 inches or less in thickness: 15 percent maximum.
 - ii. Treated lumber over 2 inches in thickness: 18 percent maximum.
 - iii. Plywood: 18 percent maximum.
3. Delivery, Handling, and Storage:
 - a. Wood materials shall be securely bundled and shipped with adequate moisture-resistant covers to preclude damage by weather or handling during delivery, when stored, and during construction.
 - b. Wood materials that must be stored outdoors before immediate use shall be placed in orderly piles and stored on blocks above ground. Lumber shall be stored in stacks with provision for air circulation within stacks. Material shall be protected from the elements with moisture-resistant covers.

C. Materials of Construction:

1. Accessories and Nails:
 - a. Anchor Bolts: Galvanized steel, size as indicated, complete with nuts and washers.
 - b. Bolts and Nuts: Lag, toggle, and miscellaneous bolts, and screws: Bolts and nuts shall be carbon steel, hot-dipped galvanized, of type and size, best suited for intended use, complete with nuts and washers, conforming to ASTM A 307. Lag screws or lag bolts shall be commercial steel, galvanized.
 - c. Clip Angles: Galvanized steel, 3/16 inch thick, size best suited for the intended use; or galvanized steel commercial clips designed for connecting wood members.

- d. Concrete Expansion Anchors: All metal type of size best suited for intended use. Steel to be cadmium zinc plated. Stainless steel Tap-Con type screws may be used as an alternate to expansion anchors in concrete.
 - e. Nails: Size and type best suited for purpose, in accordance with ASTM F 1667-03 when applicable to type used. In general, 8-penny or larger nails to be used for nailing through 1 inch thick lumber and for toe nailing 2-inch thick lumber; 16-penny or larger nails to be used for nailing through 2-inch thick lumber.
 - f. Bar or Strap Anchors shall be steel conforming to ASTM A 36. Hot-dip galvanized coating shall be in accordance with ASTM A 123.
2. Miscellaneous Wood Members Species and Grade Table:

RULES

Species	NELMA	WCLB	WWP	SPIB
Douglas Fir-Larch		Standard No. 2	No. 3 Comm No. 2	
Hem – Fir		Standard No. 2	No. 3 Comm No. 2	
Southern Pine				No. 2 Board No. 1
Douglas Fir South		No. 3 Comm No. 2		
Eastern Hemlock	No. 3 Comm			
Tamarack	No. 2			

- a. Nonstress graded members to include plates, caps, bucks, studs, blocking, furring, grounds, nailers, sleepers and cants. Members to be standard grade or No. 2 grade. Nonstress member grades to conform to National Grading Rule for Dimension Lumber established in conformance with Section 10 of Prod. Std. PS 20 and as applied in individual grading rules of applicable grading agencies. For species graded under other grading rules, grade used to be equivalent to grades outlined above. Sizes to be as follows unless otherwise shown.
3. General Use Plywood: Exterior type soft-wood plywood conforming with U.S. Department of Commerce PS 1-66, bearing APA grade mark in accordance with the American Plywood Association. Grade to be C-C plugged EXT-APA, or better. Thickness to be as indicated or as required.
4. Exterior Wood Buck Setting Compound: Vinyl emulsion type sealant, Vin-Lox Kaok Sealant, E-Bond Epo-Seal, or VIP Caulking and Bedding Compound.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Members to be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Nailing to be in accordance with the recommended Nailing Schedule as contained in the National Forest Products Association publication, Manual for House Framing. Where detailed nailing requirements are not specified, nail size and nail spacing to be sufficient to develop an adequate strength for connection without splitting members. Members to be framed for passage of ducts and

pipes and not be cut, notched, or bored more than 1/4 of their depth without adequate and review reinforcing.

- B. Blocking to be provided as necessary for application of other materials or building items. Blocking to be cut to fit between framing members and rigidly nailed thereto.
- C. Washer shall be provided under bolt heads or nuts in contact with wood. Lumber shall be bored to receive bolts.

END OF SECTION

SECTION 07900 SEALANTS

PART 1 - GENERAL

1.01 SCOPE: The required applications include, but are not necessarily limited to, the following:

- A. Flashing and Joints
- B. Partition and Ceiling Joints
- C. Equipment and Isolation Joints
- D. Gasketing for Assembly of Components

1.02 SUBMITTALS:

- A. Manufacturer's Data, Joint Sealers: Submit manufacturer's specifications, recommendations and installation instructions for each type of material required. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.
- B. Guarantee, Joint Sealers: Submit written guarantee agreeing to repair or replace joint sealers which fail to perform as airtight and watertight joints, or fail in joint adhesion, cohesion, abrasion resistance, stain resistance, or general durability, or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. Provide guarantee signed by the CONTRACTOR. Guarantee period shall be two (2) years.

1.03 JOB CONDITIONS:

- A. The CONTRACTOR must examine the joint surfaces and backing, and their anchorage to the structure, and the conditions under which the joint sealer work is to be performed. Do not proceed with the joint sealer work until unsatisfactory conditions have been corrected.
- B. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

1.04 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Colors: For exposed materials provide color as indicated or, if not indicated, as selected by the CITY from manufacturer's standard colors. For concealed materials, provide the natural color that has the best overall performance characteristics.

- B. Hardness: As recommended by manufacturer for application shown, unless otherwise indicated.
- C. Modulus of Elasticity: Provide the lowest available modulus of elasticity which is consistent with exposure to weathering, indentation, vandalism, abrasion, support of loading, and other requirements.
- D. Compatibility: Before purchase of each required material, confirm its compatibility with each other material it will be exposed to in the joint system.
- E. Size and Shape: As shown or, if not shown, as recommended by the manufacturer for the type and condition of joint, and for the indicated joint performance or movement.
- F. Grade of Sealant: For each application, provide the grade of sealant (non-sag, self-leveling, no-track, knife grade, preformed) as recommended by the manufacturer for the particular condition of installation (location, joint shape, ambient temperature, and similar conditions) to achieve the best possible overall performance. Grades specified herein are for normal condition of installation.
- G. One-Component Polysulfide Sealant: Polysulfide based, one-part elastomeric sealant, complying with FS TT-S-00230, Class A, Type II (non-sag), unless Type I recommended by manufacturer for the application shown.
- H. Two-Component Polysulfide Sealant: Polysulfide based two-part elastomeric sealant.

2.02 NON-ELASTOMERIC SEALANTS:

- A. One-Component Acrylic Sealant: Acrylic terpolymer, solvent-based, one-part, thermoplastic sealant compound; solids not less than 95 percent acrylic; complying with FS TT-S-00230, Class B, Type II, recommended by manufacturer for general use as an exposed building construction sealant.
- B. Acrylic-Latex Sealant: Latex-rubber-modified, acrylic-emulsion-polymer sealant compound permanently flexible, non-staining, and non-bleeding, recommended by manufacturer for protected exterior exposure.

2.03 CAULKING COMPOUNDS: Synthetic Resin Caulking Compounds - Oil-based caulking compound complying with FS TT-C-598, except compounded only with special synthetic resins, non-staining, non-bleeding, paintable.

2.04 JOINT FILLERS: Provide type as recommended by manufacturer for use with joint type and sealant, non-staining, resilient.

2.05 MISCELLANEOUS MATERIALS:

- A. Oakum Joint Filler: Provide untreated hemp or jute fiber rope, free of oil, tar, and other compounds which might stain surfaces, contaminate joint walls, or not be compatible with sealants.
- B. Joint Primer/Sealer: Provide the type of joint primer/sealer recommended by the sealant manufacturer for the joint surfaces to be primed or sealed.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by the sealant manufacturer to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.
- D. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam, or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer.

PART 3 - EXECUTION

- 3.01 **MANUFACTURER'S INSTRUCTIONS:** Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.
- 3.02 **JOINT PREPARATION:** Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances that would interfere with bond of sealant or caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous or glazed joint surfaces as recommended by sealant manufacturer. Prime or seal the joint surfaces wherever shown or recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- 3.03 **INSTALLATION:**
- A. Set joint filler units at proper depth or position in the joint to coordinate with other work, including the installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between the ends of joint filler units.
 - B. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.
 - C. Install bond breaker tape wherever shown and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.
 - D. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.
 - E. Install sealant to depths shown or, if not shown, as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:
 - 1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
 - 3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75 percent to 125 percent of joint width.
 - F. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.
- 3.04 **CURE AND PROTECTION:** Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability. Protect joint sealers during the construction period so that they will be without deterioration or damage at the time of the CITY acceptance.

END OF SECTION

SECTION 07920 SEALANTS AND CAULKINGS

PART 1 - GENERAL

- 1.01 SCOPE: The CONTRACTOR shall furnish all labor, materials and equipment necessary for sealing and caulking as specified herein.
- 1.02 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- A. American Society for Testing and Materials (ASTM) Publications: C920-79 Elastomeric Joint Sealants.
- 1.03 SUBMITTALS:
- A. Certifications of Conformance of Compliance: Submit certificates from the manufacturers attesting that materials meet the specified requirements.
- B. Manufacturer's Descriptive Data: Submit complete descriptive data for each type of material. Clearly mark data to indicate the type the CONTRACTOR intends to provide. Data shall state conformance to specified requirements. Data for sealant and caulking shall include application instructions, shelf life, mixing instructions for multi-component sealants, and recommended cleaning solvents.
- C. Colors: Submit one (1) sample of each color for each sealant and caulking type to verify that products match the colors indicated. Where colors are not indicated, submit not less than four (4) different samples of manufacturers' standard colors for selection by the CITY.
- 1.04 SAMPLE JOINTS: Before sealant and caulking work is started, provide a sample of each type of finished joint where directed on the project. The sample shall show the workmanship, bond, and color of sealant or caulking. The workmanship, bond, and color of sealant or caulking work throughout the project shall match the approved sample joints.
- 1.05 ENVIRONMENTAL CONDITIONS: The ambient temperature shall be within the limits of 40 and 100 degrees F. when the sealant and caulking are applied.
- 1.06 DELIVERY AND STORAGE: Deliver materials to the job site in the manufacturer's external shipping containers, unopened, with brand names, date of manufacture, color, and materials designated clearly thereon. Containers of elastomeric sealant shall be labeled as to type, class, grade and use. Carefully handle and store all materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degrees Fahrenheit or less than 40 degrees Fahrenheit.
- 1.07 WARRANTY:
- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

- 2.01 MATERIALS: Products shall conform to the reference documents listed for each use. Color of sealant and caulking shall match adjacent surface color unless specified otherwise. For ASTM C920 sealants, use a sealant that has been tested on the type(s) of substrate to which it will be applied.

- A. Interior Caulking or Sealant: ASTM C920, Type S, Grade NS, Class 12.5 or 25, Use NT. Color of caulking or sealant shall be white.
- B. Exterior Sealant: For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Color of sealant shall be gray unless in contact with window frame where it shall be dark brown or bronze.
- C. Exterior sealants used adjacent to or above roof surfaces shall be compatible with asphaltic bituminous roofing products, should contact be made with the roofing system, that would not have adverse affects to either product.
- D. Floor Joint Sealant: ASTM C920, Type M, Grade P, Class 25, Use T. Color of sealant shall be gray.
- E. Primer for Sealant: Use a non-staining, quick-drying, of type and consistency as recommended by the sealant manufacturer for the particular application.
- F. Bond Breakers: Use the type and consistency recommended by the sealant manufacturer for the particular application.
- G. Backstops: Use a closed cell polyurethane or polyethylene foam free from oil or other staining elements as recommended by the sealant manufacturer. Backstop material shall be compatible with the sealant. Do not use oakum and other types of absorptive materials as backstops.

PART 3 - EXECUTION

- 3.01 **SURFACE PREPARATION:** Surfaces shall be clean, dry to the touch, and free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Where adequate grooves have not been provided, clean out grooves to a depth of ½-inch and grind to a minimum width of ¼-inch without damage to the adjoining work. No grinding shall be required on metal surfaces.
 - A. Steel Surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a solvent that leaves no residue.
 - B. Aluminum or Bronze Surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. Use non-staining solvents recommended by the item manufacturer.
- 3.02 **SEALANT PREPARATION:** Do not modify the sealant by addition of liquids, solvents or powders. Mix multi-component elastomeric sealants in accordance with manufacturer's printed instructions.
- 3.03 **APPLICATION:**
 - A. Backstops: Where joint cavities are constructed deeper than indicated, tightly pack the back or bottom with backstop material to provide a joint of the depth indicated. Install backstops dry and free of tears or holes.
 - B. Primer: Just prior to application of the sealant or caulking compound, clean out all loose particles from joints. Apply primer in accordance with compound manufacturer's directions. Do not apply primer to exposed finish surfaces.
 - C. Bond Breaker: Provide bond breakers as recommended by the sealant manufacturer for each type of joint and sealant used.
 - D. Sealant and Caulking Compounds: Use a compound that is compatible with the material to and against which it is applied. Do not use a compound that has exceeded its shelf life or has become too jelled to

be discharged in a continuous flow from the gun. Apply the compound in accordance with the manufacturer's printed instructions. Force the compound into joints with sufficient pressure to fill the joints solidly. Compound shall be uniformly smooth and free of wrinkles.

1. Interior Sealant and Caulking: Provide sealant or caulking at all exposed joints in the building and at all joints indicated to receive sealants or caulking.
2. Exterior Sealant: Provide sealant at all joints around the perimeter of openings and at all exposed joints on the building and at all joints indicated to receive sealant.
3. Floor Joint Sealant: Provide sealant in all control joints and in other floor joints indicated or specified.

3.04 PROTECTION AND CLEANING:

- A. Protection: Protect areas adjacent to joints from compound smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.
- B. Cleaning: Immediately scrape off fresh compound that has been smeared on masonry and rub clean with a solvent as recommended by the compound manufacturer. Upon completion of compound application, remove all remaining smears and stains resulting therefrom and leave the work in a clean and neat condition.

END OF SECTION

SECTION 10200 LOUVERS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, materials, and equipment necessary for the furnishing and installation of louvers, as shown on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 - Submittals
 - 2. SECTION 07900 - Sealants
 - 3. SECTION 07920 – Sealants and Caulking

1.02 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the standards of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. See the various paragraphs for the specified standard. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail:
 - 1. Aluminum Association (AA)
 - 2. American Iron and Steel Institute (AISI)
 - 3. Air Movement and Control Association (AMCA)
 - 4. American Society for Testing and Materials (ASTM):
 - a. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
 - b. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 5. Florida Building Code (FBC)
 - 6. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1.03 SUBMITTALS:

- A. Product Data:
 - 1. Submit properly identified MANUFACTURER's literature on louvers and screening including material specifications and printed installation directions.
 - 2. Provide data on louvers to include the following information: free area chart/table, static pressure loss, air leakage, and water penetration data.
 - 3. Provide catalog information on louver motor operators.
- B. Shop Drawings: Submit Shop Drawings for review showing louvers and screen locations, dimensions, sections, gauges, thicknesses, stiffeners, clips, closures, fasteners, anchorage devices and installation procedure.
- C. Finish: Submit selected anodized finish for review and acceptance.

- D. Product Approval: Submit Florida Product Approval (FPA) and Miami-Dade Notice of Acceptance (NOA) for use of louvers and screening in a High Velocity Hurricane Zone (HVHZ) meeting large and small missile impact requirements.
 - E. Calculations: Submit calculations by a Professional Engineer registered in the State of Florida for any proposal modifications of the header, jambs, or sill.
- 1.04 QUALITY ASSURANCE: Louvers shall be licensed to bear the AMCA Certified Ratings Seal for air performance and water penetration. These ratings are to be based on tests made in accord with the AMCA Standard 500 and will comply with the requirements of the AMCA Certified Ratings Program.
- 1.05 WARRANTY: The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Airolite
- B. American Warming & Ventilating
- C. Greenheck Fan Corporation
- D. Ruskin
- E. CITY approved equal

2.02 GENERAL:

- A. Bird Screens: Minimum 14 gage AL, 1/2 inch (in) square mesh mounted in AL frames.
- B. Insect Screens: 18x16 mesh AL wire mounted in AL frames, conforming to Fed. Spec. RR-W-365. Louver design shall allow screens to be removable and mounted on the face of louvers without interfering with louver, damper, and drive function.
- C. Louvers that exceed MANUFACTURER's standard width or height shall be constructed in multiple sections, connected by hidden mullions. Fabricate mullions of same material as louver, with same finish.
- D. Provide interior and/or exterior flanged frames to overlap masonry opening as indicated on MANUFACTURER's installation instructions.
- E. Provide all supports, anchorages, and accessories for complete installation.

2.03 FIXED WALL LOUVERS:

- A. Description: Louvers shall be stationary type with wind-driven, rain-resistant style blades within a six-inch (6") deep frame. Louver head member shall incorporate a front drain gutter to channel water to the louver side frame or jambs where water is further channeled through vertical downspouts and out at the integral louver sill member.
- B. Sizes: As indicated on the Drawings.
- C. Materials: Blades to be fabricated of 0.081 in thick extruded 6063-T5 aluminum alloy in accordance with the recommendations of SMACNA.
- D. Jamb Frames, Mullions and Stiffener: 0.125 in thick extruded 6063-T5 aluminum alloy.

- E. Construction: Frame corners and blades to be all welded, and mechanically fastened with self-tapping stainless steel or anodized aluminum screws. Provide mullions with integral internal drains.
- F. Closures and Clips: Provided extruded aluminum alloy closure angles and closure flat bars for louver perimeters as indicated. Provide extruded aluminum alloy clips as required for securing mullion ends. Metal thickness 0.125 in minimum unless otherwise indicated.
- G. Fasteners: All fasteners shall be as specified by the MANUFACTURER and those exposed fasteners shall be shop enamel finished to match louvers.
- H. Rating: Louvers shall meet the performance requirements established by the AMCA 500L test procedure and shall be licensed to bear the AMCA Certified Ratings Seal for Water Penetration, Air Performance and Wind Driven Rain. Louvers shall have a minimum free area of 6.72 sq ft based on the standard 48 in W x 48 in H test specimen. Louvers shall have a maximum static pressure drop of 0.20 in water gauge based on 1000 ft per minute free area exhaust velocity. Louvers shall carry Class A Water Penetration Classification based on a ventilation core velocity of 970 ft per minute at a rainfall rate of 3 in. per hour and a 29 mph (miles per hour) simulated wind velocity and carry Class A Water Penetration Classification based on a ventilation core velocity of 982 ft per minute at a rainfall rate of 8 in. per hour and a 50 mph simulated wind velocity.

2.04 LOUVERS WITH MOTORIZED DAMPER ASSEMBLIES:

- A. Description: Unit consists of a fixed blade exterior, motorized damper, and a water collecting system for drainage.
- B. Louver construction: Louver blade and frame materials to be 0.125 in thick 6063T5 extruded aluminum. Louver blade to frame and louver frame to frame connections shall be both mechanically fastened with 300 series stainless steel threaded fasteners and welded.
- C. Damper construction: Factory mounted behind the louver must be a heavy-duty volume control damper. Damper frame material to be heavy gauge galvanized steel. Damper blades to be heavy gauge 6063T5 extruded aluminum airfoil.
- D. Rating: AMCA rated at zero water penetration with the specified air flows and for air leakage of less than 4.0 cfm per square foot of face area at a wind velocity of 30 mph (0.44 inch wc pressure) with damper blades closed.
- E. Operator: Honeywell M4182, Siebe Environmental, or CITY approved equal.
 - 1. Two-position, normally closed spring-return motor.
 - 2. Operator opening time shall not exceed 60 seconds and shall not be direct-coupled type.
 - 3. Provide additional or larger motors where required to meet louver torque requirements.
 - 4. Electrical Requirements: 115 volt, single-phase, 60 Hz.

PART 3 - EXECUTION

3.01 INSTALL LOUVERS where indicated on the Drawings in accordance with MANUFACTURER's printed installation directions, Shop Drawings, Product Approval and the following:

- A. Secure louver frame to jamb, head and sill with continuous aluminum closure angles or closure flat bars. Fasten closure to louver frame metal perimeters and to metal jambs and heads with No. 14 sheet metal screws at not over 24 inches on center, unless specified otherwise by accepted documentation. Use concealed anchorages wherever possible.
- B. For locations requiring removable louvers, install as shown in detail on drawings.

- C. Closures shall be sealed to building wall and louver frame sealed to closures with sealant specified under SECTION 07900.
 - D. Provide concealed or exposed mullions as required for a stable, rigid installation per MANUFACTURER's recommendations and code requirements.
 - E. Secure stiffener to louvers per MANUFACTURER's published recommendations.
 - F. Seal all fastenings and joints with sealant specified in SECTION 07900.
- 3.02 INSTALL INSECT SCREEN on exterior side of louvers with MANUFACTURER's standard stainless steel screws; size, spacing and type to be in accord with shop and erection drawings. Frames shall be sealed to adjacent frames with sealant specified in SECTION 07900.
- 3.03 CLEANING: After installation is complete, clean stains off of aluminum without damage to finish per MANUFACTURER's directions.
- 3.04 PROTECTION AND REPAIR OF EXISTING FINISHES: Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes so that there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make the required alterations, and refinish the entire unit or provide new units. Protect galvanized and non-ferrous metal surfaces from corrosion on surfaces that will be in contact with concrete, masonry or dissimilar metals.

END OF SECTION

PART 1 – GENERAL

I. SCOPE

This specification outlines the requirements for a low-pressure carbon dioxide (LPCO₂) fire extinguishing system. The work described in this specification includes all engineering, labor, materials, equipment and services required to install and test the LPCO₂ fire extinguishing and control system.

II. APPLICABLE STANDARDS AND PUBLICATIONS

The design, equipment, installation, testing and maintenance of the LPCO₂ Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards.

- A. ASME B16.3 - Malleable Iron Threaded Fittings Class 300.
- B. ASME B16.9 - Factory Made Wrought Steel Butt welding Fittings.
- C. ASME B31.1 - Power Piping.
- D. ASME SEC 8 - Pressure Vessel.
- E. ASME SEC 9 - Welded and Brazing Qualifications.
- F. AWS D1.1 - Structural Welding Code.
- G. NFPA 12 - Standard on Carbon Dioxide Extinguishing Systems.
- H. NFPA 70 - National Electric Code.
- I. NFPA 72 - National Fire Alarm and Signaling Code.
- J. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc coated, Welded and Seamless.
- K. ASTM A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
- L. ASTM A197 - Cupola Malleable Iron.
- M. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- N. FM - Factory Mutual Approval Guide.
- O. NEMA - Enclosures for Industrial Controls and Systems.
- P. UL - Fire Protection Equipment Directory.
- Q. Department of Transportation (DOT) Title 49 Code of Federal Regulations.
- R. All Requirements of Authority Having Jurisdiction (AHJ).

The standards listed, as well as all other applicable codes, standards, and good engineering practices shall be used as "minimum" design standards.

III. REQUIREMENTS

The Suppression System installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

IV. EXCLUSIONS

The work listed below shall be provided by others, or under other sections of this specification:

- A. 120 VAC or 220 VAC power supply to the system control panel.
- B. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.
- C. Connection to local/remote fire alarm systems or listed central alarm station(s).

V. QUALITY ASSURANCE

A. MANUFACTURER

- 1) The manufacturer of the suppression system hardware and detection components shall be ISO 9001 and 14001 registered.
- 2) The name of the manufacturer shall appear on all major components.
- 3) All devices, components and equipment shall be the products of the same manufacturer.
- 4) All devices, components and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.
- 5) All devices and equipment shall be UL Listed and/or FM Approved.

B. INSTALLER

- 1) The installing contractor shall be trained by the supplier to design, install, test and maintain fire suppression systems.
- 2) When possible, the installing contractor shall employ a NICET certified special hazard designer, Level II or above, who will be responsible for this project.
- 3) The installing contractor shall be an experienced firm regularly engaged in the installation of automatic LPCO₂, or similar, fire suppression systems in strict accordance with all applicable codes and standards.
- 4) The installing contractor must have a minimum of five (5) years experience in the design, installation and testing of LPCO₂, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.
- 5) The installing contractor shall show evidence that his company carries a minimum \$2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.
- 6) The installing contractor shall be an authorized stocking distributor of the LPCO₂ system equipment so that immediate replacement parts are available from inventory.
- 7) The installing contractor shall show proof of emergency service available on a twenty-four-hour-a-day, seven-day-a-week basis.

C. SUBMITTALS

- 1) The installing contractor shall submit the following design information and drawings for approval prior to starting installation on this project.
 - a. Working plans indicating detailed layout of system, locating each component (e.g. storage unit, control panel, electric/manual pull station, audible and visual alarms). Include control diagrams, wiring diagrams, written sequence of operation or cause to effect matrix along with battery calculations, and pipe locations including size and length. Refer to NFPA 12.

- b. Product data for each piece of equipment comprising the system including storage unit, control valves and pilot controls, control panels, nozzles, push-button stations, detectors, alarm bells or horns, switches, and annunciators.
 - c. Design calculations derived from the manufacturer written specifically for LPCO2 and verified by both Underwriters Laboratories and Factory Mutual. Analysis shall include calculations to verify system terminal pressures, nozzle flow rates, orifice code number, piping pressure losses, component flow data, and pipe sizes considering actual and equivalent lengths of pipe and elevation changes. In addition, the flow calculation software shall print specifications of all piping used in the design (mass, ID, etc). Designers using this software shall be trained and certified by Manufacturer.
 - d. Manufacturer's installation and operation manual.
- 2) Submit drawings, calculations and system component data sheets for approval to the local fire prevention agency, owner's insurance underwriter, and all other authorities having jurisdiction before starting installation. Submit approved plans to the architect/engineer for record.

PART 2 – SYSTEM REQUIREMENTS

I. SYSTEM DESCRIPTION AND OPERATION

- A. The fire protection system shall be a Total Flooding or Local Application System (as determined by designer, NFPA 12, and best practices) utilizing carbon dioxide stored in low pressure vessels. System is a fixed installation where equipment is designed and installed to provide fire extinguishing capability for hazards described. The system shall be supplied by Janus Fire Systems or approved equal.

Janus Fire Systems
 1102 Rupcich Drive
 Millennium Park
 Crown Point, IN 46307
 (219) 663-1600

- B. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, LPCO2 storage unit, carbon dioxide agent, discharge nozzles, pipe and fittings, manual release, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, UL Listed and/or FM Approved LPCO2 Suppression System.
- C. The system(s) shall be actuated by heat detectors.
- D. Automatic operation of each protected area shall be as follows:
- 1) Actuation of a detector, within the system, shall:
 - a. Flash the PRE-DISCHARGE lamp on the control panel face.
 - b. Display “PREDISCHARG OUTPUT #” on the control panel LCD.
 - c. Energize a pre-discharge horn or horn/strobe device.
 - d. Shut down the HVAC system and/or dampers.
 - e. Start time-delay sequence (not to exceed 60 seconds) as displayed on the control panel LCD (if not employing the life safety enhancements of NFPA 12).
 - 2) After completion of the time-delay sequence, the selector valve shall activate, the LPCO2 system shall discharge and the following shall occur:

- a. Illuminate the “DISCHARGED” lamp on the control panel face.
 - b. Display “RELEASING OUTPUT #” on the control panel LCD.
 - c. Shutdown of all power to high-voltage equipment.
 - d. Energize a visual indicator(s) outside the hazard in which the discharge occurred.
- 3) The system shall be capable of being actuated by manual discharge devices located at each hazard exit or egress path. Operation of a manual device shall duplicate the sequence description above except that the time delay shall be reduced to the time it takes for an occupant to be safely evacuated from the hazard the manual discharge station, if of the electrical actuation type, shall be supervised at the main control panel.

II. MATERIALS AND EQUIPMENT

A. GENERAL REQUIREMENTS

- 1) The LPCO2 System materials and equipment shall be standard products of the supplier’s latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.
- 2) All devices and equipment shall be UL Listed and/or FM approved.
- 3) The fire suppression agent shall be carbon dioxide; clean dry, non-corrosive, non-damaging, non-deteriorating, electrically non-conductive and meeting the requirements of NFPA 12.

B. LPCO2 STORAGE AND DISTRIBUTION

- 1) The storage unit shall be sized to provide two complete discharges to the largest hazard area.
- 2) The system design can be modular, central storage, or a combination of both design criteria.
- 3) Systems shall be designed in accordance with the manufacturer’s guidelines.
- 4) The storage unit shall be located centrally to all hazard areas, or as near as possible, to reduce the amount of pipe and fittings required to install the system.
- 5) The carbon dioxide shall be stored in refrigerated the manufacturer's Low-Pressure Carbon Dioxide Refrigerated Storage Units.
- 6) The storage unit capacity shall be as specified.
- 7) The storage unit shall be built to the ASME standards and bear the ASME label.
- 8) Sufficient insulation shall be provided to the storage tank for optimum operation and temperature control considering the environment in which the storage tank is to be located.
- 9) A refrigeration unit shall be provided to maintain the carbon dioxide at approximately 0°F (-17.78°C) and 300 psi (20.68 bar).
- 10) The storage unit shall be provided with a liquid level gauge and pressure gauge to provide a continuous visual indication of contents and pressure.
- 11) The liquid level gauge shall be equipped with contacts which may be used to annunciate a low liquid level in the storage unit.
- 12) The storage unit shall be equipped to sound an alarm in the event that the pressure in the vessel is 25 pounds (11.34 kg) above or below normal.

- 13) The storage unit shall be equipped with required ASME safety relief.
- 14) A high-pressure bleeder valve set at 341 psi (23.51 bar) shall be included as part of the storage unit assembly.
- 15) Vessel shall have a maximum allowable working pressure of 357 psi (24.61 bar).
- 16) The refrigeration unit shall operate on a power supply of (specify voltage).
- 17) The refrigeration unit shall use R-404A refrigerant.
- 18) Engineered discharge nozzles shall be provided within the manufacturer's guidelines to distribute the carbon dioxide throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution.
 - a. Total Flooding
 1. Radial nozzles shall be available in 1/2 in (15 mm) through 2 in (50 mm) pipe sizes. Each size shall be available in 90° Corner (Listed with a protection coverage area of 18' x 18'), 180° Sidewall (Listed with a protection coverage area of 36' x 18'), and 360° Center Room (Listed with a protection coverage area of 36' x 36') distribution patterns.
 2. Orifice nozzles shall be available for discharging into hazards where a radial nozzle is not appropriate.
 3. Nozzles shall be of corrosion resistant construction and shall be designed specifically for carbon dioxide application.
 4. Nozzles shall be permanently marked as to part number and orifice diameter.
 5. Radial nozzles shall be listed at a maximum 40' (12.19 m) elevation and listed at a maximum distance below a ceiling of 25% of the enclosure height while still achieving sufficient mixing.
 6. Nozzles should be listed and/or approved to be used in the upright or pendant position.
 7. Ceiling plates can be used with the nozzles to conceal pipe entry holes through ceiling tiles.
 - b. Local Application
 1. Local application nozzles shall be designed to direct CO₂ onto a surface at a specific projection distance and a specific flow rate.
 2. Nozzle shells shall be available in both 4-inch (101.6 mm) and 6 inch (152.4 mm) diameters.
- 19) Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 12 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations. The piping shall be laid out to give maximum flow and to avoid possible mechanical, chemical or other damage. Installation shall follow drawings as closely as possible. System designer must be consulted for anything other than minor deviations in pipe routing.
 - a. Black or galvanized steel pipe shall be either ASTM A53 seamless or electric welded – Grade A or B, or ASTM A-106 – Grade A, B, or C. ASTM A-120, ordinary cast-iron pipe, aluminum pipe, or non-metallic pipe shall not be used. Stainless steel pipe shall be TP304 or TP316 for threaded connections or TP304, TP316, TP304L, or TP316L for welded connections.
 - b. Threaded fittings must comply with NFPA 12 and be at a minimum class 300 malleable iron,

class 300 ductile iron through 3 in (80 mm) nominal pipe sizes (NPS) and forged steel fitting in all larger sizes or have a minimum rated working pressure of 450 psi (31.03 bar) at 70°F (21.1°C). Cast iron and Class 150-pound fittings shall not be used.

- c. Grooved fittings and couplings must comply with NFPA 12 and have a minimum rated working pressure of 416 psi (28.7 bar) at 70°F (21.1°C). Piping shall be rolled or cut grooved in accordance with the fitting or coupling manufacturer's guidelines.
- d. Gaskets must be compatible with LPCO₂ (typically EPDM having a temperature range of -30°F to 230°F [-34°C to 110°C]). Gasket lubricant must be in accordance with manufacturer's specifications.
- e. Flanges shall be minimum Class 300.
- f. The minimum allowable working pressure at 70°F (21.1°C) for pipe and fittings in closed sections of pipe must be greater than or equal to the maximum operating pressure of the discharge pipe safety relief valve rated at 450 psi (31.02 bar).
- g. All pipe and fittings shall be new and of recent manufacture.
- g. Reductions in pipe sizes may be accomplished using threaded or grooved concentric reducing fittings, steel or stainless steel concentric swage fittings, or forged steel or stainless steel hex bushings. Bushing must be class 3000 to maintain adequate strength. All such fittings must comply with NFPA 12. Malleable and/or cast iron bushings are NOT to be used.
- h. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.
- i. All screwed pipe shall be coated with Teflon tape or an appropriate pipe joint compound. When tape or pipe joint compound is used, coating of the threads must start at least two threads back from the pipe end. On small piping, care must be taken so as not to allow sealant to enter valves or controls.
- j. All pipe must be thoroughly cleaned before installation. A wire flue brush should be pulled through the length several times, followed by clean cloth rags treated with a noncombustible metal cleaner designed for the purpose. All foreign matter and oil must be removed by this process.
- k. All pipe and fittings installed out of doors or in corrosive areas must be galvanized or treated with a proper protective coating.
- l. All discharge piping must adhere to the piping specifications shown on the flow calculation report.

20) Valves

- a. All valves shall meet the requirements set forth in NFPA 12, 2011 edition.
- b. A manually operated tank shut-off valve shall be provided. Valves sized 3 inch through 8 inch shall be equipped with a hand operator and carry a 300 lb. Class ANSI rating. A positive visual indication of valve condition (open/close) shall be an inherent part of the actuator. This valve must be capable of being locked in either a fully open or fully closed position. The flanges mounted either side of the valve must have inside diameter chamfered 1/4" deep by 45° angle for valve clearance.
- c. The tank shut-off valve shall be equipped with (2) SPDT limit switches to permit remote annunciation if the valve is other than fully opened.
- d. Valves of sizes up to and including 2 inch shall be ball type designed for low pressure carbon dioxide service. Valves of sizes 3 inch and larger shall be high performance butterfly style

suitable for low pressure carbon dioxide service.

- e. (For Master Valve with Selector Valve arrangement) The master valve shall open automatically in the event of AC power loss to the fire alarm control panel controlling the master valve.
- f. (Master/Selector) (Selector) valves shall be provided for each hazard. CO2 vapor pressure shall provide pneumatic power to open these valves.

21) Pilot Pressure

- a. Pilot pressure to all pneumatically power devices shall be regulated to 100 psi (6.89 bar).
- b. Regulator shall be field set using inert gas.
- c. Pneumatic supply to pilot cabinets shall be normally pressurized.
- d. Pilot pressure shall be able to be isolated utilizing a lock-out valve. Closure of this valve shall cause a supervisory condition on the control panel.

22) Pilot Cabinets

- a. Each master valve shall be provided with a pneumatic pilot cabinet of the normally energized 24 VDC type. Loss of control power to the releasing control panel shall cause the master valve to automatically open. Electrical or manual actuation of the selector valve pilot cabinet shall cause the master valve to automatically open.
- b. Each master/selector or selector valve shall be provided with a pneumatic pilot cabinet of the normally de-energized type. This cabinet allows manual operation of the discharge valve by use of pilot pressure.
- c. The pilot pressure supply line shall be supervised for loss of pressure at the most remote point in the system and any trouble indication shall be annunciated at the system control cabinet.
- d. An emergency actuation shall be provided for all discharge valves.

23) Time Delay Components

- a. Pneumatic predischage alarm and pneumatic time delay shall be required for normally occupied and occupiable enclosures protected by total flooding systems as per NFPA 12.
- b. Pneumatic timer shall not be of the accumulator type. It shall have a rotary knob for adjusting the time. Needle valves used for adjusting the delay are not allowed.
- c. CO2 siren shall be pneumatically actuated by CO2 pilot pressure and shall not consume at a rate of more than 2 lbs/min of CO2 in order to sound at 100% efficiency. The CO2 siren shall not be of rotary type.

24) Discharge Pressure Switches

- a. The system shall include a normally open contact on a pressure switch actuated by the agent discharge to shut down equipment and sound alarm.
- b. Switches shall be heavy duty, single pole, double throw.
- c. Pressure switch shall require manual reset.

25) Pressure Operated Releases

- a. The system shall include releases capable of holding maximum loads of 35 lbs (15.9 kg) to release self closing doors, dampers, windows, louvers, lids or valves upon agent discharge

All devices to be closed must be self-closing and capable of being held open by a cable or chain hooked to the release.)

- b. Piping to pressure releases shall be as specified above for discharge piping. All take-offs for pressure release piping shall be from the top of the discharge piping.

26) Odorizer

- a. An odorizer shall introduce wintergreen scent into the CO2 discharge upon pressurization of the discharge piping.
- b. Odorizer shall be a single piece unit and replaceable.

PART 3 – DOCUMENTATION AND TESTING

I. SYSTEM INSPECTION AND CHECKOUT

After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards.

- A. All containers and distribution piping shall be checked for proper mounting and installation.
- B. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
- C. The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.
 - 1) Each detector shall be tested in accordance with the manufacturer's recommended procedures, and test values recorded.
 - 2) All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.
 - 3) Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

II. TRAINING REQUIREMENTS

Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include control panel operation, manual operation, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

III. OPERATION AND MAINTENANCE

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

IV. AS-BUILT DRAWINGS

Upon completion of each system, the installing contractor shall provide four (4) copies of system "As-Built" drawings to the owner. The drawings shall show actual installation details including all equipment locations (e.g. control panel(s), agent container(s), detectors, alarms, manuals, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed.

V. ACCEPTANCE TESTS

- A. At the time “As-Built” drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a “Test Plan” describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.
- B. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.
- C. A full discharge test shall be performed on all systems. Where multiple hazards are protected from a common supply, a full discharge test shall be performed for each hazard.

VI. SYSTEM INSPECTIONS

- A. The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six-month interval, and the second inspection at the 12-month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer’s guidelines and the recommendations of NFPA 12.
- B. Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

VII. WARRANTY

All Fire Systems components furnished and installed under this contract shall be warranted against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

SECTION 13850 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Design, furnish, install, test, certify, and place into service a complete addressable fire alarm system. The system shall be complete with all hardware and software specifically tailored for this installation.
2. Provide a fire alarm system consisting of, but not limited to the following components:
 - a. Fire alarm control panel (FAP)
 - b. Conduit and wiring necessary to connect the FAP to alarm initiating devices, notification appliances and auxiliary equipment
 - c. Addressable manual fire alarm stations
 - d. Addressable analog area smoke detectors
 - e. Addressable analog duct smoke detectors
 - f. Addressable analog heat detectors
 - g. Connections to sprinkler waterflow alarm switches
 - h. Connections to sprinkler supervisory switches and tamper switches
 - i. Audible and visual combination notification appliances
 - j. Air handling systems shutdown relays
 - k. Elevator recall/shunt relays (if the building has an elevator)
 - l. Battery standby
 - m. Conduit and GFE cable to building's main telecommunications room
3. Provide a fire alarm system that conforms to the requirements of the latest editions of (1) NFPA 72 National Fire Alarm Code, (2) NFPA 70 National Electrical Code, (3) ASME A17.1 Safety Code for Elevators and Escalators, and (4) NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

C. Related Sections:

1. Section 01300 SUBMITTALS
2. SECTION "Inspections and Testing of Electrical Work".
3. SECTION "Conductors and Cable."
4. SECTION "Electrical Conduit".
5. SECTION "Boxes for Electrical Systems".

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the edition of the referenced code or standard that is current at the time of the "date of record" for the Work shall be considered the effective code or standard for the duration of the project.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to specific Division 26 Sections for additional referenced codes and standards

B. ANSI/NFPA 70 - National Electrical Code.

C. ANSI - American National Standards Institute.

D. ASME A17.1 Safety Code for Elevators and Escalators

- E. FLORIDA Fire Code Regulations.
- F. FM - Factory Mutual System.
- F. LBNL Construction Details and Design Guidelines; Vol. 3 Construction Details; Part VI Electrical Details
- G. LBNL Electrical Authority Having Jurisdiction: Standard Procedure for Safe Electrical Installations (IAHJ Program)
- H. LBNL Electrical Safety Manual
- I. LBNL Facilities Department Lateral Force Design Criteria.
- J. LBNL Pub-3000 Chapter 8 – Electrical Safety Program
- K. LBNL Pub-3000 Chapter 18 – Lockout/Tagout Program
- L.NFPA – National Fire Protection Association
- M. NFPA 70E – Standard for Electrical Safety in the Workplace
- N. NFPA 72 - National Fire Alarm Code
- O. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- P. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- Q. NFPA 101 - Life Safety Code.
- R. UL – Underwriters' Laboratories:

1.3 SCOPE

- A. Fire Detection and Alarm System: manual and automatic Local Fire Alarm System, including initiating devices, indicating/notification devices and transmitters, components, appurtenances and accessories, as required. Also included is wiring and connections, including connections to water flow and valve supervisory switches, smoke management, and existing signaling system.
- B. Modifications and additions to the existing Local Fire Alarm System including wiring to the Fire Alarm Control Panels and / or to the signaling system transmitter.
- C. System Functional Description:
 - 1. The system shall identify any off normal condition and log each condition into the system database as an event.
 - a. The system shall automatically display on the control panel the first event of the highest priority by type. The priorities and types shall include alarm, supervisory, and trouble.
 - b. The system shall have a queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event.
 - c. The user shall be able to review each event by selecting scrolling keys.
 - d. New alarm, supervisory, or trouble events shall sound a silence-able audible signal at the control panel.
 - 2. Operation of any alarm-initiating device shall automatically:
 - a. Update the control/display as described above.
 - b. Audibly and visibly annunciate the alarm condition at the FAP.

- c. Activate all NAC appliances in accordance with the respective evacuation plan and matching functional matrix. The fire alarm evacuation tone shall be the three-pulse temporal pattern.
 - d. Operate the alarm relay and initiate the transmission of an alarm signal to the LBNL central station over a digital alarm communicator system.
 - e. Operate control relay contacts to shut down all HVAC units serving the floor of alarm initiation.
3. Activation of a supervisory initiating device shall:
 - a. Update the control/display as described above.
 - b. Audibly and visibly annunciate the supervisory condition at the FAP.
 - c. Operate the supervisory relay and initiate the transmission of a supervisory signal to the LBNL Central Station over a digital alarm communicator system.
 4. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the FAP. Any opens, grounds, or disarrangement of system wiring and shorts across alarm horn/strobe wiring shall automatically:
 - a. Update the control/display as described above.
 - b. Operate the trouble relay contacts to initiate the transmission of a trouble signal to the LBNL central station over a digital alarm communicator system.
 - c. Visually and audibly annunciate a general trouble condition, on the FAP. The visual indication shall remain on until the trouble condition is repaired.
 5. The FAP shall have an optional LED Annunciator/Switch Card component installed and programmed for pre-defined disable groups particular to this installation. Disable groups shall consist of the following to facilitate routine inspection, testing, and maintenance (ITM):
 - a. All control relays that initiate/control closure of the specified combination fire/smoke dampers listed in Sections 1.2.B.7 and 1.2.B.8.
 - b. All control relays that initiate/control HVAC shutdown listed in Section 1.2.B.6.
 - c. All notification appliances.
 - d. All elevator related control functions.

D. System Design

1. System Design: Provide the services of a qualified factory trained fire alarm designer for the FAP to be installed on this project. The designer shall assure the completeness and correctness of the fire alarm system design by performing the following:
 - a. Prepare drawings of FAP indicating location of components, interconnection of components and connections to alarm initiating, indicating, and auxiliary circuits.
 - b. Prepare a system input/output matrix to verify that the proper sequences occur for each initiating point or zone.
 - c. Prepare drawings of fire alarm layout, conduit and wiring plans. Show location of all fire alarm appliances, conduit layout, quantity, and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.
 - d. Prepare terminal-to-terminal field wiring diagrams for alarm initiating, indicating and auxiliary circuits; detail the interfaces with other systems; indicate labeling of each fire alarm system conductor.
 - e. Calculate conductor sizes for each alarm initiating, indicating, and auxiliary circuit; limit voltage drops so that they do not exceed the FAP manufacturer's limitations, for the most remote device on each circuit.
 - f. Prepare battery load calculations for the FAP and any remote power supply panels and select proper battery size. Battery shall be sized to include an additional 50% safety margin above calculated system demand.
 - g. Calculate alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient at all locations, but not over 120 dBA at any location.
 - h. Select alarm initiating, alarm indicating, and auxiliary devices compatible with FAP.

E. General Requirements And Operation

1. Provide an electrically supervised, manual and automatic, fire alarm and detection system, including proprietary and local alarm panels, and indication/notification appliances.

2. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, door holders, smoke dampers, relays, alarm notification appliances, and other appurtenances as specified. Battery-operated emergency power supply shall be furnished, and sized with minimum 25 percent over the capacity required for the operating system in standby mode for minimum of 24 hours followed by alarm notification mode for 5 minutes per NFPA 72 Section 1-5.2.5.
3. System Supervision: Component or power supply failure shall place the system in trouble mode and notify the Central Supervising Station at the Fire Department.
4. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of an open condition shall place the circuit in trouble mode but shall not disable that circuit from initiating an alarm. Initiating device circuits shall be provided with Class A-Style D looped wiring.
5. Sprinkler systems supervision circuits shall connect to the proprietary system transmitter via supervisory module for the tamper switch with Class A-Style D looped wiring.
6. Indication/Notification Appliance Circuits: Supervised signal modules, sufficient for the indication/notification appliances connected to system; occurrence of an open or ground fault condition shall place the circuit in trouble mode but shall not disable any device on that circuit from signaling an alarm. Indicating appliance circuits shall be provided with four-wires in polarized Class A-Style Z looped wiring.
7. Auxiliary Relays: Provide sufficient double throw auxiliary relay contacts for each detection zone to provide the accessory functions as specified.
8. Provide TROUBLE ACKNOWLEDGE, ALARM SILENCE, BELL AND ANCILLARY FUNCTION DISCONNECT switches for the testing, as required and shown in the logic diagram.
9. Trouble Sequence of Operation: System or circuit trouble shall place the system in the trouble mode, which shall cause the following system operations:
 - a. Visual and audible trouble alarm indicated by zone at fire alarm control panel.
 - b. Visual and audible trouble alarm indicated at the Central Supervising Station (CSS).
 - c. Manual acknowledge function at the fire alarm control panel shall silence the audible trouble alarm; visual alarm shall continue to be displayed and CSS notification shall be maintained until initiating device failure or circuit trouble is cleared.
10. Alarm Sequence of Operation: Actuation of initiating device shall place the circuit in alarm mode, which shall cause the following system operations:
 - a. Sound and display local fire alarm notification appliances.
 - b. Transmit zone alarm signal to Central Supervising Station.
 - c. Indicate location of alarm zone and type of device on fire alarm control panel
 - d. Transmit signal by function to building mechanical systems via the Fireman's Ventilation Control Panel, to initiate smoke control operation.
 - e. Transmit signals to building elevator(s) control panel to initiate return to main floor or alternate floor in building equipped with elevator(s).
 - f. Transmit signal to release door hold-open devices [by zone] [on general alarm].
 - g. Alarm silence function at the fire alarm control panel shall silence audible alarm signaling devices; visual alarm shall continue to be displayed at the local Fire Alarm Control Panel, and CSS notification shall be maintained until Alarm Reset occurs. Actuation of a second initiating device shall cause the alarm to re-activate in accordance with this section from a through g.
11. Alarm Reset: System shall remain in the alarm mode until manually reset with key-accessible reset switch; system shall reset only if initiating circuits are out of alarm mode.
12. Lamp Test: Manual lamp test function shall cause alarm indication at each zone at Fire Alarm Control Panel.

13. Addressing: Actual room numbers and/or names will be assigned by the City and shall be shown on the drawings.
14. Panel shall have a minimum of 20 percent additional space for future expansion.
15. The system shall be electrically supervised against open wire, shorts and ground faults in the initiating, and indication/notification circuits.
16. Supervised disconnect switches shall be provided, for each smoke detector zone, as an integral part of the zone module, for the indication/notification circuit(s) and auxiliary function circuit(s) with the exception of the water flow switch, and as shown on the contract drawings.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01 Section "General Requirements", Submittals, and Drawings and Specifications, Section "Common Work Results for Electrical - Submittals" and as required by other sections of the Specifications."
- B. Shop Drawings: The Subcontractor shall submit for approval Shop Drawings prepared in accordance with Division 01 Section "General Requirements", Paragraph 1.8.F and as required by other sections of the Specifications.
- C. All submittals and shop drawings shall be reviewed and approved by the Facilities Division Utility Group Electrical Engineer before procurement or fabrication of material and equipment.
- D. Submit five copies of shop drawings and product data. The drawing format for the Fire Alarm Control Panel layouts, general arrangement, and connection diagrams shall conform to the CITY furnished typical sample drawings.
- E. Shop Drawings - Drawings shall be stamped by FLORIDA registered electrical engineer or fire protection engineer and shall include:
 1. System logic.
 2. Control panel general arrangement, and connection wiring with individual wire numbers, and color code. Module legends must show the module type and the zone input and output connections (Proprietary system zone code).
 3. Layout plan view showing location of initiating and notification devices with zone and device numbers. Conduit size and routing with wire fill must be shown on the same drawing.
 4. Connection details typical for each device to be installed.
 5. Nameplate schedules indicating text for annunciation and labeling.
 6. Area coverage drawings with spacing requirements for the initiating, and indicating/notification appliances in accordance with the requirements and criteria specified in the applicable Codes and Standards.
 7. Standby Battery size calculations.
 8. Provide FLORIDA State Fire Marshall (CSFM) Listing numbers for the system components.

9. Prepare floor plan drawings using a minimum scale of 1/8" = 1'-0" for plans and 1/4" = 1'-0" for details.
 10. Hand-lettering shall be a minimum of 3/16" and other lettering a minimum of 1/8" to permit reproduction.
 11. Show location of FAP, all fire alarm appliances, conduit layout, quantity and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.
 12. Show layout of the FAP indicating location of components, interconnection of components, and connections to alarm initiating, indicating, and auxiliary circuits.
 13. Submit at least 30 days prior to scheduled start of fire alarm system installation. Installation shall not proceed without design approval by the LBNL Fire Protection Engineer.
 14. Submit final drawings at least one week prior to final system acceptance test.
 15. After final system acceptance test, the subcontractor shall provide Record Document – As-builts per paragraph "L" below.
- F. Product Data: Provide electrical characteristics and connection requirements.
- G. Catalog Data: At least 30 days prior to scheduled start of fire alarm system installation for all equipment furnished under this Section.
- H. Installation Instructions: At least 30 days prior to scheduled start of alarm system installation.
- I. Materials and Parts List: At least 30 days prior to scheduled start of alarm system installation.
- J. FAP Program
1. Provide FAP input/output matrix and a copy of the proposed FAP program at least 30 days prior to the anticipated final tie-in/ acceptance date of the fire alarm system.
 2. Provide final FAP input/output matrix and the final FAP program at least two weeks prior to the anticipated final tie-in/acceptance test.
- K. Reports: A certificate of compliance and other documentation, as required by NFPA 72 Paragraph 1-7.2, shall be provided at the times indicated therein. Provide Certified inspection and test reports and documents to the City as specified in NFPA 72 and the manufacturer's instructions.
1. Submit report of the pre-final tests indicating system status and corrective actions required before the final acceptance tests.
 2. Submit test plan for the final acceptance tests at least 30 days prior to scheduled final acceptance tests.
 3. Upon successful completion of acceptance tests, submit final "Record of Completion" and "Inspection and Testing Form" as required by NFPA 72.
- L. Wiring Diagrams

1. Provide terminal-to-terminal wiring diagrams for alarm circuits, supervisory circuits, remote power supply panels, and interfaces with other systems such as HVAC and elevators.
2. Submit wiring diagrams at least 30 days prior to scheduled start of fire alarm system installation.
3. Submit final wiring diagrams at least one week prior to final acceptance testing.

M. Project Record Documents (As-Built)

1. Provide updated drawings reflecting as-built conditions showing the work completed under this Section. Include notes on special systems or devices, new and existing, actual locations of equipment, actual conduit installation, wiring color-coding, wire tag notations, interconnections between all equipment, and internal wiring of the equipment. Include conduit size, conductor size, and number of conductors per conduit. The As-builts shall include final battery capacity and final voltage drop calculations and "actual" battery capacity reserve remaining and "actual" voltage drop measured and remaining reserve.
2. The Record Drawing – As-Builts shall be provided with a schedule that lists all equipment, devices, specific location of the equipment based on LBNL's Key Plan, function and the specific LBNL equipment or device ID.
3. The Record Documents (As-Builts) shall be identified as Revision A on the title block and title it "RECORD DRAWING – AS-BUILT".
4. Provide the updated drawings on electronic media in ".pdf" and AutoCAD "*.dwg" formats.

N. Warranties: Warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance, in writing.

O. Certification of installer training and contractor listing

1. Within 30 days after Notice to Proceed, certifications of the qualifications of the fire alarm installing firm as described in the quality assurance paragraph of this Section.
2. Within 30 days after Notice to Proceed, certifications of the qualifications of the fire alarm system technician as described in the quality assurance paragraph of this Section.
3. Certification from the fire alarm control manufacturer that proposed alarm-initiating devices, alarm appliances, and auxiliary devices are compatible with the FAP and other auxiliary equipment.
4. "Record of Completion" and associated documentation for the completed system according to NFPA 72 prior to the system acceptance test.

NOTE: From a review standpoint, calculations and drawings may be treated as design outputs by LBNL and reviewed using a Design Review Record form/process instead of the construction submittal form/process.

P. Calculations: Submit the following at least 30 days prior to scheduled start of fire alarm system installation. .

1. System battery capacity calculations to demonstrate that the battery is sized to support the system operating in a "normal" (non-alarm) condition for not less than 24 hours plus a general alarm condition (all alarm notification appliances used for evacuation being activated) for not less than 10 minutes following the completion of the 24-hour period. Battery shall be sized to include an additional 50% safety margin above calculated system demand.
2. Voltage drop calculations to demonstrate that the signal voltage at the most remote notification appliances on each circuit will not be less than the FAP or the notification appliance manufacturer's recommendations.
3. Final battery capacity calculations and final voltage drop calculations -- at least one week prior to final system acceptance test.

Q. Substitutions: No substitutions of materials, specified in this section, will be allowed without the written approval of the City .

R. Operation and Maintenance Data:

1. Submit operating and instruction manuals prior to testing of the system.
2. Submit five complete sets of project-specific operating and maintenance instruction manuals upon successful completion of testing. Provide complete, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each piece of equipment, and a complete trouble shooting manual explaining how to test the primary internal parts of each piece of equipment. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - a. Provide instructions for replacing any components of the system, including internal parts.

- b. Provide a list of recommended spare parts.
 - c. Provide instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.
 - d. Provide a complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
 - e. Specific equipment model number and serial number shall be identified for the O&M manual of the equipment or parts installed. Generic O&M manual is not acceptable.
3. Provide operating instructions prominently displayed on a separate sheet located next to the FAP in accordance with UL Standard 864.
- S. Spare Parts List: The supplier shall provide a recommended spare parts list for one year operation, and pricing good for 90 days from date of equipment delivery.

1.5 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL) as listed in Division 26 Specification "Common Work Results for Electrical."
- B. Equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.
- C. Installer Qualifications: A company licensed by State of California as a fire alarm installer with a C-10 contractor's license, and specializing in installing the products specified in this specification with a minimum of three years documented experience.
 - 1. Be licensed by any state in the United States to engage in the design, fabrication, and installation of fire alarm systems.
 - 2. Have satisfactorily installed at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
 - 3. Provide the services of a qualified fire alarm system technician to design the fire alarm system and to test the completed system.
 - 4. Be a factory-certified representative of the manufacturer of the FAP that will be used on this project.
- D. Principal installation personnel shall have completed the system manufacturer's training courses on the equipment to be installed.
 - 1. Be factory trained in the theory, operation, installation, and troubleshooting of the FAP that will be used for this project.
 - 2. Have satisfactorily designed at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
 - 3. Have satisfactorily field-tested at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
 - 4. Be NICET (National Institute for Certification in Engineering Technologies) Fire Alarm Certified, or certified by an equivalent organization acceptable to the City Representative.
- E. Manufacturer's Field Services: Include services of Factory or NICET (National Institute of Certification for Engineering Technician) Certified Technician to supervise installation, adjustments, final connections, and system testing.
- F. The bidder shall include the cost for providing the training to the City personnel, including the outline of the training program and the number of hours of training time.
- G. The contractor shall fill out the NFPA forms (attached) and submit to the City Representative. After ensuring that all information has been noted, the City Representative will submit the completed forms to the LBNL Fire Marshall to be used in approving beneficial occupancy.

1.6 PRODUCT HANDLING

- A. Materials and Equipment: Protect from damage during shipping, storage, and installation.
- B. All materials shall be inspected by the City Inspector for compliance with the Contract Document upon delivery to the job site prior to installation. Notify the CITY Representative to arrange for material inspection a minimum of 5 working days prior to the date of material delivery.

1.7 MAINTENANCE SERVICE

- A. The equipment and systems Warranty shall include parts, labor and field service, pickup, delivery, and restoration of the system to normal within 24 hours of notification to the Subcontractor.
- B. Provide test and maintenance service as required by the Codes for a period of one year. Provide a written certified copy of test results to the CITY within one week after completion of the work.

1.8 EXTRA MATERIALS

- A. Provide six keys of each type.
- B. Provide three spare of each type of automatic smoke detector without base.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide materials and equipment that are new and unused, free of defects, specifically designed for the use intended, conform to the requirements of the NEC and NFPA 72, and are NRTL listed for the intended use.

2.2 FIRE ALARM PANELS (FAP)

- A. The FAP shall incorporate all control electronics, relays, and necessary modules and components in a flush or semi-flush mounted cabinet (dependent on FAP mounting location). The operating controls and zone/supervisory indicators shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. The assembly shall contain a base panel, system power supply and battery charger with additional modules to meet the requirements of these specifications.
- B. System circuits shall be configured as follows: Addressable analog loops Class B/Style 4; Initiating Device Circuits (if used) Class B/Style B; Notification Appliance Circuits Class B/Style Y.
- C. The system shall store all basic system functionality and job specific data in non-volatile memory. The system shall survive a complete power failure intact.
- D. The system shall allow down loading of a job specific custom program created by system application software. It shall support programming of any input point to any output point.
- E. The system shall support distributed processor intelligent detectors with the following features: integral multiple differential sensors, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, dual normal/alarm LEDs, relay bases, and isolator bases.
- F. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is defined in the system.
- G. The system shall have a nationally recognized testing laboratory (NRTL) listed detector sensitivity test feature, which will be a function of the smoke detectors and performed automatically.
- H. All panel modules shall be supervised for placement and initiate a trouble signal if damaged or removed.

- I. The system shall have a CPU monitoring circuit to initiate a trouble signal should the CPU fail.
- J. The system evacuation signal rate shall be suitable to support audio-visual combination-type electronic three pulse temporal pattern sounder and strobe combination units.
- K. The system program shall meet the requirements of this project, current codes and standards, and satisfy the LBNL Fire Marshall.
- L. Passwords shall protect any changes to system operations.
- M. The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc for notification appliance circuits. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 10 minutes.
- N. The FAP shall have a high-contrast, alphanumeric display to show system status, alarm information, and supervisory information. The FAP shall have LED indicators for the following common control functions: AC power, alarm, supervisory, monitor, trouble, disable, ground fault, CPU fail, and test. There shall be control keys and visual indicators for; reset, alarm silence, trouble silence, and drill.
- O. Battery boxes, if required, shall be UL Listed for the purpose.
- P. The FAP shall have a digital alarm communicator transmitter (DACT) module to transmit detailed alarm, supervisory and trouble signals to a digital alarm communicator receiver (DACR) at a Central Monitoring Station.
 - 1. The DACT shall support dual telephone lines, "contact ID" communications format, and configured for dual-tone, multi-frequency (DTMF).
 - 2. The DACT shall be listed for "Central Station Fire Service" and shall be of the same manufacturer as the control panel.
 - 3. The DACT shall transmit the following information to the LBNL Fire Department Central Monitoring Station:
 - a. Fire alarm per point addressable device (e.g., detector or water flow activation, manual pull stations, etc.)
 - b. Supervisory signal per addressable device (e.g., valve tamper)
 - c. General System Trouble (alarm panel trouble)
 - 1) Loss of AC Power
 - 2) Communication Line Failure (Primary and Backup)
 - 3) Trouble per zone or point addressable device
 - 4) Battery Failure
 - 4. Restoration of each signal condition identified above shall be transmitted to the LANL Central Station.
 - 5. The secondary telephone line shall only be utilized for signal transmission in the event that attempts to communicate utilizing the primary line are unsuccessful.
 - 6. The secondary telephone line shall have the same account code and communication format as the primary line.
 - 7. A general alarm or supervisory signal shall not be transmitted by the DACT when specific point/zone information is transmitted.
 - 8. Loss of AC power shall be transmitted 6 hours after the detected failure.
 - 9. A test signal shall be sent once every 24 hours.
- Q. Manufacturers: Pyrotronics, Div. of Cerberus Technologies, Multi-Alarm VI and System 3 with modular construction and flush or surface wall-mounted enclosure, no substitutes except as specified, with the following features:
 - 1. Model CP-35 Control Panel.
 - 2. Model PS-35 Power Supply.

3. Model BC-35 Battery Charger.
 4. Model BK-33/BT-34 Battery Pack.
 5. Model SR-35 Relay Modules.
 6. Model ZN-34U Gate Valve supervision Module.
 7. Model ZU-35DS Zone Modules for smoke zones and Model ZU-35 Zone Modules for other alarm zones.
 8. Model SM-30 Switch Modules shall be provided where indicated.
 9. Panel shall have 20 percent empty module space.
- R. Transmitter/Receiver: Cerberus Pyrotronics Model MX-316 Remote Transceiver Unit with LA-16 option, no substitution.
- S. Annunciator Panel: Cerberus Pyrotronics Model MX-201 96-Zone LED, no substitution.

2.3 INITIATING DEVICES

- A. Manual Station: Surface mounted, non-coded type, double action manual station. Interior Stations shall be Gamewell Model 21868-8 with [surface back box, Model 21855] [semi-flush back box, Model 43480]. Weatherproof Stations shall be Gamewell Model M2513-24. Explosion proof Stations shall be Gamewell Model MD-59.
- B. Spot Heat Detector: Combination rate compensated and fixed temperature, rated 135 degrees F (57 degrees C) unless otherwise noted, and temperature rate of rise of 15 degrees F/minute (8.3 degrees C/minute), Fenwal Type 27021 or 27121.
- C. Ceiling Mounted Smoke Detector: Ionization type shall be Cerberus Pyrotronics type DI-3 with adjustable sensitivity. Photoelectric type shall be Cerberus Pyrotronics type PE-3T. Detectors shall have plug-in base, visual indication of detector actuation, and be suitable for mounting on 4 inch (102 mm) octagonal outlet box.
- D. [Duct Mounted Smoke Detector: Two-wire, Cerberus Photoelectric or Ionization type detector, with common power supply and signal circuits, and duct sampling tubes extending the width of the duct, complete with visual indication of detector actuation in duct-mounted housing, Cerberus Pyrotronics Series 3/X3, with type EAD-2 weatherproof enclosure, if required.]
- E. [Duct Mounted Smoke Detector: Two-wire, Photoelectric type detector, with common power supply and signal circuits, and duct sampling tubes extending the width of the duct, complete with two auxiliary SPDT relay contacts and visual indication of detector actuation in duct-mounted housing, Cerberus Pyrotronics Series 3/X3, with type EAD-2 weatherproof enclosure, if required. FAP power supply shall power and supervise two 2-wire satellite units.]
- F. Wet-Pipe Sprinkler Systems, for pressure switches, flow switches and valve supervisory switches supplied under Division 21 Section "Wet Pipe Sprinkler Systems".

2.4 INDICATION/NOTIFICATION APPLIANCES

- A. Alarm Bells: ADA & NFPA 72 compliant and shall have temporal tone per ANSI 53.41, electric motor or vibrating, 6 inch (125 mm) bell with operating mechanism behind dome and a sound rating of 92 dB at 10 feet (3 M), Cerberus Pyrotronics Model MBDC. Ten (10) inch (250 mm) bells shall be used in areas where the noise spectrum will mask the sound of a 6 inch (125 mm) bell.
- B. Alarm Lights: ADA & NFPA 72, strobe lamp with red lettered "FIRE" on white lens, Cerberus Pyrotronics Model Series "F" Model S75, no substitution.
- C. Supply bell and strobe lamp with red lettered "FIRE" on white lens where specified on the drawings, Cerberus Pyrotronics Model MBDC bell, and Series "F" Model S75 strobe, no substitution.
- D. Indication and Notification Appliances shall be mounted on a 4 inch square box without the plaster ring, flush to the finished surfaces, or surface mount in unfinished areas.

2.5 AUXILIARY DEVICES

- A. Door Release: Door closer, or magnetic doorholder, as specified in Division 08 Section "Door Hardware". Magnetic doorholder coil voltage shall be 24VDC.

2.6 FIRE ALARM WIRE AND CABLE

- A. All fire alarm wiring shall comply with the minimum size as indicated below. Larger size wires shall be used for longer circuit runs to limit maximum voltage drop to 5 percent. Solid and stranded wiring shall be terminated in accordance with the requirements specified in Division 26 Section "600 Volt Conductors and Cables."
- B. Fire Alarm Power Branch Circuits: As specified in Division 26 Section "600 Volt Conductors and Cable" for power and control cables.
- C. System 3 Wiring - Alarm Initiating Devices: No. 16 AWG, solid or stranded conductor, THHN insulation with construction as specified in Division 26 Section "600 Volt Conductors and Cable".
- D. MX-316 Wiring:
 - 1. Signaling cable to LBNL trunk loop line: Shielded 2-pair twisted, No. 18 AWG, solid copper conductor, 300V PVC insulation. The shield shall be grounded at the MX-316 end.
 - 2. Alarm Initiating Devices: Twisted pair, solid copper conductors, with overall shield, 300V PVC insulation, #18 AWG for single pair, #22 AWG for two or more pairs. The shield shall be grounded at MX-316 end.
- E. Indication/Notification Appliance Circuits: No. 14 AWG, solid or stranded conductor, THHN insulation with construction as specified in Division 26 Section "600 Volt Conductors and Cable".
- F. Provide fire alarm circuit conductors with insulation color coded as follows. The color code of the wiring shall not be transposed:
 - 1. Power Branch Circuit Conductors' Color Code:
 - a. Phase 'A': Black
 - b. Phase 'B': Red
 - c. Phase 'C': Blue
 - d. Neutral: White
 - e. Ground: Green
 - 2. Style D circuits (System 3) with individual conductors:
 - a. Fire Call Box, Water Flow Switches and Heat Detector: Red (+), Blue (-).
 - b. Smoke Detector: Red (+), Black (-), Purple (annunciation of concealed devices).
 - c. Supervisory devices (normally closed): Yellow (both conductors)
 - 3. Style C circuits (MX-316) with shielded paired cables:
 - a. Alarm devices: Red (+) to TS1 and TS4, Black (-) to TS2 and TS3.
 - b. Supervisory devices: Red (+) to TS1, Black (-) to TS4.
 - 4. Detector Indicating Light: Violet, and Red.
 - 5. Indication/Notification Appliance Circuit: Black (+) (in and out); White (-) (in and out). [Belden Cable #9527: Red and Yellow (positive); Black and Blue (negative).]
 - 6. Door Release: Gray (both conductors).
 - 7. Multiple pair cables shall be solid conductor, shall conform to ICEA color code chart #3, and shall be terminated on terminal blocks only.
 - 8. Fire/Smoke damper: Gray (both conductors).
- G. Conductors: Provide alarm and supervisory signaling system conductors that meet the requirements of Article 760 in the NEC and are NRTL listed for the type of service to which they will be subjected. Minimum conductor requirements shall be as follows:
 - 1. Use red-jacketed NEC type FPL cable with No. 16 AWG (minimum) twisted-pair conductors for addressable devices; use shielded twisted-pair cables if required by the FAP manufacturer. Other low voltage conductors shall be type TFN, No. 16 AWG (minimum), thermoplastic insulation, and single solid copper conductor.

2. Power conductors shall be type THHN/THWN, No. 12 AWG, thermoplastic insulation, and single solid copper conductor.
3. Size conductors of the fire alarm systems as recommended by the manufacturer, based on the operating ampacity of the circuit and the permissible resistance and voltage drop characteristics that will allow proper operation of the equipment. Provide conductors selected to provide voltages within the manufacturer specification limits for the most remote fire alarm notification appliance or field device.
4. Design each addressable analog loop so device loading will not exceed 80% of loop capacity in order to leave for space for future devices.

2.7 AUDIBLE AND VISUAL COMBINATION DEVICES

- A. Provide NRTL-listed 24 VDC audio-visual combination-type electronic three-pulse temporal pattern sounder and strobe combination units that are acceptable to the FAP manufacturer and are compatible with the FAP.
- B. Sounder shall include three-pulse temporal pattern generating electronics, audio transducer, and screw terminals housed in a red housing. Acoustical output shall meet requirements of UL 464. The audible signal shall be the "American National Standard Audible Emergency Evacuation Signal" (three-pulse temporal pattern) in accordance with ANSI S3.41, Audible Emergency Evacuation Signal.
- C. Strobe signal output and flash rate shall meet UL 1971 and ADAAG requirements. Unit shall have a xenon flash tube enclosed in a clear Lexan lens with "FIRE" in white lettering, and shall produce a synchronized strobe flash. Provide strobes with flash output levels as required to meet NFPA 72 visual signal requirements for each space.
- D. Horn/strobe shall mount to a 4" x 2-1/8" deep electrical box with single device cover. Provide weatherproof wall boxes for outdoor mounting.

2.8 CONDUIT

- A. Install fire alarm wiring in conduit. Minimum conduit size 3/4 inch.
- B. Refer to Section 260533, Electrical Conduits.

2.9 JUNCTION BOXES

- A. Refer to Section 260533.13, Boxes Electrical Systems, for junction boxes.

2.10 TEST EQUIPMENT

- A. Provide any special test equipment manufactured by the fire alarm equipment manufacturer for maintenance, testing, or troubleshooting.

2.11 SURGE PROTECTION

- A. Provide a UL 1449 listed 120V surge protective device for the main FAP, each sub-FAP, and each booster power supply that has a 120V supply circuit.
 1. Device shall be capable of absorbing a maximum single pulse of at least 6,500 amperes.
 2. Clamping voltage shall not exceed 330 volts line-to-neutral when tested in accordance with ANSI/IEEE C62.31 category C1/B3.
 3. Manufacturer: as recommended by the FAP manufacturer.
- B. Provide a UL 497B listed surge protective device for each analog initiating device signaling circuit entering/leaving each building that is monitored by the FAP.
 1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 2. Clamping voltage shall not exceed 30 volts.
 3. Capacitance shall not exceed 50pf.
 4. Provide matching receptacle for plug-in surge protective devices.
 5. Manufacturer: as recommended by the FAP manufacturer.

- C. Provide a UL 497B listed surge protective device for each 24-volt initiating device circuit or control circuit entering/leaving each building that is monitored by the FAP.
 - 1. Device shall be capable of absorbing a peak 8x20 microsecond current of not less than 10,000 amperes at least 10 times.
 - 2. Clamping voltage shall not exceed 30 volts.
 - 3. Provide matching receptacle for plug-in surge protective devices.
 - 4. Manufacturer: as recommended by the FAP manufacturer.

- D. Provide a UL 497B listed surge four-wire protective device for each FAP RS-232 circuit entering/leaving each building monitored by the FAP.
 - 1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 - 2. Clamping voltage shall not exceed 20 volts for RS-232 applications.
 - 3. Provide matching receptacle for plug-in surge protective devices.
 - 4. Manufacturer: as recommended by the FAP manufacturer.

- E. Provide a UL 497B listed surge four-wire protective device for each FAP RS-485 circuit entering/leaving each building monitored by the FAP.
 - 1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 - 2. Clamping voltage shall not exceed 8 volts for RS-485 applications.
 - 3. Line to line and line to ground capacitance shall not exceed 50pf.
 - 4. Provide matching receptacle for plug-in surge protective devices.
 - 5. Manufacturer: as recommended by the FAP manufacturer.

- F. Provide a UL 497B listed surge protective device for each 24-volt notification appliance circuit entering/leaving each building that is monitored by the FAP.
 - 1. Protective device shall have a series resistance not exceeding 0.2 ohms per pair and shall be capable of carrying a continuous current of 5 amperes.
 - 2. Device shall be capable of absorbing a peak 8/20 microsecond current of 5000 amperes and a 2000-ampere occurrence at least 50 times.
 - 3. Clamping voltage shall not exceed 43 volts.
 - 4. Provide matching receptacle for plug-in surge protective devices.
 - 5. Manufacturer: as recommended by the FAP manufacturer.

- G. Provide a single-point ground bus for each enclosure containing one or more surge protective devices. Manufacturer: as recommended by the FAP manufacturer.

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

- A. Prior to installation carefully inspect the installed work of other trades, whether pre-existing or part of this project and verify that such work is complete to the point where the installation of the fire alarm system may properly commence.
- B. Notify the City Representative if conditions exist, not resulting from work of this project, that prohibit the installation from conforming to applicable codes, regulations, standards, and the original, approved design.

3.2 INSTALLATION

- A. General:
 - 1. Install the fire alarm system in accordance with the NEC, NFPA 72, and this specification.
 - 2. Follow Division 26 Section "Common Work Results for Electrical", for anchorage requirements.
 - 3. Verify dimensions in the field. Lay out work in the most direct and expeditious manner to avoid interference.
 - 4. Coordinate necessary shutdowns of existing systems by notifying the City Representative a minimum of 10 working days before rendering such systems inoperative. Do not render inoperative any system with-

out the prior approval of the City Representative. The City Representative will initiate and submit the Utility Outage Request for Fire Protection.

5. Coordinate fire alarm detectors and associated equipment with existing ceiling or roof materials, lighting, ductwork, conduit, piping, suspended equipment, structural and other building components.
6. Coordinate installation of fire alarm system with work of other trades. Protect fire alarm equipment with suitable coverings until completion of Project.
7. Install initiating devices, control panels, audible signals, connections to equipment provided under other divisions, and related work following equipment manufacturers' requirements for a complete and properly functioning system that will perform specified functions.

B. Device Mounting Heights:

1. Install manual pull stations with center 44 inches above finished floor.
2. Install combination audible/visual notification appliances with the bottom 84 inches above finished floor or 6 inches below ceiling, whichever is lower. In high bay type areas the devices may be installed at a maximum of 96 inches above the floor. Any deviations from these heights require approval from the City Representative.
3. Comply with ADA Accessibility Guidelines (ADAAG) for device mounting heights and locations.

C. FAP Installation

1. Install FAP following manufacturer's written instructions, NFPA 72, and the NEC.
2. Locate the FAP in the main building lobby or entry vestibule so fire department personnel entering the building can readily access it. Coordinate location of FAP with the LBNL Fire Department.
3. Install FAP with top of cabinet trim 66 inches above finished floor. Refer to manufacturer's recommended installation height.
4. Mount FAP plumb and rigid without distortion of the box. Mount flush cabinets uniformly flush with wall surfaces.
5. Install filler plates in unused spaces in FAP.
6. Train conductors in cabinet gutters neatly in groups; bundle and wrap with cable ties after completion of testing.
7. Tighten electrical connectors and terminals, including grounding connections, according to the manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.
8. Control and other panels shall be mounted with sufficient clearance for observation and testing. Fire alarm junction boxes shall be clearly marked for distinct identification. Wiring shall be in conduit. Box and fitting covers shall be painted RED.

D. Control Relays: Install in a readily accessible location and height acceptable to the City Representative.

E. Wiring Installation:

1. Install fire alarm system wiring in conduit raceway.
2. Do not pull wire or cable until the conduit system is complete between pull points.
3. Bundle conductors in panels and boxes into groups by service and destination.
4. Run electronic cable continuous between termination points. No splicing is permitted without prior approval from the City Representative. Where splicing is approved, use terminal strips that are acceptable to the City Representative. Do not use "wire nuts."
5. Do not install AC current-carrying conductors in the same raceway with the DC or digital fire alarm detection and signaling conductors.
6. All wires and cables shall be installed in the City approved raceways. Fire alarm circuit shall be installed in dedicated raceways, and shall not be mixed with other raceway systems wiring. Initiating and notification devices wiring shall be installed in separate conduits. Refer to the appropriate Division 26 Section for raceway requirements.
7. Circuit each addressable analog loop so device loading shall not exceed 80% of loop capacity in order to leave for space for future devices--the loop shall have Class B operation. Where it is necessary to interface conventional devices provide intelligent modules to supervise Class B wiring.
8. Minimize the number of T-taps in fire alarm addressable data circuits and adhere to the manufacturer requirements/limitations. Make no T-taps in notification appliance circuits. T-taps shall only be made on device terminals or on terminal strips that are acceptable to the City Representative, do not use "wire nuts."

9. Make allowances in conductor length at panels and other enclosures to permit forming the conductors neatly within the enclosures. Where wiring troughs are not provided with the enclosures, neatly cable and adequately support the wiring.
 10. Ring out and identify power and control conductors before terminal connections are made. Check polarity and phasing and make changes as required before making terminal connections.
 11. Test conductors for continuity and for freedom from shorts or unintentional grounds.
- F. Junction Box and Conduit Installation:
1. Refer to Section 26 0533, Raceway and Boxes for Electrical Systems, requirements. Provide minimum 3/4" fire alarm system conduit.
 2. Assure that conduit size and wire quantity, size, and type are suitable for the equipment supplied and conform to equipment suppliers' requirements. No wiring other than fire alarm circuits shall be permitted in the fire system conduits; 120V circuits shall be in separate fire alarm conduits. Wiring splices shall be kept to minimum and shall be performed per E.4 above.
- G. Install audible and visual notification appliances in the following locations to obtain an audible signal level that is at least 15 dB above ambient but does not exceed 120 dB at any location:
1. Corridors
 2. Conference rooms
 3. Mechanical equipment rooms
 4. Computer rooms
 5. Enclosed offices where dB levels are questionable
 6. Common areas such as restrooms (strobes only)
 7. Use a strobe-only device in the vicinity of the FAP
 8. Laboratories, cold rooms, warm rooms, hatches
- H. End-of-line devices, for either initiating or indicating/notification appliance circuits, shall be mounted only in the control panel or the transmitter panel.
- I. Automatic Detector installation shall conform to NFPA 72.
- J. Surge Protective Device (SPD) Installation
1. Install a 120V SPD for the main FAP, each sub-FAP, and each booster power supply.
 2. Install an SPD for each initiating device circuit, notification appliance circuit, data, and signaling line circuit entering/leaving each building that is monitored by the FAP.
 3. SPDs shall be installed so that they are readily accessible for servicing.
 4. Install SPDs outside the FAP cabinet. Install one or more metal enclosures near the protected fire alarm equipment. Provide separate enclosures for 120V and signal voltage devices, no exception is permitted.
 5. Install a single-point ground bar in the enclosure for the SPD. Bond the ground bar to the enclosure and to the power circuit equipment-grounding conductor. Connect each SPD to the ground bar with a separate 12 AWG solid, green-insulated ground wire. Keep ground wires as short and straight as possible.
 6. Install SPDs in accordance with manufacturer's instructions, keeping leads and ground conductors as short and straight as possible.
- K. Mount outlet box for electric door holder to withstand 80 pounds (36.4 kg) pulling force.
- L. Make conduit and wiring connections to initiating devices, indicating/notification appliances, door release devices, sprinkler flow switches, sprinkler valve tamper switches, and duct smoke detectors.
- M. Solid conductors terminated at screwed connections of any type shall be formed about the screw shank in a clockwise direction. Stranded conductors shall be terminated with a pressure-applied lug connector, applied with a tool approved for the use by the lug connector manufacturer and the City.
- N. Identification
1. Follow Section 26, Electrical Systems, for all system identification of all system components.
 2. Label each conductor at each terminal and junction point. Use wire markers specified in Section 26, Electrical Systems. On wire markers indicate the type of fire alarm circuit (e.g. Pull Stations, Fan Shut-down, Alarm Strobes, etc.).

3. Mark floor in front of cabinet(s) to show the NEC required working clearances according to Section 26, Electrical Systems.
 3. Identify fire alarm equipment devices by means of 3/32 inch (3 mm) thick red laminated phenolic nameplate with white core. Engrave fire alarm panel identification using a minimum size of 1 inch (25 mm) character height, Helvetica style font. Attach nameplates with No. 4-36 RH nickel plated brass machine screws.
 4. Label all devices with address/zone information. Device numbers shall be a minimum of 3/16 inch (5 mm) size and fire alarm zone numbers shall be 1/4 inch (7 mm) size.
- O. All wiring shall be checked and tested to ensure that there are no grounds, opens, or shorts. The minimum allowable resistance between two conductors or between conductors and grounds is 10 mega-ohms, as checked with a 250V mega-ohm meter. This test shall be made after conduit, wire, etc. are installed, but before alarm initiators are plugged in.
- P. All tests shall be performed and recorded in the presence of a City representative.

3.3 PAINTING

- A. Exposed Surfaces: Paint exposed fire alarm conduit, panels, cabinets, pullboxes, supports, and other electrical equipment as follows:
1. Galvanized Surfaces: Paint for repairing galvanized materials shall be zinc-rich type.
 2. Refinishing: Thoroughly clean and touch up shop-primed or finish-painted surfaces damaged in handling or installation with paint supplied with the equipment or an approved matching paint.
 3. Interior Conduit: Paint new exposed interior conduit in rooms finished and/or occupied to match the existing background paint color. Paint conduit to be painted with one coat of primer. Paint conduit to match the existing background colors with two coats of paint to provide a minimum thickness of 6 mils.
 4. Box and conduit body covers shall be painted Red.

3.4 EQUIPMENT INSTALLATION

- A. Install devices or equipment not specifically covered by these specifications in accordance with manufacturer's instructions.

3.5 CONNECTION TO LBNL CENTRAL STATION

- A. Install 6 x 6 x 4 enclosure adjacent to the FAP with a conduit to the appropriate factory knockout.
- B. Install a 3/4 inch conduit with measuring pull tape from the 6 x 6 x 4 enclosure to the main telecommunications room.
- C. Install one GFE Category 5e telecommunications cable in the conduit and label each end of the cable as "emergency."
- D. City will terminate the telecommunications cable on two 8-pin RJ-31X telephone outlet jacks in a 2-port outlet that is mounted inside the 6 x 6 x 4 enclosure. City will label one jack as "primary," and the other as "backup."
- E. City will terminate the telecommunications cable pairs to two separate lines (numbers) at the telecommunications room, selecting dedicated numbers or low-usage (lobby, conference room, etc), voice-grade, loop-start DTMF numbers that provide timed-release disconnect.
- F. City will connect the "primary" and "secondary" number ports on the DACT to the corresponding telephone outlet jacks.

3.6 CLEANING

- A. Blow out junction boxes and fire alarm equipment not hermetically sealed with clear, dry, oil-free (15 psig maximum) air to remove dust and dirt prior to energizing.

3.7 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory trained and certified technician for the FAP installed on this project. The factory technician shall assure the completeness and correctness of the installation by performing the following:
 - 1. Prepare as-built documentation of FAP indicating location of components, interconnection of components, and connections to alarm initiating, indicating and auxiliary circuits.
 - 2. Field-verify and mark as-built drawings of fire alarm layout, conduit and wiring plans, and point-to-point field-wiring diagrams.
 - 3. Verify correct labeling of fire alarm system conductors.
 - 4. Verify that conductor sizes are adequate for each alarm initiating, indicating and auxiliary circuit.
 - 5. Prepare as-built battery load calculations. Battery shall be sized to include the additional 50% safety margin above calculated system demand.
 - 6. Measure and adjust audible alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient, but not over 120 dBA at any location.
 - 7. Test all devices for proper supervision and alarm operation.
 - 8. Test all interlocks with HVAC and elevator system for proper operation in normal and by-pass modes.
 - 9. Perform pre-final acceptance inspections and tests of the fire alarm system modifications.
 - 10. Prepare final acceptance test plan.
- B. After the pre-final test, provide a report to the City representative indicating the status of the fire alarm system and any corrective actions required before the acceptance tests.
- C. Submit a detailed test plan for the final acceptance test.
- D. Submit the test plan not less than 10 working days before the planned final acceptance date.
- E. Follow test methods outlined in NFPA 72.
- F. Submit FAP program at least two weeks prior to final acceptance test.
- G. Submit final drawings, calculations, and manufacturer's data at least one week prior to final acceptance test.
- H. Coordinate date of final acceptance test with installer, CITY representatives (LBNL Fire Protection Engineer and Fire Marshall), and subcontractors for HVAC, sprinklers, and elevator controls. Make corrective actions before final acceptance test date.

3.8 TESTS AND REPORTS

- A. Tests shall be made in the presence of an LBNL Inspector or the Project Manager's designated representative. The application or interruption of power shall be programmed and directed by the Project Manager and in accordance with the approved EVAP, inclusive of the Equipment Energization Plan and necessary permits, work tasks and safety compliance steps.
- B. Notify CITY at a minimum of 2 weeks in advance of final acceptance tests. The more advance notice will help minimize scheduling conflicts and delays. Perform final acceptance tests in the presence of authorized representatives of LBNL Fire Protection Engineer and Fire Marshall.
- C. Before the final acceptance test begins, present a preliminary copy of the Record of Completion to the authorized representative of the LBNL Fire Protection Engineer.
 - 1. Preliminary Record of Completion shall be of the form required by NFPA 72.
 - 2. Indicate on the preliminary Record of Completion that the pre-final inspections and tests have been performed and all corrective actions have been completed.
 - 3. The final acceptance test shall not proceed before the Record of Completion is presented to the authorized representative of the LBNL Fire Protection Engineer.
- D. The Subcontractor shall perform electrical and mechanical tests required by NFPA 72, and the equipment manufacturer's installation procedures.
 - 1. Perform final acceptance tests on the completed fire alarm system:
 - a. Follow the approved test plan and comply with NFPA 72 requirements.

- b. Test FAP and the connected initiating, alarm, and auxiliary devices.
 - c. Perform 24-hour discharge test on the FAP batteries.
 - d. LBNL Fire Protection will perform tests on connections made by other LBNL groups.
 - e. LBNL Telecommunications Group will perform the acceptance test of the telephone lines from the modular plug connectors, to verify telephone line continuity and switch features before turning lines over to the LBNL Fire Alarm Group.
2. The Subcontractor shall measure and adjust each of the ionization detectors to the maximum stable sensitivity setting. This must be performed at the operational location of the unit and under normal operational environmental conditions in the area. Bench settings are not acceptable.
 3. All test and report costs shall be included in the subcontract price. A checkout report shall be prepared by the technician and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. This report shall include, but not be limited to:
 - a. A complete list of equipment installed and wired.
 - b. Indication that equipment is properly installed and functions and conforms with these specifications.
 - c. Tests of individual zones as applicable.
 - d. Serial numbers, locations by zone, and model number for each installed detector.
 - e. Voltage (sensitivity) settings for each ionization detector as measured in place with air conditioning system operating.
 - f. Response time on thermostats, flow switches, and flame detectors (if used).
 - g. Technician's name, certificate number, and date.

3.9 SYSTEM ACCEPTANCE

- A. Procedure for the Acceptance Tests shall be submitted for CITY's approval. Tests shall be performed in the presence of the CITY representative.
- B. At the final acceptance test, have marked-up shop drawings and point-to-point wiring diagrams available for review and verification. Final acceptance test will not proceed without these as-built documents. If City verification of the as-built documents reveals errors, re-verify the complete fire alarm raceway and wiring system in the presence of a City representative.
- C. The completed smoke detection system shall be tested to ensure that it is operating properly. The testing shall consist of exposing the installed smoke detection units to the standard test per requirements of NFPA 72.
- D. Acceptance of the system shall also require a demonstration of the operation and stability performance of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Subcontractor shall readjust or replace the detector(s) and begin another ninety (90) day test period.
- E. As required by the CITY, the Subcontractor shall recheck the detectors using the installation standard test after each readjustment or replacement of detectors. This test shall not start until the City has obtained beneficial use of the building under test.
- F. Correct deficiencies discovered in the final acceptance test and re-test fire alarm system until satisfactory test results are obtained.
- G. Upon successful completion of acceptance tests, submit final "Record of Completion" and "Inspection and Testing Form" and "recommended spare parts" list per Para 1.4.N.
- H. If the requirements of the above paragraphs are not completed within one (1) year after beginning the tests described therein, the Subcontractor shall replace the system, and the process shall be repeated until acceptance of the equipment by the CITY.

3.10 SYSTEM IDENTIFICATION PLACARD

- A. Furnish and install a permanently mounted placard in or adjacent to the fire alarm control cabinet.

- B. Provide the following information typewritten or engraved on the placard:
 - 1. Name, address and telephone number of installing subcontractor.
 - 2. Reference to the standards, including date of issue to which the system conforms (e.g. NFPA 72 and NFPA 70, latest edition).
 - 3. Circuit number of power supply to FAP and location of the electrical panelboard.
 - 4. Location of fire alarm system Operating and Maintenance Instructions if they are not stored in the FAP cabinet.
 - 5. Location of fire alarm system as-built documents.

3.11 OPERATION AND MAINTENANCE TRAINING

- A. Formal operation and maintenance training shall be conducted by the vendor or manufacturer's representatives within two weeks of the date of activation of equipment. An outline of the proposed program shall be submitted for approval at least two weeks before date of commencement of training.

3.12 FINAL SUBMITTALS

- A. After completion of the tests and adjustments listed above, the Subcontractor shall submit the following information to the CITY within two weeks after equipment acceptance date.
- B. As-built conduit layout diagrams including wire color code and/or tag number.
- C. Complete as-built wiring diagrams.
- D. Detailed catalog data on installed system components.
- E. Copy of the test report described in Paragraph 3.3.
- F. "Operating and Shop Manuals". Each manual shall contain, but not be limited to the following:
 - 1. Statement of Warranty including date of termination.
 - 2. Name address and phone number of the service representative to be called in the event of equipment failure.
 - 3. Individual factory-issued Installation, Operational and Maintenance manuals containing technical information for each piece of equipment. The specific model number and the serial numbers of the equipment shall be stated on the O&M manual of the specific equipment. Advertising brochures or generic manual shall not be used in lieu of the required technical manuals.
 - 4. Overall system logic diagrams.
 - 5. System start-up, operating and shutdown Procedures.
 - 6. System troubleshooting guide.

END OF SECTION 13850

SECTION 15010 BASIC MECHANICAL MATERIALS

PART 1 - GENERAL

1.01 SCOPE:

- A. The CONTRACTOR shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, lining and coating, testing, disinfection, excavation, and backfill to provide a functional installation.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01300 – Submittals
 - 1. SECTION 02200 - Earthwork
 - 2. SECTION 02220 – Excavation and Backfill
 - 3. SECTION 02221 – Trenching, Backfilling and Compacting
 - 4. SECTION 15020 – Pipe Supports and Penetrations
 - 5. SECTIONS DIVISION 15 - Mechanical
 - 6. SECTIONS DIVISION 16 - Electrical

1.02 GENERAL:

- A. See Conditions of the Contract and DIVISION 1, General Requirements, and SECTION 15020, which contain information and requirements that apply to the WORK specified herein and are mandatory for this Project.
- B. Like items of material provided hereunder shall be the end products of one MANUFACTURER.
- C. All equipment shall be properly installed, completely interconnected and placed in working order. Workmanship and materials not covered by the specifications or standards herein shall conform to the highest standards of modern practices for WORK of similar character.
- D. Coordination with Other Work: The piping shall be installed in the most direct manner. Interference between structural features and other trades shall be avoided.
- E. Workmanship: Pipe shall be cut accurately to measurements established at the structure by the CONTRACTOR and shall be installed without inducing stress into valves or fittings. Anchors and branches shall be located and installed with due consideration for pipe temperature and future expansion. Pipe shall have the burrs removed by reaming and shall be cut into proper lengths by the use of a wheel-type mechanical cutting tool or other approved device. Piping, valves, and fittings that have not been sealed at the factory shall be thoroughly cleaned with a solvent-soaked cloth or pipe brush prior to installation. Materials shall be installed in accordance with the MANUFACTURER's recommendations. The pipe alignment shall be such that there will be no perceptible bends or kinks. Misalignment will be cause for rejection, and rework of the piping sections involved will be required.
- F. All special valves, controllers, fittings, equipment, etc., shall meet the following requirements:
 - 1. Furnished, installed, tested, and put into successful operation.
 - 2. Be complete with all necessary miscellaneous pipe, valves, unions, fittings, auxiliaries, etc., whether indicated or not, but required.
 - 3. Be insulated and covered in accordance with the pipe system to which they attach.
- G. Furnish and install piping connected to accessories, which must vary from the Drawings because of requirements peculiar to the particular equipment furnished, as required to make a complete and workable installation at no additional cost to the CITY. This requirement shall include changes required in the piping systems because of design changes made by the MANUFACTURER between the time of design and the time of Installation or because of equipment furnished of different MANUFACTURER than that specified.

- H. Furnish control valves complete including pilot lines, solenoid valves, shutoff valves, operators, etc., whether or not specific mention was made of these items. All control valves shall be by the same MANUFACTURER.
- I. Furnish the necessary pipe and fittings required to install all safety and relief valves in a vertical position. Furnish and route tail pipes to a place where the discharge will not injure personnel or as indicated.
- J. Where spare, replacement, or additional parts are required for the equipment specified herein, deliver these items to the CITY immediately upon receipt at the jobsite. Parts shall be packaged and sealed for long storage and be securely and visibly labeled as to part, function, and name of equipment to which they apply.
- K. Equip all Y-type strainers, four (4) inches and larger, with blow-down valves and piping.

1.03 STANDARDS, SPECIFICATIONS, AND CODES:

- A. The CITY will obtain any variances imposed by Site constraints.

1.04 APPLICABLE STANDARDS AND PUBLICATIONS:

- A. Standards or Codes: The edition of the publications of the organizations listed below in effect at the time of the advertisement for bids form a part of this specification to the extent referenced. See the various paragraphs for the specified standard. In the case of a conflict between the requirements of this SECTION and those of the listed document, the requirements of this SECTION shall prevail.
 - 1. American Society of Mechanical Engineers (ASME)
 - a. B1.20.1 – Standards for Pipe Threads, General Purpose, Inch
 - b. B16.1 - Standards for Cast Iron Pipe Flanges and Flanged Fittings
 - c. B16.3 – Standards for Malleable Iron Threaded Fittings
 - d. B16.11 – Standards for Forged Steel Fittings, Socket-Welding and Threaded
 - e. B16.18 - Standards for Cast Copper Alloy Solder Joint Pressure Fittings
 - f. B16.22 - Standards for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - g. B16.26 - Standards for Cast Copper Alloy Fittings for Flared Copper Tubes
 - h. B31.1 – Standards for Power Piping
 - i. B36.10 – Standards for Welded and Seamless Wrought Steel Pipe
 - 2. American Society for Testing and Materials (ASTM)
 - a. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 - c. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 - d. A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - e. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 - f. B32 - Standard Specification for Solder Metal
 - g. B88 - Standard Specification for Seamless Copper Water Tube
 - h. C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - i. D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
 - j. D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

- k. D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - l. D2000 - Standard Classification System for Rubber Products in Automotive Applications
 - m. D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - n. D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - o. D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
 - p. D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
 - q. D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
 - r. D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
 - s. F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
 - t. F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
 - u. F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
 - v. F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
 - w. F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
3. American Welding Society (AWS)
 - a. D1.1 - Structural Welding Code - Steel
 4. American Water Works Association (AWWA)/ American National Standards Institute (ANSI)
 - a. C104/ANSI 21.4 - Standards for Cement Mortar Lining For Ductile Iron Pipe And Fittings For Water
 - b. C105/ANSI 21.5 - Standards for Polyethylene Encasement For Ductile-Iron Pipe Systems
 - c. C110 - Standards for Ductile-Iron And Gray-Iron Fittings
 - d. C115 - Standards for Flanged Ductile Iron Pipe with Ductile-Iron Or Gray-Iron Threaded Flanges
 - e. C207- Standards for Steel Pipe Flanges For Waterworks Service Sizes 4 Inch Thru 144 Inch (100 Mm Thru 3,600 Mm)
 - f. C800 - Standards for Underground Service Line Valves and Fittings
 5. National Fire Protection Association (NFPA)
 - a. 54 - National Fuel Gas Code

1.05 **SUBMITTALS:**

- A. Submit as specified in SECTION 01300.
- B. MANUFACTURER's data for approval before any WORK is commenced.
- C. When any material is specified to comply with applicable standards, codes, or laws, MANUFACTURER's submittal must clearly state such compliance.
- D. The CONTRACTOR shall submit complete Shop Drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements in the SECTION 01300 and as specified in the individual piping sections.

- E. Data to be submitted shall include, but not be limited to:
1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various piping components and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 2. Complete layout and installation drawings with clearly marked dimensions and elevations. Piece numbers, which are coordinated with the tabulated pipe layout schedule, shall be clearly marked. Piping layout drawings shall indicate the following additional information; pipe supports, location, support type, hanger rod size, insert type and the load on the hanger in pounds.
 3. Weight of all component parts.
 4. Design calculations above specified.
 5. Tabulated pipe layout schedule that shall include the following information for all pipe fittings; service, pipe size, working pressure, wall thickness and piece number.
- F. Shop Drawings:
1. The CONTRACTOR shall submit to the CITY for approval, in accordance with the special clauses, complete piping drawings of each piping system as shown on the Drawings. They shall be construction drawings showing locations, dimensions, and details of all runs of piping, with pipe sizes, fittings, valves, and supports shown. The MANUFACTURER's catalog number of all valves, hangers, supports and other items shall be submitted for approval.
 2. Each Shop Drawing submittal shall be complete in all aspects incorporating all information and data listed herein and all additional information required to evaluate the proposed piping material's compliance with the Contract Documents. Partial or incomplete submissions will be returned to the CONTRACTOR without review.
- G. Certifications: Prior to installation, the CONTRACTOR shall furnish an Affidavit of Compliance certified by the pipe MANUFACTURER that the pipe, fittings and specials furnished under this Contract comply with all applicable provisions of AWWA and these specifications. No pipe or fittings will be accepted for use in the WORK on this Project until the affidavits have been submitted and accepted in accordance with the SECTION 01300.
- H. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.06 QUALITY ASSURANCE:

- A. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.
- B. Welding Requirements: All welding procedures used to fabricate pipe shall be pre-qualified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for but not necessarily limited to longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- C. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, acceptable testing agency nor more than twelve (12) months prior to commencing WORK. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.07 MANUFACTURER'S SERVICE REPRESENTATIVE:

- A. Where the assistance of a MANUFACTURER's service representative is advisable, in order to obtain correct pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the CITY.

1.08 PRODUCT STORAGE AND HANDLING:

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps in place through shipping, storage and handling to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses. Damaged pipe will be rejected and shall be replaced at the CONTRACTOR's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- C. No pipe shall be dropped from cars or trucks to the ground. All pipes shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or lining. Any broken or chipped lining shall be carefully patched. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use.
- D. Where possible, store pipe, valves, fittings, and equipment inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable waterproof wrapping.

1.09 WARRANTY:

- A. The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All piping shown, but not sized on the Drawings, shall be properly sized for the function to be performed and, unless otherwise specified herein or approved, shall be standard weight steel galvanized using standard 150 pound malleable iron screwed galvanized fittings. Valve types to be used are herein specified and shown on the Drawings for their respective systems.
- B. Lining: All requirements pertaining to thickness, application, and curing of pipe lining, shall be in accordance with the requirements of the applicable SECTIONS of Division 15, unless otherwise specified.
- C. Coating: All requirements pertaining to thickness, application, and curing of pipe coating are in accordance with the requirements of the applicable SECTIONS of Division 15, unless otherwise specified. Pipes above ground or in structures shall be field-painted in accordance with the SECTION 09900.
- D. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined on the Piping Schedule shown at the end of this SECTION.
- E. The materials to be used for the piping systems shown on the Drawings are listed by service in the Piping Schedule shown at the end of this SECTION.
- F. Pipe furnished under this Contract shall conform to ASTM material specifications herein referenced. All wrought-steel pipes shall meet the standards set forth in ASME B36.10.

2.02 ACCEPTABLE MANUFACTURERS:

- A. MANUFACTURERS and model numbers specified herein are to establish quality and performance only. Products of MANUFACTURERS regularly engaged in their manufacture are acceptable if proven to the CITY as equal or better quality and performance and as stated in the General Conditions.

2.03 PIPING REQUIREMENTS:

- A. Sanitary Drain, Waste and Vent: **PVC gravity pipe**
- B. Sump Pump Discharge: PVC pressure pipe
- C. Storm Water: **PVC gravity pipe**

D. Non-Potable Water:

1. Three (3) Inches and Larger:

- a. Pipe: Ductile iron pipe or PVC pressure pipe
- b. Stop Valves:
 - i. Ball Valves
 - a) Class 150 flanged ends, ductile iron body, full port, PTFE seat, American Valve No. 4000D or equal.
 - ii. Check Valves
 - a) Class 150 ductile iron, body swing type, flanged ends, bolted bonnet, Nibco F-938-31 or F-938-33 or equal by Nordstrom, Crane, Stockham, Jenkins, Walworth or Lunkenheimer.
 - iii. Butterfly Valves
 - a) 200 psi cold working pressure, ductile iron, PTFE seat, lug style body, handwheel gear operated, Stockham LD-722 or equal by Nibco, Crane, Jenkins, Center Line or Nordstrom.

2. Less than three (3) Inches:

- a. Pipe: Copper pipe or PVC pressure pipe
- b. Joints: Threaded or flanged adapters for valves.
- c. Fittings: Wrought copper or bronze.
- d. Stop Valves:
 - i. Ball Valves
 - a) 600 psi cold working pressure, bronze, threaded ends, TFE seat, Nibco T-580 or equal by Jamesbury or Gemini.
 - ii. Globe Valves
 - a) Class 150, bronze, union bonnet, PTFE disc, threaded ends, Crane 7TF or 17TF or equal by Lunkenheimer.
 - iii. Check Valve
 - a) Class 150, swing check type, threaded cap and ends, brass/bronze disc, Crane No. 137 or equal by Crane, Jenkins, Walworth or Lunkenheimer.

E. Potable Water:

1. Three (3) Inches and Larger:

- a. Pipe: Ductile iron pipe or PVC pressure pipe
- b. Stop Valves:
 - i. Ball Valves
 - a) Class 150 flanged ends, ductile iron body, full port, PTFE seat, American Valve No. 4000D or equal.
 - ii. Check Valves
 - a) Class 150 ductile iron, body swing type, flanged ends, bolted bonnet, Nibco F-938-31 or F-938-33 or equal by Nordstrom, Crane, Stockham, Jenkins, Walworth or Lunkenheimer.
 - iii. Butterfly Valves
 - a) 200 psi cold working pressure, ductile iron, PTFE seat, lug style body, handwheel gear operated, Stockham LD-722 or equal by Nibco, Crane, Jenkins, Center Line or Nordstrom.

2. Less than three (3) Inches:

- a. Pipe: Copper pipe or PVC pressure pipe, ASTM B88, Type K, annealed or drawn.
- b. Joints: Threaded or flanged adapters for valves.

- c. Fittings: Wrought copper or bronze.
- d. Stop Valves:
 - i. Ball Valves
 - a) 600 psi cold working pressure, bronze, threaded ends, TFE seat, Nibco T-580 or equal by Jamesbury or Gemini.
 - ii. Globe Valves
 - a) Class 150, bronze, union bonnet, PTFE disc, threaded ends, Crane 7TF or 17TF or equal by Lunkenheimer.
 - iii. Check Valve
 - a) Class 150, swing check type, threaded cap and ends, brass/bronze disc, Crane No. 137 or equal by Crane, Jenkins, Walworth or Lunkenheimer.
- 3. Hot Water:
 - a. Pipe: Copper pipe or CPVC pressure pipe.
- F. Refrigerant Piping: Copper pipe.
- G. T & P Relief Valve Piping: Copper pipe.
- H. Air Conditioning Condensate: PVC gravity pipe.
- I. Vacuum:
 - 1. Two (2) Inches and Smaller:
 - a. Pipe: Schedule 40 seamless or electric resistance welded carbon steel, ASTM A53, Grade A.
 - b. Joints: Screwed or mechanical joints.
 - c. Fittings: Class 150, malleable iron screwed fittings and unions of malleable iron mechanical joint fittings.
 - d. Stop Valves:
 - i. Gate Valves
 - a) ¼ inches through two (2) inches – Class 200 bronze, threaded ends, non-rising stem, union bonnet, one-piece wedge disc, Stockham No. B-140 or equal by Crane, Jenkins, Walworth or Lunkenheimer.
 - ii. Ball Valves
 - a) ¼ inches through two (2) inches – 600 psi cold working pressure, bronze, threaded ends, TFE seat, Nibco T-560-BR or equal by Hills McCanna, Jamesbury, or Gemini.
 - iii. Plug Valves
 - a) ¼ inches through two (2) inches – 500 psi cold working pressure, threaded ends, wrench operated, Nordstrom No. 524 or equal by Crane, Jenkins, Walworth or Lunkenheimer.
 - iv. Check Valves
 - a) ¼ inches through two (2) inches – Class 150, bronze, swing check valve, threaded cap, threaded ends, Crane No. 137 or equal by Nordstrom, Jenkins, Walworth or Lunkenheimer.
 - e. Solenoid Valves:
 - i. Vent line valves shall be normally open type.
 - ii. Isolation valves shall be normally closed type.
 - 2. 2-1/2 Inches and Larger:
 - a. Pipe: Seamless or electric resistance welded carbon steel, Schedule 40, ASTM A53, Grade A.

- b. Joints: Butt-welded or mechanical joint. Flanged where indicated.
- c. Fittings: Butt welded of same size, thickness and material grade as line fitting serves or mechanical joint carbon steel fittings. Flanged where specified or indicated.
- d. Flanges: Weld neck or slip-on.
- e. Gaskets: Synthetic fiber with SBR binder.
- f. Stop Valves:
 - i. Gate Valves:
 - a) 2-1/2 inches through twelve (12) inches - Class 250 cast-iron, bronze trimmed, bronze seats, bronze stem, flanged ends, outside screw and yoke, Crane No. 7-1/2E or equal by Nordstrom, Stockham, Jenkins, Walworth or Lunkenheimer.
 - ii. Ball Valves:
 - a) 2-1/2 inches through four (4) inches – 400 cold working pressure, full port threaded ends, stainless ball and stem, Jenkins No. 201SJ or equal by Nordstrom, Crane, Stockham, or Walworth.
 - b) Six (6) inches through twelve (12) inches – Class 300, flanged ends, PBV Trunnion Series 5700/6700 or equal by other MANUFACTURERS.
 - iii. Plug Valves:
 - a) 2-1/2 inches through four (4) inches – Screwed gland, cast-iron plug valve, Class 250 flanged ends, wrench operated, Nordstrom No. 305 or equal by Walworth, Crane, Stockham, Jenkins or Lunkenheimer.
 - b) Six (6) inches through eight (8) inches – High-strength cast-iron lubricated plug valve, Class 250 flanged ends, wrench operated, Walworth No. 2721F or equal by Crane, Stockham, Jenkins or Lunkenheimer.
 - c) Ten (10) inches through twelve (12) inches – Cast-iron plug valve, Class 250 flanged ends, wrench operated, Nordstrom No. 1589 or equal by Crane, Stockham, Jenkins or Lunkenheimer.
- g. Check Valves:
 - a) 2-1/2 inches through six (6) inches - Class 250 cast-iron, swing type, flanged ends, bolted cap, bronze trim, Crane No. 39E or equal by Nordstrom, Stockham, Jenkins, Walworth or Lunkenheimer.
 - b) Eight (8) inches through twelve (12) inches – Class 300 stainless steel, swing type, flanged ends, bolted cover, Aloyco No. 2377 or equal by Nordstrom, Crane, Stockham, Jenkins, Walworth or Lunkenheimer.
- h. Backing Rings: Split-ring type.

J. Seal Water Make-Up System:

- 1. Pipe: Schedule 40 seamless or electric resistance welded carbon steel ASTM A53, Grade A.
- 2. Joints: Screwed or mechanical joint.
- 3. Fittings: Class 150 malleable iron screwed fittings and unions or malleable iron mechanical joint fittings.
- 4. Stop Valves:
 - a. Gate Valves:
 - i. Class 200 bronze, threaded ends, non-rising stem, union bonnet, solid wedge disc, Stockham No. B-140 or equal by Crane, Jenkins, Walworth or Lunkenheimer.

2.04 PIPE AND FITTING MATERIALS:

A. Cast Iron Pipe and Fittings:

- 1. Hub and Spigot Type:
 - a. Pipe: ASTM A74 service weight.

- b. Fittings: Cast iron.
 - c. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
 - 2. Hubless Type:
 - a. Pipe: CISPI 301, service weight.
 - b. Fittings: Cast iron.
 - c. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. Plastic Pipe and Fittings:
 - 1. PVC Pressure Pipe and Fittings:
 - a. Pipe: ASTM D1785, Schedule 80.
 - b. Fittings: **ASTM D2467 socket type** Schedule 80.
 - c. Joints: ASTM D2855, solvent-weld with ASTM D2564 solvent cement.
 - 2. CPVC Pressure Pipe and Fittings:
 - a. Pipe: ASTM F441, Schedule 80.
 - b. Fittings: **ASTM F439 socket type**
 - c. Joints: ASTM D2846, solvent-weld with ASTM F493 solvent cement.
 - 3. PVC Gravity Pipe and Fittings:
 - a. Pipe: ASTM D2665.
 - b. Fittings: PVC.
 - c. Joints: ASTM D2855, solvent-weld with ASTM D2564 solvent cement.
 - 4. Polypropylene Pipe and Fittings:
 - a. Pipe: ASTM F1412, flame-retardant, Schedule 40.
 - b. Fittings: Polypropylene.
 - c. Joints: Thermo-seal fusion process.
- C. Copper Pipe and Fittings:
 - 1. Pipe: ASTM B88 seamless tubing, Type K annealed temper, or Type L annealed temper or drawn temper.
 - 2. Fittings:
 - a. Flare: ASME B16.26, cast bronze.
 - b. Compression: ANSI/AWWAC800, cast bronze.
 - c. Solder: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
 - 3. Solder: ASTM B32, Grade 95TA.
- D. Ductile Iron Pipe and Fittings:
 - 1. Pipe:
 - a. Buried: Designed in accordance with AWWAC150 and manufactured in accordance with AWWAC151; minimum thickness Class 52; mechanical joint or push-on joint.
 - b. Exposed: AWWAC115, flanged joint.
 - 2. Fittings: AWWAC110.
 - 3. Exterior Coating: Asphaltic for buried; factory-applied prime coat for exposed.
 - 4. Interior Lining: AWWAC104 cement mortar with seal coat.
 - 5. Joints:
 - a. Mechanical and Push-On: AWWAC111, rubber gasket.
 - b. Flanged: Appendix A of AWWAC115, and ANSI/ASME B16.1, Class 125; bolts and nuts zinc-plated; ductile iron flanges.
 - 6. Pipe, Fitting, and Appurtenances: Manufactured in the United States.

E. Steel Pipe and Fittings:

1. Buried:
 - a. Pipe: ASTM A53 Grade B, Schedule 40 black.
 - b. Fittings: ANSI B16.11, forged steel, or ASTM A234 Grade WPB forged steel welding type.
 - c. Joints: Welded.
 - d. Coating: Protect fittings, joints, and pipe repair with cold-applied, laminated tape; the Tapecoat Company, Tapecoat CT or Tapecoat CT 10 40W, or as approved.
 - e. Jackets: Epoxy type coating; 3M, Scotchkote 205 or 206W, or as approved.
 - f. Cathodic Protection: Anode bag for each section of buried steel pipe, nine (9) pound magnesium anode bag of high purity magnesium alloy, No. 12 copperlead wire with type Thermoplastic Water-resistant (TW) insulation, and dielectric unions installed where above ground and interior piping is connected to underground piping. Anode buried two (2) feet from pipe at or below trench depth, lead wire attached to pipe by thermite weld process using a maximum charge of fifteen (15) grams.
2. Exposed:
 - a. Pipe: ASTM A53, Schedule 40 black:
 - b. Fittings: ANSI B16.3, malleable iron, ANSI B16.11, forged steel, or ASTM A234 Grade WPB, forged steel welding type.
 - c. Joints: Threaded for three (3) inches and smaller; welded for over three (3) inches.

2.05 JOINTS:

- A. Pipe Joints for Exposed Piping: Flanged, or solvent welded, shall be used for pipe as indicated in this section.
- B. Pipe Ends for Buried Piping:
 1. Mechanical joints shall be used for all buried ductile iron pipe. Joints for buried pressure pipe shall be mechanical joints restrained by tie rods. Anchoring of retainer glands with setscrews is not acceptable.
 2. Within the limitations noted above, all pipe materials and joints do not necessarily have to be the same for all lines in a particular buried line, shall be the same. An exception to this is where ends must be changed to flanged to accommodate valves or fittings.
 3. No change in material or joint selection will be permitted after submittal of Shop Drawings and their final review by the CITY
- C. Flanged Joints: Flanged joints shall be made up with full-face gaskets as specified in the piping paragraphs. Flange faces shall have a uniform bearing on the gaskets. Flanges shall be drawn together uniformly until the joint is tight. No washers shall be permitted for the bolt and nut assemblies. The length of the bolts shall be uniform and in accordance with the standards specified herein. The bolt's maximum projection beyond the end of the nut shall be 0.25-inch nor shall the bolt fall short of the end of the nut.
 1. Flanges: Where the design pressure is 125 psi or less, flanges shall conform to either ANSI/AWWA C115/A21.15 Class D or ASME B16.1 Class 125. Where the design pressure is greater than 150 psi, up to a maximum of 250 psi, flanges shall conform to either ANSI/AWWA C115/21.15 for ductile-iron or ASME B16.1 for cast-iron, Class 250. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
 2. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12-inches and over shall be provided with lifting eyes in the form of welded or threaded eyebolts.

3. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
 4. Flange Bolts: If studs are required, they shall be in accordance with ASTM A307, Grade B, with heavy hex nuts. Machine bolts shall normally be used on all flanged connections and shall be in accordance with ASTM A307, Grade A, with hex nuts. For corrosive areas use Type 316 stainless steel, ASTM A193 Grade B 8M hex head bolts & ASTM A194, Grade 8M hex head nuts.
 5. If studs are required, they shall extend through the nuts a minimum of []-inch. All bolts and nuts shall conform to Section entitled "Miscellaneous Metalwork."
 6. Flange Gaskets: Gaskets for flanged joint shall be of materials as specified in piping sections. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.
 7. Flange Gasket Suppliers, or equal:
 - a. John Crane, style 2160.
 - b. Carlock, style 3000.
- D. Welded Joints:
1. Welded joints shall be shop-fabricated in accordance with the standards and specifications contained herein.
 2. Field welding will be permitted for black carbon steel pipe where it can be demonstrated that the interior of the pipe can be satisfactorily lined and inspected. Welding in the field shall be performed only when requested on the Shop Drawings and accepted by the CITY in writing as specified herein.
 3. All welding shall be performed using the shielding metallic arc process in accordance with ANSI/ASME B31.1 and AWWA C206 except as modified or supplemented herein. All welders shall be AWS certified in accordance with AWWA C206, and ANSI/ASME B31.1 requirements.
 4. Pipe and fittings with wall thickness of 3/16-inch and larger shall have ends beveled for welding. Shop and field bevels shall be machine cut; manual flame cutting without machine guide shall not be permitted. Bevels shall be 30° with a maximum of 37°. The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be of the single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee. Welds shall be free from cold spots, pinholes, oxide inclusion, burrs, snags, rough projections or other defects.
 5. Butt welding end preparation on all pipes shall conform to ANSI B16.25 "Buttwelding Ends".
 6. Filler metal for welding shall be of the same composition as the base metal. All welding of steel pipe flanges shall be in accordance with requirements of AWWA C207 and ANSI/ASME B31.1.
 7. Field repairs of cement motor lining a welded joints shall be made in accordance with AWWA C205 Appendix A or AWWA C602.
 8. Field welds shall be "fixed position" type.
 9. All field welds shall be radiographically inspected by the CONTRACTOR if so ordered by the CITY.
- E. Threaded Joints:
1. All threads shall be clean, machine cut and all pie shall be reamed before erection. Taps and dies shall be cleaned, sharpened and in good condition. All threaded joints shall be made tight with Teflon tape.
 2. After having been set up, a joint shall not be backed off unless the joint is broken, the threads cleaned and new tape applied.
- F. Solvent Cemented Joints:
1. Joints shall be made up in accordance with ASTM D2855 and the MANUFACTURERS' recommendations. The CONTRACTOR is advised to handle the solvent cements in accordance with ASTM F 402.

2.06 PIPING SPECIALTIES:

- A. Gaskets:
 - 1. Rubber gaskets for flanged joints, ASTM D1330.
 - 2. 1/16-inch thick full-faced red rubber for all pipe sizes ten (10) inches and smaller.
 - 3. 1/8-inch thick full-faced red rubber for all pipe sizes twelve (12) inches and larger.
 - 4. 1/16-inch thick full-faced Viton A, gylon/PTFE/teflon or equal for fuel oil and natural gas service.
 - 5. Furnish with bolt holes and pipe openings punched.
- B. Flange Bolt Thread Lubricant: An anti-seize compound and thread lubricant designed for 1,000 degrees F.
- C. Backing Rings for Butt-Welded Joints: Be machined split ring with knock-off spacer nubs for use in pipe having wall thickness 1/2-inch or less.
- D. Instrument Needle Valves:
 - 1. Class 3,000 bronze, globe or angle needle or Kel-F, stainless-steel stem, "O" ring or Teflon seal and screwed ends. Hoke Series 300 or Whitey. Install an instrument needle valve with each pressure gauge.

2.07 METERS AND GAUGES:

- A. General:
 - 1. Provide all instruments, meters, gauges, and thermometers, complete with interconnecting tubing, piping, valves as specified and as indicated.
 - 2. Provide gauge cock in the piping for all instruments, meters, and gauges, both at point of takeoff and at the instruments, meters and gauges. Gauge cock shall be of the same design requirements as the lines they serve.
- B. Indicating Pressure Gauges:
 - 1. Ashcroft "Duragauge" Crosby or Marsh.
 - 2. Bourdon Tube:
 - a. 160-psi Maximum Graduation: Grade A phosphor bronze, brazed joints stress relieved.
 - b. 200-psi to 800-psi Maximum Graduation: Drawn alloy steel, welded joints stress relieved.
 - 3. Socket and Tip:
 - a. 160-psi Maximum Graduation: Forged bronze.
 - b. 200-psi and Over Graduation: Alloy steel.
 - 4. Case: High-impact glass-fiber-reinforced polypropylene, weatherproof with safety blowout discs or release back plate.
 - 5. Ring: Bayonet-locking type.
 - 6. Movement: All stainless steel mounted on socket with milled teeth on pinion and sector.
 - 7. Dial: Six (6) inches, white laminated phenol with black markings.
 - 8. Pointer: Aluminum with micrometer adjustment.
 - 9. Accuracy: 1/2 of one (1) percent over full range of scale.
 - 10. Range: As required for the pressure range to be measured.
 - 11. Mount all pressure gauges on rigid surfaces. Differential strainer gauges shall be line-mounted. Mount outdoor gauges on pump flange. Install an instrument needle valve with each gauge.
 - 12. Be solid-front type recalibrated from back without removing dial.
 - 13. Ashcroft Type 45-P2464 with back connection for flush mounting on gauge boards.
 - 14. Ashcroft Type 45-P2462 with lower connection for differential strainer on line or pump-mounted gauges.

2.08 PIPE COUPLINGS:

A. Mechanical-Type Couplings (Grooved or Banded Pipe):

1. General: Mechanical-type couplings shall be provided where shown on the Drawings. Buried or submerged couplings shall have Type 316 stainless steel bolts and nuts conforming to the requirements of Section entitled "Miscellaneous metalwork."
2. Suppliers for Steel Pipe Couplings, or equal:
 - a. Victaulic Style 41 or 44 (banded).
 - b. Victaulic Style 77 or 07 (grooved).
 - c. Gustin-Bacon (banded grooved).

Note: Steel pipe couplings shall be furnished with grade E rubber gaskets.

3. Suppliers for Ductile Iron Pipe Couplings, or equal:
 - a. Victaulic Style 31.
 - b. Gustin-Bacon.

Note: Ductile iron pipe couplings shall be furnished with grade M flush seal gaskets.

4. Suppliers for PVC Pipe Couplings, or equal:
 - a. Victaulic Style 775.
 - b. Gustin-Bacon.

Note: PVC pipe couplings shall be furnished with grade E gaskets and radius cut or standard roll grooved pipe ends.

B. Sleeve-Type Couplings:

1. Construction: Sleeve-type couplings shall be provided where shown, and shall be of similar material as the pipe, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be no less than []-inch in thickness and shall be either 5 or 7-inches long for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.
2. Pipe Preparation: The ends of the pipe, where specified or show, shall be prepared for sleeve-type couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to an air test for porosity.
3. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. The rubber in the gasket shall meet the following specifications.
 - a. Color - Jet Black.
 - b. Surface - Non-blooming.
 - c. Durometer Hardness - 74 +/- 5.
 - d. Tensile Strength - 1,000 psi minimum.
 - e. Elongation - 175 percent minimum.
4. The gaskets shall be immune to attach by the material that is being transported. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 grade 3, except as noted above.
5. Insulation Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulation compound in order to obtain insulation of all coupling metal parts from the pipe.

6. Restrained Joints: Where harnesses are required for sleeve-type couplings, they shall be in accordance with the requirements of the appropriate reference standard, or as shown.
 7. Supplier or Equal:
 - a. Rockwell (Smith-Blair), Style 411.
 - b. Dresser, Style 38.
 - c. Ford Meter Box Co., Inc., Style FC1 or FC3.
- C. Reinforced Flexible Pipe Coupling:
1. Reinforced flexible piping couplings shall be as manufactured by Mercer Rubber Company, General Rubber Co., Metraflex or equal.
 2. The coupling shall be rated for a working pressure of 150 psi and shall be constructed of Kevlar reinforcing and natural rubber elastomer rated for a maximum temperature of 180° F. A Hypalon coating shall be applied to the exterior of the elastomer.
 3. All couplings shall have integrally molded flanges with split and beveled galvanized steel retaining rings. Galvanized steel washers shall be provided at the point where the rings are split. Bolt holes and bolt circle patterns shall conform to the mating flange patterns as specified in the piping paragraphs. Coupling lengths shall be as shown on the Drawings.
 4. Control units shall be 316 stainless steel and shall be provided and installed with all flexible pipe couplings. The coupling MANUFACTURER shall supply the control unit.

2.09 PIPE INSULATION:

- A. Hot and cold liquid piping, flues and engine exhaust piping shall be insulated as shown on the Drawings. No unprotected hot piping shall be within reach of operating personnel or others.

2.10 VALVES:

- A. Gate Valves: Gate valves shall be designed for a working pressure of not less than 150 pounds per square inch. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening. Valves two (2) inches or smaller shall be all bronze and shall conform to MSS SP 80 non-rising stem, wedge disc, Class 150 or higher.
- B. Air Release Valve: The air release valve shall have a cast iron body with stainless steel trim and shall be manufactured by Val-Matic Value and Manufacturing Co., or equal. The CONTRACTOR shall be responsible for the proper selection of the model that suits the Project's needs.

2.11 PIPING EXPANSION PROVISIONS:

- A. Flexible couplings shall be provided for piping systems and at connections to equipment where shown. The CONTRACTOR may install additional flexible couplings to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection. Acceptable types of flexible couplings shall be as follows:
- B. Metallic Piping Systems: Flexible Couplings: Except as noted, flexible couplings for use with steel pipe shall be Dresser Style 38; Rockwell Style 411; or equal. Flexible couplings for use with ductile iron pipe shall be Dresser Style 53 or 153; Rockwell Style 431; or equal, with zinc-plated bolts and nuts. Thrust ties shall be provided as required and shown to sustain the force developed by 1-1/2 times the operating pressure specified.

2.12 SERVICE SADDLES FOR FERROUS METAL PIPING:

- A. Pipe service saddles for all ferrous metal piping shall be Rockwell, Series 313 or 366; Dresser, Style 91; or equal. Service saddles shall be capable of withstanding 150 psi internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the saddle is installed. Taps shall have iron pipe threads. Saddles shall have malleable or ductile iron bodies

or galvanized steel straps, steel hex nuts with washers, and neoprene seals. Service saddles shall be of double-strap design.

2.13 TAPE WRAP:

- A. Tape wrap shall be fifteen (15) mil butyl rubber adhesive, polyethylene backed tape as manufactured by Polyken Division of the Kendall Company, Boston, MA; Royston Laboratories, Inc., Pittsburgh, PA; or equal.

2.14 PIPE BASE AND PIPE ZONE:

- A. Pipe Base: A suitable trench bottom material covering that area of the pipe trench between the bottom of the trench and the flow line of the pipe, extending the full width and length of the trench.
- B. Pipe Zone: That area of the pipe trench between the top of the pipe base and a plane above the pipe extending the full width and length of the trench. See "Execution" for the distance of the pipe zone above the pipe.
- C. Pipe Base and Pipe Zone Material:
 - 1. Pipe base and pipe zone material for ductile iron and corrugated metal pipe eighteen (18) inches in diameter and smaller shall be clean pea gravel or crushed rock with a maximum size of 3/4-inch, uniformly graded from coarse to fine. Clean beach, pit-run, or rejected crusher-run sand may be substituted for base material in trenches with no groundwater in pipe zone. Pipe base and pipe zone material for pipe larger than eighteen (18) inches in diameter may have a maximum size of 1-1/2 inches.
 - 2. Pipe base and pipe zone material for polyvinyl chloride pressure pipe, shall be 1/4-inch granular material or 1/8-inch pea gravel.
 - 3. Selected trench side material may be substituted for the pipe zone material hereinbefore specified only where approved by the CITY. Material shall be friable and contain no rock, clay masses, clods, frozen soil, or other pieces of material larger than the maximum size specified hereinbefore for the applicable piping material.

2.15 TRENCH BACKFILL:

- A. Unless otherwise shown on the Drawings, all trench backfill above the pipe zone shall be as specified in SECTIONS 02200 and 02221.

2.16 POLYETHYLENE BAGGING:

- A. Polyethylene bagging for buried ductile iron piping shall be eight (8) mils minimum thickness, manufactured in accordance with the latest edition of ASTM D 1238, Type I, Class C.

2.17 PIPE IDENTIFICATION PAINTING:

- A. All exposed and non-submerged pipe, including insulated pipe, shall be painted, color coded, and labeled. Color-coding shall be as specified in the Piping Schedule in paragraph 3.16 of this SECTION.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The CONTRACTOR shall furnish all labor, tools, materials, and equipment necessary for installation and jointing of the pipe. All piping shall be installed in accordance with Drawings in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.
- B. Furnish and install sleeves for all pipes passing through concrete floors, ceiling, and roof slabs. Sleeves shall be Schedule 40 PVC, two pipe sizes larger than the carrier pipe. Sleeves through the walls shall be grouted in-place. Sleeves through pads shall be cast-in-place. Annular space between sleeve and pipe shall be packed with Styrofoam.

- C. Before setting wall sleeves, pipes, castings and pipes to be case in place, the CONTRACTOR shall check the Drawings and equipment MANUFACTURER's drawings which may have a direct bearing on the pipe locations. The CONTRACTOR shall be responsible for the proper location of the pipes and appurtenances during the construction of and renovation of the tanks and structures.
- D. All connections to equipment shall be made with unions or flanges. Piping shall be attached to pumps, valves, equipment, etc., in accordance with the respective MANUFACTURERS' recommendations.
- E. For piping assembled with threaded, solvent cemented, welded or soldered joints, liberal use of unions shall be made. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines. A minimum of one union per straight run of pipe between fitting and/or valves with multiple lengths of pipe shall be used.
- F. All changes in directions or elevations shall be made with fittings.
- G. The Drawings are generally diagrammatic. They do not show every bend, off-set, elbow, or other fitting that may be required in the piping for installation in the space allotted. Careful coordination of the WORK of this SECTION with that of Division 2 and 16 is necessary to avoid conflicts.
- H. Line and Grade: Install gravity lines at uniform grade to low point after field verification of low point invert.
- I. Jointing Pipe:
 1. Threaded Pipe: Ream all pipe after cutting and before threading. Use non-hardening pipe compound "Tite-Seal" on male threads only.
 2. Copper Tube: Ream all pipe after cutting and polish end to be soldered.
 3. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2 inches.
 4. Provide reducing fittings where changes in pipe sizes occur.
 5. Provide dielectric unions or flanges between copper and steel piping and between brassware and steel. Do not use steel and copper piping in the same system without such isolation.
- J. Unions or Flanges: Provide unions or flanges in all service lines at each piece of equipment, specialty, valves, or at other locations required for ready disconnect.
- K. Coordinate with the other trades before installation of materials.
- L. Properly align, adjust and lubricate all equipment before final acceptance.
- M. Provide vents and drains at high and low points of water system.
- N. Provide dielectric-type unions where copper piping is connected to ferrous material.
- O. Test, flush and balance all system. Install all vents, test tees, test connections and other items required by local practice, codes, and regulations.

3.02 PIPE PREPARATION AND HANDLING:

- A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas patched in the field with material similar to the original. Clean ends of pipe thoroughly. Remove foreign material and dirt from inside of pipe and keep clean during and after laying.
- B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

3.03 PIPING INSTALLATION:

- A. Pipe and Fittings:

1. Install pipe and fittings in accordance with recognized industry practice which all achieve permanently leak-proof piping systems, capable of performing each indicated service without piping failure.
 2. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment.
 3. Reduce sizes where indicated by use of reducing fittings.
 4. Align pipe accurately at connections within 1/16-inch misalignment tolerance.
 5. Comply with ASME - Code for Pressure Piping.
 6. Locate piping runs, except as otherwise indicated on the Drawings, vertically and horizontally, pitched to drain, and avoid diagonal runs wherever possible.
 7. Orient horizontal runs parallel with walls and column lines.
 8. Locate runs as indicated or described by diagrams, details and notations or, if not otherwise indicated on the Drawings, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 9. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of the building.
 - a. Limit clearance to 0.5 inch where furring is shown for enclosure or concealment of piping but allow for insulation thickness if any.
 10. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings.
 - a. Do not encase horizontal runs in solid partitions except as indicated.
 11. Install solenoid valves in horizontal upright position.
- B. Electrical Equipment Spaces:
1. Do not run piping through transformer vaults or other electrical or electronic equipment spaces and enclosures.
- C. Piping System Joints:
1. Provide joints of the type indicated in each piping system.
 2. Threaded Joints:
 - a. Thread pipe in accordance with ASME B1.20.1.
 - b. Cut threads full and clean using sharp dies.
 - c. Ream threaded ends to remove burrs and restore full inside diameter.
 - d. Apply pipe joint compound on male threads at each joint and tighten joint to leave not more than three (3) threads exposed.
 3. Welded Joints:
 - a. Weld pipe joints in accordance with ASME Code for Pressure Piping.
 - b. Install forged branch-connection fittings wherever branch pipe is indicated or install regular "T" fitting unless indicated otherwise.
 - c. Clean each joint before welding into the system, to remove loose debris.
 - d. Align pipe joints with clamps prior to welding. Clamps or other alignment devices shall not reduce the internal pipe diameter.
 - e. Defective welds shall be prepared in accordance with ANSI B31.1.
 4. Flanged Joints:
 - a. Match flanges within piping system and at connections with valves and equipment.
 - b. Clean flange faces and install gaskets.
 - c. Tighten bolts to provide uniform compression of gaskets.
- D. Cleaning and Protection:

1. Cleaning: Clean all fabricated assemblies, in accordance with the provisions of the Pipe Fabrication Institute Standard ES5 prior to shipping to the job site.
2. Protection: Protect all pipe ends of fabricated sections with heavy metal pipe end protectors, tack welded to the pipe, and do not remove until pipe is in position for final welding. The removal or damaging of these protectors to assist in moving the pipe in the field will not be tolerated.
3. Clean exterior surfaces of installed piping system of superfluous materials and prepare for application of specified coatings.
4. Unless otherwise specified, flush out piping systems with clean water for a minimum of ten (10) minutes before proceeding with required tests.
5. Inspect each run of each system for completion of joints, supports and accessory items.

3.04 PIPE PROTECTIONS:

- A. Spirally-wrap all pipe lines embedded in concrete with two layers of 30 pound felt.
- B. Coat all exposed threads on galvanized steel pipe with two coats of zinc chromate after assembly.
- C. Provide dielectric isolation between pipes and metal parts of structure.

3.05 PIPING, VALVES AND FITTINGS:

- A. Piping shall be installed with sufficient flange or union connections so that the systems may be entirely dismantled in sections not exceeding 20 feet in length. Flanged fittings shall be used to the fullest extent possible. Connections shall ensure unrestricted circulation and permit complete drainage of the system. Changes in supply-main sizes shall be made through eccentric reduced fittings. Pipe shall be cut to measurements established at the Project Site and shall be worked into place without springing or forcing, clearing all windows, doors, and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installations will not be permitted. Pipe burrs shall be removed by reaming. Pipe supports shall permit free expansion and contraction without damage to joints or hangers. Changes in direction shall be made with fittings. Horizontal-air-piping mains shall pitch downward in the direction of flow with a slope of not less than 1-inch in 40 feet. Piping connections to equipment shall be as indicated. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system. Taps for pressure gage connections shall be provided with a nipple and a shutoff gage cock and be provided with pulsation dampeners as indicated.
- B. Joints and Fittings: Mitering of pipe to form elbows, notching straight runs to form tees, or similar construction will not be permitted. Flanged joints shall be faced true, gasketed, and made up of square and tight. Gaskets shall be factory cut in one-piece 1/16-inch thick.
 1. Threaded: Pipe threads shall be full and cleanly cut with sharp dies. Not more than three (3) threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
 2. Flanged: Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to distort the flanges.
 3. Welded: Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping," ANSI/ASME B31.1.
- C. Pipe Sleeves: Pipe passing through masonry construction shall be fitted with sleeves. Each sleeve shall extend through its respective wall, or other masonry structure, and shall be cut flush with each surface unless otherwise specified. Unless otherwise specified, the inside diameter of the pipe sleeves shall in all cases be at least 1/2-inch larger than the outside diameter of the passing pipe or pipe covering. Sleeves shall be steel pipe, cast iron pipe, or terra-cotta pipe. Pipe sleeves through exterior wall shall be circular and fabricated from 1/4-inch steel plate with welded seam or Schedule 40 carbon steel pipe with waterstop. Unless otherwise specified, piping passing through exterior walls shall be made dust-tight and gas-tight with special rubber gasketed sleeve and joint assemblies, or with sleeves sealed with modular rubber sealing elements, or sealed by caulking with oakum and sealing with polysulfide or urethane sealant.

- D. Valve Tags: Identification tags of brass or aluminum shall be provided for all valves. Tags shall be approximately two (2) inches in diameter with markings stamped and spelled out in full and shall be secured to the valves with No. 12 AWG copper wire or plastic ties.
- E. Piping Supports: Anchors in accordance with SECTION 05070 shall be used to fasten supports to existing concrete and masonry.
 - 1. Design loads for inserts, brackets, clamps, and other support items shall not exceed the MANUFACTURER's recommended loads.
 - 2. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.
 - 3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints.

3.06 INSTALLATION OF BURIED PIPING:

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of DIVISION 2 and furnished as specified herein.
- B. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with MANUFACTURER's recommendations. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the CONTRACTOR at his own expense.
- C. The CONTRACTOR shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with SECTION 02220.
- D. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.
- E. All piping 3-inches and larger shall be provided with two 4-foot-lengths of pipe for the first two joints outside a building or tank wall unless a greater number of joints are shown on the Drawings.
- F. Pipe shall be installed in accordance with the MANUFACTURER's recommendation. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter and other acceptable methods. At the close of each workday and during suspension of WORK for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.
- G. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the Drawings, the CONTRACTOR shall use laser based surveying instruments to maintain alignment and grade. At least two (2) elevation measurements shall be taken, one at each end, on each length of pipe and recorded. Additional elevation measurements shall be taken to show change in slope or grade. No abrupt changes in direction or grade will be allowed. All underground piping shall be properly blocked at all fittings where the pipeline changes direction, changes size or ends, using concrete thrust blocks. Concrete thrust blocks shall be sized so as to give bearing against undisturbed earth sufficient to absorb the thrust from line pressure, allowing an earth bearing of 200 lbs per square ft per foot of depth below finish grade to a maximum of 2,000 lbs per square ft. (Earth bearing values may be increased, if clearly substantiated by a soils analysis.) The line pressure shall be the product of the nominal cross sectional area of the pipe and the maximum internal pressure anticipated for each type of pipe. The concrete shall be placed, unless shown otherwise on the Drawings so that the pipe joints and fittings will be acceptable. All underground restrained joint piping and fittings shall be provided with concrete thrust blocks unless otherwise accepted by the CITY

- H. Preparation of Trench: Trench Excavation and Stabilization shall be in accordance with SECTIONs 02200 and 02221.
1. Pipe Base:
 - a. Provide pipe base material for supporting the pipe for the full width of the trench. Minimum depth of pipe base below the pipe barrel shall be four (4) inches. Depth of pipe base under the pipe bell shall be not less than 3" under normal trench conditions.
 - b. Hand-grade pipe base to proper grade ahead of pipe laying operation. Pipe base shall provide a firm, unyielding support along the entire pump length.
 - c. If the trench has been excavated below the required depth for pipe base placement without direction from the CITY, fill the excess depth, at the CONTRACTOR's own expense, with the pipe base specified herein or foundation stabilization material as specified in Section Earthwork to the proper subgrade. Place the pipe base or foundation stabilization material for the full width of the trench in layers not exceeding six (6) inches deep and compact each layer, until the material does not yield or move, to the grade established for the pipe bedding.
 - I. Laying Buried Pipe:
 1. General:
 - a. All buried pipe shall be prepared as herein before specified and shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the CITY, trench conditions are unsuitable. Joints shall be made as herein specified for the respective types. Take all precautions necessary to prevent uplift and floating of the pipe prior to backfilling.
 - b. Do not deviate more than 1-inch from line or 1/4-inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
 - c. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and for pipe base when specified or indicated. Remove hard spots that would prevent a uniform bearing. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.
 - d. At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides where necessary to permit easy visual inspection of the entire joint.
 - e. Provide and maintain ample means and devices at all times to remove and dispose of all water entering the trench during the process and pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Removal of water shall be in accordance with specifications in SECTIONs 02200 and 02221.
 - f. When the pipe laying is not in progress, including the noon hours, the open ends of the pipe shall be closed, and no trench water, animals, or foreign materials shall be permitted to enter the pipe.
 - g. Where the pipe is connected to concrete structures, the connection shall be made as shown. If the connection is not shown, make connections such that a standard pipe joint is located no more than 24 inches from the structure.
 2. Laying Ductile Iron and Corrugated Metal Pipe:
 - a. Join ductile iron and corrugated metal pipe in strict accordance with the MANUFACTURER's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. The pipe MANUFACTURER shall furnish lubricant for the pie gaskets, and no substitutions will be permitted under any circumstances.

- b. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow. After a section of pipe has been lowered into the pipe trench, clean the end of the pipe to be joined, the inside of the joint, and the rubber ring immediately before joining the pipe. Make assembly of the joint in accordance with the recommendations of the MANUFACTURER of the type of joint used. Provide all special tools and appliances required for the jointing assembly.
 - c. Polyethylene bagging for buried ductile iron piping shall be installed in accordance with ANSI/AWWA C105/A21.5. Installation shall be in accordance with method A or C of the indicated standard.
3. Backfill in the Pipe Zone:
- a. The pipe zone shall be considered to include the full width of the excavated trench from the bottom of the trench to a level 6 inches above the top outside surface of the pipe barrel.
 - b. Place backfill in the trench in horizontal lifts not exceeding 6 inches in uncompacted thickness on both sides of the pipe. Thoroughly tamp and supplement by "walking in" the material.
 - c. Particular attention must be given to the area of the pipe zone from the invert to the spring line of the pipe to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone.
 - d. Where the normal trench width below the top of the pipe is exceeded for any reason, the CONTRACTOR shall furnish an adequate support for the pipe, unless the CITY determines that the pipe being used is strong enough for the actual trench width. This may be accomplished by furnishing a stronger pipe of concrete cradle, cap, or envelope as approved.
4. Trench Backfill Above the Pipe Zone: See SECTIONS 02200 and 02221.
5. Pipe Cover: Minimum pipe cover shall be as shown on the Drawings.
6. Connecting Dissimilar Pipe Materials: Connect dissimilar pipe materials by means of a rubber gasketed coupling specified under Detail Pipe Specification - Corrugated Metal Pipe and Fittings. Install couplings in strict accordance with the MANUFACTURER's recommendations.

3.07 INSTALLATION OF EXPOSED PIPING:

- A. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All boltholes in flanges shall straddle vertical centerline of pipes.
- B. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings.
- C. Piping shall be installed without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
- D. Required straight runs of piping upstream and downstream of flow measuring devices shall be smooth.
- E. Where valve handwheels are shown, valve orientation shall be as shown. Where valve handwheels are not shown, valves shall be oriented to permit easy access to the handwheels, and to avoid interferences.

3.08 INSTALLATION OF FLEXIBLE COUPLINGS AND SERVICE SADDLES:

- A. Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings may be lubricated with soapy water or MANUFACTURER's standard lubricant before installation on the pipe ends. Install in accordance with the MANUFACTURER's recommendations. Bolts shall be tightened progressively, drawing up uniform tightness. Workmen tightening bolts shall use torque-limiting wrenches.

3.09 VENTS AND DRAINS:

- A. Vent the high point and drain the low point of all pipelines, whether shown on the Drawings or not, with 3/4-inch gate valves on those pipelines 2-1/2 inches and larger and 1/2-inch gate valves on those

pipelines 2 inches and smaller. Valve types shall be as shown in the Valve Schedule described in Section Valves and shown on the Drawings. Where gate valves do not appear in the Valve Schedule for a service listed, Type V102 valves shall be used.

3.10 THRUST RESTRAINT:

- A. Pipe anchors shall be spaced to divide pipe into sections. Anchors shall be located at valves, changes in direction of piping, and major branch connections. Anchors shall be of a type recommended by the pipe MANUFACTURER and accepted by the CITY
- B. On all piping, where sleeve type couplings and flanged adapters are located near fittings or valves, tie rods shall span across the coupling as specified herein to restrain movements of the pipe along its axial direction. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five (5) feet.
- C. All sleeve type couplings shall be harnessed except where noted specifically on the Drawings. The harnessing shall be as shown on the Drawings or as specified herein.
- D. Where the distance between adjacent flanges is in excess of ten (10) feet or where a harness cannot be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.
- E. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with the MANUFACTURER's recommended procedures.
- F. All buried tie rods and associated hardware shall be 316 stainless steel.
- G. In general, all valves and fittings shall be restrained in an acceptable manner such that the unbalanced force developed at them shall be supported independent of the piping system.
- H. Harnesses for ductile iron pipe shall be as shown on the Drawings.

3.11 PIPE CLEANING:

- A. Interim Cleaning: Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pie cuttings and filings, gravel, cleaning rags, etc. within the piping sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.
- B. Final Cleaning: Following assembly and testing and prior to final acceptance, all pipelines installed under this section shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the CITY. Accumulated debris shall be removed through drains two (2) inches and larger or by dropping spools and valves.

3.12 TESTING:

- A. Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all taps in the pipe, as required. Test pressure shall be as specified in the Piping Schedule shown herein.
- B. All leak tests as required in other sections of this specification or tests required by the latest edition of Standard Building Code shall be completed and witnessed by the CITY prior to any application of insulation or wrapping of pipe or backfilling of pipe in trenches. CONTRACTOR shall present a letter of certification indicating completion of such tests signed by an authorized representative of the CONTRACTOR.
- C. Preparation and Execution:

1. Buried Pressure Piping:
 - a. Conduct final acceptance tests on buried pressure piping that is to be hydrostatically tested after the trench has been completely backfilled. The CONTRACTOR may, if field conditions permit, as determined by the CITY, partially backfill the trench and leave the joints open for inspection and conduct an initial service leak test. The acceptance test shall not, however, be conducted until all backfilling is completed.
 - b. Buried pressure piping that is to be pneumatically tested or subjected only to an initial service leak test shall have all supports, hangers, and anchors.
2. Exposed Pressure Piping: Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors.

D. Hydrostatic Leak Tests:

1. Equipment: Furnish the following equipment for the hydrostatic tests:

<u>Amount</u>	<u>Description</u>
2	Graduated Containers
2	Pressure Gauges
1	Hydraulic Force Pump
	Suitable Hose and Suction Pump as Required

2. Procedure: Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The hydrostatic test pressure shall be continuously maintained for a minimum time of 30 minutes and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the CONTRACTOR's sole expense.

3. Buried Water Pressure Lines:

- a. Some leakage is permissible from buried water pressure lines. Consequently, the hydrostatic testing of these pipelines must be conducted in a different manner, as follows:
- b. When testing cement-mortar lined piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the cement-mortar lining to absorb water.
- c. Expel all air from the piping system prior to testing and apply and maintain the specified test pressure by means of the hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the pressure test for two (2) hours, reopening the isolation valve as necessary to restore the test pressure. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately. This measurement represents the leakage, which is defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

In the above formula:

L = Allowable leakage, in gallons per hour.

N = Number of joints in the length of pipe tested.

D = Nominal diameter of pipe, in inches.

P = Test pressure during the leakage test, in pounds per square inch.

- d. The CONTRACTOR shall correct any leakage greater than allowance determines under this formula at the CONTRACTOR's sole expense.

E. Initial Service Leak Tests:

1. Equipment: Equipment used for initial service leak test shall be performed by gradually bringing the piping system up to normal operating pressure and holding it there continuously for a minimum time of ten (10) minutes. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the CONTRACTOR's sole expense.

F. Hydraulic Testing of Pipelines:

1. Unless otherwise provided herein, water for testing pipelines will be furnished by the CITY; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the CITY-designated source to the points of use.
2. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of fourteen (14) days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitable restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.
3. The pipeline shall be filled at a rate that will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. The CONTRACTOR is responsible for removing all air in the piping to be tested by whatever means is necessary including addition of temporary air vent piping and valving.
4. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CITY shall be taken.
5. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of four (4) hours. The test pressure for distribution and transmission pipelines shall be 150 percent of the pipe system design pressure or 25 psig. The maximum allowable leakage for pipelines shall be 20 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 20 ft. or less joint lengths. All visible leaks shall be repaired in a manner acceptable to the CITY.

G. Corrugate Metal Pipe: Corrugate metal pipe shall be air tested as follows:

1. Time of Testing: Test pipe after backfilling has been completed. The CONTRACTOR, at his option and expense, may make other earlier tests to ensure compliance with the tests specified herein.
2. Procedure:
 - a. After all plugs are in place and securely blocked, introduce air slowly into the pipe section to be tested until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. Allow a minimum of two (2) minutes for the air temperature to stabilize. Determine the height of the ground-water table, at the time of the test.
 - b. Pipe and joints being air tested shall be considered satisfactory when tested at an average pressure of 3.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe, when (1) the total rate of air loss from the section being tested does not exceed 2.0 cubic feet per minute, or (2) the section of line does not lose air at a rate greater than 0.0030 cubic foot per minute per square foot of internal pipe surface.

- H. Test Records: Records shall be made of each piping system installation during the test. These records shall include:
1. Date of Test.
 2. Description and Identification of Piping Tested.
 3. Test Fluid.
 4. Test Pressure.
 5. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
 6. Certification by CONTRACTOR and signed acknowledgement by the CITY

3.13 CORROSION PROTECTION:

- A. Atmospheric Exposed Piping and Accessories: All atmospheric exposed surfaces of black and hot-dip galvanized steel, brass, copper, and bronze piping components including, but not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves and fasteners shall be painted in accordance with SECTION 09900, as applicable to the base metal material.
- B. Corrosion protection for carbon steel pipe:
1. Exterior Coating for Mill Type Steel Pipe: Shop prime and finish coats in accordance with SECTION 09900, System S-3.
 2. Interior Lining: All carbon steel piping that is to be lined with coal-tar epoxy, as noted in the Piping Schedule, shall be as specified in SECTION 09900. The pipe supplier shall apply lining.
 3. Exterior Protection for Buried, Submerged or Embedded Pipe:
 - a. All submerged or embedded carbon steel piping shall be coated with coal-tar epoxy. Coating shall be applied by a qualified coating applicator.
 - b. All abraded areas of coal-tar epoxy coatings on carbon steel pipe to be submerged or embedded shall be cleaned and repaired to provide a protective covering equal to the original and acceptable to the CITY.
 - c. Buried steel shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC-SP 1, and wire brushed, SSPC-SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape MANUFACTURER's recommended primer in accordance with the MANUFACTURER's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall be tape-wrapped. Joints shall be completed above grade or a sufficient size hole excavated beneath the couplings to permit joint wrapping without contamination. Tape wrapping is specified under Paragraph Materials.
 - d. Exterior Protection for Buried or Submerged Piping Accessories: Exterior protection shall be in accordance with SECTION 09900, System S-4. Coating shall be applied by a qualified coating applicator.
- C. Corrosion protection for ductile iron pipe:
1. For Atmospherically Exposed Ductile Iron: Exterior protection shall be in accordance with SECTION 09900 – Protective Coatings.
 2. Cement Linings: All piping that is to be cement-lined shall be lined and seal coated with Type II or Type III cement in accordance with ANSI/AWWA C104/ A21.3. All ductile iron pipe shall be cement-lined and seal coated.
 3. Exterior Protection for Buried Pipe: Buried ductile iron piping shall be wrapped with polyethylene bagging, 8 mils minimum thickness, manufactured in accordance with the latest edition of ASTM D 1248, Type I, Class C, Grade EI and installed in accordance with AWWA C105 and the MANUFACTURER's recommendations.

3.14 PIPE PAINTING:

A. Painting of piping systems shall be as specified in SECTION 09900.

3.15 CLEANUP:

A. After completion of the WORK, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

3.16 PIPING SCHEDULE:

A. This SECTION includes schedule of piping specified in other sections of DIVISION 15.

B. The following abbreviations are used in the schedule.

1. Material:

304 SS - 304 Stainless Steel (non-welded joints) or 304L Stainless Steel - low carbon (welded joints)

316 SS - 316 Stainless Steel (non-welded joints) or 316L Stainless Steel - low carbon (welded joints)

AL - Aluminum

CPVC - Chlorinated Polyvinylchloride

DI - Ductile Iron

PVC - Polyvinylchloride

2. Wall Thickness:

CL - Class

Sch - Schedule

SDR - Standard Diameter Ratio

3. Joint Type:

CID - Cast Iron Drainage Fitting

Flg - Flanged

MJ - Mechanical Joint

PO - Push on Joint

RJ - Restrained Joint

4. Fitting Type:

304 SS - 304 Stainless Steel (non-welded joints) or 304L Stainless Steel - low carbon (welded joints)

316SS - 316 Stainless Steel (non-welded joints) or

Al - Aluminum

CPVC - Chlorinated Polyvinylchloride

DI - Ductile Iron

PVC - POLYVINYLCHLORIDE

5. Interior Surface Protection:

CL - Cement Lined

EC - Epoxy Coated

PVC - PVC Liner

6. Exterior Surface Protective Coating:

AC - Asphalt Coated

P - Painted

NOMINAL PIPE

<u>PIPE MATERIAL</u>	<u>DIAMETER (INCHES)</u>	<u>WORKING PRESSURE</u>	<u>TYPE OF JOINT</u>
DI	4 THRU 12	350	RJ
	14 THRU 20	350	RJ
	24	300	RJ
	30 THRU 54	250	RJ
DI	ALL	350*	FLG

*Flanged joints shall be rated for 250 psi working pressure

PIPING SCHEDULE

Service	Nominal Pipe Diameter (Inches)	Material	Schedule	Working Press (PSIG)	Type of Joints	Type of Fittings	Protective Coating	
							Interior	Exterior
All unless otherwise noted								
above ground	All	DI	--	--	FLG	DI	--	P
below ground	All	DI	--	--	RJ	DI	--	AC
Potable Water								
above ground	under 4	PVC	Sch. 80	--	SW	PVC		
below ground	under 4	PVC	Sch. 80	--	SW	PVC		
*Drain: below ground	All	DI	--	--	RJ	DI	--	AC

*Refer to specifications for type of restrained joint.

PIPE COLOR-CODING SCHEDULE

<u>Piping System</u>	<u>Color</u>
Air Intake Lines	Ivory
Compressed Air Lines	Safety Red
Compressed Air Receivers	Dunes Tan
Exhaust Lines (Bare)	Aluminum
Exhaust Lines (Lagged)	Ivory
Fire Main Piping and Valves	Fire Hydrant Red
Diesel Fuel Lines	Safety Yellow
Natural Gas Lines	Safety Yellow
Jacket Water Lines	Safety Green
Lube Oil Lines	Safety Blue
Raw Water Lines	Safety Black
Exterior Piping (except where identification is necessary)	Dunes Tan
Vacuum Lines	Alpine Green

END OF SECTION

SECTION 15020 PIPE SUPPORTS AND PENETRATIONS

PART 1 - GENERAL

1.01 SCOPE:

- A. The Work of this Section shall consist of furnishing all labor, material, and equipment for the installation of plant piping as shown on the Drawings and specified herein.

1.02 GENERAL:

- A. Like items of material provided hereunder shall be the end products of one manufacturer.
- B. See Conditions of the Contract and DIVISION 1, General Requirements, which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- C. CONTRACTOR shall design, furnish and install a complete system of pipe supports for the piping systems provided under this Contract. The CONTRACTOR shall provide for piping expansion and contraction and anchoring as necessary. Contact between dissimilar metals shall be prevented.

1.03 REFERENCES:

- A. American Society of Mechanical Engineers (ASME):
 - 1. B31.1 - Power Piping
- B. Manufacturers Standardization Society (MSS):
 - 1. SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture
 - 2. SP-69 - Pipe Hangers and Supports - Selection and Application

1.04 SUBMITTALS:

- A. Submit as specified in DIVISION 1.
- B. Submit manufacturer's data for approval before any work is commenced.
- C. When any material is specified to comply with applicable standards, codes, or laws, manufacturer's submittal must clearly state such compliance.

1.05 MATERIAL DELIVERY, STORAGE, AND PROTECTION:

- A. All materials shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.06 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of this section and as shown on related drawings.

2.02 PIPING SUPPORT SYSTEMS:

A. General:

1. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Detail Mechanical Drawings. Manufacturers' catalog numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalog supports are inapplicable.
2. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the Details. The absence of pipe supports and details on any drawings shall not relieve the CONTRACTOR of the responsibility for providing them throughout the plant.
3. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
4. Detailed shop drawings of all supports, including support-anchoring devices, shall be supplied with the submittals specified hereinbefore.
5. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment.
6. Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

B. Building Piping:

1. Pipe hangers and supports shall meet the requirements of Section 5, Chapter II of ANSI B31.1 and shall be types as given for MSS Standard Practice SP-58 and SP-69.
2. Constant Support, Spring and Rigid Hangers: Bergen, Blaw-Knox, Fee and Mason, Grinnell or NAVCO.
3. Pipe hanger and supports shall be of the types listed in Table 1 "Hanger and Support Selection," MSS Standard Practice SP-69 except that the following figure types given in Figure 1 will not be acceptable: Types 5, 6, 11, 12, 7, 9, 10 and 25.
4. Horizontal piping shall be supported with adjustable swivel-ring, or Clevis type hangers as shown, Grinnell Figure 104; Elcen Figure 92; or equal.
5. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown, Grinnell Figure 264; Elcen Figure 50; or equal. Provide a neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation. Pads shall be Mason Industries, Inc. Type W; Korfund Korpapad 40; or equal.
6. Horizontal piping hanger support rods shall attach to steel beams with C-clamps or beam clamps; to concrete with inserts, brackets or flanges fastened with flush shells.
7. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories shall be galvanized unless copper plates or noted otherwise on the Drawings.

8. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for steel and ductile iron pipe shall be as follows:

<u>Pipe Size</u>	<u>Maximum Support and Hanger Span Hangers</u>	<u>Minimum Rod Size Single Rod</u>
1 inch & smaller	6 feet	1/4-inch
1-1/4 inches thru 2-1/2"	8 feet	1/4-inch

9. Hanger rod sizing for plastic pipe shall be the same as for steel pipe. Spacing of hangers shall be as recommended by the manufacturer for the flow temperature in the pipe.
10. Vertical sway bracing shall be provided where shown, or on 10' maximum centers.

C. Concrete Inserts and Expansion Shields:

1. The load rating for universal concrete inserts shall not be less than that of the hanger rods they support.
2. Type A:
 - a. Unistrut Corporation, Series P-3200 inserts or Brinkley Company.
 - b. Inserts shall be galvanized and have a recommended load capacity of 2,000 pounds per foot of length in average good concrete with a safety factor of 3.
 - c. Inserts shall be continuous and located as required.
 - d. Provide end caps at each end. End caps shall have attached anchor if spacing from end of insert to next anchor is greater than 2 inches.
 - e. Inserts shall be 5-5/8 inches wide outside by 1-3/8 inches deep outside and constructed of minimum 12-gauge galvanized steel, adequate for a 7/8-inch rod and nut.
 - f. CONTRACTOR shall furnish Unistrut galvanized nuts with or without springs required for work under this contract.
3. Type B: Concrete inserts shall be malleable iron Type 18 listed in MSS Standard Practice SP-69, Grinnell, Fig. 282 or Fee and Mason.
4. Type C: Concrete inserts shall be malleable iron, Grinnell Fig. 152, Fee and Mason or approved equal.

D. When necessary to use expansion anchors, they shall conform to DIVISION 5.

E. All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas or monorail runs.

2.03 SLAB, FLOOR, WALL AND ROOF PENETRATIONS AND CLOSURES:

- A. All piping penetrations of walls shall be sleeved, unless otherwise noted on the Drawings. It shall be the CONTRACTOR'S responsibility to verify the size and location of all building and structure penetrations prior to pouring concrete.
- B. Pipe Sleeves:
 1. Piping passing through masonry or concrete shall be installed through hot-dipped galvanized, Schedule 40 steel pipe sleeves where shown on the Drawings. Holes drilled with a suitable rotary drill will be considered in lieu of sleeves in existing walls.

2. All sleeves in exterior or water bearing walls shall have a center flange for water stoppage. The annular space between pipes and sleeves in exterior walls shall be watertight. The joint shall be caulked with rubber sealant.
3. Wall sleeves shall be coated with the appropriate system for the intended location as specified in Section Painting. When placing non-insulating type wall sleeves in concrete forms, support them by formwork to prevent contact with the reinforcing steel.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General:

1. Furnish all labor, materials and equipment necessary to make a complete installation as indicated and specified.
2. Provide all necessary supports, brackets or foundations for properly installing all equipment.
3. Coordinate with the other trades before installation of materials.
4. Provide sleeves and flashings for all piping penetrating walls or the roof. Provide all required openings in walls and floors.

3.02 HANGERS, SUPPORTS AND ANCHORS:

A. General:

1. The design, selection, spacing and application of pipe hangers, supports and anchors shall be in accordance with the codes and standards specified except the ANSI B31.1 - Code for Power Piping shall take precedence over the MSS SP-69 standard.
2. Hanger class and selection of components shall be in accordance with those specified.
3. Furnish and install all rigid and spring supports, whether or not they are shown and detailed, but are required to adequately support the piping system.
4. Furnish and install for all pipe installed under this contract.
5. Include all necessary structural steel, brackets, concrete inserts, etc., which are not a part of the building, or specified, but required to properly support the piping systems.
6. Include necessary temporary supports, pins, etc., for the hydrostatic testing of steam lines and other lines that are spring supported.
7. Install piping and provide necessary supports and anchors to prevent the forces and mounting imposed on equipment from exceeding the limits specified by the equipment manufacturer.
8. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible on common size ranges.
9. CONTRACTOR shall note that a maximum rod size of 7/8 inch can be used with Type A concrete inserts. Maximum horizontal pipe hangers and support spacing shall be reduced for 14-inch and larger lines supported from new and existing Unistrut P-3200 type concrete inserts.

B. Adjustment:

1. Prior to putting the piping systems into service, adjust all spring hangers to the correct cold load, adjust all solid hangers to correct position and remove all temporary hangers used in erection and testing.
2. After and during the time the piping systems are being put into service, adjust all spring hangers for the current hot load and align all hanger rods to the vertical position.

- C. Hangers, etc., Not on Drawings: Pipe hanger assemblies, anchors and sway braces other than those indicated on the drawings shall be designed, selected and located by the CONTRACTOR or hanger manufacturer in accordance with the following:
 - 1. Make accurate weight balance calculations to determine the required supporting force on each hanger and to show the reaction and forces on equipment on the shop drawings. Calculate expansion and movement of all pipe installed under this contract and select hanger type and components to allow for pipe expansion and movement.
 - 2. Submit detail shop drawings of each hanger assembly for review and comments.

3.03 SLEEVES, FLASHING AND COVER PLATES:

- A. Provide sleeves for all openings in walls, floors and roofs required for pipes, tubing, and equipment.
- B. Furnish and install 22-gauge galvanized iron sleeves for ducts passing through all floors and walls.
- C. Pipe sleeves embedded in concrete walls shall be embedded as shown in related drawings. Support all pipes embedded in concrete walls with formwork to prevent contact with the reinforcing steel.
- D. Pipe Sleeves shall be as follows:
 - 1. Exterior Walls:
 - a. Circular and fabricated from 1/4-inch steel plate with welded seam or Schedule 40 carbon steel pipe, with waterstop
 - b. Cast-iron wall pipe with appropriate ends as required
 - c. Seal watertight with Link-Seal by Thunderline Corporation or approved equal
 - 2. Interior Walls and Floors:
 - a. Circular and fabricated from 1/8-inch steel plate with welded seam or Schedule 40 carbon steel pipe. 22-gauge galvanized iron sleeves may be used in interior partition walls.
- E. Floor sleeves shall project 3 inches above the floor in all locations except in finished (offices and toilets) floors unless otherwise indicated.
- F. Size pipe sleeves to provide approximately 1/4-inch to 1/2-inch space all around between the sleeve and outside of pipe or pipe insulation and pack space with blanket-type fiberglass insulation or fire rated link-seal through firewalls.
- G. Furnish cover plates of minimum 1/8-inch steel plate, formed to fit around pipe or ducts. Bolt cover plates in place.
- H. Provide chromium plates or stainless steel escutcheons at ceilings of finished rooms.
- I. Set as many sleeve and openings as possible during construction of walls or floors.
- J. Provide approved type cover plates for oversize or unused designated openings. Seal and refinish all openings, provided in error, to match surrounding area.
- K. Where ducts and pipes pass through exhaust, return and outside air plenums and chases, pack space between sleeves and duct or pipe with glass fiber insulation or mineral wool and seal airtight.
- L. Flashings:
 - 1. Construct as indicated on related drawings.

END OF SECTION

SECTION 15810 MOTORIZED DAMPERS

PART 1 - GENERAL

1.01 SCOPE:

- A. Flanged frame, steel isolation dampers suitable for application in HVAC (or process) systems

1.1 RELATED WORK

- A. Section 13200 - Carbon Dioxide Fire Suppression System
- B. Section 13850 Fire Detection and Alarm -

1.3 REFERENCES

- A. AMCA 500-D – Laboratory Methods for Testing Dampers for Ratings.
- B. IECC - International Energy Conservation Code

1.4 SUBMITTALS

- A. Comply with requirements of Section 01300 – Submittals

- B. Product Data: Submit manufacturer's product data.
 - 1. Include leakage, velocity, pressure drop and maximum pressure data
 - 2. Indicate materials, construction, and dimensions.
 - 3. Include pressure drop data for all damper sizes in accordance with AMCA 500-D test figure 5.3 (Ducted Inlet, Ducted Outlet)
 - 4. Include a copy of Installation Instructions.

1.5 QUALITY ASSURANCE

- A. Dampers shall be manufactured under an ISO-9001 Quality Control Program
- B. Dampers shall be manufactured by a reputable company who is a member of the Air Movement Control Association (AMCA)
- C. Damper manufacturer shall have calibrated test equipment, tools and standard procedures for performing bubble tight damper testing. Test procedures shall be submitted to the engineer for approval prior to authorization to begin manufacturing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver Materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material,
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions.
- C. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.02 PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Greenheck, PO Box 410, Schofield, Wisconsin 54476-0410. Phone (715)359-6171. Fax (715)355-6458. Web Site www.greenheck.com

2.2 Bubble Tight Dampers

- A. Greenheck Model: HBTR-151, HBTR-451, HBTR-551
- B. Ratings
 - 1. Leakage:
 - A. Dampers are to be zero leakage bubble tight type to 10 in. wg as required by AMCA Standard 500D (HBTR-151).
 - B. Dampers are to be zero leakage bubble tight to 30 in. wg as required by AMCA Standard 500D (HBTR-451, HBTR-551)
 - 2. Differential Pressure:
 - A. Dampers shall have a maximum differential pressure rating of 10 in. wg (HBTR-151).
 - B. Dampers shall have a maximum differential pressure rating of 30 in. wg (HBTR-451, HBTR-551).
 - 3. Velocity:
 - A. Dampers shall have a maximum velocity rating of 3900 fpm (HBTR-151).
 - B. Dampers shall have a maximum velocity rating of 6500 fpm (HBTR-451/HBTR-551).
- C. Construction:
 - 1. Frame:
 - A. Damper frame shall be a minimum of 12 ga. steel (optional Type 304SS or Type 316SS) formed into a rolled channel frame with 1½ inch flange. (HBTR-151, HBTR-451).
 - B. Damper frame shall be a minimum of .188 inch steel (optional Type 304SS or Type 316SS) formed into a rolled channel frame with 1½ inch flange. (HBTR-551).
 - 2. Blades:
 - A. Damper blades shall be a minimum of 12 ga. steel (optional Type 304SS or Type 316SS) and reinforced as required to meet the system pressures it will be installed in. Blade orientation is horizontal. (HBTR-151, HBTR-451).
 - B. Damper blades shall be a minimum of .188 inch steel (optional Type 304SS or Type 316SS) and reinforced as required to meet the system pressures it will be installed in. Blade orientation is horizontal. (HBTR-551).
 - 3. Blade Stops:
 - A. Pin stops are standard.
 - 4. Seals:
 - A. Blade Edge: Silicone is standard.
 - 5. Axles:
 - A. Minimum 1/2 inch diameter plated steel and as required to meet the system pressures the damper will be installed in. Stainless steel axles are optional. (HBTR-151)
 - B. Minimum ¾ inch diameter plated steel and as required to meet the system pressures the damper will be installed in. Stainless steel axles are optional. (HBTR-451, HBTR-551)
 - 6. Bearings:
 - A. Bolted relubricable ball bearings are standard.
 - 7. Axle Seals:
 - A. Double gland stuffing boxes are standard.

8. Finish: Hi Pro Polyester paint coating is standard. Options coatings are also available.

2.3 ACCESSORIES

- A. Actuators:
 1. Type - Electric:
 - A. Commercial Grade, Industrial Grade, No Preference, Best Cost
 - B. Electric, 24V or 120V or 230V – AC or DC
 - C. Power Open/Power Close (PO/PC) or Spring Return (fail direction needed if spring return is chosen)
 - D. 2-position or Modulating – (modulating signal needs to be specified if modulating operation is required – this is typically 4-20mA or 2-10VDC)
 - E. Nema Rating if needed
 - F. Auxiliary Limit Switches if needed

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Factory cycle damper and actuator assemblies to assure proper operation prior to shipment
- B. Factory Test each damper for bubble tight construction before shipment. Test report shall be supplied with shipment for each damper

1.03 PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install dampers in accordance with manufacturer's Installation Instructions.
- B. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
- C. Install dampers square and free from racking.
- D. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
- E. Do not compress or stretch the damper frame into the duct or opening.

- F. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.

- G. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.

Install connections to actuators as per manufacturer instructions.

END OF SECTION

SECTION 16050 BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE:

- A. Summary of Work: The CONTRACTOR shall furnish all labor, equipment and material for installation of the electrical hardware as described herein and as shown on the Drawings.
- B. The provisions of this Section apply to all sections in DIVISION 16, except as indicated otherwise.
- C. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of DIVISION 16 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.
- D. For work at existing sites the CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required by the Drawings. Costs for this WORK shall be included in the CONTRACTOR'S original bid amount.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. NEC (NFPA 72) National Electrical Code
- B. NETA International Electrical Testing Association - Acceptance Testing Specifications
- C. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum)
- D. Local Building Codes and Standards

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

- A. The CONTRACTOR shall furnish submittals in accordance with SECTION 01300 - Contractor Submittals.
- B. The CONTRACTOR shall provide the following for shop drawing submittals:
 - 1. Complete material lists stating manufacturer and brand name of each item or class of material
 - 2. Front, side, rear elevations, and top views with dimensional data
 - 3. Location of conduit entrances and access plates
 - 4. Component data
 - 5. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers
 - 6. Method of anchoring, seismic requirements, weight
 - 7. Types of materials and finish
 - 8. Nameplates
 - 9. Temperature limitations, as applicable
 - 10. Voltage requirement, phase, and current, as applicable
 - 11. Front and rear access requirements

- 12. Test reports
 - 13. Grounding requirements
 - 14. Catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Mark-out any model or part numbers of material on catalog data sheets that do not specifically apply to the project. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options.
- C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.
 - D. Materials and Equipment Schedules: The CONTRACTOR shall deliver to the CITY within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
 - E. Owner's Manuals: Complete information in accordance with Section 01300.
 - F. Record Drawings: The CONTRACTOR shall show invert and top elevations and routing of all conduits in duct banks and concealed below-grade electrical installations. Buried electrical conduits shall be located by showing the horizontal distance to two fixed structures at the start of the conduit installation, the end of the conduit installation, and for every conduit change of direction. In addition, circuit schematic drawings and wiring drawings shall show all field changes. Layout drawings shall show all equipment location changes. Record drawings shall be prepared, be available to the CITY, and be submitted according to Section 01300.
 - G. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.
- 1.05 QUALIFICATIONS: All electrical work shall be performed by personnel employed by an Electrical Contractor licensed in the State of Florida. Actual work shall be performed by Master and or Journeyman electricians or personnel under direct on-site supervision of a Master and or a Journeyman electrician. If the work is performed under the direct on-site supervision of a Journeyman electrician, he or she shall be certified in the county in which the work is performed or meet the reciprocity standards of Florida State Statue 489 part II. The credentials of the Electrical Contractor, Master and/or Journeyman electricians shall be supplied to the CITY upon request.
- 1.06 RESPONSIBILITIES:
- A. The CONTRACTOR shall contact the serving utility and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and make payments for work by all utilities.
 - B. Electrical service shall be as indicated and be as required by the serving utility.
 - C. The CONTRACTOR shall verify and provide all service conduits, fittings, transformer pad, grounding devices, and all service wires not provided by the serving utility. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service and shall pay all charges levied by the serving utilities as part of the WORK.
 - D. Permits shall be obtained, and inspection fees shall be paid according to General Conditions.
 - E. The CONTRACTOR shall pay all utility construction/connection charges and turn-on service charges required by the utility company.

- F. The CONTRACTOR shall be responsible for factory and field tests required by specifications in DIVISION 16 and by the CITY and other authorities having jurisdiction. The CONTRACTOR shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

1.07 TESTING: N/A

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The Contractor shall provide 48 hours notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. The CONTRACTOR shall provide equipment and materials that shall be new, shall be listed by UL, or by an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction, and shall bear the UL label or other certification where these requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the WORK shall be products of the same manufacturer. Equipment and materials shall be of heavy duty industrial grade.
- B. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.
- C. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.02 SIGNAGE:

- A. Electrical Equipment
 - 1. Each piece of electrical equipment shall be legibly marked to indicate its purpose unless the CITY determines that its purpose is indicated by the location and arrangement.
- B. Warning Signs
 - 1. Over 50 Volts nominal, or more - Entrances to rooms and other guarded locations that contain live parts shall be marked with conspicuous signs prohibiting unqualified persons to enter.
 - 2. All buildings, rooms or enclosures containing exposed live parts or exposed conductors operating at 600 volts nominal, or more, shall be lockable. Permanent and conspicuous warning signs shall be provided reading as follows: DANGER - HIGH VOLTAGE - KEEP OUT.
 - 3. Outside branch circuits and feeders - for 600 volts nominal, or less - Warning signs shall be posted in plain view where unauthorized persons might come in contact with live parts.
- C. Isolating Switches - Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

- D. Back-up Generation - A sign shall be placed at the service entrance equipment indicating the type and location of on-site back-up generation.

2.03 AREA DESIGNATIONS:

A. General:

1. Raceway system enclosures shall comply as mentioned herein and in SECTION 16110.
2. Electric WORK specifically indicated in sections within any of the Specifications shall comply with those requirements.

AREA	NEMA ENCLOSURE CLASSIFICATION						Notes
	1	3R	4X	7	9	12	
Air Condition Space	√						
Non A/C Space Interior						√	Or as directed by project drawings
Outdoor Application			√				Or as directed by project drawings

B. Materials Requirements

1. NEMA 4X enclosures shall be 316 stainless steel.
2. NEMA 7 enclosures shall be cast aluminum where used with aluminum conduit; cast iron when used with galvanized steel conduit.
3. NEMA 1, 3R, and 12 enclosures shall be steel coated with ANSI 61 grey paint. NEMA 4X, 7, and 9 enclosures shall not be painted.

2.04 MOUNTING HARDWARE:

A. Miscellaneous Hardware

1. Threaded rods for trapeze support shall be continuous threaded, 3/8-inch diameter minimum. Utilize hot dipped galvanized steel for dry indoor non-process areas and 316 stainless steel for “wet,” “damp,” or “corrosive” areas.
2. Strut for mounting of conduits and equipment shall be 316 stainless steel or hot dipped galvanized as specified on project drawings. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion.
3. Wall-mounted panels that weigh more than 500 pounds shall be provided and mounted with steel support pedestals. Transformers hung from 4-inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.

B. Bolts and Anchors

1. Standard Service (Non-Corrosive Application): Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt material, anchor bolts and cap screws shall be in accordance with the following.
 - a. Structural connections: ASTM A307, Grade A or B, hot-dip galvanized
 - b. Anchor Bolts: ASTM A307, Grade A or B, or ASTM A36, hot-dip galvanized
 - c. High strength bolts where indicated: ASTM A325
2. Corrosive Service: All bolts, nuts, and washers in the locations listed below shall be stainless steel as indicated below.

- a. All buried locations
 - b. All submerged locations
 - c. All locations subject to seasonal or occasional flooding
 - d. Inside hydraulic structures below the top of the structure
 - e. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump
 - f. All chemical handling areas
 - g. Inside trenches, containment walls, and curbed areas
 - h. Locations indicated by the Contract Documents or designated by the CITY to be provided with stainless steel bolts.
3. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, class 2, conforming to ASTM A193 for bolts and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an anti-seize lubricant suitable for submerged stainless-steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.
- a. Anti-seizure lubricant shall be classified as acceptable for potable water use by the NSF.
 - b. Anti-seizure lubricant shall be odorless, non-toxic, weather-proof, teflon based, with operating temperatures up to 475 deg F.
4. Indoors Finished Areas Service:
- a. Expanding-Type Anchors: Expanding-type anchors if indicated or permitted, shall be 18-8 stainless steel split expansion ring with threaded stud bolt body and integral cone expander, nut and washer. Plated carbon steel, hot-dipped galvanized carbon steel, type 304 stainless steel or type 316 stainless steel anchor bodies, as identified in the drawings or other notations.

2.05 ELECTRICAL IDENTIFICATION:

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style with no characters smaller than 1/4-inch high.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Incidentals: The CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.
- B. Field Control of Location and Arrangement: The CONTRACTOR shall determine the exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. The Drawings diagrammatically indicate the desired location and arrangement of outlets,

conduit runs, equipment, and other items. Locations on the Drawings, however, shall be followed as closely as possible.

1. Where conduit development drawings or "home runs" are shown, the CONTRACTOR shall route the conduits in accordance with the indicated installation requirements. Routings shall be exposed or encased as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise. Conduits encased in a slab shall be sized for conduit OD to not exceed one-third of the slab thickness and be laid out and spaced to not impede concrete flow.
 2. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms as indicated. Where the Drawings do not indicate exact locations, such locations shall be determined by the CITY. Lighting fixture locations shall be adjusted slightly as necessary prior to installation to avoid obstructions and to minimize shadows.
 3. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR'S responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum (exposed) and 1-inch minimum (encased). Where circuits are combined in the same raceway, the CONTRACTOR shall derate conductor ampacities in accordance with NEC requirements.
- C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interference.
- D. Protection of Equipment and Materials: The CONTRACTOR shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections as part of the WORK.
- E. Incoming utility power equipment shall be provided in conformance with the utility's requirements.
- F. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 FR 1926, as applicable), state building standards, and applicable local codes and regulations.

3.02 CORE DRILLING:

- A. The CONTRACTOR shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all core drilling locations based on equipment actually furnished as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the CITY prior to any core drilling activities.

3.03 CONCRETE HOUSEKEEPING PADS:

- A. Concrete housekeeping pads shall be provided for indoor floor standing electrical equipment. Housekeeping pads for equipment, including future units, shall be 4 inches nominal above surrounding finished floor or grade and 4 inches larger in both dimensions than the equipment, unless otherwise indicated.
- B. Concrete housekeeping curbs shall be provided for all conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Such curbing shall be 4 inches nominal above finished floor or grade.

3.04 EQUIPMENT IDENTIFICATION:

A. General: Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for all panelboards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.
2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
3. Toggle switches which control loads out of sight of switch and all multi-switch locations of more than 2 switches shall have inscribed finish plates clearly indicating the load.
4. Where shown on the drawings, name tags shall be inscribed with the equipment name and tag number.
5. The CONTRACTOR shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the devices/equipment connected to each circuit breaker.

3.05 CLEANING:

A. The CONTRACTOR shall thoroughly clean the electrical WORK before final acceptance. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped, and all cracks and corners scraped out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.

END OF SECTION

SECTION 16110 RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. NEC (NFPA 70) National Electrical Code
- B. NETA International Electrical Testing Association - Acceptance Testing Specifications
- C. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
- D. Local Building Codes and Standards
- E. ASTM A47 - Standard Specification for Ferric Malleable Iron Castings
- F. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High - Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- G. ASTM A635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High - Strength Low Alloy, High - Strength Low Alloy with Improved Formability, Hot-Rolled, General Requirements for D2000 Standard Classification System for Rubber Products in Automotive Applications
- H. ASTM D2564 - Solvent Cements for Poly Vinyl Chloride Plastic Piping Systems
- I. UL 508 - Industrial Control Equipment
- J. UL 514A – Standard for Safety Metallic Outlet Boxes
- K. UL 514B – Standard for Safety Conduit, Tubing and Cable Fittings
- L. UL 886 - Standard for Safety for Outlet Boxes and Fittings for use in Hazardous (Classified) Locations
- M. UL 1059 – Standard for Safety Terminal Blocks
- N. UL 6 - Standard for Safety Electrical Rigid Metal Conduit - Steel
- O. UL 360 - Standard for Liquid Tight Flexible Steel Conduit
- P. ANSI C80.1 – Standard for Electrical Rigid Steel Conduit - Zinc Coated
- Q. UL 5B - Strut-Type Channel Raceways and Fittings
- R. UL 651 – Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

Furnish submittals in accordance with SECTION 16050 - Basic Materials and Methods.

A. Shop Drawings

1. Complete catalog cuts of all raceways, fittings, boxes, supports, and mounting hardware, marked to show proposed materials and finishes.
2. Complete catalog cuts of all pullboxes, manholes, and handholes, marked where applicable to show proposed materials and finishes
3. Dimensioned layout drawings of all cable tray routings, including elevations.
4. Dimensioned layout drawings of all conduit racks and trapeze type hangers including elevations.

1.05 QUALIFICATIONS: N/A

1.06 RESPONSIBILITIES:

- A. Unless otherwise hereinafter specified, or shown on the Drawings, all boxes shall be metal.
- B. Combination expansion-deflection fittings shall be used where exposed or embedded conduits cross structure expansion joints.
- C. All conduit, fittings and accessories shall be UL listed and labeled.
- D. Furnish sizes of conduit, fittings and accessories as indicated, specified or as required by Electrical Codes and Standards.

1.07 TESTING: N/A

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours advance notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS, and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of SECTION 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of SECTION 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Rigid Galvanized Steel (RGS) Conduit:
 1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.
 2. Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.
 3. Each conduit length shall be threaded on both ends with threads protected.
- B. Rigid Non-Metallic Conduit:
 1. Rigid non-metallic conduit shall be Schedule 40 PVC, sunlight resistant.
- C. Electrical Metallic Tubing (EMT):

1. Electrical metallic tubing shall be hot-dipped galvanized steel. EMT conduit shall only be allowed in office or control room areas which are considered air conditioned interior space.
- D. Liquidtight Flexible Conduit:
1. Liquidtight flexible conduit shall be constructed of a flexible galvanized metal core with a sunlight resistant thermoplastic outer jacket. Utilize liquid tight flexible conduit with spiral enclosed copper bonding conductors for conduit sizes 1 1/4 inches and smaller.
 2. Liquidtight flexible conduit shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.
 3. Fittings used with flexible conduit shall be of the screw-in type as manufactured by O-Z/Gedney, Appleton or Crouse-Hinds.
- E. Flexible Couplings:
1. Flexible couplings shall be of heavy-duty construction, water tight, and have electrical conductivity equal to rigid conduit. 3/4" - 2" shall have an inner brass core with insulating liner, outer bronze braid. 2 1/2"-4" shall have inner stainless-steel core with insulating liner, outer stainless steel braid. Couplings shall be in compliance with UL Standard 886 and conform to ASTM A47, Grade 32510.
- F. Boxes and Fittings:
1. Terminal boxes, junction boxes, pull boxes, etc. shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14-gauge metal and covers shall not be less than 12-gauge metal. Covers shall be gasketed and fastened with stainless steel screws.
 2. Cast iron boxes and fittings shall be galvanized with cast galvanized covers and corrosion proof screws. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with five full threads.
 3. In outdoor areas, conduit shall be terminated in raintight hubs. In other than outdoor areas, sealed locknuts and bushings shall be used.
 4. Conduit, fittings, and boxes in hazardous locations shall be suitable for the Class and Division indicated.
 5. Floor boxes shall be of the round or rectangular cast metal type. Boxes shall be watertight and cover frames shall be adjustable. Box covers shall finish flush with finished floor surface. Boxes shall be located as directed by the CITY and/or as indicated on the Drawings. Necessary gaskets, sealing compound, plugs, or devices shall be provided for the complete installation.
 6. Steel elbows and couplings shall be hot-dipped galvanized. Joints shall be taped.
 7. Electrical metallic tubing fittings shall be of the rain-tight, concrete-tight, compression type.
- G. Outlet Boxes:
1. Construction: Outlet boxes shall be Zinc-coated or cadmium-plated sheet steel boxes of a class to satisfy the condition at each outlet except where unilet or conduit bodies are required. They shall be knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight-sided gang boxes, 4-inch octagon concrete rings and 4-inch octagon hung ceiling boxes with bars, may be folded type. All other boxes shall be one-piece, deep-drawn.
 2. Size: All boxes shall be of enough size to accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Special purpose boxes shall be sized for the device or application indicated.

3. Fixture Studs: 3/8 inch malleable-iron fixture studs shall be used in outlet boxes for ceiling lighting fixtures and interior-bracket lighting fixtures, other than lamp receptacles and drop cords.
 4. Exposed: Screw-joint type boxes, with gasketed weatherproof covers shall be used in locations exposed to the weather.
 5. Tile Boxes: Boxes rectangular with square corners and straight sides shall be used for receptacles and switches mounted in furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls. Install without plaster rings.
 6. Wall-mounted Switch, Receptacle, and Signal Boxes: Shall be, unless otherwise noted or specified, not less than 4 inches square by 2 inches deep for two devices, and multigang boxes for more than two devices. Boxes for switches and receptacles on unfinished walls may be screw-joint type with covers to fit the devices.
 7. Wall-mounted Telephone Outlet Boxes: Shall be 4 inches square by 2 inches deep, unless otherwise noted on the Drawings.
 8. Light Fixture Boxes: Shall be 4-inch diameter by 2-inch-deep, minimum, for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures shall have 3-inch diameter openings. Screw-joint boxes with canopy seat shall be used for ceiling and interior bracket fixtures with exposed conduits.
 9. Grounding Terminal: Provide a grounding terminal in each box containing a green equipment ground conductor, or serving motors, lighting fixtures, or receptacles. Grounding terminal shall be green-colored, washer-in-head, machine screw or grounding bushing.
- H. Pullboxes:
1. Pullboxes shall be minimum NEC size requirements unless larger box is noted, as specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches, and as specified for cabinets for pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion resistant screw or bolt attachment.
- I. PVC Fittings:
1. Fittings for use with rigid non-metallic conduit shall be PVC, solvent welded type.
 2. Provide watertight field-applied coat of all weather PVC solvent cement compound with viscosity and wet film thickness recommended as required for installation of non-metallic conduit and fittings. The cement compound shall be furnished by the conduit manufacturer. PVC solvent cement shall meet the requirements of ASTM D2564, "Solvent Cements for Poly Vinyl Chloride Plastic Piping Systems".
- J. Stainless Steel Boxes:
1. Stainless steel boxes shall be used with RGS conduit and where indicated.
 2. Stainless steel boxes shall be NEMA 4X, Type 316 as indicated in specification SECTION 16050.
 3. Stainless steel shall be minimum 14-gauge thickness, with a brushed finish.
 4. Doors shall have full length stainless steel piano hinges. Non-hinged boxes are not acceptable.
- K. Terminal Cabinets:
1. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished with a minimum of 30% spare terminals.

2. All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120-volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.
3. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.
4. For terminal block specification refer to SECTION 16120.
5. Boxes shall be made from 14-gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum two-inch spare shall be provided between control relays. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job.
6. A single hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three-point catch and lock. Two keys will be supplied for each lock. All locks shall be keyed alike.
7. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with gray over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.
8. Cabinets shall be painted 14 gauge or 16-gauge steel with 14 gauge steel doors, seams continuously welded and ground smooth, no holes or knockouts, with latch kit hardware. Cabinets shall conform to UL 508, File No. E61997, Type 12 and Type 13, NEMA/EEMAC Type 12 and Type 13.

L. Conduit Mounting Hardware:

1. Conduit supports shall be one-hole galvanized malleable iron pipe straps with galvanized clamp backs and nesting backs where required.
2. Ceiling hangers shall be adjustable galvanized carbon steel pipe hangers. Straps or hangers of plumbers perforated tape shall not be acceptable. Hanger rods shall be 3/8-inch minimum galvanized all-thread rod and shall meet or exceed ASTM A193B7. Trapeze, rod type hangers shall not be loaded more than 500 pounds per rod. Where loading exceeds this value, rigid frames shall be provided.
3. Racks shall be constructed from framing channel. Channels and all associated hardware shall be steel, hot dipped galvanized after fabrication of the channel. Field cuts shall be painted with zinc rich paint. Channels attached directly to building surfaces shall be 14-gauge minimum material 1 5/8-inch-wide by 13/16 inch depth. All other channels shall be 12-gauge minimum 1 5/8-inch-wide by 1 5/8 inch minimum depth. Racks shall be designed to limit deflection to 1/200 of span length. All exposed ends of framing channel shall be covered with manufacturer's standard plastic inserts.

2.02 CABLE TRAYS:

- A. Cable tray systems shall be composed of straight sections, curved sections, fittings, and accessories as defined in the latest NEMA Standards publication VE-1 - Ventilated Cable Tray.
1. The cable tray and fittings shall be hot-dip galvanized after fabrication, aluminum or stainless steel.
 2. Cable tray shall be ladder type with 6, 9, 12, or 24-inch spacing with ventilated trough or solid trough. Tray sizes shall have 3, 4, 5 or 6-inch minimum usable load depth as indicated on project drawings.
 3. Loading capacities shall meet NEMA weight classification with a safety factor of 1.5.

2.03 MANHOLES AND HANDHOLES:

- A. Manholes and pullboxes shall be precast, light duty, heavy duty or extra heavy duty of square, rectangular, or round configurations with loading capacities as shown on the drawings.
 - 1. Traffic covers shall be traffic type, H-20 loading, except as indicated otherwise. Manhole and pullbox covers shall be identified as "Electric" by raised letters cast into the covers. Manhole frames and covers shall be heavy duty, frost-tight, water-tight neoprene gasketed frame, solid lids and inner lids.
 - 2. Manholes shall have frost-proof and water-tight grey iron frames and covers with solid lids and inner lids with 28-inch clear openings. Covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Covers shall be cast-iron and shall have pick-holes.
- B. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
- C. PVC ductbank conduits shall be provided with end bells. Brackets and 60-inch concrete inserts shall be provided in manholes as required for racking wiring through manholes.

2.04 DUCT BANKS:

- A. Underground ducts shall be Schedule 40 PVC, unless otherwise noted.
- B. Ducts shall be arranged as shown on the drawings and encased in concrete. Variations from the standard duct bank configurations will be considered by the CITY on a case by case basis if needed to clear obstacles or provide adequate cover. Concrete shall have 3,000 psi compressive strength conforming to SECTION 03300.
- C. Ductbanks shall contain a No. 4/0 bare stranded copper ground wire. The ground wire shall be continuous through the ductbank and terminate at power distribution equipment and grounding grid.
- D. Identification Tape: Continuous lengths of underground warning tapes shall be installed 12-inches above and parallel to all ductbanks. Tape shall be 6-inches wide polyethylene with foil backing film imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

PART 3 - EXECUTION

3.01 PREPARATION:

- A. The CONTRACTOR shall provide suitable protection for conduit risers against damage during construction.
- B. The CONTRACTOR shall cap ends of all conduits before concrete is poured.
- C. The CONTRACTOR shall install pull cord and cap all conduits after cleaning where conduits are to be left empty by this Contract.
- D. The CONTRACTOR shall carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.
- E. The CONTRACTOR shall clean out all conduits before pulling wire.
- F. The CONTRACTOR shall clean out all conduits immediately after concrete work is finished.

3.02 INSTALLATION:

- A. No conduit smaller than 3/4-inch electrical trade size shall be used, nor shall any have more than three 90° bends in any one run. Pull boxes shall be provided as required per references listed in section 1.02.
- B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
- C. The ends of all conduits shall be tightly plugged to exclude dust and moisture while under construction.
- D. Conduit supports shall be spaced at intervals of 8 feet or less, as required to obtain rigid construction.
- E. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-inch diameter.
- F. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.
- G. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.
- H. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75-feet for each 90° elbow.
- I. Conduits terminating in pressed steel boxes shall have double lock nuts and insulated bushings.
- J. Conduits terminating in gasketed enclosures shall be terminated with conduit hubs.
- K. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.
- L. Liquid-tight, flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present.
- M. Conduit stubouts for future construction shall be provided with threaded PVC end caps at each end.
- N. All wiring shall be run in raceway unless indicated otherwise.
- O. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.
- P. Where raceway routings are indicated on plan views, follow those routings to the extent possible.
- Q. Where raceways are indicated but routing is not shown, such as home runs or on conduit developments and schedules, raceway routings shall be the CONTRACTOR'S choice and in strict accordance with the NEC and customary installation practice. Raceway shall be encased, exposed, concealed, or under floor as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise.
- R. Underground raceways shall be installed between manholes, handholes, and pullboxes as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be fabricated with tools designed for this purpose. Factory elbows shall be utilized wherever possible. Continuous lengths of underground

warning tapes shall be installed 12-inches above and parallel to all underground conduits. Tape shall be 6-inches wide polyethylene with foil backing film imprinted "CAUTION – ELECTRIC UTILITIES BELOW."

- S. Routing shall be adjusted to avoid obstruction. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the CONTRACTOR as part of the WORK.
- T. Exposed raceways shall be installed parallel or perpendicular to structural beams.
- U. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.
- V. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.
- W. Holes:
 - 1. The CONTRACTOR shall provide the required insert materials and holes for all openings in new work completely bonded, curbed, flashed and finished off in an approved manner, whether in concrete, steel grating, metal panels or roofs. Resulting seal shall prevent smoke and gas penetration and adhere to Lloyds Register Standards Certificate Numbers SVG/F93/468, SVG/F93/469 and SVG/F93/470 and applicable UL Standards. Insert materials shall be of one of the following types:
 - a. Non-shrinking grout applied to continuously fill annular space between pipe and wall opening. The resulting seal shall serve as an isolator of fire, weather and gaseous conditions.
 - b. Fire rated, Ozone and Ultra-Violet radiation resistant, two-part silicone room temperature vulcanizing (RTV) foam.
 - 2. The CONTRACTOR shall core-drill all holes required in existing building work using a dustless method.
 - 3. The CONTRACTOR shall place grout or foam as specified, in the following locations:
 - a. All holes in concrete wall, floor and roof slabs after installation of conduit.
 - b. Wall entrances where conduit enters the building or vaults from exterior underground.
 - 4. The CONTRACTOR shall install fire and smoke stop fittings at all conduit penetration of fire rated walls, ceilings, and floors.

3.03 CONDUIT:

- A. Exposed conduit shall be Rigid Galvanized Steel, unless indicated otherwise:
 - 1. In areas with chlorine or hydrofluosilicic acid, Schedule 40 PVC shall be utilized.
 - 2. In lime or ferric chloride areas, rigid aluminum conduit shall be utilized
 - 3. In Class I, Div. I or Div. II hazardous locations, rigid aluminum conduit shall be utilized.
- B. Where conduit emerges from concrete encasement, use a PVC Schedule 40 elbow with a PVC terminal adapter and stainless-steel threaded coupling. Install the top of the stainless-steel coupling flush with top of concrete. Insert a PVC plug into the open end of the coupling to prevent debris from entering the conduit during construction. Use a PVC conduit nipple atop the elbow for height adjustment. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.
- C. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4-inch for concrete not exposed to weather or in contact with the ground.

- D. Conduits passing through a slab, wall, or beam shall not impair significantly the strength of the construction.
- E. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:
 - 1. Conduits with their fittings embedded within a column shall not displace more than 4 percent of the gross area of cross section.
 - 2. Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.
 - 3. Conduits shall not be spaced closer than 3 outside diameters on centers.
- F. Conduit shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.
- G. Threads shall be coated with a conductive lubricant before assembly.
- H. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to wires and cables during installation. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.
- I. Wherever possible, conduit runs shall slope to drain at one or both ends of run. Wherever conduit enters substructures below grade, the conduit shall be sloped to drain water away from the structure.
- J. Installation of rigid steel conduit through a core-drilled hole in an exterior wall below grade shall utilize a modular sealing device.
- K. Each conduit shall be identified at each end with a permanent non-corrosive metal marker. Designation shall be pressure stamped into the tag. The conduit identification shall be designated circuit number as shown.

3.04 SUPPORTS:

- A. The CONTRACTOR shall construct metal framing strut systems with enough rigidity to hold all mounted equipment and material in permanent and neat alignment. All channels, fittings and hardware of the strut assemblies shall be as per contract drawings and specifications and shall not exceed load requirements in UL classification 5B and applicable NEC, NEMA and ASTM standards. Utilize galvanized material for interior non-corrosive and air-conditioned spaces and stainless steel, for outdoor or corrosive environments.
- B. Design supports to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
- C. After Power Tool Cleaning, paint all welds, field cuts and damaged areas with one manufacturer type of primer and paint. Utilize organic zinc-rich primer at 3 mils dry film thickness.
- D. All screws, nuts, bolts, pipe clamps and other anchoring materials for struts and framing shall be stainless steel.
- E. All outdoor supports shall be constructed to meet wind load requirements of the site as set forth in structural specifications or/and contract drawings.

3.05 OUTLET BOXES:

- A. Installation: Unless otherwise specified or shown on the drawings, outlet boxes shall be flush mounted, and the front edges of the boxes or plaster covers shall be flush with the finished wall or ceiling line; or, if installed in walls and ceilings of incombustible construction, not more than 1/4 inch

back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. A multiple of box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hangers, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steelwork.

- B. Mounting Heights: The mounting height of a wall-mounted outlet box shall be construed to mean the height from the finished floor to the horizontal center line of the cover plate. On exposed tile, block, or brick constructions, mount outlet boxes at the nearest bed joint to the mounting height indicated. Verify heights with the CITY.
- C. Wall-mounted Switch, Receptacle and Signal Outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to the trim. Install according to architectural drawings, unless other locations are approved by the CITY.
- D. Back-to-Back: Outlets shown on the drawings "back-to-back" are to be installed with a minimum of 6 inches lateral separation between outlets. "Through-the-wall" type boxes are not permitted.

3.06 FIXTURE CONNECTIONS:

- A. Recessed or surface light fixtures in lay-in or accessible ceilings shall be connected with minimum 1/2 inch flexible metallic conduit, 4 to 6 feet long, with grounding provisions.

3.07 DUCTBANKS:

- A. Ductbanks shall be installed in accordance with the criteria below:
 - 1. Duct shall be assembled using high impact non-metallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet. The duct array shall be anchored every 5 feet to prevent movement during placement of concrete.
 - 2. Duct shall be laid on a grade line of at least 3-inches per 100-feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 18-inches below grade and a minimum of 24-inches below roadways.
 - 3. Changes in direction of the duct envelope by more than 10° horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
 - 4. Duct couplings shall be staggered a minimum of 6-inches.
 - 5. The bottom of trench shall be of select backfill or sand.
- B. Each bore of the completed ductbank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct. After passing of the mandrel, a wire brush and swab shall be drawn through. Spare raceways that are not indicated to contain conductors shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.
- C. Duct entrances shall be grouted smooth; ducts shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 12-inch bed of gravel as recommended by the manufacturer or as required by field conditions.
- D. Ductbank penetration through walls of manholes, pullboxes, and building walls below grade shall be watertight.
- E. Concrete encased ductbank shall terminate at building foundations. When duct enters the building with a concrete slab on grade foundation, duct shall not be encased, but shall transition to rigid steel conduits at the edge of the slab.

3.08 BURIED CONDUITS: YARD AREAS:

- A. The CONTRACTOR shall place PVC Schedule 40 conduit where indicated on project drawings.
- B. Make all joints watertight per requirements of section 2.01. J.2.
- C. Bury conduits a minimum of 24 inches below finish grade unless indicated otherwise.
- D. Slope conduit away from conduit risers where possible.
- E. Maintain 6-inch separation from underground piping.
- F. Use long radius bends at all risers unless indicated otherwise.
- G. After trench bottom has been excavated to elevation, lay conduit. Backfilling shall be as specified in DIVISION 2.
- H. Provide watertight seal around wires where conduit terminates in pull box.
- I. Empty service entrance conduits shall be PVC Schedule 40, or as otherwise required by serving utility.

END OF SECTION

SECTION 16120 WIRES AND CABLE

PART 1 - GENERAL

1.01 SCOPE:

- A. This SECTION includes furnishing and installing (including terminations) of all electrical wire, cable, and accessories.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied by this SECTION.

- A. NEC (NFPA 70) National Electrical Code
- B. UL 83 - Thermoplastic Insulated Wires and Cables
- C. NETA International Electrical Testing Association - Acceptance Testing Specifications

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

- A. The CONTRACTOR shall submit Shop Drawings in accordance with CONTRACTOR Submittals and SECTION 16050 – Basic Materials and Methods.

1.05 QUALIFICATIONS: N/A

1.06 RESPONSIBILITIES: N/A

1.07 TESTING:

- A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of NETA ATS Section 7.3.2. Factory test results shall be submitted in accordance with SECTION 01300 prior to shipment of cable. The following field tests shall be the minimum requirements:
 - 1. Power cable rated at 600 VAC shall be tested for insulation resistance between phases and from each phase to a ground using a megohmmeter.
 - 2. Field testing shall be done after cables are installed in the raceways.
 - 3. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the CITY for review and acceptance.
 - 4. Cables failing the tests shall be replaced with a new cable.
- B. Continuity Test: Control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cables in service.

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours advance notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS, and PRODUCTS specified in this SECTION against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of SECTION 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of SECTION 00700 - General Terms and Conditions.

PART 2 - MATERIALS

2.01 GENERAL:

- A. Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

2.02 LOW VOLTAGE WIRE AND CABLE:

- A. Power and Lighting Wire
 - 1. Wire rated for 600 volts in duct or conduit for all power and lighting circuits shall be Class B Type THHN or THWN, polyvinyl chloride rated at 90°C in dry locations, 75°C in wet locations, meeting the requirements of UL 83.
 - 2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
 - 3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
- B. Control Wire
 - 1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.
 - 2. Interconnecting control wiring installed in conduit to or between field devices (field wiring) shall be sized in accordance with NEC Article 310.15, Table 310.16 and shall not be smaller than No.14 AWG (minimum), unless otherwise indicated on project drawings
 - 3. Internal wiring installed within a control panel and cabinets shall be sized in accordance with NFPA 79, Table 12.5.1; and shall not be smaller than No. 18 AWG unless otherwise indicated on project drawings.
 - 4. Internal control wires within control panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.
- C. Instrumentation Cable
 - 1. Instrumentation cable shall be rated at 600 volts.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-red for two-conductor cable and black-red-white for three-conductor cable.
3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 16 AWG stranded tinned copper drain wire, and a PVC outer jacket with a nominal thickness of 0.048-inches.

2.03 CONNECTORS:

A. General Requirements:

1. Cable connectors shall be designed and sized for specific cable being connected.
2. Solderless, pressure-type connectors shall be constructed of non-corrodible tin-plated copper.
3. All connectors shall have a current-carrying capacity equal to or greater than the cable being connected.
4. Application tooling for compression type connectors shall contain die or piston stops to prevent over-crimping and cycling or pressure relief to prevent under-crimping. Dies of all application tooling shall provide wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.
5. General purpose insulating tape shall be high temperature (105°C) tape, with a dielectric strength of 1,150 V/mil of polyvinyl material.

B. Mechanical Pressure Connectors:

1. Connectors shall be threaded split bolt type of high strength copper alloy.
2. Pressure type, twist-on connectors will not be acceptable.
3. Barrel shall have funnel entry, and vinyl insulation.

C. Power Lugs (10 AWG and Smaller) 600V and Below:

1. Pre-insulated ring tongue type
2. Manufactured from high-strength copper alloy

D. Power Lugs (Sizes 8-4 AWG) 600V and Below:

1. Non-insulated ring-tongue type
2. Ring tongue sized to match terminal stud size
3. Brazed barrel seam
4. Sight hole to verify proper cable insertion
5. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp

E. Control, Instrument and Specialty Cable Connectors:

1. Tin-plated copper
2. Vinyl or nylon pre-insulated ring-tongue type (Spade lugs will not be permitted.)
3. Sized to match terminal stud size
4. Have insulation grip sleeve to firmly hold to cable insulation
5. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned-back strands.

6. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.

2.04 TERMINAL BLOCKS:

- A. For Mounting in Terminal Boxes:
 1. Designed and sized for the cables being terminated
 2. Phenolic block rated 600 volts
 3. Binding screw-type terminals for power cables and straight-strap stud terminals for control and instrument cables
 4. Rated current carrying capacity equal to or greater than the cable being terminated
 5. Marking strip
- B. For Mounting in Cabinets, Panels, Control Boards, etc.:
 1. Designed and sized for the cables being terminated
 2. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 V AC/DC, 10 A rated minimum.

2.05 CABLE IDENTIFICATION SLEEVES:

- A. Refer to SECTION 16050 for appropriate conductor identification material.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The CONTRACTOR shall provide and terminate all power, control, and instrumentation conductors except where indicated.

3.02 INSTALLATION:

- A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.
- B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
- C. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.
- D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.
- E. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

3.03 SPLICES AND TERMINATIONS:

- A. General
 1. Wire taps and splices shall be properly taped and insulated according to their respective classes.
 2. In general, there shall be no cable splices in underground manholes or pullboxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet that is stand mounted on a concrete pad. Splices in underground

manholes and pullboxes may be made only with the approval of the CITY and shall utilize outdoor mechanical type splice connectors meeting UL486D and UL50 requirements.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use compression lugs where equipment box lugs have not been provided.
 4. Surplus control and instrumentation wire shall be properly taped and terminated as spares.
- B. Control Wire and Cable
1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.
 2. In junction boxes, motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.
- C. Instrumentation Wire and Cable
1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.
 2. Two and three conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pullboxes. Such cable runs shall have only one splice per conductor. Splices, where approved by the CITY, shall be made on terminal blocks.
- D. Power Wire and Cable
1. All 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable boxes or conduit bodies at locations determined by the CONTRACTOR.
 2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of two layers of high temperature tape.

3.04 CABLE IDENTIFICATION:

- A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.
- B. Identification Numbers: The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals. "Control Conductor" shall be defined as any conductor used for alarm, control, annunciation, or signal purposes.
1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.
 2. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, and Neutral - White. The 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switched conductors shall be yellow. Insulated ground wire shall be green. Color coding and phasing shall be consistent throughout the Site, but bus bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

3. All 4-wire, delta-connected secondary where the midpoint of one phase winding is grounded, the phase conductor having the higher voltage to ground shall be identified by an outer finish that is orange in color. Color coding tape shall be used where colored insulation is not available. Such identification shall be placed at each point where a connection is made if the ground conductor is also present. The B phase shall be that phase having the higher voltage to ground on 3-phase, 4 wire delta-connected system.
4. Fire alarm cable jackets shall be red. General purpose DC control cable jackets shall be blue.
5. Spare conductors shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
6. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

END OF SECTION

SECTION 16140 WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE:

The Work of this Section shall consist of furnishing all labor, materials, and equipment necessary for installation of wiring devices and plates as shown on the Drawings and specified herein.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. NEC (NFPA 70) National Electrical Code
- B. NETA International Electrical Testing Association - Acceptance Testing Specifications
- C. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
- D. Local Building Codes and Standards
- E. UL 1449 Standard for Transient Voltage Surge Suppressors
- F. UL 498 Standard for Safety Attachment Plugs and Receptacles

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

- A. Furnish submittals in accordance with Contractor Submittals.
- B. Shop Drawings
 - 1. Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials
 - 2. Documentation showing that proposed materials comply with the requirements of NEC and U.L.

1.05 QUALIFICATIONS:

- 1. Submit documentation of the manufacturer's qualifications.

1.06 RESPONSIBILITIES:

- A. The Requirements of SECTION 16050 Basic Materials and Methods apply to this section.
- B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.07 TESTING:

- A. Provide checkout, field, and functional testing of wiring devices in accordance with SECTION 16050.
- B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.
- C. Test GFCI receptacle for correct tripping operation with suitable tester.

1.08 INSPECTIONS COORDINATION:

The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The Contractor shall provide 48 hours notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 SNAP SWITCHES:

- A. Unless otherwise specified, each snap switch (flush tumbler-toggle) shall be of the C.C. commercial grade type for mounting in a single-gang spacing, fully rated 20 amperes, minimum, at 120-277 VAC, conforming to minimum requirements of the latest revision of the Underwriters' Laboratories, Inc., "Snap Switches" and further requirements herein specified. Specification grade, heavy-duty, single pole, 3-way or 4-way, of the maintained type as indicated on the drawings shall be used. Switches shall operate in any position and shall be fully enclosed cup type with entire body molded phenolic, urea or melamine. Fiber, paper or similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts. Brass contact arm. Snap switches shall be capable of withstanding tests as outlined in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems section 7.5.1.1.
- B. Switches for hazardous locations shall be factory sealed, rated at 20 amperes, 120-277 VAC, capable of controlling 100 percent tungsten filament, fluorescent and HID lamp loads.

2.02 RECEPTACLES:

- A. Industrial or Hospital Grade: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publications and UL Listings. Receptacles shall be rated for 125 VAC, 20 amperes shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Receptacles shall also be fire-resistant, non-absorptive, with nylon top (face) and bodies and bases with metal plaster ears (integral with the supporting member). They shall be single or duplex as shown or noted on drawings, and ivory color unless otherwise noted, with triple wipe or equivalent brass alloy power contacts for each prong. Approved manufacturers are Hubbell, Cooper, Pass & Seymour, or Leviton, or CITY approved equal.
- B. Grounding Type: All receptacles shall be grounding type with a green-colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper in accordance with NEC, Article 250.
 - 1. Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.
- C. GFCI: Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated and as required by the NEC. GFCI's shall be duplex, Industrial or Hospital grade, tripping at 5 mA. Ratings shall be 125 V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage. Feed-through type GFCI's serving standard receptacles will not be permitted.

- D. Floor receptacles and jacks shall be installed in rectangular floor boxes. Floor boxes shall be 1, 2, or 3 gang as required for each installation. Boxes shall conform to requirements set forth in Specification SECTION 16110.
- E. Pedestal type boxes for laboratory bench receptacles shall be cast iron, polished finish, single face with 1/2-inch N.P.T. tapped flanged inlet; single gang, meeting UL Standard 514.
- F. Special Purpose: Receptacles for special applications shall be as indicated on the drawings.
 - 1. Special purpose receptacles shall have ratings and number of poles as indicated or required for anticipated purpose.
 - 2. Matching plug with cord-grip features shall be provided with each special-purpose receptacle.
- G. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125 VAC.
- H. TVSS Receptacles:

Transient voltage surge suppressing receptacles shall comply with the requirements set forth in paragraph 2.02A in this specification and in addition shall have the following as a minimum:

 - 1. A filtering capacitor for 7 to 1 average noise reduction
 - 2. Two-way protection for line equipment
 - 3. Response time less than 1 nanosecond for unmounted Metal Oxide Varistor (MOV)
 - 4. Overcurrent protection
 - 5. Thermal protection
 - 6. Transient suppressing MOV's
 - 7. Varistor with voltage capabilities of 150V RMS

2.03 PLUG CAPS & CORDS:

Provide and install a matching plug cap and properly-sized cord for equipment items noted on the drawings as by Electrical Contractor. No plug caps are required for duplex receptacle.

2.04 DEVICE PLATES:

- A. General: Provide device plates for each switch, receptacle, signal and telephone outlet, and special purpose outlet. Do not use sectional gang plates for multi-gang boxes. Plates shall be of commercial grade nylon.
- B. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not acceptable. Receptacles slated for special purposes shall have nameplates clearly indicating their intended use. Conform to requirements of SECTION 16050.
- C. Special Purpose: Plates for special purpose outlets shall be of a design suitable for the particular application and as called for in the project drawings.

PART 3 - EXECUTION

- 3.01 GENERAL: Perform work in accordance with the National Electrical Code.

3.02 CONNECTION:

- A. Rigidly attach wiring devices in accordance with National Electrical Code, and as indicated, avoiding interference with other equipment.
- B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.03 GROUNDING:

- A. Ground all devices, including switches and receptacles, in accordance with NEC, ART 250, and SECTION 16450 Grounding.
- B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.
- C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

END OF SECTION

SECTION 16412 MOLDED CASE CIRCUIT BREAKERS

1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for molded case circuit breakers (also identified as MCCB) as required for the complete performance of the work, as shown on the Drawings, as specified herein, and as specified elsewhere for the assemblies or systems comprised of the components specified herein.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
 - 3. Refer to the equipment specification sections in which the circuit breakers will be installed for additional requirements. This may include but not be limited to the following specifications sections:
 - a. Intelligent Electrical Power Systems
 - b. Enclosed Switches and Circuit Breakers
 - c. Low Voltage Switchgear
 - d. Switchboards
 - e. Low Voltage Motor Control Centers

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. Canadian Standards Association (CSA):
 - a. C22.2 No.5, "Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures"
 - 2. US Federal Specifications and Standards
 - a. FED W-C-375E
 - 3. International Electrotechnical Commission (IEC):
 - a. IEC 60947-2, "Low-Voltage Switchgear and Controlgear - Part 2: Circuit-Breakers"
 - b. IEC 60947-3, "Low-Voltage Switchgear and Controlgear - Part 3: Switches"
 - 4. International Organization for Standardization (ISO):
 - a. ISO 9001, "Quality Management Systems - Requirements"
 - 5. Mexican ANCE Standards
 - a. NMX-J-266-ANCE
 - 6. National Electrical Manufacturers Association (NEMA)
 - a. NEMA AB-1, "Low-voltage Circuit Breakers"
 - 7. Underwriters Laboratories, Inc. (UL):
 - a. UL 489, "Low-voltage AC and DC Circuit Breakers"

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
1. ICCB: Insulated Case Circuit Breaker
 2. LVPCB: Low Voltage Power Circuit Breaker
 3. MCCB: Molded Case Circuit Breaker
 4. LSIG or combination of these letters: type of protection and available adjustments on certain trip units.
 - a. L: Long Time (overload protection, analogous to the inverse-time thermal trip of a thermal/magnetic breaker)
 - b. S: Short Time (short circuit protection of low level faults)
 - c. I: Instantaneous (short current protection of high level faults, analogous to the instantaneous magnetic trip of a thermal/magnetic breaker)
 - d. G: Ground Fault (equipment ground fault protection)
 - e. Therefore, LSIG = Long-time + Short-time + Instantaneous + Equipment Ground-fault Protection

1.4 SUBMITTALS

1. General: Submittals shall be in accordance with the requirements of Section 01300 Submittals in addition to those specified herein.
2. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
 2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.
- B. All work performed, and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Process controllers, assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements.

- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer

1.7 WARRANTY

- A. General: Refer to Section 01770 - Closeout Procedures.
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 SPECIAL TOOLS AND SPARE PARTS

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
 - 1. Contact information for the closest parts stocking location to the Owner.
 - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
 - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit furnished. At a minimum, the following shall be provided:
 - 1. Provide the minimum spare parts recommended by the manufacturer.
- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:
 - 1. If available from manufacture, provide PC-based configuration software tool and a minimum of [one] communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.
 - 2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.
- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide PowerPact™ circuit breakers with thermal-magnetic or Micrologic electronic trip units by Schneider Electric.
- B. Acceptable Products: Circuit Breakers specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the

following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:

1. PowerPact Circuit Breakers by Schneider Electric
2. [2nd manufacturer and model]
3. [3rd manufacturer and model]

2.2 CIRCUIT BREAKERS

- A. Circuit breakers shall have voltage and interrupting ratings that meet the application requirements. Interrupting rating shall be available up to 200 kAIR without fuses. Circuit breakers shall be available in frame sizes as follows: B-frame (125A), H-frame (150A), J-frame (250A) Q-frame (225A) L-frame (600A), M-frame (800A), P-frame (1200A) and R-frame (3000A). There are also additional legacy frames FA/FH (100A) and LA/LH (400A) thermal-magnetic circuit breaker.
- B. Circuit breakers shall be constructed using glass reinforced insulating material.
- C. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.
- D. Circuit breakers shall have an overcenter, trip-free, toggle-operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
- E. From 125 A to 600 A rating frame, MCCBs breaking unit shall be made with a double rotary contact to limit let-through energy on the installation
- F. MCCBs shall be designed to trip the circuit breaker in the event of high-level short-circuit currents. This design shall be independent of the thermal-magnetic or electronic trip unit.
- G. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing international I/O markings.
- H. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on the face of the circuit breaker.
- I. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
- J. Circuit breakers shall be factory-sealed with a hologram quality mark or a tamper evident label and shall have a date code.
- K. MCCB's shall be able to receive a device for locking in the isolated position.
- L. [Circuit breaker/circuit breaker][Fuse/circuit breaker] combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations.
- M. Any series-rated combination used shall be marked on the end use equipment along with the statement: "Caution - Series Rated System. _____ A Available. Identical Replacement Component is required".
- N. Electronic components shall withstand temperatures up to 221 °F (105 °C).
- O. Circuit breakers shall be UL-listed to accept field installable/removable mechanical type lugs (except Type QB/QD/QG/QJ). Lugs shall be UL-listed to accept solid and/or stranded [copper and aluminum conductors] [copper conductors only]. Lugs shall be suitable for [140 °F (60 °C) rated wire on 125 ampere circuit breakers and below] [167 °F (75 °C) rated wire] [194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC].

- P. Circuit breakers shall be capable of accepting bus connections.
- Q. For frame ratings, higher than 250 amperes, MCCBs shall be fitted with metallic filters to reduce effects perceptible from the outside during current interruption.
- R. For a given MCCB rated frame, MCCBs dimensions shall be the same whatever the AIR.
- S. P-frame (1200 amperes frame) shall be available in manually operated version and electrically operated version.
- T. The P-frame electrically operated version shall be of the stored-energy type only and will be equipped with anti-pumping function.
- U. The P and R-frame circuit breakers shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.

2.3 TRIP UNITS

- A. MCCB's with frame ratings 150 to 400 amperes shall be equipped with [thermal magnetic] [electronic] trip units. MCCB's with frame rating 125 amperes shall be equipped with thermal magnetic trip units.
- B. MCCB's with ratings over 400 amperes shall be equipped with electronic trip units.
- C. Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
- D. MCCBs with field interchangeable trip units shall have trip units that are easily interchangeable and easily secured to the MCCB.
- E. The trip units shall not augment overall circuit breaker volume.
- F. Thermal Magnetic (400 Ampere Frame and Below):
 - 1. "PowerPact Q-, B-, H- and J-Frame", FA, FH, FY, LA, and LH as manufactured by Square D by Schneider Electric.
 - 2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.
 - 3. Circuit breaker frame sizes 250 amperes and above shall have a single magnetic trip adjustment located on the front of the circuit breaker
 - 4. Where indicated on drawings, circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.
- G. Electronic Trip Circuit Breakers. Trip units shall be Micrologic.
 - 1. "PowerPact H-, J-, L-, P-, and R-Frame" (15 to 3000 amperes) as manufactured by Square D by Schneider Electric.
 - 2. Micrologic electronic trip unit shall be true RMS sensing.
 - 3. Air core current transformers shall be used to ensure accurate measurements from low currents up to high currents.
 - 4. Electronic trip unit shall be fitted with thermal imaging to protect intermittent short circuits or ground-faults.
 - 5. The following monitoring functions shall be integral parts of electronic trip units:
 - a. A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
 - b. LED for load indication at 105 percent.

- c. LED for load indication at 90 percent of load for applications 600 amperes and smaller
 - d. LED for visual verification of protection circuit functionality for applications 600 amperes or smaller.
 - e. Optional: LED for trip indication for applications above 600 amperes.
 - f. Micrologic trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
 - g. Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (I_n), with finer adjustments available for more precise settings to match the application.
 - h. Adjustable long-time delay shall be in nine bands. At six times I_r , from 0.5 to 24 seconds above 600 amperes, and 0.5 to 16 seconds for 600 amperes and below.
 - i. Short-time pickup shall allow for nine settings from 1.5 to 10 times I_r .
 - j. Short-time delay shall be in nine bands from 0.1–0.4 I_t ON and 0–0.4 I_t OFF.
 - k. Instantaneous settings on the trip units with LSI protection shall be available in nine bands.
 - 1) Above 600 amperes, from 2 to 15 times I_n
 - 2) 600 amperes, from 1.5 to 11 times I_n
 - 3) 400 amperes from 1.5 to 12 times I_n
 - 4) 250 amperes and below, from 1.5 to 15 times I_n
 - l. Four-pole devices shall be equipped for neutral protection with a three-position setting; neutral not protected, neutral tripping threshold equal to half the phase value, and neutral threshold equal to the phase value.
 - m. Ground fault settings for circuit breaker sensor sizes 1200 amperes or below shall be in nine bands from 0.2 to 1.0 times I_n . The ground fault settings for circuit breakers above 1200 amperes shall be nine bands from 500 to 1200 amperes.
6. It shall be possible to fit the trip unit with a seal to prevent unauthorized access to the settings in accordance with NEC Section 240-6(b).
 7. Trip unit shall provide local trip indication and capability to locally and remotely indicate reason for trip, i.e., overload, short circuit, or ground fault.
 8. Neutral current transformers shall be available for four-wire systems.
 9. Trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments shall be 1 ampere. Fine increments for delay adjustments shall be one second
 10. Trip units shall be available to provide real time metering. Metering functions shall include, but shall not be limited to, the following:
 - a. Current (phases, neutral, average, maximum)
 - b. Voltage (phase-to-phase, phase-to-neutral, average, unbalance)
 - c. Power (active [kW], reactive [kVAR], apparent [kVA], power factor)
 - d. Energy (active [kWh], reactive [kVAR], apparent [kVA])
 - e. Frequency
 - f. Total harmonic distortion (current, voltage)
 - g. Metering accuracy shall be 1.5 percent current (above 600 amperes), 1.0 percent current (600 amperes and below), 0.5 percent voltage, and 2 percent energy. This accuracy shall be total system, including, but not limited to, CT and meter.
 11. Measurement chain shall be independent from the protection chain.
 12. The measurements shall be displayed on the breaker itself and/or on a remote display and/or on a remote system via Modbus communication.
 13. Connections from circuit breaker to remote display and/or communication module shall be plug-n-play via RJ45 connector. No special tools or programming shall be required.
 14. Optional features for applications 600 amperes and smaller, choose all that apply:
 - a. Zone Selective Interlocking
 - b. Contact wear indication
 - c. Operation, trip and alarm counters
 - d. Operating hours' counter
 - e. Load profile

15. Optional features for applications above 600 amperes, choose all that apply:
 - a. Inverse definite minimum time lag (IDMTL)
 - b. Zone selective interlocking
 - c. Protective relaying functions (Current unbalance, maximum demand current, reverse power, etc...)
 - d. Phase loading
 - e. Contact wear indication
 - f. Wave form capture
 - g. Data logging

H. Electronic Trip ET 1.0 Trip System (300 to 800 Amperes):

1. "PowerPact M-Frame" (300 to 800 amperes) as manufactured by Square D by Schneider Electric.
 - a. The circuit breaker trip system shall be a microprocessor-based true RMS sensing design.
 - b. Sensor ampere ratings shall be as indicated on the drawings or schedules.
 - c. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
 - d. Trip unit shall not be field-replaced.
 - e. ET 1.0 trip unit functions shall consist of adjustable instantaneous pickup with no intentional time delay.
 - f. The long time trip point setting shall be fixed and cannot be adjusted.
 - g. The instantaneous settings on the trip unit shall allow 2 to 10 times the sensor rating (In).
 - h. The trip unit shall have the capability for the adjustment to be set and read locally by a rotating switch.
 - 1) Ground fault protection shall not be provided.

2.4 Accessories:

- A. Circuit breakers shall be equipped with UL-listed electrical accessories as noted on the drawings or schedules or they may be field-installable.
- B. The addition of auxiliaries shall not increase the volume of the circuit breaker.
- C. B-frame (125 amperes) circuit breakers shall have auxiliary location and function easily identifiable outside the face plate through viewing windows.
- D. The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings.
- E. Electrical Auxiliaries: Electrical auxiliaries such as voltage releases (shunt trip and undervoltage) and indication switches as follows:
 1. Same field-installable auxiliary contacts for signaling different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal. Auxiliaries shall be common for the entire H-, J-, L-, M-, P-, and R-frame range,
 2. Electrical auxiliaries shall be separated from power circuits,
 - a. Electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
 - b. Electrical auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
 3. P and R-frame circuit breakers shall have coils designed for continuous duty.
- F. Equipment Ground Fault Protection Modules (Thermal Magnetic Circuit Breakers):
 1. "PowerPact H- and J-Frame" as manufactured by Square D by Schneider Electric.
 - a. Circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.
 - b. Ground fault sensing system shall be modified zero sequence (GFM) or zero sequence (ELM) sensing type.

- c. The ground fault system shall require no external power to trip the circuit breaker.
- d. Companion circuit breaker shall be equipped with a ground fault shunt trip.
- e. The ground fault sensing system shall be suitable for use on solidly grounded systems.
- f. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems. ELM shall be suitable for use on three-phase, three-wire circuits only.
- g. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
- h. The ground fault sensing system shall include, but shall not be limited to, a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
- i. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
- j. Local visual ground fault trip indication shall be provided.
- k. The ground fault sensing system shall be provided with zone selective interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on the Drawings or schedules. ELM shall not be provided with ZSI capabilities.
- l. The companion circuit breaker shall be capable of being group mounted.
- m. The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.

G. Motor Operating Mechanism:

- 1. It shall be possible to equip H-, J-, L-, and P-frame circuit breakers with a motor mechanism for electrical operation. An auto/manual switch in front shall, when set to the manual position, lock out electrical control; when set to auto, lock out the manual control. Remote indication of manual or auto mode shall be possible. It shall also be possible to seal the access to the auto control. Closing shall take place in less than 5 cycles (80 ms).
- 2. Following tripping due to electrical faults (overload, short circuit, earth fault), remote reset shall be inhibited. It shall however be possible if opening was initiated by a voltage release.
- 3. The operating mechanism shall be of the stored energy type only.
- 4. The addition of a motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics.
- 5. Only three stable tripping mechanism positions (ON, OFF, and tripped) shall be possible with the motor mechanism.
- 6. Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module.

H. Handle Accessories:

- 1. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
- 2. Circuit breakers through 1200 amperes shall have available rotary handle operators and 15 through 600 amperes shall have an open-door shaft operating tool.
- 3. Circuit breakers through 125 amperes shall have an available side mounted (lateral) rotary handle operator.

I. Connection Accessories

- 1. Circuit breakers rated 15 – 600 amperes shall have mechanical lugs that can be installed without the use of any tools
- 2. Circuit breakers rated 15 – 1200 amperes shall have I-LINE connections available for high density group mounted applications
- 3. Circuit breakers rated 15 – 125 amperes shall be DIN-Rail mountable without any extra components or accessories

4. Circuit breakers rated 15 – 125 amperes shall have creep-compensating terminations that maintain clamping forces over time without retightening
5. Circuit breakers rated 15 – 125 amperes shall be UL listed to accept fine stranded wire
6. Circuit breakers shall have available voltage tap connections that are separate from the power connection
7. Circuit breakers through 1200 amperes shall have available PDC lugs and long terminal shields – for UL508 applications

2.5 **Communicating Circuit Breaker Interface to Monitor, Control, and Maintain Electrical Equipment**

A. General

1. The circuit breaker shall be equipped with a communicating interface that makes it possible to monitor and control protection units with information on their status, to deliver maintenance and equipment information using an open protocol such as Modbus TCP/IP or Modbus RS485 serial line:
 - a. Energy cost management: energy saving and optimization
 - b. Electrical distribution network management: protection, monitoring & control
 - c. Asset management: use optimization, predictive maintenance, equipment alarming
 - d. Transmit data to the BMS or FTP Server
2. Communicating circuit breaker interface shall offer Ethernet TCP/IP 10/100 Mbps ports to be connected on the building Local Area Network (LAN) and shall offer a real time access to device data by using a standard internet web browser.

B. Characteristics, operating principle and indications

1. The following information shall be accessible for circuit breakers at all the layers of electrical distribution architecture (modular feeders up to incomer circuit breakers)
 - a. ON/OFF position (O/F) / trip indication (SD) / fault-trip indication (SDE)
 - b. Cradle management: Draw out position
2. The following commands shall be possible:
 - a. open / close / reset
3. When advanced trip units are used, the following information shall be accessible:
 - a. Instantaneous and demand values, maximum and minimum values, energy metering, demand current and power, power quality
 - b. Protection and alarm settings
 - c. Time-stamped trip and alarm histories and event tables
 - d. Maintenance indicators

C. Communicating Circuit Breaker Interfaces functions:

1. Energy management system shall offer main interface and secondary interfaces for energy management issue. Data shall be collected via Ethernet TCP/IP and ModBus networks by which communicating circuit breakers, I/O digital and analog input modules, pulse counter, power meter and energy meter will be connected to interface.
2. A switchboard display shall be connected via Ethernet TCP/IP network to the switchboard interface and shall offer a real time direct data access to monitor and control devices and load.
3. Ethernet communication interfaces will be compliant to Device Profile Web Service (DPWS) for discovery on the local area network (LAN).
4. Energy management interface shall offer direct access to data collection to monitor and control devices and load.
5. Energy management interface shall collect:
 - a. Data from communicating circuit breaker with embedded measurement capability
 - b. Pulse from metering pulse electrical, gas, water counters
 - c. Data from communicating energy meters or power meters

- d. Logic state of technical devices or equipment
 - e. Device alarms with time logs
 - f. Temperature analog sensor value
6. Energy management interface shall display via web pages:
- a. Energy consumption
 - b. Electrical data network monitoring
 - c. Alarms and events
 - d. Energy quality monitoring
 - e. Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current
 - f. Operation and predictive maintenance monitoring
7. Energy management interface shall integrate simple control functions via web pages:
- a. Load and devices via digital output
 - b. Orders of actuator

D. Communicating Circuit Breaker Interface features

1. The main interface enables an intelligent modular unit (IMU), for air or molded case circuit breakers to be connected to an Ethernet network and enables gateway to Modbus serial line connection.
2. An intelligent modular unit is a mechanical and electrical assembly containing one or more products to perform a function in a switchboard (incoming protection, motor command, and control). The modular units are easily installed in the switchboard.
3. The features of the main interface are:
 - a. Dual Ethernet port for simple daisy chain connection
 - b. Device Profile Web Service (DPWS) for discovery on the local area network (LAN)
 - c. Dual Universal Logic Plug (ULP) compliant for advanced connection with Air or Molded Case circuit breaker
 - d. Gateway for Modbus-SL connected devices
 - e. Embedded set-up web pages
 - f. Embedded monitoring web pages
 - g. Embedded control web pages
 - h. Built-in email alarm notification
 - i. The interface mounts on a DIN rail
 - j. A stacking accessory enables the user to connect several Modbus interface for air or molded case circuit breaker without additional wiring.
 - k. The interface must be always supplied with 24 Vdc using an UL listed and recognized limited voltage/limited current or a class 2 power supply with 3 A maximum.
 - l. The interface provides DC supply to the Modbus interfaces for Air or Molded Case circuit breaker and it is not necessary to supply them separately.
 - m. The interface indicates the status of the interface, the Ethernet communication dual color ports, ULP and Modbus connections by using LED on the front panel.
 - n. A locking pad on the front panel of the interface enables or disables to send the remote control commands over the Ethernet network to the interface, and to the other modules of the connected IMU.
 - o. Pre-defined applications add new functions to the IMU in a simple way:
 - 1) selection by the application rotary switch on the I/O application module, defining the application with pre-defined input/output assignment and wiring diagram
 - 2) no additional setting with the customer engineering tool required. The resources not assigned to the pre-defined application are free for additional user-defined applications: cradle management, breaker operation, cradle management and Energy Reduction Maintenance Setting (ERMS), light and load control and other custom for protection / control / energy management / monitoring.
 - p. The firmware can be updated using FTP connection or customer engineering tool.

E. Switchboard display

1. Energy management system shall integrate a switchboard display. Switchboard display will be connected to switchboard interface via Ethernet TCP/IP network to offer:
 - 1) Real time display monitoring of devices
- b. Simple control of devices and load.
- c. Switchboard display shall integrate functions to monitor:
 - 1) Energy consumption
 - 2) Electrical network data
 - 3) Alarms and events
 - 4) Energy quality
 - 5) Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current.
 - 6) Predictive maintenance monitoring contact wear rate, load profile, and the circuit breaker counter values

F. Operating and installation principles

1. Positioning, installation and connection of communicating interface
 - a. When the application requires the usage of several communicating interfaces:
 - 1) The interface enabling communication with the monitoring system (outside the switchboard) could be using a Modbus TCP/IP
 - 2) The other device interfaces inside the switchboard shall be using Modbus RS485 SL
 - 3) The different device interface shall be interconnected by Modbus RS485 SL daisy chaining, inside the switchboard, using stackable connectors
 - 4) The device interfaces shall be positioned on DIN rail for quick viewing of the network set up and status
 - 5) The communicating interface shall be equipped with plug-in type input/output application module
 - 6) The interfaces / devices links shall preferably be of the prefabricated type with RJ45 connectors that allow the device to be connected to the interface in a single operation and with no risk of error
2. Operation of the communicating interface
 - a. The communicating interface shall be capable of being easily integrated into the installation's communication network with automatic adaptation of their communication parameters to match those of the network
 - b. They shall provide data to the supervisor in Modbus tables, at fixed addresses that require no configuration
 - c. The data shall be of the type described in chapter 3.2
 - d. The concentrators shall be capable of receiving from the supervisor, by writing in the Modbus table at fixed addresses
 - e. They shall be capable of having the orders executed by the control devices, after having taken into account the devices' current positions
 - f. The communicating interface should be able to monitor and control auxiliaries and devices using integrated web page
 - g. The communicating interface should be able to monitor analog temperature sensors
3. Testing of the system in the switchboard
 - a. The manufacturer shall supply a (software) tool for overall testing of the system, within the limits of the switchboard: the entire data transmission and control chain between the modular devices and all of the concentrators, including communication.
 - b. The test tool shall supply a report that includes the list of all the devices connected to each channel of the data concentrators as well as a diagram describing the configuration of the system with indication of the associated Modbus addresses.
4. Operation and maintenance
 - a. Product measurement and communication capability shall offer operating assistance function:
 - 1) Status of circuit breaker operations: Open/Close/Tripped/NA
 - 2) Indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current
 - 3) Trips history

- 4) Alarms history
 - 5) Events history (setting changes, test...)
 - 6) These functions and indicators shall be available by remote display, communication or Engineering tool
- b. The main interface web pages and switchboard display allow the authorized group to:
- 1) Execute one or more reset commands per device type
 - 2) Control the following applications remotely:
 - a) Circuit breaker operations: Open/Close
 - b) Reset input counters, reset output counters, light control, load control, user-defined output control
 - 3) To provide maintenance log information:
 - a) The date and time the entry was made and the name of the user who made it.
 - b) The maintenance counter information for the selected device: circuit breaker operation counters, trip and alarm counters, load profile, contact wear counters, and the cradle counters.
 - 4) To send and display alarms:
 - a) User shall be able to activate alarms based on measurement (I, V, F, P, Q, S, THD, CosPhi, FP, I_{demand} , P_{demand} ,) or counters
 - b) Alarms shall be time stamped
 - c) Alarms could activate a digital output for local indication
 - d) These functions and indicators shall be available by remote display, communication or Engineering tool.

PART 3 - EXECUTION

3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section 16010 and Drawings.

END OF SECTION 16412

SECTION 16420 TRANSFER SWITCH EQUIPMENT:

GENERAL

1.01 SCOPE:

- A. The Work of this Section shall consist of furnishing all labor, materials, and equipment necessary for installation of transfer switch equipment as shown on the Drawings and as specified herein.

1.02 REFERENCES: The latest edition of the following codes or standards presented here and in the contract drawings shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. NEC (NFPA 70) National Electrical Code
- B. NETA International Electrical Testing Association - Acceptance Testing Specifications
- C. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
- D. Local Building Codes and Standards
- E. UL 489 - Molded-Case Circuit Breakers, Molded - Case Switches and Circuit-Breaker Enclosures
- F. UL 98 - Standard for Safety for Enclosed and Dead-Front Switches

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

- A. Furnish shop drawings in accordance with Contractor Submittals and SECTION 16050 Basic Materials and Methods.
- B. Include catalog cuts of all equipment.

1.05 QUALIFICATIONS: N/A

1.06 RESPONSIBILITIES:

- A. If required by project documents, the CONTRACTOR shall perform a system protection coordination study to properly set the protection devices.

1.07 TESTING:

- A. Test devices as called for in SECTION 16950 Field Testing.

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The Contractor shall provide 48 hours notice of its intention to begin new WORK activities.

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.

- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 TRANSFER SWITCH EQUIPMENT:

- A. Provide type OTPC automatic transfer switch for the specified engine-generator with Level 2 Control features.
- B. The transfer switch shall be a 3P, 1600A, 480V, 85KICIA, NEMA 3R ASCO Automatic Transfer Switch with a minimum of Two Auxiliary N.C. Contacts that shall be closed when the transfer switch is connected to the utility.

2.02 TRANSFER SWITCH AUTOMATIC CONTROLS:

- A. Solid-state sensors shall simultaneously monitor all phases of the normal source and all phases of the emergency source.
 - 1. Controls shall start the engine-generator upon signal from normal source voltage sensors. Solid-state time delay start, adjustable from 0 to 15 seconds shall avoid nuisance start-ups on momentary voltage dips.
 - 2. Controls shall delay transfer of the load to the emergency power system after the generator reaches proper voltage and frequency to stabilize the engine-generator before application of load. Solid-state time delay shall be adjustable from 0 to 120 seconds (factory set at 2 seconds).
 - 3. Controls shall delay retransfer of the load to the normal source after normal power is restored. Solid-state time delay retransfer shall be adjustable from 0 to 30 minutes (factory set at 15 minutes).
 - 4. Controls shall delay stopping the engine-generator after retransfer to the normal source. This feature permits the engine to run unloaded to cool down before stopping. Also, availability of the emergency source is maintained in the event the normal source fails shortly after retransfer. Solid-state time delay stop shall be adjustable from 0 to 30 minutes (factory set at 5 minutes).
 - 5. Controls shall cause the transfer switch to pause in the neutral position during transfer and retransfer for an adjustable delay period of 0 to 60 seconds. (programmed transition). This feature allows residual voltages from motors and transformers to decay before completing the switching cycle.
 - 6. Provide an auto/manual retransfer switch. The "auto" position automatically retransfers the load upon return of the normal power source. The "manual" position disables the automatic retransfer. Retransfer must be manually initiated unless the generator set fails.

2.03 TRANSFER SWITCH ACCESSORY ITEMS:

- A. Provide 7-day solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with load selector switch for the exercise period.
- B. Provide a float charge battery charger rated at 2 amperes. The battery charger will provide a charge for the engine-generator batteries located on the engine-generator skid. D.C. output voltage shall be as required. An ammeter shall display charging current. The battery charger shall have fused AC input and fused DC output.
- C. Furnish relay module option M023-7 for CITY use that provides status relay outputs for Utility Connected, Generator Connected, Utility Available, and Generator Available.
- D. Provide Level 2 Control features with Digital Bar Graph Meters.

- E. Service Entrance Rated Disconnect Switches: Service entrance rated disconnect switches shall be heavy duty quick-make, quick-break type, rated for 250 or 600 VAC as required for the application. Number of poles and ampacity shall be as noted or required by code. Switches shall include a neutral and ground assembly to comply with the NEC as service entrance equipment and meet the requirements of UL 98. Where noted, provide with fuse clips suitable for power fuses unless current-limiting fuses are noted. Short circuit rating shall be sufficient to withstand the available fault current or let-through current before the fuse melts without damage or change in rating. The enclosures shall meet the area classification set forth in SECTION 16050. Provide auxiliary control contact as required in the project drawings.
- F. Separately Enclosed Motor Snap Switches/Safety Switches: Motor snap switches and/or heavy-duty safety switches may be used for motor disconnect means, controller, and motor overcurrent protection when applicable. These devices shall be horsepower rated and may contain motor running overcurrent protection. The enclosures shall meet the classification set forth in Section 16050.
- G. Services Entrance Rated Main Circuit Breakers
 - 1. Service entrance rated circuit breakers shall be provided in a free-standing enclosure suitable for the designated installed area as called for in SECTION 16050. Stand alone main circuit breaker service shall be used for services including and above 800 AMPS. All main service entrance circuit breakers shall incorporate a neutral and a ground bus to meet the NEC. Circuit breakers shall also meet the requirements set forth in UL 489.
 - 2. Main circuit breakers used for service entrance equipment shall have a minimum interrupting rating as called for on project drawings. The circuit breakers shall incorporate a self powered microprocessor type trip unit for control of the long time, short time and instantaneous trip settings. In addition, the circuit breaker for services more than 150 volts phase to ground but not exceeding 600 volts phase to phase and rated 1000 amperes and more shall incorporate a ground fault trip unit with adjustable trip and delay settings.
 - 3. Auxiliary contacts for remote indication shall be provided if called for on project drawings.

2.04 FUSES:

- A. General: All fuses shall be dual element, time delay type, based on heavy service unless otherwise noted or required for installation.
- B. Current-Limiting Fuses: Shall be provided where indicated on the drawings. For individual motor circuit protection, provide fuse sized approximately 300 percent of full load current with 200,000 amperes interrupting capacity. For non-motor feeder protection in conjunction with fused switches, install NEMA Class L fuses sized 125 percent of full load current or as required for coordination.

2.05 SPARE FUSES:

- A. Furnish one complete spare set of each size of fuses installed. The CONTRACTOR shall deliver to the CITY Site in original boxes and store them in the fuse cabinet furnished under this Contract.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Disconnect Devices shall be installed in accordance with SECTION 16050 and in accordance with the manufacturer recommendations.
- B. Disconnect Devices shall be protected at the Site from loss, damage, and the effects of weather. Services Entrance Devices shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion and humidity.

- C. Disconnect Device interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the WORK.
- D. Conduit, conductors, and terminations shall be installed in accordance with SECTIONS 16050, 16110 and 16120.

END OF SECTION

SECTION 16441 SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, Division 01 - GENERAL REQUIREMENTS and other applicable specification sections in the Project Manual apply to the work specified in this Section.

1.2 SUMMARY

- A. **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for switchboards as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. **Section Includes:** The work specified in this Section includes, but shall not be limited to, service and distribution switchboards rated 600 volts and less.

1.3 REFERENCES

- A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. **ASTM (ASTM):**
 - 1. ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."
- C. **Federal Specifications (FS):**
 - 1. FS W-C-375, "Circuit Breakers, Molded Case, Branch Circuit and Service."
- D. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
 - 1. ANSI/IEEE C57.13, "Standard Requirements for Instrument Transformers" (copyrighted by IEEE, ANSI approved).
- E. **InterNational Electrical Testing Association (NETA):**
 - 1. NETA ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."
- F. **International Organization for Standardization (ISO):**
 - 1. ISO 9001, "Quality Management Systems - Requirements."
- G. **Military Standardization Documents (MIL):**
 - 1. MIL-STD-220, "Method of Insertion Loss Measurement."
- H. **National Electrical Contractors Association (NECA):**
 - 1. NECA 400, "Standard for Installing and Maintaining Switchboards" (copyrighted by NECA, ANSI approved).

- I. **National Electrical Manufacturers Association (NEMA):**
 - 1. NEMA EI 21.1, "Instrument Transformers for Revenue Metering (110 kV BIL and Less)."
 - 2. NEMA KS 1, "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)" (copyrighted by NEMA, ANSI approved).
 - 3. NEMA PB 2, "Deadfront Distribution Switchboards."
 - 4. NEMA PB 2.1, "General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less."
- J. **National Fire Protection Association (NFPA):**
 - 1. NFPA 70, "National Electrical Code" (copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC.
 - 2. NFPA 70B, "Electrical Equipment Maintenance."
 - 3. NFPA 70E, "Standard for Electrical Safety in the Workplace."
- K. **Underwriters Laboratories, Inc. (UL):**
 - 1. UL 98, "Standard for Enclosed and Dead-Front Switches" (copyrighted by UL, ANSI approved).
 - 2. UL 489, "Standard for Molded-Case Circuit Breakers and Circuit Breaker Enclosures."
 - 3. UL 891, "Standard for Dead-Front Switchboards" (copyrighted by UL, ANSI approved).
 - 4. UL 943, "Standard for Ground-Fault Circuit Interrupters" (copyrighted by UL, ANSI approved).
 - 5. UL 1283, "Standard for Safety for Electro-Magnetic Interference Filters" (copyrighted by UL, ANSI approved).
 - 6. UL 1449, "Standard for Surge Protective Devices."

1.4 SUBMITTALS

- A. **General:** See Section 01300 - SUBMITTALS.
- B. **Product Data:** Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Submit product data for each type of switchboard, overcurrent protective device, surge protective device device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. **Shop Drawings:** Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Submit shop drawings for each switchboard and related equipment.
 - 1. Indicate front and side enclosure elevations with overall dimensions, conduit entrance locations and requirements, nameplate legends, one-line diagrams, equipment schedule and switchboard instrument details.
 - 2. Submit mimic-bus diagram.
- D. **Wiring Diagrams:** Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
- E. **Quality Control Submittals:**
 - 1. **Test Reports:** Submit field quality control test reports.
- F. **Contract Closeout Submittals:**
 - 1. **Operation and Maintenance Data:** Submit operation and maintenance data for switchboards to include in operation and maintenance manuals specified in Division 01 - GENERAL REQUIREMENTS.
 - 2. **Warranty Data:** Submit manufacturer's standard warranty documents.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of switchboards of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.
 - a. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.
2. **Installer Qualifications:** Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing switchboards similar in type and scope to that required for this Project.
3. **Inspecting and Testing Agency Qualifications:** To qualify for acceptance, an independent inspecting and testing agency hired by the Contractor or manufacturer to test products shall demonstrate to the Architect/Engineer's satisfaction that they are qualified according to ASTM E 329 to conduct testing indicated.

B. Regulatory Requirements:

Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Standards:

Comply with applicable requirements of the following standards:

1. NEMA PB 2.
2. NEC.
3. NFPA 70B.
4. NFPA 70E.
5. UL 98.
6. UL 489.
7. UL 943.
8. FS W-C-375.

D. Electrical Components, Devices, and Accessories:

Electrical components, devices, and accessories shall be listed and labeled as defined in NEC, Article 100, by an inspecting and testing agency acceptable to authorities having jurisdiction and marked for intended use.

E. Pre-Installation Conference:

Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect/Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.7 PROJECT CONDITIONS

- A. **Environmental Requirements:** Do not install switchboards until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.8 WARRANTY

- A. **General:** See Section 01770 - CLOSEOUT PROCEDURES.
- B. **Special Warranty:** The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for period indicated below. This special warranty shall extend the one-year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the Installer and the manufacturer.
 - 1. **Surge Protective Devices:** Warranty shall be provided by the electrical distribution equipment manufacturer and supported by their respective field services organization, for a period of five years, incorporating unlimited replacement of suppressor parts.
- C. **Additional Owner Rights:** The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Products specified shall be manufactured by Square D by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 MANUFACTURED UNITS

- A. **Front Accessible Switchboard:** Provide panel-mounted fixed, individually mounted main device, fixed individually mounted branches, panel-mounted plug-on branches 1200 amperes and less, and sections front and rear aligned.
- B. **Nominal System Voltage:** Nominal system voltage shall be 480Y/277 volts.
- C. **Main Bus Continuous:** Provide 1600 ampere rating.
- D. **Short Circuit Current Rating:** 85 kA
- E. **Enclosure:** Provide steel enclosure, in compliance with UL 891, Type 3R
- F. **Enclosure Finish:** Provide factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- G. **Barriers:** Provide barriers between adjacent switchboard sections.
- H. **Insulation and isolation:** Provide taped bus for through bus.
- I. **Strip Heaters:** Provide factory-installed electric strip heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
 - 1. **Strip Heater Control:** Provide thermostats to maintain temperature of each section above expected dew point.

- 2. **Strip Heater Power Source:** Provide 120 volt external branch circuit.

- J. **Bussed Auxiliary Section:** Auxiliary section shall be matched and aligned with basic switchboard.
- K. **Utility Metering Compartment:** Provide fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- L. **Bus Transition and Incoming Pull Sections:** Match and align with basic switchboard.
- M. **Front Covers:** Front covers shall be screw removable with a single tool and doors shall be hinged with removable hinge pins.
- N. **Pull Box on Top of Switchboard:**
 - 1. Provide adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Lace cables using industry-approved methods.
- O. **Buses and Connections:** Three phase, four wire, unless otherwise indicated. Provide hard-drawn plated copper of 98 percent conductivity, tin-plated, high strength, electrical grade aluminum alloy.
 - 1. **Group-Mounted Feeder Vertical Bus Stack:**
 - a. Bus stack shall be capable of mounting feeder breakers with different frame sizes and number of poles across from one another on the bus stack.
 - b. Non-conducting surface films shall be removed during circuit breaker installation by a wiping action of the circuit breaker jaws.
 - c. The design of the circuit breaker jaws and bus stack shall create blow-on forces under fault conditions.
 - d. Bolted lap joint connections for feeder breakers shall not be allowed for group-mounted feeders.
 - 2. **Ground Bus:** Size per current NEC and UL 891 Tables 28.1 and 28.2, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 3. **Bus Composition:** Plated copper. Plating shall be applied continuously to bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements. The phase [and neutral] through-bus shall have an ampacity as shown on the Drawings. For four-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not permitted. Full provisions for the addition of future sections shall be provided. Bussing shall include, but shall not be limited to, necessary hardware to accommodate splicing for future additions.
 - 4. **Isolation Barrier Access Provisions:** Permit checking of bus bolt tightness.
- P. **Future Devices:** Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.

2.3 **SURGE PROTECTIVE DEVICES (SPD's)**

- A. Surge protective devices shall be listed, and components shall be recognized in accordance with UL 1449 to include Section 37.3 highest fault current category. Surge protective devices shall be UL 1283 listed.
- B. Surge protective devices shall be installed by, and shipped from, the electrical distribution equipment manufacturer's factory.
- C. Provide surge current diversion paths for all modes of protection; L-N, L-G and N-G in WYE systems.
- D. Surge protective devices shall be modular in design. Each mode, including N-G, shall be fused with a 200 kA IR UL-classified surge-rated fuse and incorporating a thermal cutout device.
- E. Audible diagnostic monitoring shall be by way of audible alarm. Alarm shall activate upon a fault condition. Provide an alarm on/off switch to silence alarm. Provide an alarm push-to-test switch.
- F. If a dedicated breaker for the surge protective device is not provided, the surge protective device shall include an UL-recognized disconnect switch.
- G. Meet or exceed the following criteria:
 - 1. Minimum surge current capability (single pulse rated) per phase shall be 240 kA 200 kA.
 - 2. UL 1449 suppression voltage rating, voltage L-N, L-G, N-G, shall be 208Y/120 volts; 400 volts.
- H. EMI/RFI filtering shall be minimum -50 dB at 100 kHz with insertion ratio of 50:1 using MIL-STD-220 methodology.
- I. Provide with one set of NO/NC dry contacts.
- J. Accessories shall include but shall not be limited to, six-digit transient counter set to total transient surges that deviate from the sine wave envelope by more than 125 volts.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. **Breaker Type:**
 - 1. Electronic trip, standard and advanced.
- B. **Molded Case Circuit Breaker Features and Accessories:** Standard frame sizes, trip ratings, and number of poles.
 - 1. **Lugs:** Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - 2. **Application Listing:** Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. **Ground Fault Protection:** Integral to circuit breaker with adjustable pickup and time delay settings, push-to-test feature, and ground fault indicator.
 - 4. **Communication Capability:** Web-enabled power distribution equipment with integral Ethernet port and embedded web server with factory-configured web pages (HTML file format) for viewing of power monitoring and equipment status information from connected devices with communications compatible with power monitoring and control system, specified in
 - 5. **Undervoltage Trip:** Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

6. **Auxiliary Contacts:** Two SPDT switches with "a" and "b" contacts; "a" contacts shall mimic circuit breaker contacts, "b" contacts shall operate in reverse of circuit breaker contacts.
 7. **Key Interlock Kit:** Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.
 8. **Zone Selective Interlocking:** Integral with electronic trip unit; for interlocking ground fault protection function.
- C. **Enclosed, Insulated Case Circuit Breaker:** Fully rated, encased power circuit breaker with interrupting capacity rating to meet available fault current.
1. **Mounting:** Fixed circuit breaker mounting.
 2. **Closing:** Two-step, stored energy closing.
 3. **Trip Units:** Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long-time and short-time pickup levels.
 - c. Long-time and short-time time adjustments with I²t response.
 - d. Ground fault pickup level, time delay, and I²t response.
 4. **Remote:** Remote trip indication and control.
 5. **Key Interlock Kit:** Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.
 6. **Zone Selective Interlocking:** Integral with electronic trip unit; for interlocking ground fault protection function.
- D. **Bolted Pressure Contact Switch:** Operating mechanism shall use rotary mechanical bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

2.5 INSTRUMENTATION

- A. **Instrument Transformers:** NEMA EI 21.1, ANSI/IEEE C57.13, and the following:
1. **Potential Transformers:** Secondary voltage rating of 120 volts and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 2. **Current Transformers:** Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 3. **Control Power Transformers:** Dry type, mounted in separate compartments for units larger than 3 kV.
 4. **Current Transformers for Neutral and Ground Fault Current Sensing:** Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit breaker ground fault protection.
- B. **Multifunction Digital Metering Monitor:** Microprocessor-based unit suitable for three-wire or four-wire systems and with the following features:
1. **Digital Display:** Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. **Phase Currents, Each Phase:** ± 1 percent.
 - b. **Phase-to-Phase Voltages, Three-Phase:** ± 1 percent.
 - c. **Phase-to-Neutral Voltages, Three-Phase:** ± 1 percent.
 - d. **Megawatts:** ± 2 percent.
 - e. **Megavars:** ± 2 percent.

- f. **Power Factor:** ± 2 percent.
 - g. **Frequency:** ± 0.5 percent.
 - h. **Megawatt Demand:** ± 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. **Accumulated Energy, Megawatt Hours:** ± 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 - j. **Watt-Hour Meters:** Flush or semiflush type, rated 5 amperes, 120 volts, three-phase, three-wire, with three elements, 15 minute-indicating-demand register, and provision for testing and adding pulse initiation.
 - k. **Recording Demand Meter:** Usable as totalizing relay or as indicating and recording maximum demand meter with 15 minute interval. Meter shall count and control a succession of pulses entering two channels.
2. **Mounting:** Display and control unit flush or semiflush mounted in instrument compartment or main device door.

2.6 CONTROL POWER

- A. **Control Circuits:** 120 volts, supplied through secondary disconnecting devices from control power transformer.
- B. **Electrically Interlocked Main and Tie Circuit Breakers:** Two control power transformers, with interlocking relays, connected to the primary side of each control power transformer at the line side of the associated main circuit breaker. Provide 120-volt secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. **Control Power Fuses:** Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. **Control Wiring:** Factory-installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Provide accessory set, including, but not limited to, tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Provide one remote racking device for drawout circuit breakers.
- C. Provide portable test set to test functions of solid state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- D. Provide one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- E. Provide overhead circuit breaker lifting device, mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- F. Provide spare fuse cabinet, suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.8 IDENTIFICATION

- A. **Mimic Bus:** Provide an anodized aluminum or plastic engraved plaque. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic bus diagram. Produce a concise visual presentation of principal switchboard components and connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Verification of Conditions:** Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect/Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

- A. **General:** Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.
 - 1. Install switchboards and accessories according to NEMA PB 2.1 and NECA 400.
 - 2. Install and anchor switchboards level on concrete bases, 4 inch (102 mm) nominal thickness. Concrete base is specified in Section 16050 - BASIC ELECTRICAL MATERIALS AND METHODS, and concrete materials and installation requirements are specified in Division 3 - CONCRETE.
 - 3. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
 - 4. Frame and mount the printed basic operating instructions for switchboards, including, but not limited to, control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
 - 5. Install overcurrent protective devices, surge protective devices, and instrumentation.
 - a. Set field-adjustable switches and circuit breaker trip ranges.
 - 6. Install spare fuse cabinet.
- B. **Identification:**
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified Section 16050 - BASIC ELECTRICAL MATERIALS AND METHODS.
 - 2. Label each switchboard compartment with engraved metal or laminated plastic nameplate mounted with corrosion-resistant screws.

3.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the switchboards shall be without damage at time of Substantial Completion.

END OF SECTION

SECTION 16450 GROUNDING

PART 1 - GENERAL

1.01 SCOPE:

- A. The CONTRACTOR shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents. Including but not limited to the building grounding grid, the grounding rod system and ground riser extension to electrical equipment.
- B. The requirements of SECTION 16050 - Basic Materials and Methods, General apply to this SECTION.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. NEC Article 250 - Grounding
- B. UL 467 - Standard for Safety Grounding and Bonding Equipment
- C. IEEE 837 - Standard for Qualifying Permanent Connections Used in Substation Grounding
- D. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- E. AWWA C210 - Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- F. NETA (International Acceptance Testing Specifications)

1.03 DEFINITIONS:

- A. Low Voltage Grounded System (600V or less): A low voltage grounded system is a system where the local power supply is a transformer with the transformer secondary grounded.
 - 1. The first disconnecting means on the load side of this transformer shall provide the point where the neutral conductor is grounded.
 - 2. The neutral shall be connected to the Equipment Grounding Circuit Conductor only at one point which is within the enclosure of the disconnecting means.
 - 3. The Grounding Electrode Conductor or the Equipment Grounding Circuit Conductor shall not be used as the neutral.

1.04 SUBMITTALS:

- A. Furnish submittals in accordance with CONTRACTOR Submittals and SECTION 16050.
- B. Product Data: Manufacturer's product information for connections, clamps, grounding rods and grounding system components, showing compliance with the requirements of this SECTION.
- C. "As-built" Drawings: Provide the CITY with "as-built" drawings of actual grounding system installation. The "as-built" drawings of the grounding system shall be signed and sealed by a State of Florida licensed land surveyor.

1.05 QUALIFICATIONS: N/A

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall not conceal or cover any ground connections until the CITY has established that every grounding connection conforms to the Contract Documents and has given the CONTRACTOR written confirmation.

1.07 TESTING:

- A. Measure and test the ground impedance in accordance with IEEE Standard 81 after installation but before connecting the electrode to the remaining grounding system. Verify all ground potentials on plan drawings and submit to the CITY for final approval.
- B. Test the grounding system per NETA ATS section 7.13 and called for in SECTION 16950 - Field Testing.
- C. INSPECTIONS COORDINATION: The CONTRACTOR shall provide access to the WORK for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours advance notice of its intention to begin new WORK activities.

1.08 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS, and PRODUCTS specified in this SECTION against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of SECTION 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of SECTION 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.02 GROUNDING ELECTRODE SYSTEM:

- A. Grounding loop conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be #2/0 AWG unless indicated otherwise.
- B. Ground Rods
 - 1. Unless indicated otherwise, the ground rod shall be a minimum of 3/4-inch in diameter, 10-feet long with pointed end to facilitate driving, and have a uniform covering of electrolytic copper metallically bonded to a rigid steel core. The copper to steel bond shall be corrosion resistant. The rod length shall be clearly stamped near the top of the rod.
 - 2. Conform to ANSI/UL 467.
 - 3. Sectional type joined by threaded copper alloy couplings.
- C. Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds or compression connectors suitable for direct burial.
- D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application.
- E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.
- F. Equipment Grounding Circuit Conductors
 - 1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be in accordance with the NEC-Article 250, unless indicated otherwise.
 - 2. Present in all raceways. The conduit system is not an allowable equipment ground.
 - 3. Cable to equipment ground lugs shall be compression type, bolted to the equipment with silicon bronze bolts and lock washers.

2.03 COATINGS:

- A. Coal Tar:

1. All underground grounding connections shall be coated with coal tar as specified herein.
2. Coating shall be of Polyamide Epoxy-Coal Tar with high build corrosion resistance. Resulting coat shall conform to the performance requirements of AWWAC 210.

PART 3 - EXECUTION:

3.01 WIRE, CABLE AND RACEWAY GROUNDING:

- A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material as well as in each raceway with parallel feeder run.
- B. Size shall be as given on the conduit schedule and in accordance with the NEC-Article 250.
- C. Provide the duct bank ground system indicated, including, trenching, splices, ground rods, and connections to equipment and structures.
- D. Grounding Wires and Cables:
 1. Install using as few joints as possible.
 2. Protect against abrasion by several wrappings of rubber tape at all points where cable leaves concrete in exposed areas.
 3. Suitably protect cable against damage during construction.
 4. Replace or suitably repair cable if damaged by anyone before final acceptance.

3.02 GROUNDING BOXES, MOTORS AND ELECTRICAL EQUIPMENT:

- A. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.
- B. Provide a grounding type bushing for secondary feeder and branch circuit conduits which originate from the secondary section of each MCC section, switchboard, or panelboard.
- C. Individually bond these raceways to the ground bus in the secondary section.
- D. Provide solid copper green insulated wire as grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.
- E. Interconnect the secondary switchgear neutral bus to the ground bus in the secondary switchgear compartment only at service entrance point or after a transformer.

3.03 GROUNDING SYSTEMS:

- A. Embedded Ground Connectors
 1. The connection shall be made in accordance with the manufacturer's instructions.
 2. Lay in bottom of trench or in other excavations at least 18 inches below finished grade.
 3. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.
 4. Duct Bank Ground: A grounding conductor shall be embedded in every duct bank as indicated.
- B. Ground Ring
 1. Furnish trenching and materials necessary to install the ground ring as indicated.
 2. Bonding conductor shall be in direct contact with the earth and be of the size indicated.
 3. Minimum burial depth **30**-inches or as indicated on the Drawings, whichever is greater.
 4. Re-compact disturbed soils to original density in 6-inch layers.
- C. Ground Rods
 1. Ground rods forming an individual ground array shall be equal in length.
 2. The CONTRACTOR shall install rods as indicated by driving and not by drilling or jetting.
 3. The CONTRACTOR shall drive rods into unexcavated portion of the earth where possible.

4. In excavated areas, the CONTRACTOR shall drive grounding rods after compaction and backfill is completed.
5. The CONTRACTOR shall drive to a depth such that top of rods will be approximately **30** inches below final grade, or subgrade, and connect main grid ground cable thereto.

3.04 SHIELD GROUNDING:

- A. Shielded instrumentation cable shall have its shield grounded at one end only unless Shop Drawings indicate the shield will be grounded at both ends.
- B. The grounding point shall be at the control panel or otherwise at the receiving end of the signal carried by the cable.
- C. Termination of shield drain wire shall be on its own terminal screw.
- D. All terminal screws shall be jumpered together using manufactured terminal block jumpers.
- E. Connection to the ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 16620

STANDBY ENGINE-GENERATOR SYSTEM

OUTDOOR WEATHER PROTECTIVE ENCLOSURE

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification Sections apply to Work covered by this Section.
- B. Comply with other Division 16 Sections, as applicable. Refer to other Divisions and the Drawings for coordination of the Work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a new standby engine-generator system, including all related systems and accessories for a complete working installation in place.
- B. These Specifications define requirements for a stationary emergency standby generator system, which shall be provided to allow completely automatic unattended operation. The generator set shall be consistently capable of reaching proper operating range within the shortest time practicable and shall be able to be transferred to the connected facility loads within no longer than ten (10) seconds of initial start signal issue. System voltage shall be 480 volts AC, 3 phase, 4 wire, 60 Hz, at 0.8 power factor. The generator system starting and control logic shall be powered by the generator sets' starting / control batteries. Manually selectable complete automatic and manual operation of the EG system shall be provided
- C. It is the intent of these Specifications that there is a single source of supply and responsibility for the entire specified engine generator system. Due to the coordination required between the related equipment and systems, the engine generator supplier shall be the responsible party, through the installing Contractor, and supply the entire generator system as a unit, less installation materials and installation related services and labor to be furnished by the Installing Contractor.
- D. The Installing Contractor shall be responsible for all costs, materials, and services as required for all mechanical and electrical provisions of the complete installation and for the proper and coordinated interface of the furnished engine generator equipment with the generator electrical transfer equipment, remote annunciation equipment, communications requirements', emergency shutdown systems , and all other EG system accessory equipment as required for proper automatic starting and stopping, operation, performance, and electrical power transfer operations of the furnished EG system
- E. The standby engine-generator system shall include, but not necessarily be limited to, the following basic components:

1. Engine
2. Engine governor
3. Generator
4. Generator set control panel
5. Generator automatic voltage regulator
6. Generator mounted main AC circuit breaker
7. Engine-mounted radiator closed loop cooling system
8. Generator set diesel fuel oil sub base tank fuel storage system
9. Exhaust system with specified hospital attenuation grade silencer
10. Generator starting/control battery and automatic battery charger.
11. Generator vibration isolators
12. Generator remote annunciation panel
13. Engine-generator set accessories
14. Generator outdoor weather protective enclosure

F. The Installing Contractor shall be responsible to provide all equipment, materials and installation requirements necessary to provide a fully functioning and properly operating standby emergency power system, whether all specific requirements necessary to provide such is specifically mentioned or identified in these Specifications or shown on the Drawings.

1.3 GENERATOR SYSTEM

A. System Description

1. The emergency standby engine-generator set to be furnished shall be the generator set manufacturer's currently manufactured standard production model which shall be nameplate rated to have a minimum Factory rating and site capability of 800 KW, 1,000 KVA at 0.80 power factor, 277/480 Volt AC, 3-phase, 4-wire, 12 lead, 60 hertz, with the engine and generator set both operating at 1800 RPM. The generator set shall be UL2200 Listed, Labeled, and certified by the generator set manufacturer, no exceptions. The generator set shall be capable of automatically properly transferring electrical power to the Facility's connected electrical loads through the facility's electrical transfer equipment as shown on the Drawings. The generator set system, including equipment and operation, shall, in its entirety, be designed, and manufactured so as to comply with NFPA 110, Level 1, type 10

requirements and in accordance with all applicable Codes and regulations, including, but not limited to those indicated herein.

B. System Function

1. The Specification defines requirements for the stationary emergency continuous duty power rated engine generator system which shall be provided for completely automatic unattended operation. The engine generator set (EG) shall include the capability of being automatically controlled for start, run, and stop by the generator set automatic transfer switch equipment. After starting, the unit shall independently and consistently attain proper speed and voltage, and shall be capable of accepting electrical load within ten (10) seconds of time from generator set start signal initiation. The generator system starting and control logic shall be powered by the generator sets' starting / control batteries. Manually selectable automatic and manual operation of the EG system shall be provided. Generator set speed shall be controlled by the engine governor, while generator output voltage regulation shall be a function of the generator automatic voltage regulator. Manual adjustment controls for engine speed and generator voltage shall be provided on the generator mounted control panel face.

C. Generator System Operational Parameters

1. The engine, when operated on diesel fuel oil, shall be capable of one step load acceptance of 100 % generator nameplate rating with voltage dip not to exceed 20 % of rated voltage and stabilized voltage and frequency recovery within 7.0 seconds.
2. Maximum steady state voltage transient while loads are running:
+ / - 0.25 %, within no load to full load operational range.
3. Maximum steady state frequency transient while loads are running:
+ / - 0.25 %, within no load to full load operational range.
4. Provide generator set manufacturer transient analysis information for the proposed generator sets confirming these operational performance requirements.

D. Site Conditions

1. The operating environment of the standby engine-generator system shall be:

Altitude, Sea level up to maximum 1,000 ft
Outdoor temperature, maximum 110 °F
Outdoor temperature, minimum 10 °F
Outdoor humidity, maximum 95 %
Engine jacket water, glycol mixture percentage 50/50
Installation type outdoors within a weather protective enclosure
Fuel type Industry standard No. 2 ULSD diesel fuel oil
Fuel system generator set diesel fuel oil sub base tank

Cooling system type engine mounted radiator with blower fan
Exhaust system Inside generator outdoor enclosure

E. System Performance

1. The standby engine-generator system shall conform to the following general performance criteria:
 - a. Rating - Engine brake horsepower shall be sufficient to deliver full rated engine-generator set KW/KVA when operated at rated rpm and equipped with all engine-mounted parasitic and external loads.
 - b. Conditions - The rating shall be based on ISO 3046/1 conditions of 29.53 in Hg and 27°C (81°F).
 - c. Fuel - Diesel engines shall be able to deliver rated power when operating on Industry standard No. 2 diesel fuel having 35 degree API (16°C or 60°F) specific gravity. Furnished generator set shall be manufacturer designed and rated to operate satisfactorily on Ultra Low Sulfur Diesel (ULSD) fuel.
 - d. Fuel Consumption - Diesel fuel rates shall be based on fuel having a low heating value (LHV) of 18,390 Btu/lb when used at 29°C (85°F) and weighing 7.001 lbs/U.S. gal.
 - e. Start Time and Load Acceptance - Engines shall start, achieve appropriate voltage and frequency, and be capable of accepting load within 10 seconds when properly equipped and maintained.

1.4 REFERENCE STANDARDS

- A. The standby engine-generator set shall be designed, manufactured, and tested in accordance with the latest edition of the specific component manufacturers governing standards. The design, manufacture, assembly and operation of all elements of the engine generator system shall be furnished as specified herein and in accordance with, but not limited to, the latest published standards, guidelines, codes, and requirements of the following:
 1. American Society of Mechanical Engineers (ASME)
 2. Diesel Engine Manufacturers Association (DEMA)
 3. Electrical Generating Systems Association (EGSA)
 4. International Electro-Technical Commission (IEC)
 5. International Standards Organization (ISO)
 6. Institute of Electrical and Electronics Engineers (IEEE)
 7. National Electrical Code (NEC)
 8. National Electric Manufacturers Association (NEMA)

9. National Fire Protection Association (NFPA) standards, including, but not limited to NFPA 20, 30, 37, 70, 99, and 110.
 10. Occupational Safety and Health Administration (OSHA)
 11. Society of Automotive Engineers (SAE)
 12. United States Military Standards for Generators and Controls (MIL-STD)
 13. American Welding Society (AWS)
 14. Underwriters Laboratories (UL) – (UL2200 for generator sets)
 15. US Environmental Protection Agency (EPA) - New Source Performance Standard for Stationary Reciprocating Compression Ignition Engines (NSPS), including all amendments
 16. Florida Building Code (FBC), including all amendments
 17. Florida Department of Environmental Protection (FDEP)
- B. Where the above standards and these Specifications conflict in any manner, the most stringent, in the Engineer's sole opinion, will control the requirements and approval of the submitted equipment.
- C. The generator enclosure equipment manufacturer shall submit certification by a Florida Registered Professional Engineer that the generator set enclosure meets the 200 mph wind gust loading and wind speed requirements of these Specifications, including meeting all High Velocity Hurricane Zone (HVHZ) large missile impact design and construction criteria as is applicable for Category Type IV Occupancy meeting all of the requirements of the Florida Building Code (2010 and 5th edition 2014) for coastal location in Miami Dade County, Florida, and in compliance with the 2017 edition of the Florida Building Code. The enclosure manufacturer shall include documentation confirming these compliance requirements as well as providing the Miami Dade County Notice of Acceptance approved file number associated with the manufacturer's designed, assembled, and furnished enclosure for this project. The enclosure shall carry a permanent label stating that it is Miami Dade County product control approved. No exceptions to these requirements shall be allowed.

1.5 QUALITY ASSURANCE

- A. The complete engine generator set, outdoor weather protective enclosure, and sub base fuel oil tank package, and all related systems and accessories, shall be provided by one vendor, the engine generator set supplier (EG vendor), thus assuring that the responsibility for performance to this Specification and equipment responsibility shall not be divided among individual suppliers, but shall be assumed solely by one primary vendor. The complete provision and performance responsibility for the furnished engine generator system equipment shall be assumed solely by one primary vendor who shall directly deliver, service, test, commission, and warranty all of the furnished generator set and accessory generator system equipment. The EG vendor furnishing the generator

set equipment for this project shall be the engine generator manufacturer's factory authorized direct distributor physically located in South Florida, who maintains complete local sales, parts, and service facilities and provision in the field of electric power generation on direct behalf of the manufacturer of the engine generator set to be furnished, including factory trained mechanics and technicians and engine generator replacement parts for the generator set supplied. The generator supplier shall be located within fifty (50) miles of the Project site location. Generator set distributors or vendors based or located outside of this perimeter area, second level manufacturer's sub-dealers, equipment redistribution suppliers, and subcontracted service providers do not comply with this requirement and shall not be accepted.

- B. The furnished engine-generator set package including the generator set mounting structural support base and radiator system shall be the generator set manufacturer's standard and current production model furnished as required by these Specifications. and provided by a Manufacturer regularly engaged in the design and production of this type, size, and model of equipment. The engine, generator, and radiator furnished with the generator set shall be manufactured in the United State of America and assembled by the generator set manufacturer in the USA, no exceptions. Generator sets utilizing engines or generators manufactured outside of the United States are not acceptable and will be rejected. The generator set to be furnished shall include an engine model with proven performance and that has been in manufacturing production by the generator set manufacturer for use with US manufactured and US EPA approved engine generator sets for a minimum of five (5) continuous years. The furnished generator set model shall be designed, constructed, and installed in accordance with best practices and methods to achieve and provide optimal physical and operational performance of the standby power engine generator system. Generator sets not meeting these manufacturing requirements shall not be accepted
- C. All system components shall have been designed to achieve optimum physical and performance compatibility and prototype tested to prove proper integrated design and operational capability. The engine furnished with the generator set package shall be manufactured and assembled on the generator set by the engine generator set manufacturer, no exceptions. The furnished generator set shall be designed, built, and assembled as a complete unit by the engine manufacturer, shall be complete in all respects, and shall include all equipment and controls necessary for a fully operational alternative electric power supply.
- D. All materials, generator equipment, and parts provided shall be new and unused of current design and of the highest grade. The generator set package shall be manufactured and shipped by the generator set manufacturer only after the generator set equipment Shop Drawings have been reviewed and approved by the Engineer, unless otherwise approved by the Owner.
- E. Provide engine generator set Manufacturer's prototype torsional vibration testing analysis report to confirm that the model engine generator set to be furnished it has been designed, constructed and assembled by the generator set engine generator manufacturer so as to be free from objectionable or harmful vibrations in any operational mode. The Manufacturer's detailed torsional report for the factory testing of a similar production unit shall demonstrate that the generator set model to be furnished shall operate free from excessive torsional vibrations and is to be submitted to the Engineer for review prior to generator set delivery.

- F. The engine generator set shall be manufacturer designed, built, and certified by the generator set manufacturer to meet the applicable emissions Tier level regulatory and certification requirements of the United States Environmental Protection Agency's (US EPA) New Source Performance Standard for Stationary Reciprocating Compression Ignition Engines (NSPS) rules and regulations, including EPA 40 CFR 60, Subpart III in affect for EPA defined stationary emergency generator equipment at the time of the generator sets' manufacture. The generator set shall be certification labeled EPA "Stationary Emergency" standby meeting EPA "Tier 2" exhaust emissions levels by the engine generator manufacturer in accordance with the US EPA emissions regulations. The generator set to be furnished shall not be released for manufacture until Engineer review approval of the EG vendor issued generator set shop drawing submittals has been issued. Engine generator sets that do not meet these specified EPA certification, manufacturing, and production timeline requirements shall not be acceptable and shall be rejected in their entirety.

- G. The generator supplier (EG vendor) must be the engine generator set manufacturer's factory authorized direct distributor, physically located in South Florida, must maintain no less than 90% of all generator set replacement parts available at all times, and must maintain service facilities with service and parts personnel available to the Owner on a 24-hour / 365day basis. Proof of this requirement shall be provided by the generator supplier and included in the Shop drawing submittals. Inspection of the generator supplier's local sales and service facility may be made by the Engineer to substantiate these mandatory requirements.

1.6 SUBMITTALS

- A. Submit ten (10) bound copies of Shop Drawing Submittals to include generator system product data, technical information, and detailed mechanical, electrical and structural drawings indicating Specification and Drawing compliance for all furnished equipment, including operations, performances, all mechanical and electrical interfaces, and services as required and as specified herein.

- B. Specification Compliance Certification: Submit a Specification Compliance Certification in accordance with Division 26 Section "Common Work Results for Electrical".

- C. Engine-Generator Set
 - 1. Component List - A breakdown of all components and options including controls and switchgear.

 - 2. Technical Data - Manufacturer's specifications and data sheets identifying make and model of the engine generator set package, including relevant manufacturer's component design and performance data determined from Factory prototype testing of the proposed generator set model, not on the unit to be furnished.

 - 3. Documentation identifying and confirming that the engine and generator used with the generator set to be furnished are both to be manufactured and assembled in the United States of America. Generator sets not meeting this requirement will be rejected.

a. Engine

- 1) Type, aspiration, compression ratio, and combustion cycle
- 2) Bore, stroke, displacement, and number of cylinders
- 3) Engine speed (1800 RPM)
- 4) Break Horsepower rating (BHP)
- 5) Engine lubricating oil capacity
- 6) Engine coolant capacity without radiator
- 7) Engine coolant capacity with radiator
- 8) Coolant pump external resistance (maximum)
- 9) Coolant pump flow at maximum resistance
- 10) Combustion air flow

b. Generator

- 1) Model
- 2) Frame
- 3) Insulation class
- 4) Number of leads
- 5) Excitation type (shall be permanent magnet type)
- 6) Air flow
- 7) Stator type random or form wound)
- 8) Temperature rise at nameplate KW rating (shall not exceed 80 Deg C rise over 40 Deg. C ambient)
- 9) Stator winding coil pitch (shall be 0.6333)
- 10) Generator operational rotating speed (1,800 RPM)

c. At rated voltage

- 1) Efficiency at 0.80 PF for: 50 % load, 75 % load, 100% load
- 2) Time constants, short circuit transient (T'D)
- 3) Time constants, armature short circuit (TA)
- 4) Reactance, subtransient - direct axis (X'D)
- 5) Reactance, transient - saturated (X'D)
- 6) Reactance, synchronous - direct axis (XD)
- 7) Reactance, negative sequence (X2)
- 8) Reactance, zero sequence (X0)
- 9) Fault current, 3-phase symmetrical ,L-L and L-N
- 10) Decrement curves
- 11) Damage / withstand curves
- 12) Short circuit ratio
- 13) Time current characteristic curves for generator circuit breaker

d. Radiator

- 1) Model
- 2) Type
- 3) Fan drive ratio
- 4) Coolant capacity, radiator
- 5) Coolant capacity, radiator and engine
- 6) Radiator air flow with connected engine drive

- 7) Radiator ambient capability on generator set
- e. Major System Equipment (generator set, outdoor enclosure, sub base tank, stairs / platforms, exhaust muffler, AC load center, charger , battery, etc.):
 - 1) Dimensions
 - a) Length
 - b) Width
 - c) Height
 - 2) Weight
 - a) Dry
 - b) Wet
 - 3) Attachment, securement, interconnection locations and information
 - a) For all equipment, both mechanical and electrical
 4. Performance - Based on SAE J1349 standard conditions of 29.61 in Hg and 25°C (77°F); also at conditions of ISO 3046/1. Fuel rates are based on ISO 3046 and on fuel oil of 35 degrees API (16°C or 60°F) gravity having a low heating value (LHV) of 18,390 Btu/lb when used at 29°C (85°F) and weighing 7.001 lbs/U.S. gal.
 - a. Power (BHP, KW, and KVA) rating at 0.8 power factor
 - b. Standard condition fuel consumption at: 50 % load, 75 % load, 100% load
 - c. Combustion air inlet flow rate
 - d. Exhaust gas flow rate and maximum allowable backpressure
 - e. Exhaust stack temperature
 - f. Allowable exhaust system backpressure (maximum)
 - g. Exhaust emissions at varying loads
 - h. EPA emissions level certification
 - i. Mechanical sound data (Overall and at different frequencies and varying distances)
 - j. Exhaust sound data (Overall and at different frequencies and varying distances).
 5. Generator set transient performance responses of generator set frequency and voltage relative to time for the generator set when separately imposing single step 50%, 75%, and 100 % block loads on the generator set.
 6. Auxiliary Equipment specifications, data sheets, and drawings including, but not necessarily limited to, generator set vibration isolators, engine governor, generator voltage regulator, automatic battery charger, batteries, jacket water heaters, exhaust muffler, exhaust flex, generator outdoor weather protective enclosure, stairs . platforms, and the diesel fuel oil sub base tank.

7. Drawings - Dimensional drawings showing overall complete engine-generator set,, generator set outdoor weather protective enclosure, and sub base tank measurements, locations of all interconnection points for AC power load leads, AC service requirements, all DC control and annunciation and communication interfaces. Provide equipment installation mounting locations and information.
8. Wiring Diagrams - Wiring diagrams, schematic diagrams and control panel outline drawings published by the manufacturer in Joint Industrial Council (JIC) format for engine-generator set controls and all remote annunciation /communication provisions, showing all interconnection points and logic diagrams for interface wiring use by the Installing Contractor and the Owner.
9. Warranty Statements – Provide warranty verification published by the respective manufacturers of the component equipment.
10. Service - Location and description of EG vendor's parts and service facilities including parts inventory and number of qualified generator set service personnel.
11. Maintenance Service Options - Outline of the various maintenance services and contracts available from the generator supplier. Include details of all items and services covered within the proposed maintenance service contracts. Generator supplier owned and maintained service facility shall be located within fifty (50) miles of the installed generator location.
12. Include details for all generator equipment deviations from these Specifications and the Drawings for Engineer review. All deviations are subject to Engineer approval prior to implementation or provision. Engineer rejected deviations shall require the generator supplier (EG vendor) to furnish the equipment completely as specified, or as otherwise allowed by the Engineer, no exceptions.

1.7 BASIS OF DESIGN

- A. The basis of design for these Specifications and Drawings is around diesel electric generator set model no. C27, US EPA certified for stationary emergency application and be EPA Tier 2 emissions level compliant, as currently manufactured by Caterpillar, Inc., and around generator set outdoor weather protective enclosure and sub base tank as manufactured by Phoenix Products, LLC. Jacksonville, Florida. Provision of a specified alternate acceptable manufacturer's generator set or outdoor enclosure and sub base tank shall require that the Installing Contractor and EG vendor be responsible, without additional cost to the Engineer or to the Owner, for the furnishing of all of the EG system equipment including appurtenances and accessory equipment items to be in complete equipment and performance compliance with all EG system equipment as specified herein and as shown on the Drawings and for any provisions and installation modifications or revisions that may be necessary to properly furnish, install, and operate the new alternate manufacturer's generator sets and associated EG system equipment. This responsibility shall include, but not necessarily be limited to, all costs for any

necessary revisions, Engineering services and drawing changes, mechanical and electrical modifications, additional permitting and approval requirements, additional Engineer and Owner review and approval or rejection actions, additional or alternate equipment construction materials and equipment, generator building / room alterations, for labor and services associated with the proper provision and installation of the alternate manufacturer's generator set, enclosure, sub base tank, and associated equipment, including any penalties and Owner costs and Owner loss in revenue directly or indirectly associated with the approvals, disapprovals, and rejections of the submitted or furnished generator system.

1.8 SERVICE AND WARRANTY

- A. The generator supplier (EG vendor) shall be directly capable, without subcontracting, and to be solely responsible to maintain and provide qualified Factory trained servicemen, the required stock and availability of replacement parts, technical assistance, and complete equipment warranty administration on direct behalf of the generator equipment Manufacturers. Subcontracting or rerouting of these services by the EG vendor is not acceptable. Generator equipment Supplier (EG vendor) written certification of compliance to the specified warranty provisions and requirements shall be included in the EG vendor's furnished generator system Submittals and equipment parts and operation manuals furnished to Engineer and Owner for review and approval. Any exceptions to the specified generator equipment warranty shall not be acceptable.
- B. All of the generator system equipment furnished for this project shall be guaranteed by the generator equipment supplier against defects in materials, parts, and workmanship. The generator system equipment warranty and associated coverage shall be for a continuous period of five (5) years (60 months). The warranty shall be comprehensive covering all furnished EG vendor furnished equipment including, but not limited to, the complete generator set, outdoor weather protective enclosure, diesel fuel oi sub base tank, electrical transfer switch equipment, exhaust equipment, and remote annunciation equipment. There shall be no warranty or service related deductible costs or associated deductible charges applicable to the Owner for the entire duration of the warranty period. The EG vendor shall be directly responsible for any furnished equipment manufacturer's warranty deductibles and to provide the specified warranty coverage and services regardless of any manufacturer warranty coverage exclusions or limitations. The warranty shall commence on the date of satisfactory completion of generator system startup and load bank testing on site, and shall include labor, parts, travel time, expenses and expendable items (such as engine lubricating oil, coolant, filters, and other service items made unusable by the defect) necessary for repairs at the job site. The furnished generator set batteries are considered a consumable item and shall be warranted against defects in material and workmanship for a period of two (2) years from generator set startup, with no cost prorating. The Owner shall be responsible to maintain the generator equipment at all times in accordance with the generator equipment manufacturer's maintenance guidelines.
- C. The generator system Submittals and furnished generator system parts, operation and maintenance manuals shall include written warranties and supporting documentation clearly indicating and certifying complete compliance by the EG vendor to provision to the Owner of these specified warranty requirements for all furnished generator system equipment. Failure of the generator equipment supplier (EG vendor) to provide the OWNER with the specified warranties and associated warranty coverage and services for

all EG supplier furnished equipment shall be sufficient cause for rejection of the EG vendor's furnished generator equipment.

- D. The EG vendor's failure to furnish the specified warranty coverage for the entire EG system (including outdoor enclosure and sub base tank) shall be sufficient cause for Engineer / Owner complete rejection of the EG vendor's submitted / furnished the generator system equipment. The Installation Contractor and the EG vendor shall be responsible for all project delays, costs, Engineer fees, and Owner revenue losses associated with any partial or complete rejection of the EG vendor's submitted and / or furnished equipment.

1.9 MAINTENANCE SERVICE AVAILIBILITY

- A. The engine-generator set supplier (EG vendor) shall be capable of offering an optionally available to the Owner a full year service maintenance contract for the furnished generator set. The EG vendor's proposed generator set equipment service maintenance contract shall include four (4) routine scheduled maintenance service visits per each year. Details of all EG vendor's optionally available services and provisions of the maintenance contract shall be included in the Shop Drawing submittals. The Owner may or may not elect to optionally purchase the EG vendor's equipment maintenance contract at the time of substantial completion / final acceptance of the EG system equipment. Owner nonpurchase of the optionally available service maintenance contract from the EG vendor shall have no impact the specified warranty coverage provided to the Owner by the EG vendor.
- B. The EG vendor shall maintain 24-hour / 365 day emergency access to an EG vendor account manager to expedite emergency service and repairs including parts replacements. The EG vendor must be capable of furnishing the proposed service maintenance contract and associated parts and service provisions directly to the Owner, not through alternate service or parts providers or suppliers, no exceptions. The EG vendor shall maintain a 24-hour emergency access to an account manager to expedite emergency repairs, including parts replacements.
- C. The EG vendor shall have locally available at all times parts inventory stock of not less than 80% of all engine replacement parts and must maintain generator set equipment service and parts availability on a 365 day / 24-hour basis. Proof of this requirement shall be provided by the generator supplier and inspection of the EG vendor's facility may be made by the Engineer in order to substantiate this requirement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE GENERATOR SET MANUFACTURERS / SUPPLIERS

- A. Project Basis of Design Product: Subject to compliance with requirements.
 - 1. Caterpillar, Inc./ Pantropic Power, Inc. (Basis of design).
- B. The following alternate manufacturer's generator sets shall be acceptable only provided the proposed and furnished equipment shall be in complete compliance with the Specifications and Drawings, including manufacturing and dimensional installation compliances and compatibility. The Contractor and generator supplier shall be

responsible for all costs associated with the provision of Specification and Drawing compliant equipment, no exceptions.

1. Cummins Power Generation / Cummins Power South
 2. Detroit Diesel/ Florida Detroit Diesel
- C. Manufacturer listing does not solely constitute acceptance of the equipment. Listed acceptable manufacturer products for the generator set, generator outdoor enclosure, and sub base tank shall comply with the requirements of Basis of Design, the Specifications, Drawings, and must receive Engineer approval.
- D. The power system for this project has been designed to the specified Basis of Design manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around Caterpillar supplied equipment. Should any substitutions be made, the CONTRACTOR shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions

2.2 ENGINE-GENERATOR SET

A. Generator set engine

1. The furnished generator set engine, generator, and radiator must be manufactured in the United States of America. The diesel engine provided with the furnished assembled generator set shall be manufactured by the generator set manufacturer, no exceptions
2. The engine shall be a stationary, diesel cycle, compression ignition, liquid cooled, 1800 rpm, four-stroke design, V-type with no less than twelve (12) engine cylinders, and with dry exhaust manifolds.
3. The engine shall be equipped with air filters, fuel water separators and filters and pressure gauge, lubricating oil cooler, filters, and pressure gauge, water pump and temperature gauge, service hour meter, flywheel, and flywheel housing.
4. The design of the basic engine shall provide for maximum structural integrity to extend service life. Materials used in the engine shall incorporate the highest level of proven metallurgical and manufacturing technology.
5. The use of an electronic engine control system to provide overall engine management is acceptable. This system must perform self-diagnostic checks and monitor engine-generator system operations. The system may control the basic engine functions, such as rated speed and power, timing of fuel injection, engine governing, torque shaping, cold start logic, transient fuel delivery, diagnostics, and engine protection.

B. Lubrication System

1. The lubrication system shall include an engine driven mechanical positive displacement oil pump, full flow filtration filter with replaceable elements and a bypass valve to continue lubrication in the event of filter clogging, flexible oil lines and an oil cooler. The bypass valve shall be integral with the engine filter base or receptacle. The filter shall incorporate a self-lubricating, free rotating seal and have a non-metallic core sufficiently rigid to minimize movement or shifting of the filtration media.
2. The engine shall be furnished with flexible hoses sufficiently long enough to route and direct the engine's crankcase ventilation fumes to the generator set's radiator air flow path.

C. Fuel System

1. The generator set engine fuel transfer system shall be integral with the engine. It shall consist of a fuel filtration system; engine mounted mechanically driven fuel transfer pump; injection pumps or electronic fuel control system, and flexible supply and return fuel lines. The engine transfer pump shall be engine driven and shall deliver fuel under low pressure to the engine's fuel injection system. The engine fuel supply system shall be capable of directly withdrawing fuel flow from the generator sub base fuel tank for delivery to the engine fuel inlets or nozzles, sufficient for full rated operation of the engine generator set under all specified ambient temperature conditions and shall return any unused fuel back to the sub base fuel tank. The engine's air intake, turbo charger, governor and fuel control systems shall properly operate to deliver fuel to the engine at rated engine horsepower and full rated generator output when operating on diesel fuel oil. No overheating of any engine component or system shall occur when operating at full rated load on sub base tank diesel fuel as installed inside of the furnished weather protective enclosure
2. Unit fuel injectors or electronic fuel injection systems shall be designed for optimal and efficient fuel combustion and engine performance at the rated engine horsepower while complying with the US EPA and local Jurisdiction engine emissions standards and requirements.
3. Provide a fuel filter / water separator system installed on the engine for fuel inlet flexible connection to the sub base tank engine fuel supply piping. The fuel filter / water separator assembly shall be installed and connected on the engine prior to site delivery. Ship loose filters for Installing Contractor site installation next to the engine shall not be acceptable.
4. The generator set engine package shall be furnished with a fuel oil cooling system by the generator set manufacturer. The fuel shall be piped with flexible connections from the engine filter/water separator supply system to the intake of the engine fuel pump and then from the

engine's fuel return through a generator manufacturer furnished radiator mounted diesel fuel oil cooler for return of cooled fuel to the sub base tank. The fuel cooler shall not be electrically operated and must be rated and capable of exchanging engine frictional heat rejected to the fuel at full load with the engine's cooling system radiator airflow including a 10% cooling capacity reserve to accommodate operational fouling.

5. Provide installed diesel fuel oil impervious flexible fuel lines on the engine fuel supply and return connections. Flexible connections shall be N.P.T. Provide and install properly routed schedule 40 fuel extension piping, as required, for final connections to the fuel supply and return piping between the engine flexible fuel connections and the sub base fuel tank fuel supply and return connections.

D. Governor

1. The engine governor shall be an electronic speed controller. Speed droop shall be adjustable from 0 (isochronous) to 10% from no load to full rated load and shall automatically adjust generator set frequency from within a maximum of 0.25% deviation of rated frequency under steady state operating conditions within the range of no load to full load. Engine speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for manual speed adjustment of the generator set shall be provided on the generator mounted control panel face. The use of an electronic engine control system to perform the governor functions of controlling fuel and speed is acceptable.

E. Cooling System

1. The engine jacket water-cooling system shall be a pressurized closed circuit design with provision for manual filling, thermal expansion, and coolant deaeration. The radiator blower fan and engine cooling water centrifugal type transfer pump shall be driven by the engine and circulate the engine jacket water through the entire engine cooling water system including the radiator. The charge air of air to air aftercooled engines shall be routed through the radiator as required for proper cooling of the engine and as required to assure rated generator set engine performance is achieved. Any auxiliary coolant transfer pumps required for separate or combined circuit aftercooling of the engine through the radiator shall also be engine driven and furnished by the engine generator set manufacturer. The radiator shall be of sufficient capacity to allow generator set full rated operation at 110 degrees F outside ambient temperature as installed within the furnished weather protective sound attenuating enclosure and with a total ventilation air inlet the external exhaust duct static back pressure restriction not to exceed maximum of 0.48 inch water pressure, including any air restrictions due to radiator ducting and enclosure air intake and radiator discharge louvered openings in the generator set outdoor enclosure.
2. Radiator and radiator fan assembly shall be totally enclosed. The radiator shall be furnished with a duct flange for use with a radiator air

discharge duct or shroud to be furnished and installed by the enclosure manufacturer between the radiator and the generator enclosure radiator air discharge louvered opening as required to prevent radiator discharge air recirculation back into the enclosure.

3. Heat rejected to the engine jacket water shall be discharged to the atmosphere through the generator set mounted close coupled radiator. The radiator shall adequately cool the engine jacket water and engine aftercooler water or engine air to air aftercooling charge air up to maximum site temperature while the generator set is operating at full load capacity inside of the outdoor enclosure.
4. The radiator cooling fan shall be a blower type driven from the engine. Radiator ventilation air shall be drawn from the engine sides and top and discharge exhausted through the radiator core.
5. The coolant lines shall be high temperature, strength reinforced and with removable flexible connections. Radiator fan, fan drive, and fan belts shall be covered for personnel protection and shall be OSHA approved construction
6. An electronic coolant level sensor / alarm switch shall be furnished and installed in the radiator by the engine Manufacturer for coolant level monitoring of an excessive low coolant level condition and activation of generator set emergency shutdown control circuitry.
7. A UL recognized electric engine jacket water heater shall be provided and installed on the engine by the engine generator manufacturer, complete with automatic thermostatic control suitable sized so as to maintain uniform engine coolant temperature of (90 - 175°F) while the engine is idle. Jacket water heater power shall be 240 volt or 208 volt AC single-phase. Appropriate AC power for the heater and circulation pump if used shall be from the enclosure installed AC panel board / load center wired in EMT conduit with compression fittings and flexible connections at the generator set in compliance with NFPA 70 by the enclosure manufacturer. AC electrical service for the heater shall be provided by the Installing Contractor to the AC load center.
8. Provide a water/ethylene glycol coolant and mixture content for the engine cooling water system per the engine manufacturer's recommendations.

F. Combustion Air System

1. The engine intake air system shall include an engine mounted, dry element, intake air filters with installed removable air filter restriction indicators.
2. Generator set engine intake air shall be after cooled as required by the engine manufacturer to provide the specified rating.

G. Exhaust System

1. The complete engine exhaust system, including piping, shall be installed to discharge combustion gases quickly and silently. The exhaust system including the generator exhaust silencer shall be designed for minimum restriction, and in no case, at any time during all ranges of generator set operation, from no loads to full load, shall the total exhaust system backpressure restriction imposed on the engine at full operating load exceed the engine Manufacturer's maximum allowable exhaust backpressure.
2. All generator set engine exhaust piping shall be carbon steel. The exhaust muffler and all enclosure interior installed piping shall be insulated / lagged so that the surface temperature does not exceed 200 degrees F, Insulation shall not contain any asbestos or asbestos bearing products The insulation shall be furnished and installed so that it does not interfere with the functioning of the engine flexible exhaust connector and allows compensation for exhaust system thermal and vibrational movements. Engine exhaust discharge air shall be piping routed outside through the generator outdoor enclosure roof utilizing a stainless steel or aluminum rain shield at the point of enclosure roof penetration and terminating with a stainless steel or aluminum construction counter balanced exhaust piping raincap. All exhaust piping and exhaust system equipment, piping, and insulation shall be furnished and installed by the muffler and enclosure manufacturer.
3. The exhaust silencer and associated piping for the generator set shall be installed inside of the enclosure by the generator enclosure manufacturer and shall be supported and braced to prevent weight or thermal growth being transferred to the engine. Flexible expansion fittings shall be provided to accommodate thermal growth. Generator set engine flexible exhaust connector shall be piping flanged with stainless steel bellows construction. Support dampers and springs shall be included where necessary to isolate vibration. All exhaust system piping, installation and insulation materials, and installation of the entire exhaust system shall be provided by the enclosure manufacturer.
4. The generator set engine exhaust silencer (muffler) shall be a minimum of "hospital" grade silencing to provide noise attenuation for environments with low background noise where noise emissions would be objectionable. Provide all required muffler inlet and outlet connections, gaskets and bolts/ nuts, and an appropriately sized stainless steel bellows type engine expansion flex connector for connection to the engine. Suitable rated high temperature resistant gaskets shall be utilized for all exhaust system flanged connections The silencer shall be capable of up to a minimum of 35 - 40 dB(A) attenuation at between 125 and 2000 Hz octave band center frequencies.
5. The exhaust silencer body shall be furnished with a N.P.T. drain fitting and shall be piped to the outside of the enclosure by the enclosure manufacturer with a stainless steel construction manual shutoff isolation valve installed inside of the enclosure. The muffler water drain line shall be flexibly terminated on the outside of the generator enclosure with a

stainless steel N.P.T. fitting and stainless steel threaded cap and properly identified.

H. Starting System

1. The engine shall be equipped with a dual heavy duty rated 24 VDC electric starting motor system which shall include two (2) solenoid shift positive engagement starting motors and starter relays, an engine driven battery charging alternator, starting / control battery, an automatic battery charger, and automatic reset circuit breaker to protect against engine flywheel and starter damage. Each starting motor shall be capable of independently providing sufficient generator set engine cranking for ninety (90) consecutive seconds without damage to the starting motor, engine starting system, or engine. The system shall be capable of crank starting a properly equipped engine so as to allow crank termination to occur as necessary for the generator set to consistently achieve proper starting operating speed within ten (10) seconds anywhere between the specified minimum and maximum site ambient temperatures. Timing adjustable automatic engine cranking on / off cycle and termination control logic and circuitry to comply with NFPA 110 cranking cycle requirements shall be furnished on the engine by the generator set manufacturer.
2. Furnish an engine Manufacturer generator set installed 24 VDC battery charging alternator, minimum of 45 ampere output, with a transistorized voltage regulator. The engine mounted battery charging alternator / belt assembly is to be furnished with an OSHA approved guard.
3. Battery for starting and control shall be a heavy duty, low-maintenance, lead acid or low antimony calcium type with thru-partition connectors, and housed in a hard rubber or polypropylene case with provision for venting. Maintenance free batteries shall be electrolyte accessible type.
4. Starting battery shall consist of a two (2) battery system which shall be rated 24 volt DC and sized to start the engine generator set based on specific application requirements of engine oil viscosity, ambient starting temperature, control voltage, overcharging and vibration. Minimum battery size shall be 1,300 CCA, 190 AH at the 20 hour rate. Battery shall have engine starting cranking amperage capacity adequate to be able to provide a minimum of 90 seconds of continuous generator set cranking at firing speed.
5. Battery shall be located as close to the starting motor as practical, away from spark sources, in a location to permit easy inspection and maintenance. A corrosion resistant or coated steel battery rack shall be provided for battery installation and mounting. Required battery connection cables with appropriate terminals shall be provided and sized to satisfy circuit requirements.
6. Provide an engine mounted key operated starting / control battery disconnect switch shall be furnished by the engine manufacturer.

Provide an alarm light on the generator set control panel to activate when the battery disconnect switch is in the “ off battery “ position.

7. Furnish a solid state, four (4) rate charge type, constant voltage automatic battery charger, UL Listed, designed for use with lead acid electrolyte type batteries. The charger shall be of the current limiting type, designed for float charging, with automatic equalize charge circuitry and controls. It shall accept 120 volt AC, single-phase input power from the generator enclosure installed AC panel board to provide 24 volt DC, minimum of twenty (20) Ampere output. Battery charger AC power and alarm wiring shall be routed in separate EMT conduit with compression fittings to the AC load center and to the generator set with flexible connections. It shall be fused or circuit breaker protected on the AC input and DC output, and shall incorporate current limiting circuitry. The charger shall include an AC power monitor with light, with a digital 1% accuracy DC ammeter to monitor the battery charging current, a digital 1% accuracy DC voltmeter with selector switch. The charger shall be furnished with alarms for input AC failure, charger / malfunction, low battery voltage, high battery voltage, low DC amperage, with individual local alarm light indications with dry alarm contacts for remote annunciation for each individual condition and shall be housed in a NEMA 1 enclosure suitable for wall mounting. The furnished battery charger shall comply with all of the requirements of NFPA 110, for Level 1 generator systems.

I. Generator

1. The alternating current synchronous generator shall be generator set manufacturer rated and generator set nameplate rated for continuous standby emergency duty service at 800 KW, 1,000 KVA, 0.80 power factor, 277/480 volt AC, 3 phase, 4-wire, 12 lead, wye-connected, 60 hertz. The generator set shall provide a minimum of 3,420 SKVA with a maximum 30% instantaneous voltage dip. The generator set standby power rating shall be based on no higher than a 80° C alternator winding temperature rise when operated at generator set nameplated rated power output within a 40° C ambient, no exception on this shall be allowed. This electrical information shall be included on the generator nameplate by the manufacturer of the generator set. The generator shall be capable of supplying satisfactory electrical power to solid state switching devices and nonlinear type electrical loads such as variable frequency drives, solid state soft starters, and fluorescent lighting, and of properly operating with connected load generated electrical harmonics. Provide generator set manufacturer documentation indicating compliance with these requirements.
2. As installed, the generator shall meet the applicable sections of the following standards:
 - a. National Electrical Manufacturers Association (NEMA) - NEMA MG1, Motors and Generators

- b. Institute of Electrical and Electronic Engineers (IEEE) - IEEE 43, Recommended Practice for Insulation Testing of Large AC Rotating Machinery
 - c. International Electrotechnical Commission (IEC) - IEC 34, Rotating Electric Machines
 - d. Underwriters Laboratory – (UL)
3. The generator shall be brushless type, revolving field, air cooled, open drip proof enclosure, single or two bearing design and construction.
 4. The generator housing shall be one piece and mount directly to the engine flywheel housing. Engine torque shall be transmitted through a torsional coupling to the generator rotor. Provide generator set Manufacturer's prototype torsional vibration testing analysis report for the engine generator set model to be furnished that confirms that it has been designed, constructed and assembled so as to be free from objectionable or harmful vibrations in any operational mode. The Manufacturer's detailed torsional report for the factory testing of a similar production unit shall demonstrate that the generator set model to be furnished shall operate free from excessive torsional vibrations and is to be submitted to the Engineer for review prior to generator set delivery. The furnished torsional report shall be provided in the generator shop drawing submittal documentation.
 5. The generator shall be permanent magnet excited and shall be capable of maintaining excitation field forcing of the generator during generator set operation to sustain 300% of rated generator current for 10 seconds when a 3 phase symmetrical short circuit is applied at the generator terminals.
 6. All generator mounted potential transformers and current transformers shall be U.L. labeled and recognized
 7. The generator stator winding shall be 2/3 (0.667) pitch design to eliminate the third harmonic waveform distortion.
 8. Stator, rotor, and exciter insulation shall all be full NEMA Class H insulation system as defined by NEMA MG1-1.65. The alternator insulation must be certified under UL 1446 Standard. Stator copper windings shall be random or form wound construction. Generator coils shall be random or machine wound, and precision made, with turn-to-turn and ground insulation of glass yard and mica materials. Provide 100% epoxy varnish impregnation and a coat of epoxy asphalt insulating material to increase resistance to abrasive dust or sand, high humidity, and light acidic, oil, or salt-laden atmospheres, as well as to prevent fungus growth.
 9. Radio frequency noise suppression shall meet or exceed the requirements of MIL-STD-461.

10. The generator shall be designed, prototype tested and manufactured for operational overspeed capability of up to 125% of rated generator set speed without incurring physical damage.
11. The generator shall be equipped with a permanent magnet generator (PMG) excitation system to provide power to the automatic voltage regulator. The exciter shall be high frequency, direct connected, rotating brushless type, three-phase, full wave rectified, completely compatible with the automatic voltage regulator. The rotating part of the exciter, including the rectifier assembly, shall rotate together with the generator rotor as a complete assembly on one shaft.
12. Provide an installed appropriately selected ground fault sensing system utilizing current transformer and ground fault alarm sensing wired inside of the generator for ground fault alarm indication on the generator mounted control panel. Ground fault sensing shall be for alarm indication only. Provide a ground fault alarm signal interface with the generator set local control panel and remote annunciator panel for alarm indication only, not for trip control.
13. The generator shall be equipped by the generator manufacturer with an internally installed UL Listed 120 Volt AC single-phase powered anti-condensation space heater to minimize condensation formation inside of the generator housing while the generator set is idle. The heater shall be automatically electrically energized when the generator is idle and automatically cut off when the generator is running via generator controls. The space heater shall be wired to the enclosure AC load center in EMT conduit and flexibly connected to the generator set by the enclosure manufacturer. Installing Contractor shall provide electrical service power to the generator enclosure installed AC load center.

J. Generator Voltage Regulator

1. The voltage regulator shall be automatic to maintain generator output voltage by controlling the current applied to the exciter field of the generator.
2. The regulator shall be a digital design with microprocessor control to allow for programmability based on the type of load connected.
3. The regulator shall be suitable for mounting and removal from inside of the generator junction box, and have provision for remote voltage level control.
4. As installed, the voltage regulator shall meet the applicable sections of the following standards:
 - a. National Electrical Manufacturers Association (NEMA)
 - b. Institute of Electrical and Electronic Engineers (IEEE)
 - c. International Electrotechnical Commission (IEC)

5. The automatic voltage regulator shall be microprocessor based and shall sense line-to-line three phase of generator output voltage and exhibit the following characteristics:
 - a. Generator output voltage maintained within +/- 1/2% at steady state conditions for any load variation between no load and full load
 - b. Generator output voltage drift no more than +/- 2% of rated value within a 40° change over ambient temperature range of -40°C to 70°C.
 - c. Response time less than 10 milliseconds.
 - d. Voltage buildup with generator output as low as 6 volts.
 - e. At full throttle engine starting, output voltage overshoot no more than 5% of its rated value, with respect to the volts/Hz curve.
 - f. Telephone Influence Factor (TIF) of less than 50.
 - g. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.
 - h. Maintain voltage control with 20% total electrical harmonic distortion.

K. Generator Circuit Breaker

1. Provide a main line circuit breaker mounted and connected on the generator in a guarded drip- proof enclosure meeting NEMA 1, IP 22 and IECC 144 requirements. The circuit breaker shall be UL Listed main line, solid-state electronic trip, three-pole generator output circuit breaker for the purpose of providing an AC electrical load circuit interrupting and protection device on the generator. The circuit breaker shall be a 100% rated and LSI, of the amperage size, rating, and trip as shown on the Contract Drawings. The circuit breaker's electronic trip current sensors shall monitor each phase. The circuit breaker shall have adjustable long time, short time, and instantaneous trip and delay functionality during overload and short circuit conditions. Generator exciter field circuit breakers do not meet this requirement and are not acceptable in lieu of the generator mounted circuit breaker.
2. The circuit breaker shall include a generator DC battery control voltage operated circuit breaker shunt trip coil shall be furnished to be able to automatically trip open the circuit breaker concurrently with any generator set fault or emergency shutdown condition or detection of an event that could cause catastrophic failure of the generator.
3. The circuit breaker shall be furnished with a minimum of one (1) set of circuit breaker installed auxiliary circuit breaker open / close status dry contacts for remote signal annunciation purposes.
4. The circuit breaker and generator neutral bar assembly shall be furnished with mechanical lugs suitable for proper connections with the quantities and sizes of the generator AC power conductors / conduits as shown on the Contract Drawings. AC power cable and conduit entry into the generator circuit breaker enclosure shall be from underneath. There shall be an open area in the sub base tank assembly to allow stub up entry of AC power conductors and conduits through the sub base tank into the generator enclosure for connection to the bottom of the generator set mounted circuit breaker junction box.

2.3 ENGINE-GENERATOR SET CONTROL

A. The generator set shall be provided with an open protocol, microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions for the generator set. Generator control panel shall be minimum of NEMA 1 enclosed, dead front construction, with true RMS sensing, transfective digital LCD 1 % accuracy metering display, local annunciation, and shall include The control system shall also be designed to allow local and remote monitoring and control of the generator set. The systems control panel shall be mounted on the generator set. The control panel shall be vibration isolated. The control panel shall be Caterpillar model no. EMCP 4.2 or approved equal.

B. The generator set mounted control panel furnished by the engine generator set manufacturer shall include the following functions:

1. A three position control switch or keys labeled RUN/STOP/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the STOP position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. A red EMERGENCY STOP pushbutton type switch to cause the generator set to immediately shut down, and be locked out from automatic restarting.
3. A RESET switch to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. A LAMP TEST switch to cause the entire control panel to be lighted with DC control power. The panel lamps shall automatically be switched off within 15 minutes after the switch is depressed, or after the switch is depressed a second time.

C. The control panel shall include a digital metering package with the following functions:

AC Metering display:

1. A.C. ammeter , per phase and average
2. A.C. voltmeter with simultaneous L-L and L-N display for all phases
3. Frequency meter
4. KW , total and per phase
5. KVAR, total and per phase
6. KVA , total and per phase
7. KW-Hr and KVA- Hr
8. Power factor

DC metering display to be furnished:

1. Elapsed time meter (Engine operating hours).
2. Engine water temperature
3. Engine oil pressure
4. Engine speed
5. Battery volts
6. Crank attempt counter

7. Engine start counter
8. Real time clock

Controls provide with panel:

1. Panel illumination lamps.
 2. Voltage adjusting switch or rheostat.
 3. Governor speed control switch or rheostat.
 4. Automatic start/stop control (solid state, cycle crank, six cycles of fifteen seconds cranking and three cycles of rest, with adjustable programming capability for up to one continuous cranking cycle of 90 seconds). If the generator set fails to start, lockout the engine and indicate overcrank on alarm status panel.
 5. Mode control switch or keys for "off / reset", "manual run", and "automatic".
 6. Lamp test switch or key
 7. Alarm horn
 8. Alarm acknowledge / silence switch or key
 9. Automatic generator set shutdown protection with specific indications for each of the following:
 - a. Overcrank (failed to start).
 - b. Overspeed.
 - c. Low lubricating oil pressure.
 - d. Excessive high engine coolant temperature
 - e. Low engine coolant level
 - f. Sub base tank critical low fuel level
 - g. Emergency remote shutdown
 10. Visual pre-alarm warning indications for each of the following:
 - a. Low engine oil pressure.
 - b. High engine coolant temperature.
 - c. Coolant low water temperature
 - d. Low fuel level (sub base tank)
 - e. High fuel level (sub base tank)
 - f. Fuel leakage (sub base tank)
 - g. Mode selector switch not in "automatic" position
 - h. Battery charger failure.
 - i. Low / high battery voltage
 11. Generator control panel annunciated electrical protection alarms
 - a. Overvoltage
 - b. Under voltage
 - c. Over frequency
 - d. Under frequency
 - e. Generator overcurrent
 12. Provide two (2) spare fuses for each type and size utilized on the generator set for both the generator controls and the voltage regulator system.
- D. The generator enclosure manufacturer shall furnish one (1) NEMA 3R enclosed generator emergency shutdown breakglass station to be installed on the exterior of the generator outdoor enclosure and interface wired to the generator set's emergency shutdown controls by the enclosure manufacturer. The enclosure manufacturer shall furnish one (1) additional loose generator emergency shutdown breakglass station for

Contractor installation on the site and Contractor wiring interface with the generator emergency shutdown controls. Activation of either of the emergency stop breakglass stations shall signal the generator set to immediately shutdown and simultaneously trip open the generator circuit breaker. Proper operation of both of the breakglass stations with the generator emergency shutdown system shall be tested and demonstrated in the presence of the Engineer and appropriate Authorities Having Jurisdiction.

2.4 ENGINE-GENERATOR BASE AND ENCLOSURE

A. General

1. The engine, generator and radiator shall be mounted on a structural steel mounting support base including vibration isolation means. The engine-generator and mounting base set shall then be installed on top of a structural steel construction diesel fuel oil sub-base which shall house the generator set's fuel source tank and support the outdoor weather protective outdoor enclosure.
2. The generator set and outdoor weather protective enclosure assembly shall offer protection as specified by OSHA from all moving and hot parts of the engine, generator and radiator. The generator equipment weather protective enclosure as constructed and installed on top of the sub base tank shall allow full access to the engine, generator and radiator and interior installed accessory equipment items for proper operation, maintenance, and typical service actions.

B. Engine-Generator Base

1. The engine and generator shall be assembled to a common base. The base shall be constructed of heavy duty structural steel designed and built to resist deflection and maintain alignment during skidding, lifting, generator set operation, and minimize resonant linear vibration during any range of generator set operation.
2. The generator set base shall be designed and constructed to prevent unit deflection during the entire range of generator set operation as mounted on top of the sub base fuel oil tank and designed as a package to be mounted on a level foundation surface.
3. The generator set shall be furnished with an appropriate quantity of generator manufacturer supplied steel spring type vibration isolators to be installed between the bottom of the engine-generator set base and the top of the sub base tank's generator mounting surface. The isolators shall bolt to the generator base with manufacturer furnished securing / leveling bolts, and have a waffled or ribbed pad on their bottom mounting surface. The pads shall be resistant to heat and age, and impervious to oil, coolant, diesel fuel and cleaning compounds. The isolators shall provide a minimum of one (1) inch static deflection while limiting the maximum vibration transmissibility to 10% during all ranges of generator set operation. Each spring isolator shall be lagged

and properly secured to the generator and the sub base tank mounting surfaces by the enclosure manufacturer.

C. Generator Set Diesel Fuel Oil Sub Base Tank

1. The generator equipment vendor shall supply a one above ground double wall steel construction generator diesel fuel oil storage sub base tank, UL142 construction and nameplate labeled for stationary installation with the generator set. The sub base tank shall meet the requirements of these Specifications and all of the applicable guidelines and construction and installation requirements of NFPA 30, NFPA 30A, NFPA 37, NFPA 110, and the Florida Department of Environmental Protection (FDEP) when used with the specified generator system at full standby generator set rating as installed on the Project site. The Installing Contractor shall be responsible for site installation of the sub base tank. The sub base tank shall be clearly labeled with a permanent label indicating the type of product, the volume capacity, the top loading capacity, and the tank manufacturer. The generator set, engine exhaust system, and generator weather protective outdoor enclosure are to be installed and appropriately secured on top of the sub base tank furnished by the enclosure manufacturer. Sub base tank height shall not exceed twenty (20) eighteen (18) inches overall installed height, including all mounting channels furnished on the bottom of the tank.
2. After sub base tank approval has been issued, the sub base manufacturer shall provide sub base tank wind load and floatation uplift calculations and recommendations for site foundation anchoring means which shall be provided and installed on the site by the Installing Contractor. Anchor recommendation information shall be included on the manufacturer's sub base tank drawings. The Installing Contractor shall install the complete sub base tank and generator set / enclosure assembly and sub base tank on the site, as coordinated with and in accordance with the generator supplier's furnished recommendations and instructions, in compliance with all referenced and applicable Standards and Codes, and as required by all applicable local approval Authorities Having Jurisdiction (AHJ).
3. The furnished sub base tank shall be designed and constructed to allow for the proper installation of the furnished generator set and generator set outdoor weather protective enclosure on top of the sub base tank. The tank shall incorporate mounting channels on the bottom of the tank to provide free air space between the bottom of the sub base tank and the top of the site concrete foundation surface.
4. The generator set sub base diesel fuel oil tank shall be listed and labeled as UL142 Generator Set Base Tank and constructed per UL142 requirements. It shall be double wall steel construction and sized for a minimum of 110% secondary containment.
5. The sub base tank shall be sized and constructed as required so as to provide sufficient volume of generator set useable fuel to be able to

allow a minimum of twenty-eight (28) hours of generator set continuous operation with the generator set operating at full rated generator set power, but in no case shall the sub base tank capacity be less than 1,800 gallon sub base tank nameplated rated fuel storage capacity.

6. Both the primary inner and the secondary outer containment tanks shall be fabricated from a minimum of 3/16 inch thick steel. The tank top shall be minimum of 1/4 inch thick steel. Each tank shall be built to UL standards and pressure tested by the manufacturer to a minimum of 3 PSI as outlined in UL142. The tank shall incorporate suitable internal stiffeners to create a smooth tank top surface and to limit the accumulation of water. The outer tank shall be abrasive blast cleaned per SSPC-SP10 (White Metal Blast) and shall be properly surface prepared and coated with one coat of a high build polyester glass flake to a minimum of 12-15 mils (DFT) thickness, and a top finish coat of UV resistant aliphatic polyurethane gray colored enamel with a minimum of 2-3 mils (DFT) thickness. All sub base tank fittings shall be stainless steel. The tank shall be constructed with no sharp edges to insure uniform coating coverage on all surfaces. No external support beams shall be permitted on top of the tank. Confirmation of the specified painting requirements shall be included on the manufacturer's sub base tank drawings.
7. The sub-base shall be constructed of structural steel and furnished as specified herein. The sub base shall be designed to rigidly support the engine-generator set, enclosure, fuel tank, ensure permanent alignment of all equipment and rotating parts is maintained. The sub base tank shall be sized and arranged to allow ready access to all sub base tank connections and equipment with the generator set and enclosure being installed on top of it. The sub-base shall also withstand the effects of synchronous vibration of the engine and generator. The sub-base shall be provided with suitable mounting holes for foundation anchor securement hardware.
8. The manufactured sub base tank shall be designed and constructed to support the total wet weight of the generator set, enclosure, and all installed accessory equipment. Provide mounting means and hardware on the top of the sub base tank top to install the generator set and the outdoor enclosure to the top of the sub base tank. The tank shall incorporate a minimum of six (6) lifting points each with eyelets designed and installed so as to allow single point spreader bar lifting of the empty sub base tank with the generator set, accessory equipment, and enclosure installed on top of the sub base tank.
9. The tank shall be provided with appropriate quantity of earthquake/hurricane resistant tie down restraint points and a minimum of 1/4 inch thick, 2 inch high cross support channels installed on the bottom of the exterior tank assembly by the tank manufacturer across the width of the bottom of the sub base tank in adequate locations as required to support the fuel filled sub base tank, generator set, and enclosure as an assembled package, to control moisture accumulation

under the sub base tank, and to allow visual fuel leakage inspection. Each cross support channel shall include foundation mounting holes on both ends to allow for adequate securing of the sub base tank on the site's mounting foundation. Provide a drawing indicating dimensional locations for sub base tank foundation mounting securing points and recommended securement means. The sub base tank manufacturer shall provide 3/8" thick by 6" wide full-length diesel fuel and oil impervious neoprene pads for isolation of all tank channel supports to be installed underneath the sub base tank between the bottom of the tank support channels and the site foundation during site installation.

10. The Installing Contractor shall be responsible to furnish all required sub base tank foundation mounting hardware and installation services to properly install and secure the sub base tank on the site's concrete foundation.
11. The tank shall be provided with generator supply and return ports, generator supply line double poppet foot valve in the bottom of the tank, fuel fill port, mechanical overfill limier valve (OPV) for the tank fuel fill inlet, overfill / spill containment, overspill drain required fuel level sensor ports, fuel level gage, required primary and secondary tank normal and emergency vents, specified fuel level and leakage sensors, primary and secondary tank drain ports. All applicable sub base tank equipment and items shall be FDEP approved. Provide FDEP approval numbers for each applicable item on the sub base tank manufacturer sub base tank drawings.
12. The generator set sub base tank shall include inner and outer tank standard updraft vent pipe riser with vent cap terminating at a height twelve (12) foot above the bottom of the sub bas tank. UL142 vent caps and shall be installed in compliance with all applicable NFPA and local code and permitting requirements. The emergency vent capacity shall be calculated by the tank manufacturer in accordance with NFPA 30 & UL142. Primary and secondary emergency vent caps shall be furnished installed on the sub base tank. The enclosure manufacturer shall furnish and install removable aluminum or stainless steel construction rain collars and shields in the enclosure roof for all tank vent extension piping exiting the enclosure roof. All sub base tanks vents must be routed, installed, and terminated so as to comply with all Code requirements and AHJ approval requirements.
13. The tank shall be furnished with low fuel level, high fuel level, and fuel leak sensors/ switches as alarm level activation points. The fuel level switches shall be wired to the generator set control alarm panel and to the generator controls for remote annunciation use.
14. The sub base tank shall include a critical low fuel level generator shutdown switch to be wired to the generator shutdown / annunciation controls. Activation of the sub base tank critical low fuel level switch shall cause the generator set to immediately shutdown while

simultaneously shunt trip open the generator mounted main circuit breaker and activate local alarm at the generator control panel.

15. Provide and install an FDEP approved mechanical tank fuel level gage to monitor fuel tank level from empty to full and locate on top of the tank near the fuel fill.
16. Provide an FDEP approved sub base tank installed exterior fuel fill with mechanical fuel limiter valve (OPV), overspill fuel oil containment around the sub base tank fuel fill port. Provide a two (2) inch manual fuel fill with a minimum sized five (5) gallon capacity fill bucket and vandal resistant fuel fill cap. Provide a spring loaded drain pull to allow fuel contained within the fill box to be returned directly into the primary fuel tank.
17. All sub base tank level switches, components, and associated equipment items furnished for the sub base tank shall be identified by manufacturer, part number, and all applicable FDEP equipment approval identification and numbers.
18. The Installing Contractor shall ensure that the site generator equipment foundation shall be level and furnished so as to accommodate the dynamic weight of the generator set and sub base tank including fuel weight and to allow proper installation of the generator set and sub base day tank assembly onto the foundation.
19. The Installing Contractor shall install the complete sub base tank and generator set / enclosure assembly on the site, as coordinated with and in accordance with the sub base tank manufacturer's instructions. The Installing Contractor shall be responsible for all costs and services to fill the generator sub base tank to 100% full fuel capacity with new acceptable quality ULSD diesel fuel, engine manufacturer recommended and approved for use with furnished generator set engine after the generator sub base tank has been verified to be properly installed and immediately prior to generator set equipment site startup and testing initiation. After all generator set and fuel system site testing and demonstrations have been satisfactorily completed by the generator set supplier and Contractor, approved by the Engineer and applicable AHJs, and as accepted by the Owner, the Installing Contractor shall be additionally responsible for all costs and services to once more refill the sub base tank to 100% sub base tank full fuel level.
20. The sub base tank drawings shall include sub base tank manufacturer equipment technical documentation, mechanical and electrical drawings clearly indicating compliance with these Specifications and the Drawings. The sub base tank shall be manufactured only after the

Engineer has reviewed and approved the EG vendor's equipment Shop Drawing submittal.

21. The UL142 Listed double wall steel generator sub base tank shall be furnished by the generator supplier as designed and manufactured by Phoenix Products, LLC, Jacksonville, Florida (FDEP EQ#625 approved design and construction), or Engineer approved equal. Detailed documentation and certifications by the enclosure manufacturer and generator supplier (EG vendor) indicating complete compliance with these Specifications and the Drawings and with FDEP compliance, are to be included in the EG vendor's submitted Shop Drawing Submittals and on the final generator equipment operating and maintenance manual documentation furnished to the Owner.

D. Outdoor weather Protective sound attenuated enclosure

1. The generator supplier shall furnish one (1) walk in type, aluminum construction, sound attenuated, wind and flying debris / large missile impact resistant outdoor weather protective enclosure to completely enclose the generator set and additional generator system auxiliary equipment as specified herein. The generator set and outdoor enclosure are to be installed and secured on top of the specified diesel fuel oil sub base tank. The enclosure shall be sized large enough so as to allow operating and maintenance personnel adequate walk in access to all of the enclosure installed generator set and accessory equipment items for operation and normal maintenance purposes, including access to all fuses, circuit breakers, switches, batteries, and all manually operable devices, and shall provide all NEC and OSHA required installations and clearances. The engine exhaust silencer shall be mounted inside of the enclosure.
2. The enclosure and engine-generator set and sub base tank assembled package shall be complete in every detail and ready for operation after site installation. The entire package shall be completely and securely assembled and all enclosure / generator set equipment / sub base tank wiring and piping terminated in place by the enclosure manufacturer prior to shipment
3. The entire generator set outdoor enclosure, installed generator set and sub base fuel tank assembly shall be manufactured in compliance with the National Electrical Code (NEC) and the National Fire Protection Association (NFPA). The enclosure and sub base fuel tank assembly shall conform to the specified equipment design criteria. The generator enclosure and sub base manufacturer shall provide calculations and written stamped certification by a Professional Engineer (P. E.), licensed in the state of Florida indicating that the furnished generator set enclosure is designed and constructed to meet the applicable wind resistance requirements of ASCE 7-10 and the Florida Building Code (FBC) including the 2012 FBC supplement, the 2014 fifth edition of the

FBC. As well as the 2017 FBC edition. Provide three (3) copies the P. E. stamped certified wind load calculations and report, and enclosure drawings indicating compliance for the specific designed generator outdoor enclosure and sub base tank to be furnished for this Project prior to site delivery of the equipment. Copies of the P.E. calculations report and certification and P.E. stamped drawings are to be included in the Manufacturer's enclosure and sub base tank parts, operation and maintenance manuals to be furnished for the generator system.

4. The entire generator set outdoor enclosure, installed generator set, and sub base tank assembly design and construction shall be in compliance with the National Electrical Code (NEC), the National Fire Protection Association (NFPA), and Occupational Safety and Health Administration (OSHA) including physical space clearances and protection around all electrical and mechanical equipment. The enclosure assembly shall conform to the equipment design criteria as specified herein and as shown on the Drawings. In addition, the enclosure manufacturer shall be listed as an approved vendor by the Florida Department of Community Affairs (DCA) and the furnished generator equipment enclosure and sub base tank assembly shall meet the DCA design and construction requirements and approvals shall construction structures as well as meeting the windblown missile impact resistance requirements of the 2014 and 2017 editions of the Florida Building Code (FBC). The manufacturer's enclosure design to be furnished shall have been physically tested to demonstrate compliance by a State of Florida approved independent testing laboratory. Proof of the enclosure manufacturer's listing and enclosure construction design compliance with these requirements shall be included in the Shop Drawing Submittals, no exceptions.
5. The enclosure design and construction must comply with the requirements of these Specifications and with the requirements of the Florida Building Code (FBC). The enclosure shall be certified by a Professional Engineer (P. E.) licensed in the state of Florida, to be designed and constructed to withstand a constant wind load resistance up to 170 MPH, shall be capable of withstanding a 200 MPH ultimate wind speed gust for three (3) seconds, with Exposure C criteria as per ASCE 7- 10 with FBC 2012 supplement. The enclosure shall be certified by the enclosure manufacturer to meet the Miami Dade County High Velocity Hurricane Zone (HVHZ) missile impact ratings and compliances under Miami Dade Regulations no. 1624.2, 1626.2–1626.2.4, under Florida product no. 12724, 12868, and 12871. The enclosure manufacturer shall provide documentation and file number data confirming the generator set outdoor enclosure meets Miami Dade Notice of Acceptance (NOA) approval requirements. Enclosure equipment not complying with these construction and compliance requirements shall not be acceptable and shall be rejected in their entirety
6. The average overall sound pressure level on the A scale produced by the furnished generator enclosure with the generator set operating at any

range from no load to full rated load and rated speed as specified herein shall be attenuated by the furnished enclosure by thirty (30) decibels (dBA), reference 21 micro-newtons per square meter, at a distance of 23 feet in any direction from the generator set weather protective enclosure at an elevation of 5 feet above ground level, measured in accordance with NEMA standards. This equipment compliance requirement shall be indicated on the enclosure manufacturer's drawings

7. Enclosure construction shall include individual components generally consisting of a roof, two (2) side walls, and two (2) end walls using prepainted white epoxy formed aluminum, enclosure mounted and secured intake and discharge air acoustic hoods or plenums, four (4) inch thick fiberglass or equivalent non-asbestos acoustical insulation and securement linings, and all hardware shall be stainless steel. Furnish the enclosure designed and constructed as specified herein and as shown on the Drawings.
8. All exposed metal parts of the enclosure and appurtenances shall be sanded, cleaned and primed with a rust inhibitor finished in a durable machinery enamel of the manufacturer's standard color. All necessary field touch-up shall be provided to have a complete finished appearance at the final inspection. All furnished outdoor components shall be suitable for outdoor installation without need for any additional protection from the weather.
9. The roof shall be constructed of 5052 marine grade mill finish 0.125 in. minimum thickness formed aluminum panels using an interlocking seam design. The roof top skin shall be painted the same color (white) as the enclosure. A weatherproof mastic / sealant shall be used along the roof perimeter and any roof skin joints. The roof rail perimeter shall have internally installed two (2) roof lifting rings per side (a total of 4 lifting points) of 10,000 pound lifting capacity each for lifting of the complete enclosure. All external roof attaching hardware shall be stainless steel screw type mechanical fastener utilizing neoprene watertight washers.
10. The generator set exhaust piping shall be vertically terminated through the roof of the outdoor enclosure. The enclosure roof shall incorporate an internally installed and removable aluminum or stainless steel construction rain collar and rain shield for the generator exhaust silencer piping at the roof penetration point to prevent the entry of rainwater into the enclosure and allow for expansion and vibration of the exhaust piping without stress to the exhaust system. An exhaust piping aluminum construction counter weighted rain cap shall be installed on the vertical discharge piping termination point of the exhaust gases. Installed removable aluminum or stainless steel construction rain collars and shields shall also be furnished for all sub base tank UL approved screened vents / caps that penetrate the enclosure roof. Sub base tank primary vent shall be pipe riser extended and terminated with an NFPA approved vent cap a minimum distance of twelve (12) foot above the bottom of the sub base tank.

11. The enclosure side walls shall be manufactured utilizing formed 0.125 inch minimum thickness prepainted aluminum modular panels utilizing an interlocking seam design. Thermal acoustic insulation with fire retardant properties shall be installed on all of the interior sidewalls and roof of the enclosure.
12. All external attaching hardware shall be stainless steel screw type mechanical fasteners. The enclosure shall be fastened to the sub base tank by the enclosure manufacturer by means of an aluminum base channel and stainless steel clips that are welded to the sub base tank and bolted to the base channel with stainless steel bolts, washers, and nuts. The base channel shall include enclosure water drainage construction.
13. The radiator discharge end wall section shall incorporate a properly sized opening for the furnished generator set radiator discharge core / opening and shall include appropriately furnished and installed shroud or baffle assemblies to prevent the recirculation of radiator discharge air into the enclosure.
14. Thermal acoustic insulation of non-asbestos material or fiberglass insulation, with fire retardant properties shall be installed on the interior sidewalls and roof of the enclosure. Insulation shall not be less than four (4) inches in thickness. All insulation installed inside of the enclosure shall be completely covered with mill finish 0.032 inch thick perforated aluminum lining secured to the enclosure interior. Provide thickness of sound attenuation material as required to meet the noise level requirements specified for the enclosure.
15. The generator ventilation intake air shall enter the enclosure through the bottom of an enclosure end wall air intake plenum, which shall be constructed of the same materials as the enclosure and equipped with metal screening and 1" by 1" galvanized wire cloth at the intake air opening. Include sound attenuation baffles as required which shall be securely mountable to the enclosure. The enclosure air intake system shall be designed and constructed to minimize water penetration into the enclosure during heavy rainfall and be constructed for automatic drainage of falling rain water into the plenum to the outside of the enclosure. Enclosure side mounted intake hoods are not acceptable. Maximum design enclosure ventilation air flow velocity through the enclosure shall not exceed 1,250 FPM. The enclosure manufacturer shall submit airflow calculations for confirmation of these requirements. The combined air inlet and discharge system shall be designed to maintain a combined total static pressure drop / air restriction of no more than 0.5 inches of water gauge through the enclosure with the generator set operating at full rated load and operating duty.
16. The radiator air shall be vertically discharged through enclosure end wall gravity operated aluminum construction dampers from the enclosure through the top of an enclosure end mounted air discharge plenum which shall be of the same material and construction as the enclosure. The air discharge plenum shall be furnished with a deflector

plate and a bottom drain extension line for prevention of falling water entry into the enclosure and for rainwater removal from the plenum. Provide an installed removable plenum access plate. Provide 1 by 1" galvanized wire cloth over the top of the open end of the discharge plenum. The combined air inlet and discharge system shall be designed to maintain a combined total static pressure restriction of no more than 0.48inches of water gauge through the enclosure with the generator set operating at full rated load and duty.

17. The enclosure shall incorporate two (2) personnel doors located on each side of the enclosure for a total of four (4) enclosure installed doors for enclosure personnel access. If the generator set mounted circuit breaker is installed on the side of the generator set, one of the doors on the enclosure shall be located directly in front of the generator side mounted main AC power circuit breaker junction box. All doors shall be no less than 42 inches wide, no exceptions. The doors shall be constructed of 3105 prepainted aluminum to match the enclosure exterior color, and installed into 3/16 inch mill finish aluminum frames that are structurally integrated into the enclosure wall using heavy duty continuous stainless steel hinges constructed with stainless steel hinge pins of a diameter not less than 0.25 inch. Provide gasketing to prevent entry of water into the enclosure through the closed doors. The door passage latches shall be stainless steel and all doors shall be lockable from the outside. Each door shall include "holdback" hardware and restraints to secure the door to the enclosure side wall when the door is opened fully. Include door handle strike plates on the enclosure walls adjacent to the door to provide impact protection from the door handle. Rain gutters that shall channel rainwater away from the top of the enclosure door opening shall be provided for the top of all doors.
18. All components of the enclosure shall be assembled utilizing 0.375 inch minimum stainless steel bolts or screw fasteners, nuts, and lock washers. In addition, watertight neoprene flat washers shall be used on all roof bolts.
19. The enclosure manufacturer shall provide all required hangars, supports, mounting materials and hardware for the generator exhaust silencer and exhaust piping installed inside of the enclosure. Provide insulation around the exhaust piping sections that are physically located inside of the generator enclosure. The exhaust muffler shall be shipped to the site installed by the enclosure manufacturer inside of the enclosure, located so as to be readily and properly connected to the engine's stainless steel exhaust flexible connector. The silencer shall be fitted with an NPT threaded drain connection and piped to the outside of the enclosure by the enclosure manufacturer. Silencer drain piping shall be fitted with a stainless steel construction fluid suitable manual isolation valve.
20. The generator set high sound attenuation exhaust muffler and associated piping system size and type is to be furnished and installed by the enclosure manufacturer so as not to exceed the engine manufacturer's published maximum exhaust flow restriction values and to provide the

specified exhaust silencer sound level attenuation and so as to not allow more than the specified maximum enclosure sound and noise levels at any range of generator set operation. Refer to the exhaust silencer section of these Specifications for additional exhaust silencer system requirements.

21. The enclosure shall be manufactured to be finish coated with a long lasting epoxy coating finish to prevent oxidation and maintain the paint finish.
22. Provide one (1) UL and NFPA approved dry type fire extinguisher. The extinguisher shall be mounted on the enclosure interior wall of the enclosure in a readily accessible location next to the enclosure door that the exterior generator emergency shutdown breakglass station is installed adjacent to.
23. The engine's crankcase fumes disposal hoses shall be extended and routed to the interior of the radiator air discharge plenum by the enclosure manufacturer.
24. Provide a minimum of three (3) tube fluorescent lights (32Watt, T8, (4) foot long lamps, or LED equivalent) with covered fixtures installed within the enclosure, and strategically located above the installed generator set control panel. The light fixture shall be ceiling mounted and properly secured against harmful heat and vibrations. Provide and install two (2) light control switch to be located on the inside of the enclosure adjacent to the enclosure doors located at the generator end of the enclosure. Provide and install two (2) GFI duplex receptacles on the interior of the generator enclosure with weather resistant covers. Receptacles shall be mounted near the enclosure interior light switches. The enclosure manufacturer shall wire the lights, light switches and receptacles to each other and to the enclosure installed AC load center. The Installing Contractor shall provide AC electrical power to AC load center for power for these devices.
25. Provide three (3) separate DC powered light bulbs installed within vapor proof type protective covered fixtures and mounted on the interior roof of the enclosure in locations above the generator's control panel, away from damaging heat, and secured against harmful vibrations. The light is to be connected to a manually operated automatic 0-60 minute timer switch, labeled "DC Light", installed inside the enclosure adjacent to one of the generator end enclosure doors. The DC light shall be appropriately fused and wired to the generator set's starting/control battery power in conduit by the enclosure manufacturer. The lights shall be large enough to provide adequate illumination for the generator control panel in an emergency situation yet not such that overburdening drain shall be placed on the generator set starting battery system

26. The installing Contractor shall be responsible to provide the required primary AC electrical services to the enclosure installed AC load center for use with service electrical power to all required generator and enclosure AC electrical equipment. The enclosure manufacturer shall wire all enclosure interior AC electrical items in EMT / conduit to the AC load center. Any junction boxes used shall be NEMA 3R rated construction.
27. Generator AC power cables and conduits shall enter the enclosure from the bottom of the sub base tank through the sub base tank cable stub up opening which shall be located under the installed generator mounted circuit breaker junction box. All of the generator system control and signal wiring for interface with the remote electrical transfer equipment, AC electrical services, remote controls and annunciation requirements shall be furnished, installed, and terminated by the Installing Contractor.
28. The enclosure manufacturer shall furnish enclosure access galvanized steel stairways with platforms and handrails to be installed on site adjacent to the generator sub base tank for each side of the generator enclosure for personnel access into the enclosure from all enclosure doors. The stairs and platforms shall extend as required to access entry into both doors on each side of the enclosure and shall include handrails, shall be OSHA compliant. The top of the platforms shall be at the same level as the bottom of the enclosure doors with adequate door opening clearances. The Installing Contractor shall be responsible to furnish suitable concrete foundations for the furnished stair / platform assemblies next to the enclosure doors for proper site installation and securement of the stairs / platforms and for proper access into all enclosure doors, and shall be responsible for the complete and proper anchoring installation of the stair / platform assemblies on site.
29. The generator set equipment outdoor enclosure shall be furnished by the generator supplier as designed and manufactured by Phoenix Products, LLC, Jacksonville, or approved equal. Any proposed provision of an alternate enclosure manufacturer shall require detailed documentation and certifications indicating complete compliance with these Specifications and the Drawings including the overall dimensions of the enclosure and sub base tank package and the enclosure and door sizes to be included in the Shop Drawing submittals for Engineer review and approval.

2.5 REMOTE ANNUNCIATOR

- A. Provide one (1) solid state LED type annunciation panel for remote installation. The panel shall be generator 24 VDC battery powered and incorporate an alarm horn and silence switch with ring-back operation. Primary communication between the panels and the generator set shall be by a RS-485 primary annunciator data link and any additional copper stranded wiring as required by the generator supplier for proper power, signal use, interface, and operation of the remote annunciator. All remote annunciation interface wiring shall be furnished, installed, and terminated by the Installing Contractor. The panel shall be mounted where shown on Drawings and shall include

separate indicating lamps with common lamp test, alarm horn, and silence switch for visual annunciation audible alarm of each of the following indicated conditions when present:

<u>Lamp Legend</u>	<u>Generator Set Condition Indicated</u>	<u>Light</u>	<u>Audible Alarm</u>
High Battery Voltage	Battery charger too high	Red	No
Low Battery Voltage	Battery voltage too low	Red	No
Generator Supplying Load	Generator set supplying the load	Green	No
Pre-Low Oil Pressure	Oil pressure approaching low limit	Yellow	Yes
Low Oil Pressure	Engine has shut down due to low oil pressure	Red	Yes
Pre-High Coolant Temp	Temperature of coolant approaching high limit	Yellow	Yes
High Coolant Temp	Engine set has shut down due to high coolant temperature	Red	Yes
Low Engine Temp	Engine heater has malfunctioned	Red	Yes
Low Coolant Level	Radiator low coolant level condition	Red	Yes
Overspeed	Engine has shut down due to overspeed	Red	Yes
Overcrank	Engine failed to start	Red	Yes
Not in Auto	Engine control switch not in AUTO position	Flashing	Yes
Battery Charger Malfunction	Charger is signaling a failure	Red	Yes
Low Fuel Level	Sub base Tank Fuel level below minimum	Red	Yes
Fuel Leak	Fuel leak detected with dual wall containment of the sub base fuel tank	Red	Yes
Emergency Shutdown	Generator set emergency shutdown activated	Red	Yes
Ground Fault alarm	Generator ground fault condition	Red	Yes

- B. Provisions for satisfactory and descriptive labeling of the annunciator panel in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch shall be provided. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared. The remote annunciator shall comply with requirements of NFPA 110 for Level 1 emergency power supply systems.

PART 3 - EXECUTION

3.1 FACTORY TESTING AND INSPECTION

A. Engine-Generator Set

1. The engine-generator set manufacturer shall perform factory testing and quality control inspections on the engine-generator set provided. A certified report of these tests and inspections shall be submitted to the Engineer prior to delivery of the generator set to the site.
2. The engine, generator, and engine-generator set shall be subjected to standard factory testing and quality control inspections to insure reliable operation. These tests and inspections shall include, but not necessarily be limited to, the following:

- a. Factory testing at the generator set's nameplate power rating and power factor utilizing diesel fuel to confirm baseline data with recording of each of the following:
 - 1) Voltage (each of three phases and average)
 - 2) Amperage (each of three phases and average)
 - 3) KW output
 - 4) Power Factor
 - 5) Frequency
 - 6) Engine Speed
- b. The reactive load banks utilized for testing of the generator set at the factory shall not be dependent on the generator control instruments to read amperage and voltage on each phase. Rather, the test instrumentation shall serve as a check of the generator set meters. Confirmation of comparable readings of the generator control panel display parameters with the load bank testing instrumentation shall be indicated on the furnished factory test reports Rated engine speed.
- c. The generator manufacturers certified Factory test report of the factory testing and inspection shall be submitted to the Engineer for approval prior to delivery of the unit to the project site. Copies of the factory test report for the furnished generator set shall also be included in the generator supplier furnished generator set equipment Parts, Operation and Maintenance manuals.
3. Prior to delivery the engine-generator set shall be tested to show it is free of any defects and will start automatically and carry full load. This testing shall be performed at the factory or at the facility of the generator set manufacturer's authorized local dealer.
4. The testing shall be performed with load banks capable of definite and precise incremental loading. The testing shall be performed at rated load and at rated power factor as required by per NFPA 110.
5. The load banks shall not be dependent on the generator control instruments to read amperage and voltage on each phase. Rather, the test instrumentation shall serve as a check of the generator set meters.
6. A certified test report of the factory testing and inspection shall be submitted prior to delivery of the generator set to the project site. A minimum six (6) copies shall be provided.
7. All consumables and equipment necessary for Factory testing shall be furnished by the generator set manufacturer. Any generator set equipment defects or operational deficiencies which become evident during the Factory testing shall be corrected by the manufacturer at their own expense prior to shipment of the equipment.

3.2 INSPECTION

- A. Examine the area to receive the generator equipment to assure adequate clearances for all installations.
- B. Check that all concrete foundations are level and free of irregularities.
- C. Start work only after unsatisfactory conditions are corrected.
- D. Contractor shall ensure that the generator equipment shall be properly protected and stored after delivery.

3.3 INSTALLATION

- A. The generator equipment shall be installed as indicated on the Drawings and per the manufacturer's recommended procedures and guidelines.
- B. The engine-generator set vendor shall be responsible for providing wiring diagrams showing the electrical connections for the engine-generator for use by the Installing Contractor during installation and checkout of the equipment.
- C. After installation by others, the engine-generator set vendor shall provide the services of competent factory based service engineers to instruct the Installing Contractor, and to coordinate the installation, startup, and testing of the equipment.
- D. The engine-generator set supplier shall maintain a competent factory trained service organization that is available for site service on a 24-hour / 7 day week call basis at all times.

3.4 FIELD QUALITY CONTROL

- A. The complete installation shall be checked for procedural and operational compliance by technical representatives of the engine-generator set supplier. Any deficiencies shall be noted for correction by the Installing Contractor.
- B. The generator supplier shall be available to technically assist the Installing Contractor during installation.
- C. The generator supplier shall perform start-up procedures, systems checks, adjusting, and site testing required after the generator equipment installation is complete.
- D. Initial fill of generator set manufacturer recommended engine lubricating oil, and coolant conditioner / antifreeze shall be provided for the unit by the engine generator supplier.

3.5 DELIVERY INSPECTIONS

- A. The Installing Contractor shall examine and confirm that the site delivery areas to receive the generator system equipment is free of obstructions, debris, and moisture, and that adequate clearance for delivery, offloading, and installation of the generator system equipment is available at the time of generator equipment delivery.
- B. The Installing Contractor shall confirm that the generator set concrete foundation pad is suitably sized, level, and free of irregularities.

- C. Prior to generator system equipment site delivery, the Installing Contractor shall obtain from the generator supplier adequate information for the Installing Contractor's use in ensuring that all of the delivered generator system equipment will be properly offloaded, rigged, cared for, protected, and stored by the Installing Contractor.
- D. The Installing Contractor shall be responsible to confirm that all unsatisfactory site conditions are corrected prior to scheduling generator system equipment deliveries.

3.6 SYSTEM START-UP AND OPERATIONAL TESTING

- A. The generator supplier's field service technician shall be responsible for field start-up and testing of the furnished generator equipment. The generator equipment supplier shall furnish the Engineer with written certification confirming that all equipment of the generator system is complete, in good condition, free from damage and properly installed, connected, adjusted and operational.
- B. The Installing Contractor shall provide the required assistance to the generator supplier's field service personnel during all phases of generator equipment start-up, testing, and commissioning. This assistance shall be limited to tasks directly associated with the installation of the generator equipment, not with the internal components or inherent function of the generator equipment.
- C. The Contractor and generator supplier shall conduct generator equipment pre-start inspections to confirm the installation is ready for site startup and testing. As a minimum, the following action items shall be checked:
 - 1. Generator set engine oil level
 - 2. Generator set engine coolant level
 - 3. Sub base fuel tank leakage, fuel level, and alarm provisions
 - 4. Battery / charger connections, battery charge condition, and battery charging operation
 - 5. Generator set control interconnects, including for remote annunciation
 - 6. Engine-generator and generator set enclosure ventilation intake air/discharge system including for any obstructions
 - 7. Engine exhaust system installation and for any obstructions
 - 8. Proper installation and adjustment for all vibration isolation equipment
 - 9. Removal of all packing materials.
 - 10. Generator equipment mounting and installation
- D. The Installing Contractor shall be responsible to furnish and initially fill the generator set sub base tank to 100 % capacity with new acceptable quality ULSD diesel fuel, engine manufacturer recommended and approved for use with furnished generator set engines immediately prior to generator set equipment startup initiation, maintain an

adequate supply of diesel fuel in the generator sub base tank for all required site testing and demonstrations, and then once more refill the sub base tank to 100 % full level upon Engineer and Owner final acceptance of the generator equipment system.

- E. The generator set shall automatically start and stop in response to signal activation and deactivation by the remote transfer switch equipment. Automatic operation and proper functioning of the complete emergency power system shall be confirmed and demonstrated.
- F. Generator system start-up and operational testing procedures shall not be limited to those specified herein. Others shall be performed by the generator supplier (EG vendor) and Installing Contractor as necessary to confirm and demonstrate that the system is properly installed and functions as required by NFPA 110, Level 1, and as described and required by these Specifications and other related Specification Sections.
- G. Generator system site operational and load bank testing shall be performed by the generator supplier in coordination with the Installing Contractor in the presence of the Engineer. Two (2) weeks advance written notice shall be given for all generator system start-up testing, and demonstration procedures requiring Engineer witnessing.
- H. Generator Site Operational Testing
 - 1. The generator supplier shall provide and deliver to the site, temporary, dry type resistive load bank equipment for load bank testing of the generator set. The load bank shall be sized and furnished to have a minimum load testing capability of 100% of the generator set's nameplated standby KW rating. Building load shall not be used in conjunction with the generator system load bank testing. The Installing Contractor shall be responsible for connection and disconnection of the generator supplier furnished temporary use load bank cables to generator set and the temporary load bank equipment as necessary to perform the required generator set equipment load bank testing on the site.
 - 2. Upon satisfactory preliminary site startup and operational testing of the generator set by technical representatives of the generator supplier, the generator set shall be load bank tested by the generator supplier in coordination with the Installing Contractor and the Engineer.
 - 3. Site load testing for the entire generator system shall be provided as required by NFPA 110 for Level 1 generator systems and as specified herein for the furnished generator set. The generator supplier furnished Factory and site testing documentation shall be provided for review and approval by the Engineer.
 - 4. Site testing: Cold start block load the generator set at the full load 100% generator set standby rating KW in one single block load step and operate sustained full load for two (2) hours continuous. Then, remove the full connected load from the generator set in one step and allow the generator set to continue to operate to cool down for five (5) minutes, then reapply full standby 100% generator set standby rating KW block

load in one single step and operate sustained load for additional two (2) hours continuous for a combined generator full load testing period of four (4) hours. For each addition and removal of test load on the generator set, record each of the generator block loading and unloading transient high and low voltage and high and low frequency levels and actual recovery time to achieve to steady state operation and stabilized voltage and frequency levels. Record the following readings in five (5) minute increments for the first fifteen (15) minutes at the initiation of each block load testing and thereafter in ten (10) minute increments thereafter for the duration of the complete load bank testing period.

- a. Kilowatts
 - b. Voltage (each of 3 phases)
 - c. Amperage (each of 3 phases)
 - d. Frequency
 - e. Power factor
 - f. Engine fuel pressure, oil pressure, and water temperature
 - g. Ambient outside air temperature
 - h. Battery charging amperage rate
 - i. Battery voltage
 - j. Time at each recorded measurement
5. Proper site installed generator system operation, including proper manual and automatic electrical and transfer operations shall be confirmed and demonstrated. Field verify proper operation of all generator controls, generator set alarms and shutdowns, safety devices, fuel delivery system, and remote annunciation.
 6. In addition to the Contractor, technical representatives of the generator supplier shall be present on site for generator system testing and demonstration purposes as may be required and witnessed by the Engineer.
 7. Should these tests fail or indicate that any of the generator system equipment or its operation and performance is not in compliance with the requirements for the generator system as specified herein and as shown on the drawings, the costs of all corrective measures shall be borne by the EG vendor if generator supplier equipment related or by the Installing Contractor if installation related. Once corrective measures are implemented, the operational testing requirements shall be repeated at the cost of the responsible party.
 8. Upon satisfactory completion of all generator system testing including electrical transfer operations, fuel transfer system, and remote annunciation, completion of final demonstrations, and Engineer, and Owner final acceptance of the complete generator system has been provided, the Installing Contractor shall be responsible to provide and re-fill the generator set sub base tank to 100 % full with new diesel fuel.

9. The Installing Contractor shall ensure that all furnished equipment is properly cleaned and touched up if necessary to match original finishes prior to acceptance by the Owner.
10. The generator supplier shall provide six (6) copies of certified test reports of the complete EG system field testing after satisfactory completion of startup and testing of the generator set equipment. The generator equipment site testing documentation and reports must be compiled so as to indicate compliance with the specified EG system testing and operational requirements. Copies of all EG vendor EG system equipment factory and field testing reports, torsional compatibility reports, and all required field testing certifications shall be provided to the Engineer.

3.7 INSTALLATION, OPERATION AND MAINTENANCE MATERIALS

A. Installation Instructions

1. Provide three (3) copies of generator equipment storage, and installation instructions for all equipment and devices provided under this Contract for use during the installation and commissioning into service of the standby generator emergency power system.

B. Operation Instructions and Maintenance Manuals

1. After completion of work and start-up of the equipment at the project site, deliver to the Owner's Representative, three (3) copies of operation instructions, maintenance manuals and drawings presenting full details for operation, care, and maintenance of each equipment item of the furnished generator system.
2. Each manual shall contain the operating and maintenance information and parts breakdowns and lists for all equipment provided under this Contract. When necessary, provide supplemental drawings to show system operation and servicing and maintenance points. For all electrical components, provide wiring and connection diagrams. Manuals shall include instructions required to accomplish specified operation and functions. Data shall be neat, clean, legible copies. Drawings shall be accordion folded. Non-applicable information shall not be included or shall be sufficiently crossed out in each of the manuals furnished.
3. In general the generator equipment parts, operation and maintenance manual shall include, but not necessarily be limited to, the following:
 - a. Operating Instructions - with description and illustration of the engine-generator set, engine and generator controls and any other controls and indicators.
 - b. Parts Books - that illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).

- c. Preventative Maintenance Instructions - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
- d. Routine Test Procedures - for all electronic and electrical circuits and for the main AC generator.
- e. Troubleshooting Chart - covering the complete engine-generator set showing description of trouble, probable cause, and suggested remedy.
- f. Recommended Spare Parts List - showing all consumables anticipated to be required during routine maintenance and testing, including pricing.
- g. Wiring Diagrams and Schematics - showing all electrical components.

3.8 ORIENTATION

- A. The generator supplier shall provide a complete orientation for the Owner's engineering and generator system operation and maintenance personnel. Training topics to be covered by the generator supplier shall include complete generator system sequence of operations, control operations, schematics, wiring diagrams, meters, status and operational indicators, warning lights, shutdown system, and routine maintenance and troubleshooting procedures for all of the furnished generator system equipment. Training shall be coordinated and scheduled with the Owner.

END OF SECTION

SECTION 16950 FIELD TESTING

PART 1 - GENERAL

1.01 SCOPE:

- A. This Section specifies the work necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these specifications and functions as required by the Contract Documents.
- B. The work of this Section includes furnishing the labor, equipment, and power required to support the testing specified in other divisions of these Specifications. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.
- C. The requirements of SECTION 16050 Basic Materials and Methods apply to the WORK of this Section.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

- A. (ASTM) American Society for Testing and Materials
- B. (ICEA) Insulated Cable Engineers Association
- C. NEC (NFPA 70) National Electrical Code
- D. (NEMA) National Electrical Manufacturers Association
- E. (NETA) International Electrical Testing Association - Acceptance Testing Specifications

1.03 DEFINITIONS: N/A

1.04 SUBMITTALS:

- A. Five (5) bound copies of the certified test reports shall be submitted by the independent testing firm to the CONTRACTOR upon completion of the project. The final report shall be signed and shall include the following information:
 - 1. Summary of the project
 - 2. Description of equipment tested
 - 3. Visual Inspection report
 - 4. Description of tests
 - 5. Test data
 - 6. Analysis and recommendations
 - 7. Appendix including appropriate test forms
 - 8. Identification of test equipment used and calibration dates

1.05 QUALIFICATIONS:

- A. The testing CONTRACTOR shall submit appropriate documentation to demonstrate that it satisfactorily complies with the following. The CONTRACTOR shall have a "Full Membership" classification issued by the International Electrical Testing Association. The following criteria shall be met.

1. The testing CONTRACTOR shall be an independent, third party, testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the CONTRACTOR.
 2. The testing CONTRACTOR shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- B. The testing organization shall utilize technicians who are regularly employed for testing services.
- C. Each on-site crew leader shall hold a current registered certification in electrical testing applicable to each type of apparatus to be inspected or tested. The certification in electrical testing shall be issued by an independent, nationally-recognized, technician certification agency. The following entities shall qualify as independent, nationally-recognized, technician certification agencies:
1. International Electrical Testing Association (NETA)
Accepted certifications:
 - a. Certified Senior Technician/Level IV
 - b. Certified Technician/Level III
 2. National Institute of Certification in Engineering Technologies (NICET)
Accepted certifications specifically in Electrical Testing Engineering Technology:
 - a. Senior Engineering Technician/Level IV
 - b. Engineering Technician/Level III

1.06 RESPONSIBILITIES:

- A. The CONTRACTOR shall notify and coordinate scheduling with the Independent Testing SUBCONTRACTOR when equipment becomes available for acceptance tests.
- B. The CONTRACTOR shall provide the Independent Testing SUBCONTRACTOR with a complete set of approved electrical drawings, coordination study (if applicable), settings of all adjustable devices (if applicable), manufacturer's instruction manuals and any other information necessary for an accurate evaluation of the equipment and systems prior to performance of any tests.
- C. The CONTRACTOR shall provide a suitable source of electrical power as specified by the Independent Testing Firm at each test site point of need.
- D. The CONTRACTOR shall report to the CITY any system, equipment, material, or workmanship which is found deficient on the basis of acceptance tests.
- E. The CONTRACTOR shall correct deficiencies identified by tests and make ready for retest.
- F. The CONTRACTOR shall hire and pay for the services of the Independent Testing Firm to retest any equipment found to be deficient at initial testing until specified requirements are met.

1.07 TESTING:

- A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.
 1. Lighting: Switching, including remote control, if indicated. Verify circuitry is in accordance with panel schedules. Switches rated less than 600V shall be tested in accordance with NETA ATS Section 7.5.1.1. Switches shall be toggled, back and or side contacts tested for correct wiring, any special features verified.
 2. Meters shall be tested as per NETA ATS Section 7.11.
 3. Instrument transformers shall be tested as per NETA ATS Section 7.10.

4. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
5. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. Testing procedures outlined in NETA ATS Section 7.14 - Ground Fault Protection Systems - shall also be used.
6. Surge arrestors rated less than 600V shall be tested as per NETA ATS Section 7.19.1
7. Protective relays shall be tested as per NETA ATS Section 7.9.
8. Transformers dry type rated less than 600 VAC (167kVA single-phase, 500kVA three-phase and smaller) shall be tested according to NETA ATS Section 7.2.1.1.
9. Transformers dry type rated less than 600 VAC (greater than 167kVA single-phase and 500kVA three-phase) shall be tested according to NETA ATS Section 7.2.1.2.
10. Switchgear and switchboard assemblies rated less than 600V shall be tested as per the requirements of NETA ATS Section 7.1.
11. Automatic Transfer Switches shall be tested as per NETA ATS Section 7.22.3.
12. Batteries shall be tested as per NETA ATS Section 7.18.1.
13. Battery chargers shall be tested as per NETA ATS Section 7.18.2.
14. Emergency/Standby generators shall be tested as per NETA ATS Section 7.22.1
15. Uninterruptible Power Systems shall be tested as per NETA ATS Section 7.22.2
16. Motor starters rated less than 600V shall be tested in accordance with NETA ATS Section 7.16.1.1.
17. Motor control centers shall be tested as per NETA ATS Section 7.16.2.
18. Cable Testing: Low voltage 600-volt maximum cable shall be tested for insulation resistance. Testing shall be done after the equipment is terminated. Inspection and test procedures, as outlined in NETA ATS Section 7.3.2 - Cables, shall be followed. Test results, stating equipment used and time of test shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test.
19. Metal Enclosed Busways shall be tested as per NETA ATS Section 7.4
20. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer. Inspection and test procedures outlined in NETA Acceptance Testing Specifications Section 7.14 - Ground Fault Protection Systems - shall also be used.
21. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Inspection and test procedures outlined in NETA ATS Section 8.1 - System Functional Tests - shall be used. Functional testing shall comprise:
 - a. Circuit breakers insulated case or molded shall be tested per the requirements set forth in NETA ATS Section 7.6.1.1. Circuit breakers which have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker manufacturer. Time and pickup setting shall correspond to the recommendations of the

Short Circuit Study provided by the equipment vendor. Setting shall be tabulated and proven for each circuit breaker in its installed position.

- b. Draw-out circuit breakers rated less than 600V shall be tested per the requirements set forth in NETA ATS Section 7.6.1.1. Circuit breakers which have adjustable time or pickup settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study provided by the equipment vendor. Setting shall be tabulated and proven for each circuit breaker in its installed position.
 - c. Switches rated less than 600V shall be tested in accordance with NETA ATS Section 7.5.1.1. Switches shall be toggled, back and or side contacts tested for correct wiring, any special features verified.
22. Complete ground testing of all grounding electrodes per requirements below prior to operating the equipment. Inspection and test procedures outlined in NETA ATS section 7.13 - Grounding Systems - shall be used.
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the CITY and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
 - C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
 - D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.
 - E. Provide ground resistance tests on the main grounding electrode or system in the presence of the CITY and submit results. Utilize the fall-of-potential method or alternative, in accordance with IEEE Standard 81.
 - F. Subsystems shall be defined as individual and groups of pumps, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.
 - G. General: Carry out tests indicated herein for individual items of materials and equipment in other Sections.

1.08 INSPECTION COORDINATION:

- A. The CONTRACTOR shall provide access to the work for the CITY as requested for inspection. The CONTRACTOR shall provide 48 hours notice of its intention to begin new work activities

1.09 WARRANTY:

- A. The MANUFACTURER shall warrant the EQUIPMENT, MATERIALS and PRODUCTS specified in this section against defective materials and workmanship with the MANUFACTURER'S standard warranty, but for no less than one year from the date of Substantial Completion, and as described in Article 13 of Section 00700 - General Terms and Conditions.
- B. The CONTRACTOR shall warrant the WORK against defects for one year from the date of Substantial Completion and as described in Article 13 of Section 00700 - General Terms and Conditions.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS:

- A. The CONTRACTOR shall provide all testing equipment required which includes but are not limited to following:
1. Wet- and dry-bulb thermometer
 2. 1000V meggers
 3. Battery-powered portable telephone sets and portable radios
 4. Digital High Precision Multimeter
 5. Commercial model three-point ground test set
 6. Miscellaneous cable, test lights, buzzers, bells, switches, receptacles, plugs, and other equipment as required

PART 3 - EXECUTION: N/A

END OF SECTION

**Department of Regulatory and Economic Resources
Miami-Dade County
Plan Review Summary**

Process Number: M2018017786

FINAL CORE REVIEW DATE: 9/11/2018

OVERALL STATUS: Overall Disapproval

PROJECT DETAILS:

FOLIO: 01-4102-005-5490

ADDRESS: 1301 NW 6 ST, , FL

PERMIT TYPE DESC.: REPL GENERATOR

CONTACT DETAILS:

NAME: PEDRO ALVARADO

EMAIL:

PHONE #: 3054161200

DISAPPROVAL CODES:

Disapproval Code 01: 0308 - Requires DERM Storage Tanks approval. Contact the West Dade office at 11805 Coral Way Miami,

Disapproval Code 01: 0308 - Requires DERM Storage Tanks approval. Contact the West Dade office at 11805 Coral Way Miami, Fl. (786) 315-2800

TASK	REVIEWED BY	STATUS DATE	STATUS
Initial Core Review	Julio Diaz	08/30/2018	Reviewed
Comments: PERMIT FOR REMOVAL OF EXISTING GENERATOR AND INSTALLATION OF NEW DIESEL GENERATOR/CO2 FIRE SUPPRESSANT SYSTEM AND MAIN SWITCH DISCONNECT PROJECT TO EXISTING CITY OF MIAMI PS#30-0055. (CITY OF MIAMI RIVERVIEW STORM SEWER PUMP STATION) NO FEES TO BE CHARGED. (CITY OF MIAMI PROJECT) 2-SETS OF PLANS SUBMITTED. SHEETS#C-O/#C-1/#C-2/#C-3/#C-4/#E-1/#E-2/#E-3/#M-1/#EE-1/#EE-2/#FS-1 AND #FS-2. (SEE ATTACHMENT)			
AIR Review	Laura E Hernandez	08/31/2018	Approved
Comments: 8/31/2018-Approved-Sheet C-2 indicates removal of existing generator to install a new 800 kw Caterpillar Model C27DRA1 diesel emergency generator for a City of Miami sewer pump station PS#30-005 burning 56.3 GPH at 100% load x 500 hours = 28,150 GPY, which is under the threshold of 64,000 GPY to require a county operating permit.			
ASBES Review	Sean Tracey	09/05/2018	Approved
Comments: 09/05/2018 - Scope of work does not appear to disturb over 160 SF of potential ACM within the project. Plans approved.			
TANKS Review	Anthony Hung	09/07/2018	Disapproved

Comments: 1. Complete a "Storage Tank System Application for Removal" for existing genset and pad to be removed on C-3.

2. Show on plans a detail of the subbase aboveground storage tank (AST) being installed to fuel an 800kW generator and all of its components (i.e. valve, fuel gauge, overspill containment box, etc.), it might need different views of the AST. No cut-sheets will be accepted.

3. Call on plans size of the tank, material of construction, all piping connections, valves, and manufacturer's name and model number (if known). No cut-sheets will be accepted.

4. All equipment to be installed must be approved by the Florida Department of Environmental Protection (FDEP) so provide a statement on plans that all of the applicable equipment will be FDEP approved.

5. Call on plans whether the proposed AST to be installed will be new, relocated, or properly recertified.

6. The AST shall be equipped with an overfill prevention device to prevent release of fuel when the tank is filled upon capacity and an overspill containment box at the fill port to prevent spills during filling operations. Show on plans the location of the overfill prevention device(s) (fill limiter, mechanical fuel level gauge and high flow switch (max 90% tank capacity)) and size of the overspill prevention box being proposed.

7. If the overfill prevention system uses electrical or electronic devices such as high level switch or sensor, etc. then show on plans the location of the electronic device, the type of alarm system (audible, visual, etc.) and the location of the overfill prevention annunciator panel or console. Note that the overfill annunciator shall be as close as possible to the fill port.

8. The AST shall be equipped with an interstitial monitoring system to monitor the space between primary and secondary walls. Show on plans the location of any device (sensor, switch or gauge) being used.

9. If the fuel tank interstitial monitoring systems use electrical or electronic devices such as switch or sensor, etc. then call on plans the type of alarm system (audible, visual, etc.) and show the location of the switch or sensor (lowest point of the tank interstice) and the location of the annunciator panel or console.

10. Complete, notarize, and submit the enclosed Spill Prevention and Response Plan (SPRP) form along with a list of materials/equipment to handle minor spills (i.e. cat litter, sand, absorbent mats, shovel, etc.).

11. Provide an extra set of signed, dated, and sealed plans for the DRER environmental operating file just with the following pages C-0 thru C-4, E-1 thru E-3, and any new and/or revised pages relating to the above items.

Should you have any question concerning this matter, Thursdays have been designated as "Design Professionals Day for DERM". 786-315-2844.

<http://www.miamidade.gov/building/plan-review.asp>

Final Core Review	Yailyn Guilarte	09/11/2018	Overall Disapproval
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PLAN CONDITIONS:

NO CONDITIONS

PLAN REVIEW FEES (FEES ARE SUBJECT TO CHANGE PENDING FINAL APPROVAL):

FEE CODE	DESCRIPTION	USER	DATE	UNIT	TOTAL
Total					

FOR MORE INFORMATION PLEASE CONTACT:

YOUR DERM CORE REVIEWER: guilay@miamidade.gov

DERM PERMITTING AND INSPECTION CENTER, 11805 SW 26 ST, 786-315-2800

DERM OVERTOWN TRANSIT CENTER, 701 NW 1 CT, 305-372-6899

Coastal: dermcr@miamidade.gov

EQCB: eqcb@miamidade.gov

Specialty Engineering Reviews (industrial, storage tanks, industrial waste pretreatment, asbestos, paving & drainage, trees): dermengreviews@miamidade.gov

Tree Permit applications: dermtreeprogram@miamidade.gov

Water Control: dermwatercontrol@miamidade.gov

Wetlands: dermwetlands@miamidade.gov



Storage Tank System Application for Removal

Permit/File #

Department of Environmental Resources Management
Environmental Evaluation & Compliance Section
(305) 372-6600
(305) 372-6893 FAX

Facility Name:

Facility Address:

How many storage tanks are being removed?

Disposition of piping? (Removed, capped or filled with inert material)

What product was held in the tanks?

Property owner or responsible party:

Name:

Company Name:

Mailing Address:

PSSS Contractor performing the work:

Company Name:

PCC Number: Exp Date:

Representative Name:

Phone:

TCAR Contractor or Consultant Representative

Company Name:

Representative Name:

Phone:

Requirements:

1. All work must be conducted in compliance with Chapter 62-761, Florida Administrative Code (F.A.C.) and Section 25-45 of the Miami-Dade County Environmental Protection Ordinance.
2. Attach site sketch showing location of tanks, on-site buildings, and adjacent streets.
3. All storage tank system components removed must be properly cleaned and disposed of in accordance with American Petroleum Institute RP 1604 and National Fire Protection Administration 30. The contents of the tank must be properly recovered and disposed of by a DERM permitted waste transporter.
4. Discovery of new contamination requires submission of a Discharge Report Form to DERM or DEP. Chapter 62-761 requires the owner to immediately undertake to contain, remove and abate the discharge.
5. All inspections must be scheduled with the DERM Inspection Coordinator at (305) 372-6600 two business days prior to commencing any closure activities. The groundwater must be made accessible for the inspector.
6. Removal of a storage tank system regulated by Chapter 62-761 requires the submission of a Tank Closure Assessment Report (TCAR) to the Department within 60 days.

For Department Use

03/2009

Complete: Incomplete: Reviewer: