CITY OF HOUSTON
INVITATION TO BID
Issued: February 18, 2011

Bid Opening:
Sealed bids, in duplicate, will be received by the City Secretary of the City of Houston, in the City Hall Annex, Public Level, 900 Bagby, Houston, Texas 77002 until **10:30 A.M. Thursday, March 17, 2011,** and all bids will be opened and publicly read in the City Council Chamber, City Hall Annex, Public Level, 900 Bagby at 11:00 A.M. on that date for the purchase of:

ELECTRIC VEHICLE SUPPLY EQUIPMENT
FOR THE FLEET MANAGEMENT DEPARTMENT
Bid No. S50-C23736
NIGP Code: 910-82 / 928-38

Buyer:
Questions regarding this solicitation should be addressed to Arturo Lopez, Senior Procurement Specialist**, at 832-393-8731or e-mail to arturo.lopez@houstontx.gov**

Electronic Bidding:
In order to submit a bid for the items associated with this procurement, you must fill in the pricing information on the "**PLACE BID"** page.

Prebid Conference:
A Pre-Bid Conference will be held for all Prospective Bidders in the Strategic Purchasing Division, Concourse Level (Basement), Conference Room, #1 City Hall, 901 Bagby, at **10:00** a**.m. on Wednesday, March 2, 2011**. **The site visit will be scheduled at the pre-bid conference.**

All Prospective Bidders are urged to be present. It is the bidder's responsibility to ensure that they have secured and thoroughly reviewed all aspects of the solicitation documents prior to the Pre-Bid Conference. Any revisions to be incorporated into this solicitation document arising from discussions before, during and subsequent to the Pre-Bid Conference will be confirmed in writing by Letter(s) of Clarification prior to the bid due date. Verbal responses will not otherwise alter the specifications, terms and conditions as stated herein.

Bidding forms, specifications, and all necessary information should be downloaded from the Internet at www.purchasing.houstontx.gov. By registering and downloading this solicitation document, all updates to this solicitation document will be automatically forwarded via e-mail to any registered bidders. This information may also be obtained from the Supplier Assistance Desk, Strategic Purchasing Division, 901 Bagby, Concourse Level, Houston, Texas 77002.

The place of the bid opening may be transferred in accordance with Paragraph (b), (5) of Section 15-3 of The Code of Ordinances, Houston, Texas. The bid-opening meeting may be rescheduled in accordance with Paragraph (b), (6) of said Section 15-3.

The City reserves the right to reject any or all bids, or to accept any bid or combination of bids deemed advantageous to it.
City employees are prohibited from bidding on this solicitation in accordance with the Code of Ordinances Section 15-1.

*__CONTENTS__:

*NOTE 1: Actual page numbers for each section may change when the solicitation document is downloaded from the Internet or because of letters of clarification. Therefore, bidders must read the solicitation document in its entirety and comply with all the requirements set forth therein.
***NOTE 2: To be considered for award please submit the electronic bid form and the forms listed in section A, including the signature page, which must be signed by a company official authorized to bind the company and a 10% Bid Bond.**

SECTION A

FORMAL ONE-TIME BID
ELECTRIC VEHICLE SUPPLY EQUIPMENT
FOR THE FLEET MANAGEMENT DEPARTMENT
Bid No. S50-C23736
NIGP Code: 910-82 / 928-38

To The Honorable Mayor
and City Council Members
of the City of Houston, Texas (the "City"):

The undersigned hereby offers to provide services necessary to **Furnish and Install Electric Vehicle Supply Equipment Stations throughout the City of Houston for the Fleet Management Department,** F.O.B. destination point Houston, Texas, in accordance with the City's Specifications and General Terms & Conditions and/or samples/drawings provided herein. When issued by the City of Houston, Letters of Clarification shall automatically become part of this bid document and shall supersede any previous specifications or provisions in conflict with Letters of Clarification. It is the responsibility of the bidder to ensure that it has obtained all such letters. By submitting a bid on this project, bidder shall be deemed to have received all Letters of Clarification and to have incorporated them into the bid.

The City may accept this bid offer by issuance of a Notice of Award Letter and/or a Purchase Order at any time on or before the 120th day following the day this Official Bid Form is opened by the City. This offer shall be irrevocable for 120 days after bid opening or for 90 days after City Council awards the bid, whichever comes last, but this period may be extended by written agreement of the parties.

The City reserves the right to INCREASE quantities during the twelve-month period following the issuance of the first purchase order subject to agreement in writing by the Prime Contractor/Supplier to honor the same bid price.

The City reserves the option, after bids are opened, to adjust the quantities listed on the electronic bid form upward or downward, subject to the availability of funds, and/or make award (s) on a line item basis.

SECTION A

Documents/forms must be downloaded from the City's Website
http://www.houstontx.gov/purchasing/index.html

Additional Required Forms to be Included with this bid:

In addition to the electronic Bid Form and the Official Signature Page, the Forms listed in Table 1 **must be completed and submitted to the Office of the City Secretary on or before the date and time the bid is due:**

Table 1
Affidavit of Ownership
Fair Campaign Ordinance
Statement of Residence
Conflict of Interest Questionnaire
Contractors References
Pay or Play Contract Compliance Acknowledgement Form
10% Bid Bond

Table 2 lists other documents and forms that should be viewed/downloaded from the City's website, but are not required to be submitted with the bid. The City will request these forms, as applicable, to be completed and submitted to the City by the recommended/successful bidder:

Table 2
Formal Instructions for Bid Terms
Drug Forms
Insurance Certificates Over $50,000.00
OCP Insurance Certificate Over $100,000.00
Performance, Maintenance and Statutory Payment Bonds
Davis/Bacon TX2008046 Highway Wage Decission
Pay or Play Certification of Agreement to Comply with Program
Pay or Play Form 3 / List of Participating Contractors

NOTE:

1. Questions concerning the Bid should be submitted in writing to: City of Houston, Strategic Purchasing Division, 901 Bagby, Room B506, Houston, TX 77002, Attn: Arturo Lopez or via fax: 832-393-8759 or via email (preferred method) to arturo.lopez@houstontx.gov no later than ***4:00 PM, Friday, March 7, 2011.***

2. Although it is the intent of the City to award one contract as results of this invitation to bid, the City reserves the right to award by line item/group.

PERMITS:
Successful Contractor shall be responsible for securing any and all permits for proposed work. Any fee charged for these permits should be the responsibility of the Contractor and not the City of Houston.

CITY BUILDING CODES:

All work performed or equipment installed shall be in strict accordance with the City of Houston Building Codes. The Contractor will immediately correct any deficiencies discovered during work or after completion. Failure to correct deficiencies will result in the City having corrections made at the Contractor's expense.

BID BOND:

The Contractor shall be required to provide and submit with the bid a Bid Bond in the amount of 10% of the total amount bid by the Contractor. The Bid Bond shall be in the same form as that distributed by the City, and attached hereto, all duly executed by this Bidder (as "Principal") and by a corporate surety company licensed to do business in the State of Texas, and if the amount of the bond is greater than $100,000.00 the surety must hold a certificate of authority from the United States Secretary of the Treasury, or a Cashier's or a Certified check in a like amount. Company or personal checks are not acceptable.

PERFORMANCE BOND and PAYMENT BOND:

The successful Contractor(s) shall be required to provide a Performance and Payment Bond in the total amount (100%) of the Contract if the award is in excess of $25,000.00.

The Performance and/or Payment Bond shall be in the same form as that distributed by the City, and attached hereto, all duly executed by this bidder (as "Principal") and by an incorporated surety company licensed to do business in the State of Texas. If the amount of the bond is greater than $100,000.00 the surety must hold a certificate of authority from the United States Secretary of the Treasury.

The Contractor(s) shall be required to provide a Performance and/or Payment Bond as outlined above, which will be delivered to the City Purchasing Agent of the City, on or before the tenth (10^{th}) day following the day the bidder receives notice from the City.

MAINTENANCE BOND:

The Contractor shall furnish a maintenance bond in the total (100%) bid amount in the form required by the City (samples attached). One bond, also referred to as the One Year Maintenance Bond, will be conditioned upon Contractor's repair, replacement or restoration of any work or any portion of the work which is found to be defective or fails in any way to comply strictly with this contract or the plans and specifications for such work within a period of one (1) year from the date of acceptance of such work by the City Council or after the date that the "CO", or his designee in writing, determines, in a written notice to the Contractor, to be the date upon which the project is both substantially complete and available for the full and beneficial occupancy or use of the City.

QUALITY AND WORKMANSHIP:

The bidder must be able to demonstrate upon request that it has performed satisfactorily, services similar to the services specified herein. The bidder will provide records of warranty and repair services performed for others upon request. The City of Houston shall be the sole judge whether the services performed are similar to the scope of services specified herein.

SITE INSPECTION

1.0 The City of Houston reserves the right to inspect the bidder's current place of business to evaluate equipment condition and capabilities, staff experience, training and capabilities, and storage capabilities as they relate to the performance of this contract.

2.0 All prospective bidders are encouraged to arrange and attend a site visit to clarify the actual scope of work to be done. Failure of a bidder to arrange and attend a site visit shall not constitute grounds for later claim against the City. Site visits may be scheduled by contacting Carlos Macias at (281) 813.6962.

3.0 The successful bidder's product shall be supported by an authorized service facility for securing replacement material without undue delay.

4.0 Any revisions to be incorporated into this solicitation document arising from discussions before, during and subsequent to the site visit conference will be confirmed in writing by Letter(s) of Clarification prior to the bid due date. Verbal responses will not otherwise alter the specifications, terms and conditions as stated herein.

FEDERAL WAGE RATE REQUIREMENT CERTIFICATION

The City of Houston assures that it and its contractor(s) and subcontractor(s) shall fully comply with subchapter IV of chapter 31 of title 40, United States Code (Davis-Bacon Act), as required by the FY 2010 Appropriations Act. Notwithstanding any other provision of law, all laborers and mechanics employed by vendors, contractors and subcontractors on projects funded directly by or assisted in whole or in part by and through the federal government, shall be paid wages at rates not less than those prevailing on projects of a similar character in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code. With respect to the labor standards specified in this section, the Secretary of Labor shall have the authority and functions set forth in Reorganization Plan numbered 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and section 3145 of title 40 United States Code. For City Construction Contracts, these rates are found at: http://choice.cityofhouston.net/aad/index.html. This location provides access to the current wage rates posted for engineering and building construction projects.

AWARD

Although it is the intent of the City to award one contract as results of this invitation to bid, the City reserves the right to award by line item/group.

EXHIBIT "1"

CONTRACTOR'S QUESTIONNAIRE

In order to receive bid award consideration, the bidder must be able to demonstrate that they are currently providing or have had at least one contract, to **furnish and install electric vehicle supply equipment stations** that is similar in size and scope to this contract. **Bidder must have references documenting that it has performed Installation of electric vehicle supply equipment stations.** The reference(s) should be included in the space provided below. Please attach another piece of paper if necessary. If references are not included with the bid, the bidder shall be required to provide such references to the City of Houston within five working days from receipt of a written request from the City of Houston to do so. **Bidder's capability and experience shall be a factor in determining the Contractor's responsibility.**

1. Business Name: _____

Business Address:_____

City, State, Zip: _____

Name of Owner/Contact Person: _____

Phone: _____ Fax: _____Email:_____

No. of Years providing Service to this business:_____

2. Business Name: _____

Business Address:_____

City, State, Zip:_____

Name of Owner/Contact Person: _____

Phone: _____ Fax: _____ Email:_____

No. of Years providing Service to this business:_____

3. Business Name: _____

Business Address:_____

City, State, Zip:_____

Name of Owner/Contact Person: _____

Phone: _____ Fax: _____ Email:_____

No. of Years providing Service to this business:_____

4. Business Name: _____

Business Address:_____

City, State, Zip:_____

Name of Owner/Contact Person: _____

Phone: _____ Fax: _____ Email:_____

No. of Years providing Service to this business:_____

EXHIBIT "2"

REQUIREMENTS FOR CONTRACTS BETWEEN THE CITY OF HOUSTON AND THIRD PARTY CONTRACTORS USING AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 ("ARRA") GRANT FUNDS

1.0 Contractor will adhere to and comply with the special reporting requirements associated with ARRA grants as required by the granting agency and the City of Houston ("City"). The ARRA is available at http://frwebgate.access.gpo.gov/cgi- bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h1enr.pdf

2.0 The City will adhere to and comply with the special reporting requirements associated with applicable ARRA grants as required by the granting agency and the U.S. Office of Management and Budget.

3.0 Compliance with Laws:

3.1 Contractor shall comply with all federal, state, and local laws, statutes, ordinances, rules, and regulations and with the orders and decrees of any courts or administrative bodies or tribunals in any manner affecting the requirements of the ARRA. After receiving a written request from the City, Contractor shall furnish the State with satisfactory proof of its compliance with this section.

4.0 Compliance with Comptroller General Requests:

4.1 Contractor will adhere to and comply with requests for any of its records or those of its subcontractors, that directly pertain to, and involve transactions relating to, this contract or subcontract and with any requests for interviews of any officer or employee of Contractor or any subcontractors to the Comptroller General. This will not limit or restrict existing authority of the Comptroller General.

4.2 The City will adhere to and comply with requests for any interviews or records that directly pertain to, and involve transactions relating to, this contract and any interviews of any officer or employee of any State or local government agency administering this contract. This will not limit or restrict existing authority of the Comptroller General.

5.0 Compliance with Inspector General Reviews:

5.1 Contractor will adhere to and comply with any requests from any inspector general of a Federal department or executive agency's reviewing of any concerns raised by the public about specific investments using funds made available by the ARRA.

5.2 The City will adhere to and comply with any requests from any inspector general of a Federal department or executive agency's reviewing of any concerns raised by the public about specific investments using funds made available by the ARRA.

6.0 Compliance with Office of Inspector General:

6.1 Contractor will adhere to and comply with requests from any representative of an appropriate inspector general to conduct interviews or examine any records of the Contractor any of its subcontractors that pertain to, and involve transactions relating to this contract or subcontract.

6.2 The City will adhere to and comply with requests from any representative of an appropriate inspector general to conduct interviews or examine any records that pertain to, and involve transactions relating to this contract.

7.0 Compliance with protection of Whistleblowers:

7.1 Contractor will adhere to and comply with all federal, state, local laws, statutes, ordinances, rules, and regulations and with the orders and decrees of any courts or administrative bodies or tribunals in any manner affecting protection of the State, Local Government or Contractor Whistleblowers. Employers must post notice of the rights and remedies available. Poster available at http://www.recvoery.gov/sites/default/files/Whistleblower+Poster.pdf

7.2 The City will adhere to and comply with all federal, state, local laws, statutes, ordinance, rules, and regulations and with the orders and decrees of any courts or administrative bodies or tribunals in any manner affecting the protection of State, Local Government or Contractor Whistleblowers. Employers must post notice of the rights and remedies available. Poster available at: http://www.recovery.gov/sites/default/files/Whistleblower+Poster.pdf

8.0 Compliance with Buy American:

8.1 Contractor will adhere to and comply with the Buy American requirements of the ARRA.

8.2 The City will adhere to and comply with the Buy American requirements of the ARRA.

9.0 Compliance with the Davis-Bacon Act:

9.1 Contractor will adhere to and comply with the wage rates requirements of the ARRA. Notwithstanding any other provision of law in a manner consistent with other provisions of the ARRA, all laborers and mechanics employed by contractors and subcontractors on projects funded directly by or assisted in whole or in part by and through the Federal Government pursuant to the ARRA shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code. With respect to the labor standards specified in this section, the Secretary of Labor shall have the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and section 3145 of title 40, United States Code. For City Construction Contracts, these rates are found at http://choice.cityofhouston.net/aad/index.html.

9.2 The City will adhere to and comply with the wage rates requirements of the ARRA. Notwithstanding any other provision of law in a manner consistent with other provisions of the ARRA, all laborers and mechanics employed by contractors and subcontractors on projects funded directly by or assisted in whole or in part by and through the Federal Government pursuant to the ARRA shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code. With respect to the labor standards specified in this section, the Secretary of Labor shall have the authority and functions set forth in

Reorganization Plan Numbered 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and section 3145 of title 40, United States Code. For City Construction Contracts, these rates are found at http://choice.cityofhouston.net/aad/index.html.

10.0 Compliance with the Hire American Workers:

10.1 Contractor will adhere to and comply with section 1611 of the ARRA.

10.2 The City will adhere to and comply with section 1611 of the ARRA.

SECTION B
SCOPE OF WORK

1.0 SUMMARY OF SCOPE OF WORK:

1.1 The scope work for this project requires the Contractor to provide all labor, equipment, materials, supervision, transportation, electrical permitting drawings and incidentals necessary to furnish and install 28 pedastal, stand alone, level 2 type, Electric Vehicle Supply Equipment, (EVSE) charging station charge points and all associated equipment in the City of Houston locations specified herein. Installation shall be in strict accordance with specifications. Also, the Contractor shall be required to test, and program the EVSE.

1.2 Although it is the intent of the City to award one contract as results of this invitation to bid, the City reserves the right to award by line item/group.

1.3 Training: Bids must include training of city facilities, and office management personnel

2.0 AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 ("ARRA") GRANT FUNDS (See Exhibit No. 2):

2.1 The City of Houston's funding for bid items in this bid solicitation will be supplemented with funds received by the City through an ARRA grant. Therefore, per the ARRA Act requirements, both the City and the City's awarded Prime Contractor/Supplier are required to accept and comply with the requirements listed in the attached **Exhibit 2**.

2.2 The Prime Contractor/Supplier must accept all of the terms and conditions listed in **Exhibit 2,** and by submitting a bid for these items, acknowledge acceptance of and compliance to the terms and conditions listed in **Exhibit 2**.

4.0 PRODUCT LITERATURE/SPECIFICATIONS SHEETS:

4.1 To evaluate bids, the user department and the City purchasing staff may require product literature/specification sheets. When required, the bidders(s) shall submit the requested product literature/specification sheets within five (5) calendar days from date of request. The Contractor shall provide a CD-ROM containing documentation for the EVSE that provides instructions on how to operate and maintain the EVSE. The electronic format of the documentation must be Adobe Acrobat PDF or Microsoft Word. **FAILURE ON BIDDER'S PART TO FURNISH THE REQUESTED TECHNICAL DATA IN THE TIME LIMIT GIVEN ABOVE MAY BE CAUSE FOR REJECTION OF THE BID.**

END OF SCOPE OF WORK

TECHNICAL SPECIFICATIONS

Electric Vehicle Supply Equipment (EVSE)

PART ONE – GENERAL PRODUCT

1.0 INTRODUCTION

1.0.1 The scope of this specification includes Level 2 conductive charging stations, (EVSE). The City of Houston (COH) plans to have 28, Level 2, EVSE charging station charge points, both for public and City fleet use.

1.1 ACRONYMS AND DEFINITIONS

1.1.1 Acronyms:

EV - Electric Vehicle

EVSE - Electric Vehicle Supply Equipment

IEEE - Institute of Electrical and Electronics Engineers

NEC - National Electrical Code

NEMA – National Electrical Manufacturers Association

SAE - Society of Automotive Engineers

UL - Underwriters Laboratories

VAC - Voltage Alternating Current

EM – Electric Motor

ICE – Internal Combustion Engine

BEV – Battery Electric Vehicle (EM provides the sole means of propulsion, batteries the sole means of energy storage, and plugging-in is the sole means of refueling)

HEV – Hybrid Electric Vehicle (ICE and EM both provide propulsion, relying on both a batteries and gasoline/diesel for energy storage, but gasoline/diesel is the sole means of refueling)

PHEV – Plug-in Hybrid Electric Vehicle (ICE and EM both provide propulsion, relying on both a batteries and gasoline/diesel for energy storage, and either gasoline/diesel or plugging-in can be used for refueling)

E-REV – Extended-Range Electric Vehicle (EM provides the sole means of propulsion, with an ICE generator onboard to charge batteries when extended range is needed, relying on both a batteries and gasoline/diesel for energy storage, and either gasoline/diesel or plugging-in can be used

for refueling)

NEV – Neighborhood Electric Vehicle (EV that meets DOT requirement for surface street operation only and has a limited max speed to 35 MPH)

PEV – Personal Electric Vehicle (EV designed for single person such as Segway, Scooter

GFCI - Ground fault circuit interrupter

CCID20 – 20 mA Charge Circuit Interrupter Device (essentially a GFCI specifically designed for EV charging)

F – Fahrenheit

C – Celsius

KWH – kilowatt-hour

NRTL – Nationally Recognized Test Lab

SAE - Society of Automotive Engineers

UL - Underwriters Laboratories

VAC - Voltage Alternating Current

AWG – American Wire Gauge

1.1.2 Definitions:

1.1.2.1 Level 2 – A charging method that allows an EV to be connected to permanently wired EVSE with a specialized connector (SAE J1772) with power levels rated at less than or equal to 240 VAC/80 amps.

1.1.2.2 Charging Station – A physical pedestal that is wired for Level 2 EVSE charging. A charging station can support multiple charge points. Multiple charge points on a station can only be counted if all charge points are able to operate simultaneously..

1.1.2.3 Charging Station Charge Point – The City seeks 30 charge points in this solicitation. A charge point is a SAE J1772 connector on a charging station that allows an electric vehicle to be charged at the Level 2 method.

1.2 NECESSARY COMPONENTS

1.2.1 The Contractor shall provide all EVSE components, hardware, software, and parts necessary for the proper assembly and operation of the EVSE. All EVSE components, hardware and parts must be new and unused.

1.3 BASIC EVSE REQUIREMENTS

The EVSE must meet the following minimum requirements. The Contractor shall not deviate from any of the mandatory specifications without prior approval of the City of Houston.

1.3.1 Charging Support / Power & Safety

1.3.1.1 Level-2 Support: The EVSE should have a SAE J1772, 240VAC/30Amps (minimum) coupler and 20ft (minimum) cord to accommodate EVs, and BEVs with level-2 support.

1.3.1.2 Leakage/Ground Current Protection: The EVSE must be equipped with leakage and ground current monitors with interruption capabilities.

1.3.2 Access Control

1.3.2.1 The EVSE must use sensors and control mechanisms that only deliver energy to EV users that have properly connected their EV and identified themselves. (authenticated users)

1.3.3 Power Metering

1.3.3.1 Each charging port must be individually metered to 5% or better accuracy, with energy readings collected, stored, and sent to server regularly for each charging session.

1.3.4 Ground Faults and Resetting

1.3.4.1 Each charging port on the EVSE must independently sense ground faults and disconnect the affected port according to UL2231-2. According to UL2231-2, ports must wait 15 minutes after tripping, then automatically reset. After the 3rd trip, the port must remain disconnected and the station must display instructions for the user to check their vehicle and manually reset.

1.3.5 Breaker Trip Prevention

1.3.5.1 The EVSE must provide automated over-current detection and disconnect that preempts the tripping of a service breaker.

1.3.6 Certifications

1.3.6.1 The EVSE must comply with the NEC (2008 edition) Article 625 and related articles and tables.

1.3.6.2 The EVSE must comply with the SAE recommended practice SAE J1772 “SAE Electrical Vehicle Conductive Charge Coupler”.

1.3.6.3 The EVSE electrical components, enclosures and mounting systems must be UL listed.

1.3.7 Connectivity (Networking)

The EVSE must provide intelligent networking via cellular or other technology to enable the following,

1.3.7.1 Authentication to prevent electricity theft and enforce safety

1.3.7.2 Usage statistics for subscribers, hosts, utilities, fleets and station location and status. (available or in-use)

1.3.7.3 Payment model for subscribers and non-subscribers to enable a self sustaining business model

1.3.7.4 Utility access to enable demand response management

1.3.7.5 24 hr automatic remote monitoring and remote control

1.3.8 Warranty, Documentation, and Technical Support

1.3.8.1 Warranty: The Contractor must provide a ***one-year*** warranty on installation and workmanship. The EVSE manufacturer must provide a ***one-year*** repair, replacement warranty against manufacturer's defects. The warranty must commence on the date of acceptance by the City of Houston.

1.3.8.1.1 The Contractor shall provide a warranty that includes repair or replacement of EVSE as necessary to correct any defects or failures. The warranty must include all materials, equipment, tools, labor and incidentals necessary to complete such repairs or replacements.

1.3.8.1.2 Upon request of the The City of Houston, the Contractor shall initiate on-site repair or replacement services and have the EVSE repaired or replaced within three (3) Business Days from Contractor's acknowledgement of request.

1.3.8.2 Documentation: On the first delivery of each type of EVSE to the City, the Contractor shall provide a CD-ROM containing documentation for the EVSE that provides instructions on how to operate and maintain the EVSE. The electronic format of the documentation must be Adobe Acrobat PDF or Microsoft Word. The Contractor shall allow the City to post the documentation on their intranet site. The Contractor shall notify the City when documentation updates are published and provide updates free of charge to the City upon request.

1.3.8.3 Technical Support: The Contractor shall provide customer support service (telephone or e-mail) 365/24/7 to the City during the warranty period and beyond the warranty period that allows the City to request repairs and troubleshoot technical problems with the Contractor's technicians at no charge.

1.3.9 Physical Appearance and Design

1.3.9.1 The EVSE pedestals must be a minimum of four (4) feet in height and provide adequate visibility for EVSE users.

1.3.9.2 The EVSE must provide a minimum 6 inch square area for state-provided decal placement on the front of the enclosure.

1.3.9.3 Identification Plate: Advertising is not allowed on the exterior of the EVSE. An identification nameplate shall be mounted on the EVSE housing bearing the manufacturer's name, model and serial number, electrical rating (voltage and current).

1.3.9.4 Printed Circuit Boards: Printed circuit boards must be conformal coated with silicon, acrylic, or equivalent conformal coating for protecting the electronics circuits from the environment as required to conform to UL specifications.

1.3.9.5 The EVSE must utilize tamper-resistant screws and design.

1.3.9.6 EVSE Enclosure: The EVSE enclosure must be constructed for use outdoors in accordance with UL 50, Standard for Enclosures for Electrical Equipment, NEMA Type 3R or equivalent.

1.3.9.7 Environmental: The EVSE must be capable of operating without any decrease in performance over an ambient temperature range of minus 22 to 122 degrees Fahrenheit with a relative humidity of up to 95 percent.

1.3.9.8 The EVSE must be capable of serving a minimum of one EV.

1.3.9.9 Cord Management System: The EVSE must incorporate a cord management system or method to eliminate potential for cable entanglement, user injury or connector damage from lying on the ground.

1.3.9.10 Reset: The EVSE must include manual reset capabilities with instructions on the EVSE to enable the end user to reset the EVSE in the event of an over current or leakage/ground current interruption.

1.3.9.11 Display: The EVSE instructions must be clearly readable in direct sunlight as well as in the dark.

1.3.9.12 Extremes in Humidity: The EVSE must be capable of operating without any decrease in performance in relative humidity of up to 95 percent.

1.3.9.13 Construction: The EVSE must be constructed to sustain impact from vehicles traveling between 2 – 3 miles per hour without additional protective barriers. The EVSE must include connections that will enable it to be secured to a concrete foundation or wall. The EVSE must utilize tamper-resistant design and where fasteners are exposed they must be tamper resistant. The EVSE must be designed and constructed so as to deter vandals from targeting device. Where possible the finish used on the EVSE must be conducive to easy removal of graffiti. The EVSE must incorporate a coupler holster and convenient place to hang each Level-2 cord set.

1.4 ADDITIONAL FEATURES

The EVSE shall meet the following requirements.

1.4.1 Operator Display - The EVSE shall have a visible means of indicating the following conditions:

1.4.1.1 Ready Light (e.g. there is power to the EVSE)

1.4.1.2 Charging in progress

1.4.1.3 Fault

1.4.1.4 The EVSE should be of modular design for easy upgrade as EVSE standards change.

1.5 EVSE USER INTERFACE FEATURES

The EVSE interface must provide the following features for the graphical user and an:

1.5.1 Availability Indication (Distance Read): From a distance an EV user must be able to determine that each charging port is either “currently available”, “in-use”, in “fault, or “out of order”.

1.5.2 User Access: The interface must provide the EV user with simple step by step instructions on how to turn on the station.

1.5.3 Plug-in and un-plug instructions: The interface must clearly provide the user with a detailed instruction on how to plug-in and un-plug their vehicle safely.

1.5.4 Upgradability: EVSE Interface and firmware must be upgradable remotely over the network.

1.6 BASIC NETWORK FEATURES

The EVSE stations must be connected via a network with the following features;

1.6.1 Data Collection: The EVSE must collect, store, and transmit to a central server, the following types of data at a minum: User ID, time, energy usage (kWh), and status of EVSE.

1.6.2 User Authentication: The User ID, collected at the station should be authenticated against a database of valid customers.

1.6.3 Back-Office Interface: The above mentioned data must be stored securely with backup procedures in place. An easy to use online network interface must be provided to the city. This interface must be capable of graphically displaying the data and allow this data to be mined for statistical, fleet management and user billing purposes.

1.7 VENDING / BILLING FEATURES

1.7.1 Price Display: The EVSE must have the capability to display a price per EV customer. The following prices formats must be possible:

1.7.1.1 Dollar per kilowatt hour ($/KWH), indicating that the user is being billed in direct proportion to the quantity of electrons passed through the station into the vehicle.

1.7.1.2 Dollar per hour ($/Hour), indicating that the user is being billed for a combination of energy, parking time, and time occupying the charging equipment.

1.7.2 Price Management Network Interface: The price displayed on the EVSE must be manageable over the network. City requires ability to manage pricing of charging ports, and groups of ports through an easy to use network interface that allows for automated pricing structure at various times of day.

1.7.3 User Management: Back office user management tools must be provided that allow

for the creation and management of user IDs.

1.7.4 Billing: The EVSE and supporting network must be able to process usage by a single user ID across various stations on the network and calculate billing charges for that user accordingly.

1.7.5 Network Security: The EVSE and supporting control and data network must have security measures in place to prevent data theft or outside control of the network.

1.8 LIST OF CERTIFIED MANUFACTURERS:

1. Optimization Technologies, Inc.
   Nathan Isaacs – 503-690-4475 xt 16
   nisaacs@opconnect.com

2. Pep Stations, LLC
   Sales – 734-793-2000
   info@pepstations.com

3. Sema Connect Technologies, Inc.
   Mark Pastrone – 410-384-4223
   mpastrone@semaconnect.com

4. Shore Power Technologies, Inc.
   Alan Bates – 503-892-7345
   abates@shorepower.com

5. Go Smart Technologies, Inc.
   Brian Smith – 720-524-7002
   Brian.smith@gosmarttechnologies.com

6. Aero Vironment, Inc.
   Sales – 626-357-9983
   exscs@avinc.com

7. Aker-Wade Technologies, Inc.
   Dan Walker – 312-285-4393
   Dan.walker@akerwade.com

8. AVCon Corporation
   Sales – 877-423-8725
   powerpak@webcom.com

9. Alpha Energy, Inc.
   Sales – 602-997-1007
   alpha@alpha.com

10. Better Place, Inc.
    Lisa Moreno, Sales – 650-845-2800
    Lisa.moreno@betterplace.com

11. BLINK / ECOtality
Sales – 480-219-5338
ecotality@antennagroup.com

12. Coulomb Technologies, Inc.
Sales – 408-841-4500
info@coulombtech.com

13. Clipper Creek, Inc.
David Packard – 912-882-0702
dave@clippercreek.net

14. EV Charge America
Sales – 702-696-1600
info@ev-chargeamerica.com

15. Evoasis USA
Sales – 858-509-2973
info@evoasis.com

16. General Electric Industrial Solutions
Sales – 866-433-3277
geelectrical@ge.com

17. Greenlight AC
Sales – 202-204-2184
info@greenlightac.com

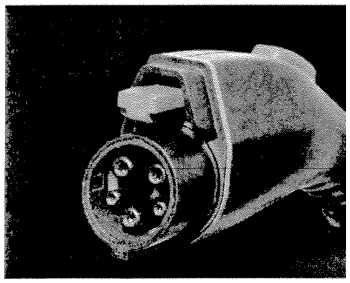
18. Liberty Plugins, Inc.
Forest Williams, Sales – 818-216-5776
forest@libertyplugins.com or sales@libertyplugins.com

1.9 Sample EVSE, Level 2, Charging Systems, Pedestal Bollard Stand Alone Units, including minimum required specifications:

Level 2 Pedestal EVSE

Simply Smart Pedestal Design

Electric Vehicle Supply Equipment (EVSE) provides convenient means to charge electric vehicles. Level 2 charging (240 volt AC input) is the primary and preferred method for charging in residential and public locations. The ECOtality design provides intelligent, user-friendly features to easily and safely charge electric vehicles



Benefits of ECOtality's Unique Binary Design

- Dramatic, timeless, stylish appearance
- Ease of installation
- Specified advertising space on pedestal
- Convenient cable management for long reach and storage between uses
- Connector holster for protection and storage
- Intuitive connector docking
- Selective height design for convenient compliance with ADA requirements
- 360° beacon light for easy wayfinding

J1772 Standard EV Connector

The SAE J1772 is the standard for electric vehicle charging in the United States.

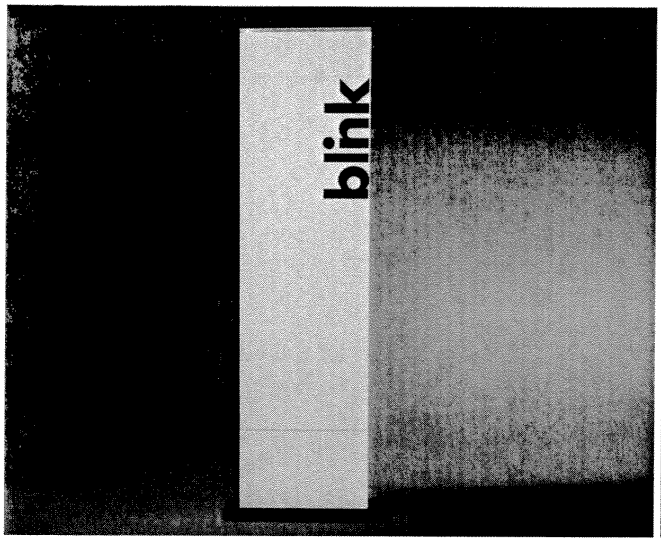
- Ergonomic design
- Prevents accidental disconnection
- Grounded pole - first to make contact, last to break contact
- Designed for over 10,000 cycles
- Can withstand being driven over by a vehicle
- Safe in wet or dry use

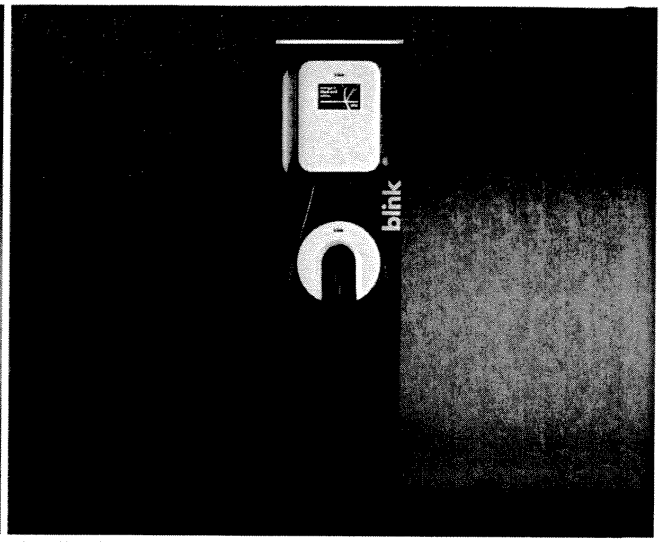
Energy Meter

- Internal meter to monitor energy and demand usage
- Supports energy usage data evaluation
- Supports electric utility EV billing when certified to ANSI 12.20 and IEC standards

Touch Screen

- Convenient, user-friendly touch screen display
- Charge status and statistics
- Find charging stations
- Status messages delivered to user's smart phone





Proven technology and reliable safety

ECOtality

Features

- Charge circuit interruption device (CCID) with automatic test
- Ground monitoring circuit
- Nuisance-tripping avoidance and auto re-closure
- Cold load pickup (randomized auto-restart following power outage)
- Certified energy and demand metering
- Wireless IEEE 802.11g
- LAN capable
- ZigBee SEP 1.0 capable
- AMI interface capable
- Web-based bi-directional data flow
- Cord management system

ECOtality's Blink Level 2 Electric Vehicle Supply Equipment (EVSE) Specifications

Input Voltage	208 VAC to 240 VAC +/- 10%
Input Phase	Single
Frequency	50/60 Hz
Input Current	30 Amps (maximum); 12A, 16A, 24A available
Breaker Size	40 Amps; settings at 15A/20A/30A available
Output Voltage	208 VAC - 240 VAC +/- 10%
Output Phase	Single
Pilot	SAE J1772-compliant
Connector/Cable	SAE J1772-compliant; UL-rated at 30A maximum
Cable Length	18 feet (estimated)
Exterior Dimensions	Pedestal: 66" H x 20" W x 17" D
Temperature Rating	-22° F (-30° C) to +122° F (+50° C)
Enclosure	NEMA Type 3R; sun-and-heat-resistant

Additional Features

- Smart Phone Applications for status charges and notification of completion or interruption of charge
- Controllable output to support utility demand response requests
- Revenue systems support
- Multiple input current settings to conveniently accommodate electric service capabilities
- Communication systems, multiple modes of communications including wireless, cellular, LAN and Zigbee

Safety

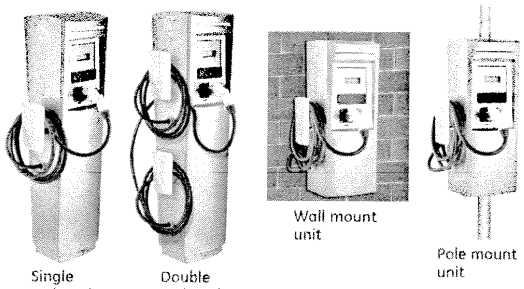
- Interlocks with EV drive system so EV cannot drive when connector is inserted in vehicle inlet
- De-energizes EVSE if connector and cable are subjected to strain
- Charge current interrupting device (CCID) with automatic test feature for personal protection
- Connector parts are de-energized until latched in vehicle inlet
- Meets all National Electric Code requirements

Standards and Certifications

- SAE J1772 compliant
- NEC article 625 electric vehicle charging system
- UL and ULc to 2594

GE Energy
Industrial Solutions

EV Charging Station
FACT SHEET



Overview

Over the next 5 years, virtually every automobile manufacturer plans to introduce a plug-in hybrid or battery electric vehicle. GE will supply the charging station infrastructure to support this industry change. The EV Charging Station's design is suitable for various locations. This product offers Level II charging, which is capable of reducing charge time from 12-18 hours to 4-8 hours, with service needs of 208-240VAC at 40A, assuming a 24kWh battery and a full-cycle charge. GE has more than 100 years of experience in the design and manufacture of electrical distribution products and, as a result, can supply all necessary upstream infrastructure.

Mounting options

- The double pedestal option offers two charging stations in the space of one, so two drivers can charge simultaneously at one station.
- The single pedestal option is designed for parking lots and sidewalks, so users can easily access charging stations while in their parking spaces.
- The pole option is for areas where restrictive sidewalk space calls for alternative solutions. This option can be mounted on a lamppost or any other structure.
- The wall option is for areas with limited floor space and for residential garages. Parking garages will be able to install wall mounted units to provide drivers with the ability to charge while parked.

Product features and benefits

The EV Charging Station's basic features are upgradeable, resulting in a robust and reliable solution for EV charging infrastructure.

- The cord holder keeps the cord organized and out of the way of parking spaces, sidewalks and streets.
- LEDs display status: Green = Station active; Blinking green = Vehicle connected, not charging; Amber = Charging; Red = Fault occurred.
- Option for a Radio Frequency Identification (RFID) reader: users will gain charging authorization by waving RFID cards in front of the readers.
- Ethernet network offered for RFID authorization.
- RFID software registers usage of the EV Charging Station, enabling data collection and monitoring status of communication between RFID and EVSE.
- Vacuum Fluorescent Display (VFD) screen shows greetings, instructions and station messages.
- Nuisance tripping avoidance and auto re-closure.
- Vehicle ground monitoring circuit.
- Single phase metering, displayed on included VFD.
- A building ventilation interface signal can be provided to operate facility and garage fans when required.

Standards and approvals

- SAE J1772
- NEC 625
- UL 2202, 2231, 2251, 2594
- cUL
- NEMA and NIST

imagination at work

EV Charging Station

Preliminary Specifications

SAE Compliant	Level II per J1772
Vehicle Interface	SAE J1772 EV connector
Cable Length	20 feet
AC Charging Power Output	7.2kW (240VAC @ 30A)
Voltage and Current Rating	208-240VAC @ 30A
AC Power Input	208-240VAC requiring only Line 1, Line 2, and Earth ground
Recommended Service Panel Breaker	Pole, Wall: Single Pedestal: 2-pole 40A breaker on dedicated circuit
	Double Pedestal: (Qty. 2) 2-pole 40A breaker on dedicated circuit
Ground Fault Protection	Internal 20mA GFP with auto re-closure, does not require a GFCI in service panel
Cold Load Start	Random start up between 0 and 15 minutes
Local Area Network	CAT5 Ethernet
Network Communication Protocol	TCP/IP
Network Security	GE recommends that network be VPN and Firewall protected
Metering Accuracy	2% accurate on voltage and current; 4% accurate on power and energy
RFID Reader	ISO 15693 compliant
Display Screen	Vacuum Fluorescent Display
Standby Power	5W typ.
Indoor Ventilation	Signal provided to turn on facility fans
Outdoor Rated	NEMA 3R
Safety Compliance	UL 2231, UL 2594, NEC 625, SAE J1772
Surge Protection	6kV @ 3,000A
EMI Compliance	FCC Part 15 Class A
Operating Temperature	-30°C to +50°C ambient
Operating Humidity	Up to 95% non-condensing
Approximate Shipping Weights	Single Pedestal: 90 lbs
	Double Pedestal: 90 lbs
	Pole: 45 lbs
	Wall: 45 lbs
Dimensions	Single Pedestal: 51.1"H x 14.9"W x 13.8"D
	Double Pedestal: 51.1"H x 14.9"W x 13.8"D
	Pole: 31.52"H x 11.82"W x 11.16"D
	Wall: 31.52"H x 11.82"W x 11.16"D

Selection

All units are 208-240V, 30A out, single phase integrated meter

Type	Enclosure	Connectors	RFID	Cat. No.	List Price, GO-150A
Single Pedestal	NEMA 3R	1	No	EVSN3	$6,250
			Yes	EVSRN3	$7,188
Double Pedestal	NEMA 3R	2	No	EVDN3	$9,375
			Yes	EVDRN3	$10,313
Pole	NEMA 3R	1	No	EVPN3	$4,838
			Yes	EVPRN3	$5,175
Wall	NEMA 3R	1	No	EVWN3	$4,500
			Yes	EVWRN3	$4,838

Accessories

Accessory	Description	Cat. No.	List Price, GO-150A
RFID Cards	White Design - Qty. 50	EVRCW50	$100
	GE Design - Qty. 50	EVRCG50	$100
RFID Reader	USB Enrollment Reader	EVRR1	$200

imagination at work

DEE-524 (12/10)

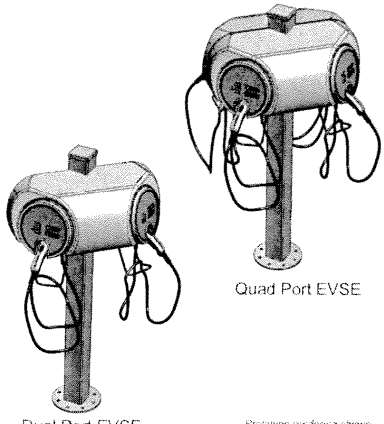
EV Solutions™

Model EVSE-RS "Dual" and "Quad"

Practical multi-port EVSE configurations for your commercial parking facilities

The AeroVironment Model EVSE-RS is available in Dual and Quad configurations for higher traffic commercial and public charging applications. While maintaining the same safe, convenient, and easy-to-use design of the EVSE-RS, this integrated multi-unit system can simplify installation and costs by consolidating wiring runs and mounting locations. The attractive, weather-resistant housing provides a polished look that complements professionally maintained commercial properties and public spaces, such as dealerships, multi-family dwellings, shopping malls, corporate offices, and retail stores.

Both EVSE-RS multi-port configurations perform all required SAE J1772 operations and are designed to be compatible with any vehicle that runs on electric battery power and contains a J1772 compliant receptacle. Each charge port complies with all features and specifications of the single-port EVSE-RS. An optional communication module for WiFi, Zigbee, or cellular is also available.



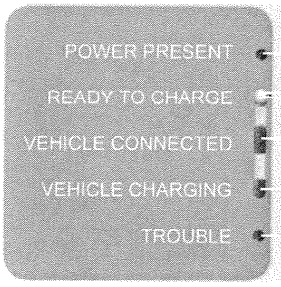
Quad Port EVSE

Dual Port EVSE

Prototype rendering shown. Production model may vary.

Features

- SAE J1772 compliant
- Auto restart in event of power outage or ground fault
- ADA compliant for installation
- Breakaway safety cable
- Integrated cable stowage
- Outdoor rated NEMA4 enclosure
- Optional payment terminal



Intuitive User Interface

Green = utility voltage connected
Green = ready to operate
Green blinking = "off" state due to a manual STOP
Green = connected to vehicle
Green = vehicle is charging
blinking = charge near completion
Red = fault has occurred; blinking pattern based on fault type

Specification	EVSE-RS
Connector	SAE J1772
Voltage	208VAC to 240VAC
Frequency	50/60 Hertz
Current	30A max
Operating Temperature	-30°C to 50°C
Enclosure	NEMA 4
Regulatory Compliance	UL, CSA, CE pending

SAFETY FEATURES

- GFI/CCID
- Service Ground Monitor
- CCID-Self Test
- Automatic Re-closure
- SAE 1772
- UL2231-1
- UL2231-2
- UL2594
- CSA 107.11 SEC17

SERVICE AND INSTALLATION*

Will be supported by:

- Network of certified, trained electricians
- Nationwide U.S. coverage
- Convenient site assessment and installation
- 24-hour response time during business hours

** Planned regional roll-out begins approximately October 2010. Installation and non-standard services, pricing and delivery may vary depending on factors, including but not limited to site conditions, codes/permitting requirements and service personnel availability. Business hours are defined as Monday through Friday, 8am-5pm, local time.*

No energy efficiency claims or environmental claims are intended or being made.

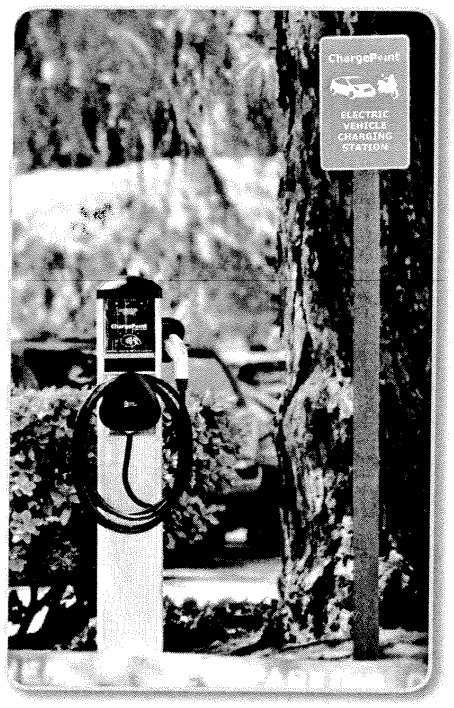
Information and specifications are subject to change.

AeroVironment, Inc. 181 W. Huntington Dr., Suite 202, Monrovia, CA 91016
(p) 626.357.9983 (f) 626.359.9628 www.avinc.com/evsolutions

ChargePoint
by Coulomb Technologies

ChargePoint Networked Charging Stations

CT2000 FAMILY



ChargePoint® Networked Charging Stations, by Coulomb Technologies, offer municipalities, corporations, fleets, and utilities, high-reliability, plug-in electric vehicle charging that drivers prefer. The easy-to-use stations provide multiple power options, integrating aesthetics and ergonomics with sturdy construction—ideal for residential, commercial and outdoor public applications.

The CT2000 family of charging stations provide 7.2 kW (208/240 V @ 30 A) Level II charging and are designed for public outdoor applications for the North American marketplace. Charging is delivered via a standard SAE J1772™ connector and 18-foot cable.

To enhance safety and eliminate energy theft, drivers access and energize the station using a ChargePass™ Card or contactless credit card. The station's highly visible display guides drivers with instructive messages and can be used to display custom advertisement or greetings for drivers.

ChargePoint Network Enabled

Includes 24/7 driver assistance, station location, station availability, trip mapping, driver billing, and driver notification services. Compatible with remote management, billing, maintenance and other on-demand software applications.

Smart Card Reader

Integrated standards-based RFID reader that accepts ChargePass cards or contactless credit cards. Provides optional driver billing and custom access control, preventing electricity theft and enhancing safety.

Intelligent Power Control

Algorithms ensure power is delivered only when a driver is authorized and the EV connector is properly inserted.

Vacuum Florescent Display with Multiple Language Support

Bright, easy-to-read display used for instructive, advertisement and greeting messages in many languages.

Integrated Fault Detection

- Ground Fault Detection: Integrated ground-fault detection circuitry with auto retry and driver notification.
- Over-Current Detection: Disconnects power to prevent nuisance breaker trips at service panel. Auto retry and driver notification.
- Plug-Out Detection: Algorithm disengages power and notifies the driver when a plug is removed.
- Charging Complete Detection: Algorithm detects completion of EV charge and notifies the driver.

Over-the-Air Station Upgrade

Upgrade station firmware remotely over-the-air to keep charging station current with future and evolving EV charging needs.

Utility Grade Energy Meter

Integrated power metering circuitry provides accurate bi-directional energy measurement.

Remote Diagnostics and Control

Real-time remote alarm monitoring and control minimizes the need for on-site maintenance.

Network Interface

Wireless mesh and cellular network interfaces allow seamless integration with back office business systems, utility Advanced Metering Infrastructures (AMIs), or home area networks.

Smart Grid Compatible

Utility grade meter and smart-grid interfaces enable demand response and Time-Of-Use (TOU) pricing.

Coulomb Technologies

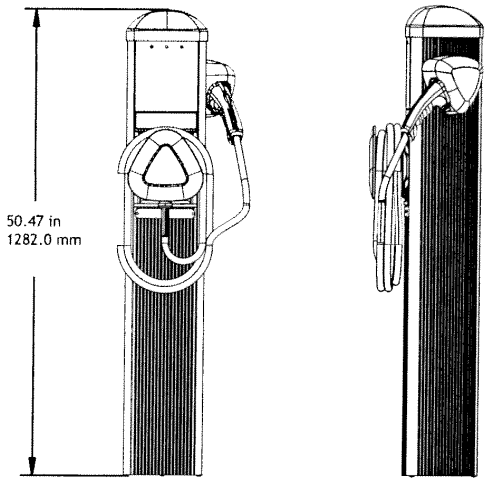
Coulomb Technologies, Inc.
1692 Dell Ave.
Campbell, CA 95008-6901 USA
US toll free: +1-877-370-3802
www.coulombtech.com
www.mychargepoint.net

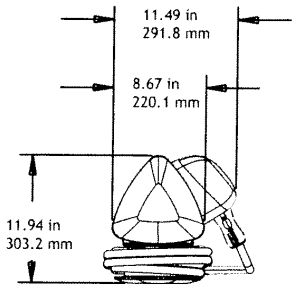
ChargePoint
by Coulomb Technologies

Mechanical Drawings

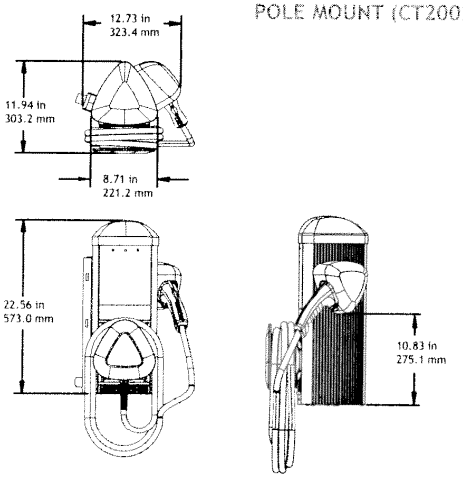
CT2000 FAMILY

BOLLARD (CT2001)

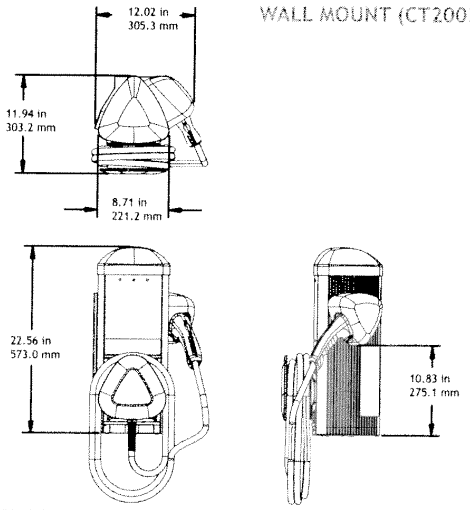




POLE MOUNT (CT2002)



WALL MOUNT (CT2003)



ChargePoint
by Coulomb Technologies

Specifications

CT2000 FAMILY

Electrical Input

Input Power	7.2 kW
Input Voltage	208/240 VAC
Input Current	30 A
Input Power Connections	Line 1, Line 2, Earth
Recommended Service Panel Breaker	40 A double pole breaker (non-GFCI type) on dedicated circuit
Standby Power	5 W typical

Electrical Output

Output Charging Power	7.2 kW
Output Voltage	240 VAC
Output Current	30 A
Output Charging Connector	SAE J1772™ EV Connector on 18' (5.48 m) cable

Functional Interfaces

Card Reader	ISO 15693, 14443
Ground Fault Detection	20 mA CCID with auto retry (15 minute delay, 3 tries)
Plug-Out Detection	Power terminated per SAE J1772™ specification
Power Measurement	2% @ 5 minute intervals; IEC Class 1 capable (special order)
Local Area Network	2.4 GHz 802.15.4 dynamic mesh network
Wide Area Network	Commercial CDMA or GPRS cellular data network

Safety and Operational Ratings

Safety Compliance	Complies with UL 2594, UL 2231-1, UL 2231-2, UL 1998, NFPA 70, NEC Article 625
Surge Protection	6 kV @ 3,000. In geographic areas subject to frequent thunderstorms, supplemental surge protection is recommended.
EMC Compliance	FCC Part 15 Class A
Operating Temperature	-22°F to 131°F (-30°C to +55°C)
Operating Humidity	95% non-condensing
Enclosure	NEMA 3R per NEMA 250-1997
Terminal Block Temperature Rating	100°C (212° F)
Maximum Charging Stations per 802.15.4 Radio Group	100. Each station must be within 150 feet of at least one other station.
Approximate Shipping Weights	Bollard (CT2001) 77 lbs (34 kg) Pole Mount (CT2002) 52 lbs (23 kg) Wall Mount (CT2003) 55 lbs (25 kg)

A PDF version of the Level 2 EVSE Charging Systems can be viewed on the following link:
https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

PART TWO - INSTALLATION

2.0 INSTALLATION SCOPE

2.0.1 The scope of work includes the installation of 28, Level 2 charging station charging points at various locations.

2.0.1.1 The Contractor shall Install bollard or pole at specified locations for installation of charging units.

2.0.1.2 The Contractor shall trench as necessary and run conduit from electrical panel location for head unit.

2.0.1.3 Upon code enforcement approval, the Contrator must cover and fill trenches with appropriate material as necessary to return surface to existing conditions (includes but not limited to concrete, brick pavers, asphalt, grass, etc.)

2.0.1.4 The Contractor shall properly label electrical panels upon completed work indicating circuits used.

2.0.1.5 The Contractor must strictly follow product specifications for installations.

2.0.1.6 The Contractor must perform a site evaluation including a load analysis of the existing utility power service and behind the meter distribution breaker panel to determine the maximum number of EVSE circuits (breakers) that can be supported without upgrade.

2.0.1.7 Should the City require more EVSE than can be supported by the existing utility service, the Contractor must request an appropriate upgrade of electrical service from the Utility, and provide the city with a quote for additional cost.

2.0.1.8 The Contractor must perform all electrical work and provide all permits required, installing and connecting the EVSE units to the existing power service. All electrical work must be performed by a licensed electrician. All final inspections by City code enforcement shall be the responsibility of the Contractor.

2.1 PERFORMANCE TIME:

2.1.1 The Contractor shall have ***80 Calendar Days*** to furnish, deliver and install the 7.2KW, 208VAC – 240VAC @ 30+ Amps, Level 2, Electric Vehicle Supply Equipment stations (EVSE), in strict accordance with the specifications after receipt of the notice to proceed.

2.1.2 The Contractor shall work at one installation site diligently as opposed starting multiple sites and extending the duration of work at each site.

2.2 ADDITIONAL SPECIFICATIONS:

2.2.1 The following required specifications can viewed in PDF format at the following web link.
http://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

2.2.1.1 GSD Specification #01292 – SCHECDULE OF VALUES

2.2.1.2 GSD Specification #01312 – COORDINATION & MEETINGS

2.2.1.3 GSD Specification #01321 – CONSTRUCTION PHOTOGRAPHS

2.2.1.4 GSD Specification #01340 – SHOP DRAWINGS, PRODUCT DATA & SAMPLES

2.2.1.5 GSD Specification #01422 – REFERENCE STANDARDS

2.2.1.6 GSD Specification #01576 – WASTE MATERIAL DISPOSAL

2.2.1.7 GSD Specification #01610 – BASIC PRODUCT REQUIREMENTS

2.2.1.8 GSD Specification #01731 – CUTTING AND PATCHING

2.1.1.9 GSD Specification #1755 – STARTING SYSTEMS

END OF SCOPE OF WORK

Section 01255

CHANGE ORDER PROCEDURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;

2. Documentation of change in Contract Price and Contract Time;

3. Change procedures, using proposals and construction contract modifications, work change directive, stipulated price change order, unit price change order, time and materials change order;

4. Execution of Change Orders;

5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Rental Rate Blue Book for Construction Equipment (Data Quest Blue Book). Rental Rate is defined as the full un-adjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Contractor shall provide a letter indicating the name and address of the individual authorized to execute change documents, and who shall also be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. The information shall be provided at the Preconstruction Conference.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Contractor shall maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Contractor shall document each proposal for a change in cost or time with sufficient data to allow evaluation of the proposal.

C. Proposals shall include, as a minimum, the following information as applicable:

1. Quantities of items in the original Document 00405 - Schedule of Unit Price Work with additions, reductions, deletions, and substitutions.

2. When Work items were not included in the Schedule of Unit Price Work, Contractor shall provide unit prices for the new items, with supporting information as required by the City Engineer.

3. Justification for any change in Contract Time.

4. Additional data upon request.

D. For changes in the Work performed on a time-and-material basis, the following additional information may be required:

1. Quantities and description of products and equipment.

2. Taxes, insurance and bonds.

3. Overhead and profit as noted in Document 00800 - Supplementary Conditions.

4. Dates and times work was performed, and by whom.

5. Time records and certified copies of applicable payrolls.

6. Invoices and receipts for products, rented equipment, and subcontracts, similarly documented.

E. For changes in the work performed on a time-and-materials basis, rental equipment will be paid as follows:

1. Rented equipment will be paid by actual invoice cost for the duration of time required to complete the extra work without markup for overhead and profit. If the extra work comprises only a portion of the rental invoice where the equipment would otherwise be on the site, the Contractor shall compute the hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and one week equals 40 hours.)

2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost.

F. For changes in the work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:

1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete the extra work without markup for overhead and profit. The Rental Rate utilized shall be the lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of the Rental Rate for double shifts (one extra shift per day) and 200 percent of the Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in the Blue Book. No other rate adjustments shall apply.

2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost. Operating costs will not be allowed for equipment on standby.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of Document 00666 - Change Order. Issuance of Document 00664 - Work Change Directive will be formalized into a Change Order. All changes will be in accordance with the requirements of Document 00700 - General Conditions.

B. The City Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions.

C. Contractor may request clarification of Drawings, Specifications or Contract Documents or other information by using Document 00660 - Request for Information. Response by the City Engineer to a Request for Information does not authorize the Contractor to perform tasks outside the scope of the Work. All changes must be authorized as described in this section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. The City Engineer may issue Document 00661 - Request for Proposal, which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications. The City Engineer may also request a proposal in the response to a Request for Information. Contractor shall prepare and submit a proposal within 7 days or as specified in the request.

B. The Contractor may propose an unsolicited change by submitting a proposal to the City Engineer describing the proposed change and its full effect on the Work, with a statement describing the reason for the change and the effect on the Contract Price and Contract Time including full documentation.

1.07 WORK CHANGE DIRECTIVE

A. City Engineer may issue a signed Work Change Directive instructing the Contractor to

proceed with a change in the Work. A Work Change Directive will subsequently be incorporated in a Change Order.

B. The document will describe changes in the Work and will designate a method of determining any change in Contract Price or Contract Time.

C. Contractor shall proceed promptly to execute the changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A stipulated price Change Order will be based on an accepted proposal including the Contractor's lump sum price quotation with Schedule of Values.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for the affected items of Work are included in Document 00405 - Schedule of Unit Price Work, the unit price Change Order will be based on the unit prices, subject to Articles 7 and 9 of Document 00700 - General Conditions.

B. Where unit prices of Work are not pre-determined in the Document 00405 - Schedule of Unit Price Work, the Work Change Directive or accepted proposal will specify the unit prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Contractor shall provide an itemized account and supporting data after completion of change, within time limits indicated for claims in Document 00700 - General Conditions.

B. City Engineer will determine the change allowable in Contract Price and Contract Time as provided in Document 00700 - General Conditions.

C. Contractor shall maintain detailed records of work done on time-and-material basis as specified in paragraph 1.04, Documentation of Change in Contract Price and Contract Time.

D. Contractor shall provide full information required for evaluation of changes and shall substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. City Engineer will issue Change Orders, Work Change Directives, or accepted proposal for signatures of parties as described in Document 00700 - General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, Contractor shall promptly revise the Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item.

B. For Unit Price Contracts, the next monthly estimate of work after acceptance of a Change Order will be revised to include any new items not previously included and the appropriate unit rates.

C. Contractor shall promptly revise progress schedules to reflect any change in Contract Time, and shall revise schedules to adjust time for other items of work affected by the change, and resubmit for review.

D. Contractor shall promptly enter changes to the on-site and record copies of the Drawings, Specifications or Contract Documents as required in Section 01785 - Project Record Documents.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01325

CONSTRUCTION SCHEDULE

PART 1 G E N E R A L

1.01 GENERAL

A. Provide Construction Schedules for Work included in this Contract in accordance with requirements in this Section. Create a Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) schedules. Provide printed activity listings and bar charts in formats described in this Section.

B. Combine activity listings and bar charts with a narrative report to form the Contractor's Construction Schedule submittal for the City Engineer.

1.02 SCHEDULING STAFF

A. Employ or retain services of an individual experienced in critical path scheduling for the duration of the Contract. This person shall cooperate with the City Engineer and shall update the Contractor's schedule at least monthly as required to indicate current status of the Work.

1.03 SUBMITTALS

A. Make Construction Schedule submittals for review by the City Engineer in accordance with requirements of Section 01330 - Submittal Procedures.

B. During the pre-construction meeting, as described in Section 01312 - Coordination and Meetings, provide sample bar charts and activity listings produced from the scheduling software proposed. Scheduling software is subject to approval of the City Engineer and must meet requirements provided in this Section. Review of the samples will be provided by the City Engineer within 7 days of the submittal.

C. Within 21 days of receipt of approval of the Contractor's format, or 30 days of the Notice to Proceed, whichever is later, submit a proposed Construction Schedule for review. The Construction Schedule submittal shall be based on the following:

1. The level of detail and number of activities required in the schedule are dependent on the project type.

    a. For wastewater projects, the work shall be categorized by Work Type and Area Code in the schedule.

        1) For wastewater rehabilitation projects, there are 6 work-type categories. An area code will be assigned for each Meter Service Area or Basin. The schedule shall include at least one activity for each unique combination of work type and area code. Normal schedules of wastewater rehabilitation projects contain between 35 and 100 activities, depending on the number of basins and the work types involved in each basin.

        2) For wastewater relief projects (line work), area codes will be assigned geographically.

        3) For wastewater plant or facility work, other criteria may apply to the assignment of area codes, such as a combination of geographical and craft categories.

2. For projects with multiple types of tasks within the scope, these types of work shall be indicated separately within the schedule.

3. For projects with work at different physical locations or service areas, or different facilities within a site, each location or facility shall be indicated separately within the schedule. Work on each floor of a multi-story building shall be shown as separate tasks.

4. For projects with multiple crafts or significant subcontractor components, these elements shall be indicated separately within the schedule. Unless permitted by the City Engineer, tasks shall consist of work covered by only one division of the Project Manual.

5. Unless permitted by the City Engineer, each schedule task shall be the same as a schedule of values line item, and vice versa.

6. For projects with significant major equipment items or materials representing over 5 percent of the Total Contract Price, the schedule shall indicate dates when these items are to be purchased, when they are to be delivered, and when installed. Activities for testing, adjustment, and delivering O & M manuals shall be included.

7. No task except the acquisition of major equipment items shall represent more than one percent of the Total Contract Price for facility projects and 3 percent of the Total Contract Price for other projects. The duration of tasks may not exceed 40 calendar days.

8. For projects where operating facilities are involved, each period of work which will impact any process or operation shall be identified in the schedule and must be agreed to by the City Engineer and the facility operator prior to starting work in the area.

9. Construction Schedule submittals shall include:

   a. Printed bar charts which meet the criteria outlined in this Section and which are produced by the Contractor's approved scheduling software.

   b. Activity listings which meet the criteria outlined in this Section and which are produced by the Contractor's approved scheduling software.

   c. Predecessor/successor listing sorted by Activity ID which meets the criteria outlined in this Section and which is produced by the Contractor's approved scheduling software.

   d. A logic network diagram shall be required with the first construction schedule submittal for facilities projects.

   e. A graphic or tabular display of estimated monthly billings for the Work shall be prepared and submitted by the Contractor with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require resubmittal of the schedule for review. The display shall allocate units indicated in the bid schedule or the schedule of values to Construction Schedule activities. (Weighted allocations are acceptable, where appropriate). The dollar value associated with each allocated unit will be spread across the duration of the activity on a monthly basis. The total for each month and a cumulative total will be indicated. These monthly forecasts are only for planning purposes of the City Engineer. Monthly payments for actual work completed will be made by the City Engineer in accordance with Document 00700 - General Conditions.

   f. A narrative report which shall provide the information outlined in this Section.

D. No payment will be made until the Construction Schedule and billing forecast are accepted by the City Engineer.

E. If the Contractor desires to make changes in his method of operating and scheduling, after approval of the original schedule has been given by the City Engineer, the Contractor shall notify the City Engineer in writing, stating the reasons for the change. If the City Engineer considers these changes to be of significant nature, the Contractor may be required to revise and resubmit for approval all or the affected portion of the Contractor's Construction Schedule to show the effect on the Work.

F. Upon written request from the City Engineer, the Contractor shall revise and submit for approval all or any part of the Construction Schedule submittal to reflect changed conditions in the Work or deviations made from the original plan and schedule.

G. The Contractor's Construction Schedule shall thereafter be updated with Actual Start and Actual Finish Dates, Percent Complete, and Remaining Duration of each Activity

and submitted monthly. The data date to be used in updating the monthly Construction Schedule shall be the same data date as is used in the monthly Application for Payment. This monthly update of the schedule shall be required before the monthly Application for Payment will be processed for payment.

1.04 SCHEDULING COMPUTER SOFTWARE REQUIREMENTS

A. The Contractor's Construction Schedule shall be created using CPM computer software which provides mathematical analysis of PDM schedules. The software shall be capable of creating bar charts and activity listings which can be sorted by various fields, i.e., Sort by Activity ID; Sort by Early Start; Sort by Total Float; Sort by Area Code; sort by specification section number; and sort by Subcontractor. The software shall be capable of producing a logic network diagram.

B. The PDM scheduling software shall be capable of producing activity listings and bar charts with the following information for each activity in the schedule:

1. Activity ID
2. Activity Description
3. Estimated (Original) Duration
4. Remaining Duration
5. Actual Duration
6. Early Start Date
7. Late Start Date
8. Early Finish Date
9. Late Finish Date
10. Free Float
11. Total Float
12. Activity Codes (such as Area Code, Work Type, Specification Section, Subcontractor)

C. The PDM scheduling software shall be capable of printing calendars using the mathematical analysis of the schedule, indicating the Contractor's standard work days of the week and scheduled holidays.

D. Scheduling software shall be capable of printing an activity listing which indicates the Predecessors and Successors, Lag Factors and Lag Relationships used in creating the logic of the schedule.

E. Scheduling software shall be capable of printing a bar chart of the entire schedule for the Work included in this Contract. The bar chart format shall provide a monthly time scale and shall be such that a 12-month time scale shall not exceed one page width. Bar charts may be printed or plotted on 8.5" x 11", 8.5" x 14" or 11" x 17" sheet sizes. Over-size plots are not acceptable.

1.05 NARRATIVE SCHEDULE REPORT

A. The Narrative Report shall include a listing of the Activities Started This Month; Activities Completed This Month; Activities Continued This Month; Activities Scheduled To Start or Complete Next Month; Problems Encountered This Month; Actions Taken to Solve These Problems.

B. The narrative Schedule Report shall include a description of changes made to the Construction Schedule Logic (i.e., changes in Predecessors and Lags); Activities Added to the Schedule; Activities Deleted from the Schedule; any other changes made to the Schedule other than the addition of Actual Start Dates and Actual Finish Dates and changes of Data Date and Remaining Durations for re-calculation of mathematical analysis.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01330

SUBMITTAL PROCEDURES

PART 1 G E N E R A L

1.013 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values.
2. Construction Schedules.
3. Shop Drawings, Product Data, and Sampler/
4. Operations and Maintenance Data.
5. Manufacturer's Certificates.
6. Construction Photographs.
7. Project Record Documents.
8. Video Tapes.
9. Design Mixes.

1.014 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Schedule submittals well in advance of the need for the material or equipment for construction. Allow time to make delivery of material or equipment after submittal is approved.

2. Develop a submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. The City Engineer will review and return submittals to the Contractor as expeditiously as possible but the amount of time required for review will vary depending on the complexity and quantity of data submitted. In no case will a submittal schedule be acceptable which allows less than 30 days for initial review by the City Engineer. This time for review shall in no way be justification for delays or additional compensation to the Contractor.

3. The City Engineer's review of submittals covers only general conformity to the Drawings, Specifications and dimensions which affect the layout. The Contractor is responsible for quantity determination. No quantities will be verified by the City Engineer. The Contractor is responsible for any errors, omissions or deviations from the Contract requirements; review of submittals in no way relieves the Contractor from his obligation to furnish required items according to the Drawings and Specifications.

4. Submit 5 copies of documents unless otherwise specified in the following paragraphs or in the Specifications.

5. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

6. The Contractor shall assume the risk for material or equipment which is fabricated or delivered prior to approval. No material or equipment shall be incorporated into the Work or included in periodic progress payments until approval has been obtained in the specified manner.

B. Transmittal Form and Numbering:

1. Transmit each submittal to the City Engineer with a Transmittal Form. A copy of the Transmittal Form is attached.

2. Sequentially number each transmittal form beginning with the number 1. Resubmittals shall use the original number with an alphabetic suffix (i.e., 2A for first resubmittal of Submittal 2 or 15C for third resubmittal of Submittal 15). Each submittal shall only contain one type of work, material, or equipment. Mixed submittals will not be accepted.

3. Identify variations from requirements of Contract Documents and identify product or system limitations.

4. For submittal numbering of video tapes, see paragraph 1.10 Video.

C. Contractor's Stamp:

1. Apply Contractor's stamp, certifying that the items have been reviewed in detail and are correct and in accordance with Contract Documents, except as noted by any requested variance.

2. As a minimum, Contractor's Stamp shall include:

a. Contractor's name.

b. Job number.
c. Submittal number.
d. Certification statement that the Contractor has reviewed the submittal and it is in compliance with the Contract Documents.
e. Signature line for Contractor.

1.015 SCHEDULE OF VALUES

A. Submit a Schedule of Values in accordance with Section 01292 - Schedule of Values.

1.016 CONSTRUCTION SCHEDULES

A. Submit Construction Schedules as provided in Project Manual.

1.017 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Submit shop drawings in accordance with Section 01340 - Shop Drawings, Product Data, and Samples.

1.018 OPERATIONS AND MAINTENANCE DATA

A. Submit Operations and Maintenance data in accordance with Section 01782 - Operations and Maintenance Data.

1.019 MANUFACTURER'S CERTIFICATES

A. When specified in Specification sections, submit manufacturers' certificate of compliance for review by City Engineer.

B. Contractor's Stamp, as described in paragraph 1.02C, shall be placed on front page of the certification.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Certificates may be recent or previous test results on material or product, but must be acceptable to City Engineer.

1.020 CONSTRUCTION PHOTOGRAPHS

A. Submit Construction Photographs in accordance with Section 01321 - Construction Photographs.

1.021 PROJECT RECORD DOCUMENTS

A. Submit Project Record Documents in accordance with Section 01785 - Project Record Documents.

1.22 VIDEO - NOT USED:

1.23 DESIGN MIXES

A. When specified in Specifications, submit design mixes for review.

B. Contractor's Stamp, as described in paragraph 1.02C, shall be placed on front page of each design mix.

C. Mark each design mix to identify proportions, gradations, and additives for each class and type of design mix submitted. Include applicable test results on samples for each mix.

D. Maintain a copy of approved design mixes at mixing plant.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01502

MOBILIZATION

PART 1 G E N E R A L

1.024 SECTION INCLUDES

A. Mobilization of construction equipment and facilities onto the site.

1.025 UNIT PRICES

A. Measurement for mobilization is on a lump sum basis.

B. Mobilization payments will be included in monthly payment estimates upon written application by Contractor subject to the following provisions:

1. Authorization for payment of 50 percent of the contract price for mobilization will be made upon receipt and approval by City Engineer of the following items, as applicable:

a. Schedule of values.
b. Trench safety program.
c. Construction schedule.
d. Pre-construction photographs.
e. Establishment of the field office for the City Engineer where an office is required by other sections.
f. Dewatering plan, if required.

2. Authorization for payment of the remaining 50 percent of the Contract Price for mobilization will be made upon completion of Work amounting to 5 percent of the Contract Price less the mobilization unit price.

C. Mobilization payments will be subject to retainage amounts stipulated in the General

Conditions.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01630

PRODUCT SUBSTITUTION PROCEDURES

PART 1 G E N E R A L

1.026 SECTION INCLUDES

A. Options for making product or process selections.

B. Procedures for proposing equivalent construction products or processes, including preapproved, prequalified, and approved products or processes.

1.027 DEFINITIONS

A. Product: Means materials, equipment, or systems incorporated into the Project. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for reuse.

B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Product includes Processes.

1.028 SELECTION OPTIONS

A. Preapproved Products: Construction products of certain manufacturers or suppliers designated in the Specifications as "preapproved." A list of preapproved products is maintained by the City. Preapproved products for this Project are designated as preapproved in the Specifications. Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Prequalified Products: Construction products of certain manufacturers or suppliers designated in the Specifications as "prequalified." Prequalified products for this Project are designated as prequalified in the Specifications. Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.

C. Approved Products: Construction products or processes of certain manufacturers or suppliers designated in the Specifications followed by the words "or approved equal."

Approval of alternate products or processes not listed in the Specifications may be obtained through provisions for product options and substitutions in Document 00700 - General Conditions, and by following the submittal procedures specified in 01330- Submittal Procedures. The procedure for approval of alternate products is not applicable to preapproved or prequalified products.

D. Product Compatibility: To the maximum extent possible, provide products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available as a Contractor's option, select a product which is compatible with other products already selected, specified, or in use by the City.

1.029 CONTRACTOR'S RESPONSIBILITY

A. The Contractor's responsibility related to product options and substitutions is defined in Document 00700 - General Conditions.

B. Furnish information the City Engineer deems necessary to judge equivalency of the alternate product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish the equivalency between products in order to obtain information upon which the City Engineer can base a decision.

D. If the City Engineer determines that an alternate product is not equal to that named in the Specifications, the Contractor shall furnish one of the specified products.

1.030 CITY ENGINEER'S REVIEW

A. Alternate products or processes may be used only if approved in writing by the City Engineer. The City Engineer's determination regarding acceptance of a proposed alternate product is final.

B. Alternate products will be accepted if the product is judged by the City Engineer to be equivalent to the specified product or to offer substantial benefit to the City.

C. The City retains the right to accept any product or process deemed advantageous to the City, and similarly, to reject any product or process deemed not beneficial to the City.

1.031 SUBSTITUTION PROCEDURE

A. Collect and assemble technical information applicable to the proposed product to aid in determining equivalency as related to the approved product specified.

B. Submit a written request for a construction product to be considered as an alternate product.

C. Submit the product information after the effective date of the Agreement and within the time period allowed for substitution submittals given in Document 00700 - General Conditions. After the submittal period has expired, requests for alternate products will be considered only when a specified product becomes unavailable because of conditions beyond the Contractor's control.

D. Submit 5 copies of each request for alternate product approval. Include the following information:

1. Complete data substantiating compliance of proposed substitution with Contract Documents.

2. For products:

   a. Product identification, including manufacturer's name and address.
   b. Manufacturer's literature with product description, performance and test data, and reference standards.
   c. Samples, as applicable.
   d. Name and address of similar projects on which product was used and date of installation. Include the name of the Owner, Architect/Engineer, and installing contractor.

3. For construction methods:

   a. Detailed description of proposed method.
   b. Drawings illustrating methods.

4. Itemized comparison of proposed substitution with product or method specified.

5. Data relating to changes in construction schedule.

6. Relation to separate contracts, if any.

7. Accurate cost data on proposed substitution in comparison with product or method specified.

8. Other information requested by the City Engineer.

E. Approved alternate products will be subject to the same review process as the specified product would have been for shop drawings, product data, and samples.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01770

CLOSEOUT PROCEDURES

PART 1 G E N E R A L

1.032 SECTION INCLUDES

A. Closeout procedures including final submittals such as operation and maintenance data,

warranties, and spare parts and maintenance materials.

1.033 CLOSEOUT PROCEDURES

A. Comply with Document 00700 - General Conditions regarding Final Completion and Final Payment when Work is complete and ready for City Engineer's final inspection.

B. Provide Project Record Documents in accordance with Section 01785.

C. Complete or correct items on punch list, with no new items added. Any new items will be addressed during warranty period.

D. The City will occupy portions of the Work as specified in other Sections.

1.034 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to a sanitary condition.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and temporary construction facilities from the site following the final test of utilities and completion of the work.

1.035 ADJUSTING

A. Adjust operating equipment to ensure smooth and unhindered operation. The value of this testing and adjusting is 5 percent of the Lump Sum Price in the Schedule of Values for the item being tested.

1.036 OPERATION AND MAINTENANCE DATA

A. Submit operations and maintenance data as noted in 01330 - Submittal Procedures.

B. Five percent of the lump sum amount of each piece of equipment as indicated in the Schedule of Unit Price Work or Schedule of Values will be paid after the required O&M data submissions are received and approved by the City Engineer.

1.037 WARRANTIES

A. Provide one original of each warranty from Subcontractors, suppliers, and manufacturers.

B. Provide Table of Contents and assemble warranties in 3-ring/D binder with durable plastic cover.

C. Submit warranties prior to final Application for Payment.

D. Warranties shall commence in accordance with the requirements in Document 00700 - General Conditions, paragraph 9.10, Substantial Completion.

1.038 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.

B. Deliver to location within City limits as directed by City Engineer; obtain receipt prior to final Application for Payment.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01782

OPERATIONS AND MAINTENANCE DATA

PART 1 G E N E R A L

1.039 SECTION INCLUDES

A. Submittal requirements for equipment and facility operating and maintenance manuals

1.040 MEASUREMENT AND PAYMENT

A. The value of approved equipment operations and maintenance manuals is 5 percent of the individual equipment value as indicated in the Schedule of Unit Price Work or Schedule of Values. This amount can be included in the next Application for Payment after approval of a submitted manual.

1.041 SUBMITTALS

A. Along with the schedule for other submittals as required in Section 01330 - Submittal Procedures, submit a list of operation and maintenance manuals and parts manuals to be provided.

B. Submit documents, bound in 8-1/2x11-inch text pages, 3-ring/D binders with durable plastic covers.

C. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders

are required.

D. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

a. Significant design criteria.
b. List of equipment.
c. Parts list for each component.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Air and water balance reports.
c. Certificates.
d. Photocopies of warranties.

F. Within one month prior to placing the equipment or facility in service, submit two copies of operation and maintenance manual and parts manual for review.

G. Submit one copy of completed volumes in final form 10 days prior to final inspection. This copy will be returned after final inspection, with City Engineer comments. Revise content of documents as required prior to final submittal.

H. Revise and resubmit final volumes within 10 days after final inspection.

1.042 EQUIPMENT OPERATION AND MAINTENANCE DATA

A. Furnish operation and maintenance manuals for all equipment. Operation and maintenance manual must contain all information required for City to operate, maintain, and repair equipment. The manual must be prepared by equipment manufacturer, furnished to the City Engineer by Contractor, and, as a minimum, contain the following:

1. Equipment functions, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, adjustment, and checking instructions.

3. Operating instructions for start-up, normal operation, regulation and control, normal

shutdown, and emergency shutdown.

4. Lubrication and detailed maintenance instructions. The maintenance instructions are to include detailed drawings giving the location of each maintainable part and lubrication point and detailed instructions on disassembly and reassembly of the equipment.

5. Troubleshooting guide.

6. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

7. Outline, cross-section, and assembly drawings; engineering data; wiring diagram.

8. Test data and performance curves.

B. Furnish parts manuals for all equipment. The manual must be prepared by equipment manufacturers, furnished to City Engineer by Contractor, and, as a minimum, contain the following.

1. Detailed drawings giving the location of each maintainable part.

2. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01785

PROJECT RECORD DOCUMENTS

PART 1 G E N E R A L

1.043 SECTION INCLUDES

A. Maintenance and Submittal of Record Documents and Samples.

1.044 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain one record copy of documents at the site in accordance with Document 00700 - General Conditions, paragraph 3.14, Documents and Samples at the Site.

B. Store Record Documents and samples in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents and Samples available for inspection by City Engineer.

1.045 RECORDING

A. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

B. Contract Drawings and Shop Drawings: Legibly mark each item to record all actual construction, or "as built" conditions, including:

1. Measured depths of elements of foundation in relation to finish first floor datum.

2. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Elevations of underground utilities referenced to City of Houston bench mark utilized for project.

4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.

5. Field changes of dimension and detail.

6. Changes made by modifications.

7. Details not on original contract drawings.

8. References to related shop drawings and Modifications.

C. Record information with a red felt-tip marking pen on a set of blue line opaque drawings, provided by City Engineer.

1.046 SUBMITTALS

A. At contract closeout, deliver Project Record Documents to City Engineer.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 02221

REMOVING EXISTING PAVEMENTS, STRUCTURES, WOOD,
AND DEMOLITION DEBRIS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, brick pavement and base courses.

B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.

C. Removing pipe culverts, sewers, and sewer leads.

D. Removing existing inlets and manholes.

E. Removing and disposing of pre-stressed concrete beams and drill shafts.

F. Removing miscellaneous structures of concrete or masonry.

G. Removing existing bridge.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for removing and disposing of asphaltic surfacing with or without base, regardless of thickness encountered, is on square yard basis measured between lips of gutters.

2. Payment for removing and disposing of reinforced concrete pavement, with or without asphalt overlay, regardless of its thickness, is on square yard basis measured from back- to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.

3. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on square yard basis.

4. Payment for removing and disposing of concrete sidewalks and driveways is on square yard basis.

5. Payment for removing asphaltic surface course only is on a square yard basis paid under item description "Asphalt Surface Mill." This includes removal of existing surface to pavement base.

6. Payment for removing and disposing of miscellaneous concrete and masonry is

on cubic yard basis of structure in place.

7. Payment for removing and disposing of pipe culverts, sewers, and sewer leads is on linear foot basis for each diameter and each material type of pipe removed.

8. Payment for removing and disposing of existing inlets is on unit price basis for each inlet removed.

9. Payment for removing and disposing of prestressed concrete piles and drill shafts is on linear foot basis.

10. Payment for removing and disposing of existing bridge, including piles and abutments to minimum of 4 feet below ground level, is on a lump sum basis.

11. Payment for removing and disposing of existing manholes is on unit price basis for each manhole removed.

12. No payment for saw cutting of pavement, curbs, or curbs and gutters will be made under this section. Include cost of such work in unit prices for items listed in bid form requiring saw cutting.

13. No payment will be made for work outside maximum payment limits indicated on Drawings, or for pavements or structures removed for Contractor's convenience.

    a. For utility installations: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings. Limits of measurement will be as shown on Street Cut Pavement Replacement Rules.

14. Refer to Section 01270 - Measurement and Payment for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris. B. Coordinate removal work with utility companies.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Obtain advance approval from Project Manager for dimensions and limits of removal work.

B. Identify known utilities below grade. Stake and flag locations.

3.02 PROTECTION

A. Protect following from damage or displacement:

1. Adjacent public and private property.

2. Trees, plants, and other landscape features designated to remain.

3. Utilities designated to remain.

4. Pavement and utility structures designated to remain.

5. Bench marks, monuments, and existing structures designated to remain.

3.03 REMOVALS

A. Remove pavements and structures by methods that will not damage underground utilities. Do not use drop hammer near existing underground utilities.

B. Minimize amount of earth loaded during removal operations.

C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to minimum depth of 2 inches.

D. When street and driveway saw cut location is greater than one-half of pavement lane width, remove pavement for full lane width or to nearest longitudinal joint as directed by Project Manager.

E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.

F. Where existing end of pipe culvert or end of sewer is to remain, install 8-inch-thick masonry plug in pipe end prior to backfill in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

3.04 BACKFILL

A. Backfill of removal areas shall be in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

3.05 DISPOSAL

A. Inlet frames, grates, and plates; and manhole frames and covers, may remainCity property. Disposal shall be in accordance with requirements of Section 01576 - Waste Material Disposal.

B. Remove from site, debris resulting from work under this section in accordance with

requirements of Section 01576 - Waste Material Disposal.

END OF SECTION

Section 03315

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure.

2. Obtain services of and pay for certified testing laboratory to prepare design mixes.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 309R - Guide for Consolidation of Concrete.

G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.

H. ACI 315 - Details and Detailing of Concrete Reinforcement.

I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.

K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

M. STM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

S. ASTM C 33 - Standard Specification for Concrete Aggregates.

T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.

X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

Y. ASTM C 150 - Standard Specification for Portland Cement.

Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

AB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

AC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

AD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

AE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

AF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.

AG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

AH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

AI. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.

AJ. CRSI MSP-1 - Manual of Standard Practice.

AK. CRSI - Placing Reinforcing Bars.

AL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

AM. NRMCA - Concrete Plant Standards.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed mix design and test data for each type and strength of concrete in Work.

C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Project Manager.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.05 HANDLING AND STORAGE

A. Cement: Store cement off of ground in well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Project Manager; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of $Na_2O + 0.658K_20$.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

C. Aggregate:

1. Coarse Aggregate: ASTM C 33. Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

2. Fine Aggregate: ASTM C 33.

3. Determine potential reactivity of fine and coarse aggregate in accordance with Appendix to ASTM C 33.

D. Air Entraining Admixtures: ASTM C 260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C 494, Type A.

2. Water Reducing Retarders: ASTM 494, Type D.

3. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A 615, ASTM A 767, or ASTM A 775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.

2. Where shown, use welded wire fabric with wire conforming to ASTM A 185 or ASTM A 884. Supply gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.

3. Wire: ASTM A 82. Use 16 1/2 gauge minimum for tie wire, unless otherwise indicated.

H. Fiber:

1. Fibrillated Polypropylene Fiber:

a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.

b. Physical Properties:

1. Material: Polypropylene

2. Length: 1/2 inch or graded

3. Specific Gravity: 0.9l

c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.

a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.

b. Physical Properties

1. Material: Steel

2. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1

3. Specific Gravity: 7.8

4. Tensile Strength: 40-400 ksi.

5. Young's Modulus: 29,000 ksi

6. Minimum Average Tensile Strength: 50,000 psi

7. Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking

I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.02 FORM WORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.03 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.04 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.

B. Measure water and liquid admixtures by volume.

2.05 DESIGN MIX

A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Project Manager for review.

C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Project Manager.

D. Classification:

CLASS	TYPE	MINIMUM COMPRESSIVE STRENGTH		MAXIMUM W/C RATIO	AIR CONTENT (PERCENT)	CONSISTENCY RANGE IN SLUMP (INCHES)
		7-DAY 3200	28-DAY			
B	Pipe Block Fill, Thrust	----	1500	----	4± 1	5 to
*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be 6						

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.03 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

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A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.

B. Measure water and liquid admixtures by volume.

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A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Project Manager for review.

C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Project Manager.

D. Classification:

CLASS	TYPE	MINIMUM COMPRESSIVE STRENGTH (LBS/SQ		MAXIMUM W/C RATIO	AIR CONTENT (PERCENT)	CONSISTENCY RANGE IN SLUMP (INCHES)
		7-DAY	28-DAY			
A	Structural	3200	4000	0.45		
B	Pipe Block Fil Thrust Block	----	1500	----	4± 1	5 to 7
*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be (						

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Preformed plastic adhesive waterstop at least 2 inches in diameter.

2. Meets or exceeds requirements of Federal Specification SS-S-210A.

3. Supplied wrapped completely by 2 part protective paper.

4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.

5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.

6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko- Flex Products, Inc.; or approved equal.

PART 3 E X E C U T I O N

3.01 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back form work with sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by Project Manager, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.02 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by Project Manager and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2 1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with

CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of Project Manager. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

3.03 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.04 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Project Manager before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by Project Manager.

3.05 PLACING CONCRETE

A. Give sufficient advance notice to Project Manager (at least 24 hours prior to

commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to Project Manager's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after
depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.06 WATERSTOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

C. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.

2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.

3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Project Manager, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight- run portions of waterstop in forms.

D. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.

2. When requested by Project Manager, provide technical assistance by manufacturer's representative in field at no additional cost to City.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.

5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.

6. Bentonite Waterstop:

a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.

b. Where thickness of concrete member to be placed on bentonite waterstop is less than
12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.

7. Adhesive Waterstop:

a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.

b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.

c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.

d. Do not remove protective paper until just before final form work completion. Place concrete immediately. time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.07 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.

2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints;

joints other than those indicated on Drawings will not be permitted without written approval of Project Manager. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.08 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Project Manager.

B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.

2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Project Manager. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.

2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.09 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.

B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Project Manager.

3.10 DEFECTIVE WORK

A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.

B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.

C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Unless otherwise directed by Project Manager, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.

1. Take concrete samples in accordance with ASTM C 172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.

3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.

4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C 42.

D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Project Manager, at no additional cost to City.

3.13 PROTECTION

A. Protect concrete against damage until final acceptance by City.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Project Manager.

END OF SECTION

Section 04061

MORTAR

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Mortar and grout for masonry.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for mortar under this Section. Include payment in Lump Sum for building or structure with price breakdown included in Schedule of Values.

2. Refer to Section 01270 - Measurement and Payment and Section 01292- Schedule of Values.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 143 - Standard Testing Method for Slump of Hydraulic Cement Concrete

B. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

C. ASTM C 150 - Standard Specification for Portland Cement.

D. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.

E. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.

F. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout.

G. ASTM C 476 - Standard Specification for Grout for Masonry.

H. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

I. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Include design mix, indicate Property Method used, required environmental conditions, and admixture limitations.

C. Samples: Submit two ribbons of each mortar color, illustrating color and color range.

D. Submit test reports under provisions of Section 01450 - Contractor's Quality Control.

E. Submit test reports on mortar indicating conformance to ASTM C 270.

F. Submit test reports on grout indicating conformance to ASTM C 476.

G. Submit manufacturer's certificate under provisions of Section 01450 - Contractor's Quality Control, that products meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site and store and protect products under provisions of Section 01610 - Basic Product Requirements.

B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperatures to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

1.07 MIX TESTS

A. Test mortar and grout in accordance with Section 01454 - Testing Laboratory Services.

B. Testing of Mortar Mix: Test in accordance with ASTM C 780. Test mortar mix for compressive strength, consistency, mortar aggregate ratio, water content, air content, and splitting tensile strength.

C. Testing of Grout Mix: Test in accordance with ASTM C 109. Test grout mix for compressive strength and slump.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Portland Cement: ASTM C 150, Type I, white color.

B. Masonry Cement: Not permitted.

C. Mortar Aggregate: ASTM C 144, standard masonry type. Grading and color suitable for type of masonry, one source for entire project. (Not less than 5

percent shall pass No. 100 sieve).

D. Hydrated Lime: ASTM C 207, Type S.

E. Grout Aggregate: ASTM C 404.

F. Water: Clean and potable.

2.02 MORTAR COLOR

A. Mortar Color: Mineral oxide pigment; color; to be selected by Project Manager from manufacturer's samples.

2.03 ADMIXTURES

A. Antifreeze: Antifreeze admixtures will not be permitted.

B. Accelerator: Accelerator may be used only with approval of Project Manager.

2.04 MORTAR

A. Mortar for Load Bearing Walls and Partitions: ASTM C 270, Type S utilizing Property Method to achieve 1800 psi strength.

B. Mortar for Non-load Bearing Walls and Partitions: ASTM C 270, Type S utilizing the Property Method to achieve 1800 psi strength.

C. Mortar for Masonry Below Grade or in Contact with Earth: ASTM C 270, Type M utilizing the Property Method to achieve 2500 psi strength.

D. Pointing Mortar: ASTM C 270, Type N, using the Property Method to achieve 750 psi strength.

2.05 MORTAR MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 270 to achieve strengths noted in Paragraph 2.04.

B. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

C. Do not use anti-freeze compounds to lower freezing point of mortar.

D. If water is lost by evaporation, retemper only within 2 hours of mixing.

E. Use mortar within 2 hours after mixing at temperatures of 80 degrees F, or 2 1/2 hours at temperatures under 50 degrees F.

2.06 GROUT

A. Bond Beams, Lintels, and Other Areas to be Grouted Solid: 3000 psi strength at 28 days; 7 to 8 inches slump per ASTM C 143; mixed in accordance with ASTM C 476, Fine Grout.

2.07 GROUT MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 476, Fine Grout.

B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.

C. Do not use anti-freeze compounds to lower freezing point of grout.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Request inspection of spaces to be grouted.

3.02 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean out holes with masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.03 INSTALLATION

A. Install mortar and grout in accordance with manufacturer's instructions.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not displace reinforcement while placing grout.

D. Remove grout spaces of excess mortar.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general conditions, special conditions, and all other divisions apply to this and all other sections of Division 16.

1.2 SECTION INCLUDES

A. Summary of Work.

B. Submittals, Analysis and Device Schedules.

C. Record Documents.

D. Operating and Maintenance Manuals.

E. General Electrical Product Requirements.

F. General Electrical Installation Requirements.

1.3 SUMMARY OF WORK

A. Provide all work required for complete electrical system as indicated on the drawings and in these specifications. This may include, but is not necessarily limited to: panelboards, cabinets, circuit breakers, fuses, disconnect switches, controls, wire and cable, grounding and bonding, equipment wiring system, conduit, raceways, boxes, supporting devices, identification, testing, conduit sleeves and supports, anchors, vibration and sound isolation, access panels, record drawings, installation permits, inspections by governing authorities, electrical work of certain temporary facilities and services, cutting-and-patching work, start-up of electrical systems and equipment, training of owner's operating personnel, operating and maintenance manuals, final cleaning of electrical and similar work.

B. Except where otherwise indicated, electrical drawings prepared by Engineer (contract drawings) are diagrammatic in nature and may not show locations accurately for various components of electrical systems. It is the intention of the Construction Documents to establish the types and functions of the systems, but not to set forth each and every item essential to the functioning of any system. The Contractor shall make necessary changes or additions as may be reasonably inferred from the construction documents for a complete operating system as required and record these on the record documents.

C. Contractor shall visit site prior to submitting his proposal and become familiar with the conditions under which the work is to be performed, and correlate site observations with the requirements of the Contract Documents. Errors, inconsistencies or omissions discovered shall be reported to the Architect/Engineer at once.

D. All electrical products and installations shall comply with the latest additions of the following standards where applicable:

1. ADA - AMERICANS WITH DISABILITIES ACT
2. ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE
3. ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIALS
4. CBM - CERTIFIED BALLAST MANUFACTURERS
5. ETL - ELECTRICAL TESTING LABORATORIES
6. FM - FACTORY MUTUAL
7. ICEA - INSULATED CABLE ENGINEERS ASSOCIATION
8. IEEE - INSTITUTE OF ELECTRONICS AND ELECTRICAL ENGINEERS
9. NEC - NATIONAL ELECTRICAL CODE
10. NECA - NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION

11. NEMA - NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
12. NESC - NATIONAL ELECTRICAL SAFETY CODES
13. NFPA - NATIONAL FIRE PROTECTION ASSOCIATION
14. NETA - INTERNATIONAL ELECTRICAL TESTING ASSOCIATION
15. OSHA - OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION
16. UBC - UNIFORM BUILDING CODE
17. IBC – INTERNATIONAL BUILDING CODE
18. ICC – INTERNATIONAL CODE COUNCIL
19. IECC – INTERNATIONAL ENERGY CONSERVATION CODE
20. ISO – INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
21. UL - UNDERWRITERS LABORATORIES, INC.
22. STATE ENERGY CONSERVATION CODE
23. MUNICIPAL OR COUNTY CODES. IN THE EVENT OF CONFLICTS BETWEEN CODES OR STANDARDS, THE MORE STRINGENT REQUIREMENTS SHALL GOVERN

E. All work and materials shall be warranted for a period of one year.

F. Contractor is responsible for filing and paying for all fees and obtaining necessary permits and certificates of inspection, and shall deliver all certificates of inspection to Owner/Construction Manager, and include copies with maintenance manuals.

1.4 SUBMITTALS, ANALYSIS AND DEVICE SCHEDULES

A. General Submittal Requirements:

1. Submit six copies.
2. Applicability: Wherever it is indicated that shop drawings, samples, manufacturer's brochure, certification, test, copy of standard operating instructions, manual, extra stock, or warranty is required, appropriate submittal is required regardless of whether it is specified as "submittal"; Engineer's decision shall be final.
3. Do not purchase equipment until submittals have been reviewed by Engineer with no exceptions taken.
4. Signed Commitments: Do not proceed with transfer of electrical systems to owner for operation until warranties, performance certifications, maintenance agreements and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Engineer (for owner's records).
5. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that submitter has already determined that products fulfill specified requirements, and that submittals are for engineer's information only, but will be returned without action where observed to be non-complying with requirements. Where uniquely prepared information is submitted, it is recognized to represent preparer's interpretation or solution to specified requirements, subject to Engineer's concurrence and appropriate action.
6. Submittals shall be signed by the General Contractor and Subcontractor responsible for this work.
7. The Engineer's review of submittals is solely for general conformance with the design concept. The Engineer's review does not relieve the Contractor from total responsibility for quantities, errors, omissions or compliance with the intent of the original contract documents. Review and approval by the Contractor is required before fabrication, shipment or installation.

8. Substitutions: Electrical submittals are not opportunities for gaining acceptance of substitutions. Any variance from the contract documents shall be identified in accordance with specification requirements. Substitutions will be reviewed only for those reason identified in accordance with specification and only if procedures are followed. Any variances from the contract documents in the submittals which are not identified by the Contractor in accordance with these procedures and subsequently not identified by the Engineer's review shall be corrected by the Contractor at no cost to the Owner. Substitution request would only be considered if product is equal or better than what listed.

B. Shop Drawings: By submitting shop drawings on the project, this contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed and will operate as specified and intended. Submittals for each group will be returned without review unless all sections are included. Sections will not be reviewed separately. At the Engineer's discretion, when a re-submittal is required for one section, any other sections within each group may require re-submittal. Contractor shall expedite submittals and re-submittals as required to allow for four weeks of the Engineer's review time. The groups of equipment shall be divided as follows:

1. Raceways, Conductors and Miscellaneous Equipment

    a. Conduit
    b. Raceways, Wireways and Auxiliary Gutters
    c. Wires and Cables
    d. Outlet Boxes
    e. Cabinets and Enclosures
    f. Grounding and Bonding
    g. Supporting Devices
    h. Electrical Identification

2. Distribution Equipment

    a. Branch Circuit Panelboards
    b. Electrical Controls

3. Luminaries

C. Shop Drawings: Prepare electrical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show conduit layouts and wire/cable connections and other electrical service connections and show interfaces with other work, including structural support. Indicate by note, portions of electrical work shown on shop drawings which deviates from indication of work in contract documents, and explain reasons for deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of work, currently or previously submitted. Show wiring diagrams, erection, setting, weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, hertz, phases, noise levels, etc. Provide dimensions as required.

D. Samples: Engineer's review of required sample submittals will be limited to observation of general type, pattern, and finish; and will not include testing and inspection of submitted samples, except for those specifically indicated for that purpose in the contract documents. Compliance with specified requirements remains the exclusive responsibility of the Contractor.

E. Manufacturer's Data: Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which variations are to be provided. Delete or mark-out all portions or pre-printed data which are not applicable. Where operating ranges are shown, mark data to show portions of range required for project application. Expansion or elaboration of standard data to describe non-standard product must be processed as shop drawing data to describe non-standard product. For each product include manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating characteristics, ratings, conduit and wire/cable connection sizes and locations, statements of compliance with required standard and governing regulations (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with requirements.

F. Manufacturer's Certification: Each manufacturer is required to review the system design as related to the proper operation of his equipment, including electrical requirements, automatic controls, mechanical systems and equipment locations and related items. With shop drawings submit a letter from the manufacturer stating that his equipment will operate satisfactorily under the design conditions. The manufacturer's representative shall review the final installation at the site and submit a second letter stating that the equipment operates satisfactorily as installed. Furnish certification for the systems listed in each section of Division 16.

G. Test Reports: The contractor shall submit proposed testing procedure for distribution system, subject to review and approval and owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the system have been demonstrated and verified and reports have been provided, reviewed and accepted. The project will not be declared substantially complete otherwise.

H. Warranties: Refer to individual equipment specifications for warranty requirements. A minimum of one-year warranty period is required for all materials and equipment. Warranty period starts upon first beneficial use or acceptance by Owner.

1. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.
2. Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by Engineer), product is automatically disqualified from use on project, except where manufacturer prepares and issues specific project, warranty on product, stating that it is in lieu of published warranty, and is executed by authorized officer, and complies with requirements.

1.5 OPERATING AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with this specification. Provide the following as a minimum.

B. Submit sets prior to final inspection, in 8½ x 11 inch text pages, bound in style D, three ring binders with durable plastic covers.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS, ELECTRICAL", and title of project.

D. Internally sub-divide the binder contents with permanent page dividers, logically organized, with tab titling clearly printed under reinforced laminated plastic tabs.

E. Contents:

1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractor, and major equipment suppliers.
2. Operation and maintenance instructions, arranged by system.
3. Project documents and certificates.
4. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
5. Manufacturer's original printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. (Copies are not acceptable).
6. Maintenance procedures for routine preventative maintenance and troubleshoot; disassembly, repair, and re-assembly; aligning and adjusting instructions.
7. Servicing instructions and lubrication charts and schedules.
8. Warranty information including any corrections made during submittals.
9. Replacement parts list.
10. List of tools and accessories needed for maintenance.

PART 2 - GENERAL ELECTRICAL PRODUCT REQUIREMENTS

2.1 GENERAL MANUFACTURER QUALIFICATION

A. Production Experience: For all electrical equipment, manufacturer shall be firm with not less than five (5) years successful production experience. Experience means production of units similar to those required, as judged by Engineer. Comply with longer-period experience requirements specified in other Division 16 sections of these specifications. Product shall be new and design for quiet, vibration free operation.

2.2 GENERAL ELECTRICAL PRODUCT REQUIREMENTS

A. Standard Products: Provide not less (quality) than manufacturer's standard products as specified by published product data. Do not assume that available off-the-shelf condition of product complies with requirements; as example, specific finish or color may be required.

B. Unencumbered Purchases: Avoid purchases and use of products which are encumbered with questionable title transfers, patent rights, trade union restrictions, code compliance, non-listings as "approved products" for compliance with

governing regulations, duties due, embargoes and similar possible encumbrances, claims or sellers interest. Do not purchase specific electrical materials and equipment for project until completion of submittals.

C. Condition of Products: Except as otherwise indicated, provide new electrical products, free of defects and harmful deterioration at time of installation. Do not use units, which have been subjected to destructive testing, or other high-limits testing except where pre-tested products are specified. Provide each product complete with trim, accessories, finish, guards, safety devices and similar components specified or recognized as integral parts of products, or required by governing regulations.

D. Assembly and Testing: To greatest extent possible and unless otherwise indicated, complete fabrication, assembly, finishing and testing of products prior to delivery to project. Notify Engineer not less than one week in advance of pre-installation testing to be performed in response to project requirements. Engineer reserves right to be present at tests of electrical products; however, neither their absence nor presence relieves the Contractor of responsibility for compliance with requirements.

E. Uniformity: Where multiple units of generic product are required for single major system of electrical work, e.g., cable trays, lighting system, provide identical products by same manufacturer, without variations.

F. Limitations: Product/manufacturer uniformity does not apply to conduit and fittings, 600V electrical wire, sheet metal, steel bar stock, welding rods, solder, factory applied paint between different systems, fasteners, motors for unalike equipment units, and similar items used in work, and except as otherwise indicated.

G. Product Compatibility, Options: Where more than one product selection is specified, selections are Purchaser's or Installer's options, except do not provide products which are not compatible with previously purchased or installed products which must interface with selections. Provide electrical adaptations as needed for interfacing of selected products in work.

H. Quality Assurance: Provide products listed by and installed in accordance with all references in each section under quality assurance any other applicable requirements.

I. Elevation Requirements: Electrical equipment provided shall perform at mean elevation of 1000 feet above sea level.

PART 3 - GENERAL ELECTRICAL INSTALLATION REQUIREMENTS

3.1 GENERAL ELECTRICAL INSTALLATIONS

A. The contractor shall provide all necessary items for a complete operating system.

B. Provide all electrical systems required by and in accordance with Division 16.

C. Verify all dimensions by field measurements.

D. Where mounting heights or locations are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom and working clearances possible, but not less than required by Code.

J. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings and manufacturer's instructions, to greatest extent possible. Conform to arrangements indicated by the Contract Documents,

recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

K. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

L. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

M. Install J-boxes for equipment requiring access or maintenance, which are concealed behind surfaces so that these devices can be serviced from the access panels. Where practical, group J-boxes and equipment so that they can be accessed from the same panel or door. If additional panels are needed, panels must be submitted for approval.

N. Cut, remove and legally dispose of selected electrical equipment, components, and materials, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.

E. The Engineer reserves the right to make relocations up to 6 feet of outlets, boxes, cabinets, etc. before finished rough-in at no cost to the Owner.

F. Contractor shall notify design prime consultant and Owner when he requests an inspection by the City Inspector.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protection and Identification: Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identification; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in dry, well ventilated, indoor space, except where prepared and protected by manufacturer specifically for exterior storage.

3.3 TEMPORARY WIRING

A. The electrical contractor shall arrange for and provide all necessary equipment, outlets, and temporary lights, as required during construction period for electrical power.

B. It shall be the responsibility of the electrical contractor to determine voltage of temporary electrical service required to operate construction equipment to be employed and to provide such services to the project.

C. It shall be the responsibility of the electrical contractor to make all arrangements for, and to furnish and install, any and all temporary wiring, switches, and structures which may be required to maintain service continuity during the entire construction period. Temporary power and lights shall be UL listed and shall include a ground wire, a guard and a proper means of support.

D. All temporary installations shall be performed in accordance with the current edition of the National Electrical Code. All machinery and equipment powered by electricity shall have effective electrical equipment grounding provided with all electrical circuits.

3.4 CLOSEOUT PROCEDURES

A. General Coordination: Coordinate electrical closeout work with variable loads on electrical system. Coordinate taking of final photographs with electrical closeout, so that maximum detail of work as finally accepted is shown. Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance with be fully tested and demonstrated.

B. System Performance Test Runs: Check each item in each system to determine that it is set for proper operation. With Owner's Representative and Engineer present, operate each system in test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances where possible, including noise and vibration reductions, elimination of hazards, better response of controls, and similar system performance improvements. Provide testing or inspection devices as may be reasonably requested for Engineer's observation of actual system performances.

C. Cleaning and Lubrication: After final performance test run of each electrical system, clean system both externally and internally. Comply with manufacturer's instructions for lubrication of both power and hand-operated equipment, and remove excess lubrication. Touch-up minor damage to factory-painted finishes and other painting specified as electrical work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specific training of Owner's operating personnel specified in individual Division 16 work sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified in Division-16 Sections and elsewhere in these specifications, provide general operating instructions for each operational system and equipment item of electrical work. Coordinate instructions with instructions for mechanical work, elevators and other equipment where associated with electrical systems or equipment.

1. Describe each basic electrical system and functioning of its control system.
2. Explain identification system, mimic diagrams, signals, actuators, sensors, alarms, telecommunication systems, and similar audio/visual provisions.
3. Describe interfaces with mechanical equipment, including interlocks, sequencing, and start-ups, shut down, emergency, safety, system failure, security and similar provisions.
4. Outline basic maintenance procedures and major equipment turnaround requirements, including adjustments to optimize output and efficiency of electrical system.
5. Display and conduct "thumb-through" explanation of maintenance manuals, record drawings, and spare parts inventory, storage of extra materials, meter readings and similar service items.

E. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installer's tools, test facilities, construction equipment and similar devices and materials used in execution of work but not incorporated in work.

F. Security and Protection: During electrical work closeout phase, meet with Owner's operating representative frequently (daily where necessary) and agree upon status

of operational responsibility for electrical systems (including securing provisions to prevent unauthorized operations, and including protective measures to ensure that systems are not neglected or misused.

3.8 CONTINUED SYSTEM OPERATIONS

A. Acceptance and Continued Services: Coordinate Owner's take-over of electrical systems with take-over of mechanical systems, including the provision of skilled electrical operating and maintenance personnel until time Owner's personnel take over operation of entire mechanical and electrical plant. Contractor shall continue consultation and services (beyond take-over date) for electrical systems, matching required continued services on associated mechanical systems and equipment.

END OF SECTION

SECTION 16111

CONDUIT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Rigid Metal Conduit (RGS or GRS)

B. Intermediate Metal Conduit (IMC)

C. Liquid Tight Flexible Metal Conduit (Liquid-Tight) (Sealtite)

D. Fittings and Conduit Bodies

E. Conduit Seals

F. Flashings

G. Conduit Sleeves

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Submit no more than two (2) manufacturer's product data for each type of conduit and fitting.

B. Provide UL category and file number of products.

C. Information on approved PVC conduit benders to be used.

D. Warranties.

1.4 QUALITY ASSURANCE: Comply with the following

A. Rigid Metal Conduit (RGS or GRS)

1. ANSI C80.1 - Specification for zinc-coated rigid steel conduit.

2. UL 6 - Rigid metal conduit.
3. ANSI B1.20.1 NPT threads.

B. Intermediate Metal Conduit (IMC)

1. ANSI C80.6 - Intermediate metal conduit (IMC) - zinc coated.
2. UL 1242 - Intermediate metal conduit.
3. ANSI B1.20.1 - NPT threads.

C. Liquid Tight Flexible Metal Conduit (Liquid-Tight) (Sealtite)

1. CSA C22.2 Certified.
2. UL 360 - Liquid-tight flexible steel conduit.

D. Fittings and Conduit Bodies

1. NEMA FB1 - Fittings, cast metal boxes, and conduit bodies for conduit and cable assemblies.
2. NEMA TC3 - PVC fittings for use with rigid PVC conduit and tubing.
3. UL 467 - Grounding and bonding equipment.
4. UL 514B fittings for conduit and outlet boxes.
5. CSA 22.2 - No. 18 certified.
6. ASTM D2564 PVC solvent cement.
7. Federal Spec W-F-406D.
8. Federal Spec W-F-408E.
9. Federal SPec W-C-586D
10. Federal Spec FF-S-760A(2).

1.5 SEQUENCING AND SCHEDULING

A. Coordinate with other work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Rigid metal conduit (RGS or GRS), intermediate metal conduit (IMC) and electrical metallic tubing.

1. Allied Tube and Conduit, Grinnell Co.
2. Triangle PWC
3. Western Tube
4. Wheatland Tube and Conduit

B. Rigid nonmetallic conduit (PVC)

1. Cantex
2. Carlon
3. J-M Manufacturing Company
4. Quail Plastics

C. Liquid tight flexible metal conduit (liquid-tight)

1. Anaconda Sealtite
2. Electri-Flex Liquatite
3. Hubble/RACO
4. International Metal Hose

D. Conduit Bodies and Fittings

1. Adalet-PLM, Scott Feltzer Company.
2. Appleton Electric Co., Emerson Electric Co.
3. Midwest Electric
4. Crouse-Hinds Division, Cooper Industries, Inc.
5. O-Z/Gedney, General Signal
6. American Electric
7. Thomas & Betts Corp.
8. RACO, Hubbell, Inc.
9. Shamrock Conduit Products, Inc.

E. Conduit Sealing Bushings:

1. Adalet
2. Appleton
3. Crouse-Hinds
4. O-Z/Gedney
5. RACO
6. Thomas and Betts Corp.

2.2 CONDUIT AND FITTINGS

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

B. Rigid Steel Conduit (RGS or GRS): Provide rigid steel, galvanized, threaded type conforming to ANSI C80.1, ANSI B1.20.1 and UL 6.

1. Provide zinc coating fused to inside and outside walls. Coating may be applied by the hot-dip metalizing or sherardizing process. All threads shall be galvanized after cutting.

C. Intermediate metal conduit (IMC): Provide intermediate metallic steel, galvanized, threaded type conforming to ANSI C80.6, ANSI B1.20.1 and U.L. 1242.

1. Provide zinc coating fused to inside and outside walls. Coating may be applied by hot-dip metalizing or sheradizing process. All threads shall be galvanized after cutting.
2. Running threads and Erickson couplings shall not be used.

D. Rigid Metal Conduit Fittings (RGS or GRS) and Intermediate Metal Conduit (IMC): Cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408E, U.L. 514B, U.L. 467 and ANSI/NEMA FBI.

1. Use Type 1 fittings for rain-tight connections.
2. Use Type 2 fittings for concrete tight connections.
3. Use Type 3 fittings for other miscellaneous connections.
4. Thread-less fittings shall not be used.

E. Conduit Bodies: Provide galvanized malleable iron conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

F. Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron insulated throat conduit fittings for use with flexible steel conduit conforming to UL 514B, U.L. 467, FS W-F-406D and ANSI/NEMA FB1.

G. Liquid-Tight Flexible Metal Conduit (Liquid Tight) (Sealtite): Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC) conforming to UL 360 and CSA C22.2.

H. Liquid-Tight Flexible Conduit Fittings: U.L. 514B, U.L. 467, Type 1 Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.

L. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws. Sealing bushings shall be Oz/Gedney Type CSB or equal.

M. Provide OZ/Gedney dux sealing compound in conduits within 5 feet of penetrations of walls to rooms required to be maintained at a positive or negative pressure (such as laboratory areas) as required by the mechanical system.

PART 3 - EXECUTION

3.1 TYPE ACCORDING TO USE

A. Rigid Metal Conduit (RGS or GRS):

1. 3/4" minimum above or below grade unless indicated otherwise.
2. Maximum size 4".
3. Provide conduit supports at a maximum of every 10 feet and within 3 feet of each cabinet, box, fitting, conduit body and other terminations.
4. Locations Permitted:

a. 30" minimum underground.
b. 6" minimum under slab (do not run in slab).
c. Exposed outdoors where indicated.
d. Concealed inside wall.
e. Above accessible and inaccessible ceilings.

f. Exposed above 10 feet in finished rooms with no ceilings.
g. Exposed in unfinished spaces such as mechanical rooms, electrical rooms, and telephone rooms.

B. Intermediate Metal Conduit (IMC):

1. 3/4" minimum unless otherwise indicated.
2. Maximum size 4".
3. Provide conduit supports at a maximum of every 10 feet and within 3 feet of each cabinet, box, fitting, conduit body and other terminations.
4. IMC shall be permitted in all locations as rigid metal conduit (RGS or GRS).

C. Electrical Metallic Tubing (EMT): Not Acceptable

D. Rigid Non-Metallic Conduit (PVC): Not Acceptable.

E. Flexible Metal Conduit: Not Acceptable.

F. Liquid tight Flexible Metal Conduit:

1. Connect electrical equipment subject to vibration or movement when located in wet or damp unfinished spaces and all motors with liquid-tight flexible metal conduit two (2) feet minimum length and four (4) feet maximum length.
2. Conduit shall be supported every 4-1/2 feet and within 12-inches on each side of every outlet box, junction box, cabinet, or fitting, except conduit may be supported at lengths not to exceed three (3) feet at connection requiring flexibility.
3. Minimum size 3/4 inch, maximum size 4-inches.
4. Provide supplementary external bonding conductor the same size as the internal ground for conduit above 1-1/4 inches.
5. Where run parallel to framing members, comply with NEC 350.

3.2 TRANSITIONS

A. Continue the heavier, more protective type conduit application not less than 4-inches into the area where lighter, less protective type conduit is permitted.

3.3 INSTALLATION METHODS

A. Conduit Routing:

1. Metallic conduits must be between enclosures such as outlet, junction and pull boxes, panels, cabinets, etc. The conduit must enter and be secured to enclosures so that each system is electrically continuous throughout.
2. Run conduit parallel or at right angles to construction lines in a neat and orderly manner. Unless otherwise shown conduit may be exposed.
3. Conduits are not to change in size unless terminated in boxes, conduit fittings or cabinets.
4. Make bends with standard ells or conduit bent in accordance with the NEC. Make field bends using equipment designed for the particular conduit material and size involved. Bends must be free from dents or flattening. Use no more than the equivalent three 90-degree bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes.

5. Install each entire conduit system complete before pulling in any conductors. Clean the interior of every run of conduit before pulling in conductors to guard against obstructions and omissions.
6. Provide a No. 30 nylon pulling line in conduits in which wiring is not installed under this work. Identify both ends of the line by means of labels or tags reading "Pulling Line - Telephone," etc.

B. Conduit supports shall be in accordance with Section 16190.

END OF SECTION

SECTION 16123

WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. 600V insulated non power limited building wire.

B. Connectors.

C. Cable pulling lubricant.

1.3 SUBMITTALS: Submit the following in accordance with 16010.

A. Product Data for electrical wires, cables and connectors. Provide no more than two (2) manufacturers for each product.

B. Provide UL category and file number for products.

C. Warranties.

1.4 QUALITY ASSURANCE: comply with the following standards

A. UL Compliance: Provide components which are listed and labeled by UL under the following standards.

1. UL Std. 83 - Thermoplastic-Insulated Wires and Cables.
2. UL Std. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3. UL 13 - Power limited circuit cables.
4. UL 1666 - Test for flame propagation height of electrical and optical-fiber cables installed vertically in shafts.
5. UL 910 - Test for flame propagation and smoke density values for and optical fiber cables used in spaces environmental air.
6. UL 1685 - Vertical tray fire propagation and smoke release test for and optical fiber cables.

B. NEMA WC-5: Thermoplastic-insulated wire and cable for the transmission and

distribution of electrical energy.

C. Federal Specifications

1. J-C-30B(1) cable and wire, electrical (power, fixed installation).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. 600V insulated non power limited building wire

a. American Insulated Wire Corp.
b. Anaconda
c. General Cable

2. Connectors for Wires and Cable Conductors: provide products by one manufacturer for each type of connector.

a. Appleton
b. AMP
c. Appleton Electric Co.
d. Arrow-Hart Div, Crouse-Hinds Co.
e. Burndy Corporation
f. General Electric Co.
g. Gould, Inc.
h. Harvey Hubbell, Inc.
i. O-Z/Gedney Co.
j. Square D. Company
k. Thomas and Betts Corp.
l. 3 M

3. Cable pulling lubricant:

a. American Polywater Corporation - Polywater J.

2.2 600V INSULATED NON POWER LIMITED BUILDING WIRES

A. General: Provide wire and cable suitable for the temperature, conditions and location. Conforming to UL 83, NEMA WC-5 and Federal Spec J-C-30B(1).

B. Conductors: Provide ASTM-B-3 solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide ASTM-B-8 stranded conductors for power conductors sizes no. 8 AWG and larger and larger.

C. Conductor Material: Copper for all wires and cables.

D. Insulation: Provide 600V THHN/THWN insulation.

E. Color Coding for phase identification in accordance with Section 16195.

2.3 CONNECTORS

A. Provide UL 486A listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

B. Provide steel or malleable iron connectors for AC and MC cable with insulating grommet to prevent conductor abrasion.

C. Provide vinyl insulated fork type connectors for terminating control wiring.

PART 3 - EXECUTION

3.1 600V Insulated non Power Limited Building Wire

A. Non power limited premise wiring

B. All wire shall be installed in conduit or raceways.

C. All circuits shall have a hot, neutral and green ground wire unless otherwise indicated.

D. Provide #12 conductors and #12 ground minimum to all 15 and 20 amp devices unless otherwise indicated.

E. Provide #10 minimum conductors for 120/240V 20 amp circuits for which the distance from the panelboard to the first device is more than 100 feet.

F. Do not install wires in conduit until entire system of conduit and outlet boxes is permanently in place. NO MORE THAN 3 CIRCUITS PER CONDUIT.

G. Exercise care when installing wire in conduit so as to prevent injury to the conductor insulation. Mechanical means of pulling shall not be used unless approved. Conductors shall be pulled using UL non-flammable listed lubricant when necessary.

H. Whenever wiring leaves the conduit and terminates at a terminal board, the wiring shall be formed and laced with plastic wire ties.

I. In the event circuits feed through outlet boxes, provide splice and pigtail for device connection, with sufficient slack to pull splice out of box at least 6 inches (for inspection).

J. Pull conductors simultaneously where more than one is being installed in same raceway.

K. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

L. Keep conductor splices to a minimum.

M. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.

N. Use splice and tap connectors which are compatible with conductor material.

O. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no.10 AWG cabled in individual circuits. Make terminations

so there is no bare conductor at the terminal.

P. Home Runs: except where specifically indicated, provide lighting branch circuit home runs with not more than three different line conductors and a common neutral in a single raceway for 4-wire, 3-phase systems.

Q. Conductors may be run inn parallel in sizes 1/0 through 750 MCM where indicated and provided that all conductors of each phase are the same length and so arranged and terminated as to ensure equal division of the current between all paralleled phase conductors.

R. Feeders shall be installed in continuous pieces without splice.

3.2 INSTALLATION OF CONNECTORS

A. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with a electrical tape to 150% of insulation rating of conductor.

B. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller unless otherwise directed for motor connections.

C. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller unless otherwise directed for motor connections.

D. Conductors for control circuits shall be connected with either compression type Hi-Dent, Hi-Press, Stakon, or Scotchlok connectors.

E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified in U.L. 486A.

3.3 Cable Pulling Lubricant:

A. The cable jacket and/or conduit and/or conduit walls shall be completely lubricated when cable is pulled into conduit. The lubricant shall be applied immediately before or during the pull. Minimum quantities of lubricant are as follows:

1. Quart of Lubricant Per 100 Feet of 1" Conduit.
2. Quarts of Lubricant Per 100 Feet of 2" Conduit.
3. Quarts of Lubricant Per 100 Feet of 3" Conduit.
4. Gallon of Lubricant Per 100 Feet of 4" Conduit.

B. The lubricant shall contain no waxes, greases, silicones, oils or waxes.

C. Lubricant has no flash point and dried residue is non-flammable.

3.4 FIELD QUALITY CONTROL

A. Refer to Section 16195 for conductor identification requirements.

B. Prior to energizing, check installed wires and cables with megohm meter as required.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate properfunctioning. Correct malfunctioning units, and retest to demonstrate compliance.

3.5 FIELD TESTING

A. The insulation resistance testing specified herein shall be done on any circuit which has an over current protection device equal to or greater than 100 amps.

B. The insulation resistance testing specified herein shall be done on any power circuit of any amperes which leaves the building of origin underground and terminates in another building or outside device.

C. Visual and Mechanical Inspection: Inspect cables for physical damage and proper connection in accordance with schematic diagram. Check cable color-coding with applicable Engineer's specifications and National Electrical Code standards.

D. Electrical Tests: Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts DC for 1 minute.

E. Provide torque tests for all conductor terminations in transformers, switchboards, disconnect switches, panelboards, motor controllers, etc. as specified below. Any value which is less than manufacture's data or NETA Standards shall be tightened. Torque 10% of all connections. If more than 10% of those tested fail, test an additional 10%. If more than 10% of the second test fail, test 100% of all connections.

END OF SECTION

SECTION 16130

BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this section.

1.2 SECTION INCLUDES

A. Standard steel outlet, device, pull and junction boxes.

B. Standard cast metal boxes.

C. Pull and junction boxes.

D. Standard floor boxes.

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Product data for boxes. Submit no more than two (2) manufacturers for each type.

B. Shop drawings for floor boxes and boxes that are to be shop fabricated, (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

C. Provide U.L. category file number for products.

1.4 QUALITY ASSURANCE: Comply with the following:

A. UL Listing and Labeling: Items provided under this section shall be listed and labeled:

1. UL 514A "Metallic Outlet Boxes".
2. UL 514B "Fittings for Conduit and Outlet Boxes,"
3. UL 50 "Enclosures for Electrical Equipment,"

B. NEMA Compliance:

1. NEMA 0S1 "Steel Outlet Boxes, Device Boxes, Covers and Box Supports."
2. NEMA FBI fittings, cast metal boxes and conduit bodies for conduit and cable assemblies.
3. NEMA 250 "Enclosures for Electrical Equipment (1000 volts maximum).

C. Federal SPEC W-J-800F junction box; extension, junction box; cover junction box (steel, cadmium or zinc-coated).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Standard steel outlet device, pull and junction boxes:
   a. Americal Electric/Steel City
   b. Bowers
   c. Walker
   d. Midwest Electric
   e. Raco
   f. Spring City Electrical Manufacturing
   g. Thepitt
   h. Thomas R. Betts

2. Standard cast metal boxes:

   a. Adalet, Scott Feltzer Company
   b. Appleton Electric Co, Emerson Electric Co.
   c. Midwest Electric
   d. Crouses Hinds Div, Cooper Industries Inc.
   e. O-Z/Gedney, General Signal
   f. Raco

2.2 STANDARD STEEL OUTLET, DEVICE, PULL AND JUNCTION BOXES

A. Outlet, pull and junction boxes shall have dimensions, trade sizes and types as indicated in NEC Article 314 and conform to U.L. 514A, U.L. 514B and NEMA 0S1 and Federal Spec W-J-800F.

B. Boxes shall be flat rolled, code gauge, galvanized steel and suitable for location.

C. Luminaire and Equipment Supporting Boxes: rated for weight of equipment supported in accordance with construction document details where required.

D. All boxes shall be rated for outdoor installation.

E. Provide narrow and/or shallow boxes only when minimum size standard box will be too large or deep.

PART 3 - EXECUTION

3.1 GENERAL

A. Boxes shall be of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

B. Install electrical boxes as indicated, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Electrical boxes are shown on drawings, in approximate locations. Refer to drawings for related installation requirements and details. Verify suitability and type of box required with equipment shop drawings, product data and manufacturer's instructions.

D. Install products in accordance with NECA Standard of Installation.

E. Sized shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

F. Install knockout closure in unused box opening.

H. Install electrical boxes to present neat mechanical appearance.

I. Remove sharp edges where they may come in contact with wiring or personnel.

J. Electrically ground metallic cabinets, boxes and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

K. Support and fasten items securely in accordance with Division 16 Section "Supporting Devices."

3.2 STANDARD STEEL OUTLET, DEVICE, PULL AND JUNCTION BOXES

A. Boxes shall be installed so that the front edge of the box or fitting will not set back of the finished surface more than 1/4 inch per NEC 314.

B. Maximum of one extension ring shall be allowed per box.

C. Cover Plates for Surface Boxes: use plates sized to box front without overlap.

D. Protect outlet boxes to prevent entrance debris. Thoroughly clean foreign material from boxes before conductors are installed.

3.3 STANDARD CAST METAL BOXES

A. Cast boxes shall be used at all locations requiring threaded conduit unless otherwise indicated.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "BASIC ELECTRICAL REQUIREMENTS" apply to this Section.

1.2 SECTION INCLUDES

A. Cabinets

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Product Data for cabinets and enclosures indicating materials, dimensions, and accessories.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Provide U.L. category and file number for products.

1.4 QUALITY ASSURANCE: Comply with the following:

A. UL 50 “Electrical Cabinets and Boxes."

B. NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

1.5 EXTRA MATERIALS

A. Provide two of each cabinet key

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electric Panelboard, Inc.

B. Erickson Electrical Equipment Co.

C. Hoffman Engineering Co.

D. Parker Electrical Mfg. Co.

E. Square D Co.

2.2 Enclosure: Provide NEMA enclosures suitable for the environment installed. Electrical contractor is responsible for determining the area NEMA rating based on use, and install appropriately rated products in accordance to chart below:

A.. Type 3R Outdoor use, undamaged by the formation of ice on the enclosure.

B.. Type 3S Same as 3R plus windblown dust, eternal mechanisms remain operable while ice laden.

C.. Type 4 Outdoor use, splashing water, windblown dust, hose-directed water, undamaged by the formation of ice on the enclosure.

D. Type 4X Same as 4 plus resists corrosion. air-break equipment.

2.3 CABINETS

A. Comply with UL 50, "Electrical Cabinets and Boxes" and NEMA ICS 6 "Enclosures for industrial controls and systems and NEMA 250 enclosures for electrical equipment (1000 volts maximum).

B. Construction: Sheet steel 16 gauge minimum with continuous welded seams, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a concealed hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame.

C. Mounting Panel: Provide painted removable internal mounting panel for component installation.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks shall be of a type to permit doors to latch closed without locking.

E. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.

F. Provide accessory feet for free-standing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABINETS AND ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor unless otherwise noted.

C. Set cabinets in finished spaces flush with walls.

D. Install surface mounted cabinets with a minimum of six (6) anchors.

E. Provide steel channel supports to stand cabinets 1 inch off wall in wet locations and kitchens.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Grounding Electrodes (Ground Rods).

B. Grounding Electrode Conductors.

C. Equipment Grounding Conductors.

D. Ground Connectors.

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Product data for ground rods, conductors, test wells and connectors.

B. Provide U.L. category and file number for products.

C. Manufacturer's installation instructions for exothermic welds.

1.4 QUALITY ASSURANCE: Comply with the following

A. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

B. Comply with IEEE Standard 241 "Recommended Practice for Electric Power Systems in Commercial Buildings."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ground Rods:

1. Eritech/Carolina Galvanizing Corp.
2. Nashville Wire Products Apache Grounding Division

B. Equipment grounding conductors per Section 16123.

C. Ground Connectors:

1. Cadweld by Erico Products.
2. Thermoweld by Continental Industries, Inc.
3. Cooper Power Systems.

4. Burndy.
5. Thomas & Betts/Blackburn.
6. Oz Gedney/General Signal.

2.2 GROUNDING ELECTRODES (GROUND RODS)

A. Ground Rods: Single piece 3/4" diameter by 10 feet copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.

2.3 GROUNDING ELECTRODE CONDUCTORS

A. Bare copper conductors shall be stranded and conform to:

1. Assembly of stranded conductors: ASTM B-8.
2. Tinned Conductors: ASTM B-33.

B. Ground Bus: Bare annealed copper bars of rectangular cross section.

C. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.

D. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2-inches wide, except as indicated.

2.4 EQUIPMENT GROUNDING CONDUCTOR**:** Equipment Grounding Conductor shall be per Section 16123.

2.5 GROUND CONNECTORS

A. General: listed and labeled as grounding connectors for the materials used.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Clamps: Heavy-duty units listed for the application.

D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes and combinations of conductors and other items to be connected.

E. 8 square inch structural steel grounding plates U.L. listed as lightning protection down conductors.

2.6 FIELD-PROVIDED GROUND BUS

A. Use round-edge copper bar with 98 percent International Annealed Copper Standard (IACS) conductivity.

B. Size the bus for not less than 25 percent of the cross-sectional area of the related feeder. A minimum size of 1/4 inch by 2 inches is required.

C. Install bus in sheet metal enclosure.

PART 3 - EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Metal Frame of Structure:

1. Bond the metal frame of the structure where effectively grounded to the electrical service entrance grounding electrode with a copper conductor sized per NEC 250-V.

C. Concrete - Encased Electrode:

1. Bond concrete encased electrodes to the electrical service entrance grounding electrode with a copper conductor sized per NEC 250.

D. The service entrance panelboard shall have a main bonding jumper and service entrance grounding electrode conductor sized per NEC 250-V.

E. Provide #6 AWG minimum green ground from grounding electrode system to each telephone/communication closet and telephone service entrance.

F. Bonding – All of the electrodes in B. thru E shall be bonded together per NEC 250.66.

3.2 EQUIPMENT GROUNDING SYSTEM

A. All circuits shall have a green ground wire sized per NEC-250 as a minimum. Ground wire is not shown for all circuits on construction documents however, it shall be installed.

3.3 INSTALLATION

A. Raceway systems shall be mechanically and electrically continuous and shall be bonded at all points to the insulated equipment grounding conductor in accordance with the applicable provisions of Articles 250 of the NEC.

B. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

C. Braided-Type Bonding Jumpers: Use for flexible bonding and grounding connections.

D. Ground Rods: Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Use 3/4-inch by 10-ft. ground rods except as otherwise indicated. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

E. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

F. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

G. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

H. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to assure high conductivity and with contact points closer in order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
   4. Aluminum to galvanized steel connections shall be with tin- plated copper jumpers and mechanical clamps.
   5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

3.6 FIELD TESTING

A. Subject the complete grounding system to a resistance to ground test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

B. Equipment grounds: Utilize two-point method of IEEE std.81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

C. Ground Resistance Maximum Values shall be as follows: Upon completion of installation of electrical ground and bonding systems, test ground resistance. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods ant no cost to the Owner; then retest to demonstrate compliance.

3.7 CLEANING AND ADJUSTING

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary top soiling, fertilizing, liming, seeding, sod, sprigging, or mulching. Restore vegetation. Restore disturbed paving as required.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

C. Fittings.

D. Brackets.

E. Cable ties.

F. Spring vibration isolators.

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Support equipment schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of support and fastener to be used.

B. Shop drawings indicating details of fabricated products and materials.

1.4 QUALITY ASSURANCE: Comply with the following.

A. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

B. Comply with Federal Specification W-C-582A, FF-B-575C and FS-S-760A(2).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Slotted Metal Angle:

a. Allied Tube & Conduit
b. American Electric
c. B-Line Systems, Inc.
d. GS Metals Corp.

e. Unistrut Corporation

2. Brackets:

a. Erico
b. Bowers
c. Raco
d. Steel City

3. Vibration Isolators:

a. Amber/Booth
b. Dynasonic
c. Grinnell
d. Mason Industries

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, column brackets and supports, spring steel clamps.

B. Fasten hanger rods, conduit clamps, and junction boxes to structure using beam clamps.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Do not drill structural steel members.

E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

2.4 FIELD FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from specified and detailed components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

2.5 VIBRATION ISOLATORS

A. Pads: Provide ribbed neoprene pads amber/booth Type NR or equal for installation at the back of fixture box.

PART 3 - EXECUTION

3.1 GENERAL

A. Install supporting devices to fasten electric components securely and permanently in accordance with NEC, NECA, detailed drawings, and manufacturer's requirements.

B. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the structure, including but not limited to conduits, raceways,

cables, cabinets, panelboards, boxes, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel.
2. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
3. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used. It is the responsibility of contractor to obtain approval from TXDOT for all required drilling in existing concrete columns and road structure for the purpose of supporting hardware attachment.
4. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete columns and slabs.

C. Touch up all scratches or cuts on supporting structure with an approval product.

3.2 CONDUIT, RACEWAYS AND SLEEVES

A. Fabricate light fixture supports per drawings details. Rigidly weld members or use hexagon head bolts to connect fixture to the supporting hardware appearance with adequate strength and rigidity. Use spring lock washers under all nuts unless otherwise noted. Install neoprene between light fixture back support and mounting brackets.

B. Strength of each support shall be adequate to carry present load multiplied by a safety factor of at least four.

C. Install individual and multiple raceway and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for securing conduits.

D. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving branch circuits.

E. Branch circuit raceways which are 1-inch or smaller may be attached to columns by clips.

F. Space supports for raceways in accordance with NEC.

3.5 LIGHTING FIXTURES

A. Provide supports as indicated in Section 16510 and details on drawings.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Identification labeling for raceways, junction boxes.

B. Identification of conductors and cables.

C. Equipment Nameplates.

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Product Data for each type of product specified.

1.4 QUALITY ASSURANCE: Comply with the following

A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. American Labelmark Co.
2. Ideal Industries, Inc.
3. Seton Name Plate Co.
4. W.H. Brady Co.
5. Panduit Corp.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Raceway and Cable Labels: Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is over laminated with a clear, weather and chemical-resistant coating.
2. Color: Black legend on orange field.
3. Legend: Indicates voltage.

B. Colored Adhesive Marking Tape for Raceways, Wires and Cables: Self-adhesives vinyl tape not less than 3 mils thick by 1 inch wide (0.08 mm thick by 25 mm wide).

C. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square

inches, or 8 inches in length; 1/8-inch thick for larger sizes. Use 1/2 inch letters for identifying individual equipment and 1/4 inch letters for identifying equipment data under equipment name. Engraved legend in white letters on black face and punched for mechanical fasteners. For emergency circuits and equipment, use engraved legend in white letters on red face and punched for mechanical fasteners.

D. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

E. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.

PART 3 - EXECUTION

3.1 GENERAL

A. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

B. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 CONDUIT AND JUNCTION BOXES

A. Makings on conduit and junction boxes shall be made with a black permanent marker for power, control and communications conduits. Markings on conduit and junction boxes shall be made with a red permanent marker for emergency power and fire alarm conduits.

B. Marking shall indicate the circuit number and voltage, for power circuits. Marking shall indicate the zone, control wire number, etc. for fire alarm, control and communication conduits.

C. Provide identification on the conduit at the source termination and load termination. Provide identification at each junction box not visible from the source or load terminations. Provide identification on each side of wall where conduit passes through wall and is not visible from source or load termination.

3.3 CONDUCTORS AND CABLES

A. Conductor color coding:

1. Provide color coding for service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

Phase	208/120 Volts
A	Black
B	Red
Neutral	White
Ground	Green

2. Use conductors with color factory-applied the entire length of the conductors except as follows: The following field-applied color-coding methods may be

used in lieu of factory-coded wire for sizes No. 4 AWG and larger. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

B. Conductor Tagging:

1. Tag conductor at each panelboard, pull box, junction box and load connection with the circuit number or control wire number.
2. Power and Lighting Circuits: Branch circuit or feeder number indicated.
3. Control Circuits: Control wire number indicated on schematic and interconnection diagram or shop drawings.

3.4 EQUIPMENT NAMEPLATES

A. Factory Applied: Provide permanent operational-data nameplate on each item of power operated electrical equipment, indicating manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliances, and similar essential operating data. Locate nameplates in easily-read locations; except where product is visually exposed in occupied areas of building, locate nameplate in concealed position (where possible) which is accessible for reading by service personnel.

B. Field Applied:

1. Provide plastic-laminated nameplates at each piece of equipment including, but not limited to, panelboards, disconnect switches, and cabinets.
2. Panelboard: Nameplates shall designate panel number and voltage. Typewritten branch circuit connector sheet shall be inserted within the card holder provided by panelboard manufacturers. Branch circuit designations shall be made only after the load balancing of the panelboards has been completed.
3. Disconnect Switches and Motor Starters: Nameplates shall describe the equipment to be controlled and power circuit number.
4. Install nameplate and label parallel to equipment lines.
5. Secure nameplate to equipment front using screws or rivets.
6. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations using adhesive.

END OF SECTION

SECTION 16471

BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Branch circuit panelboards rated 600 volts or less.

1.3 SUBMITTALS: Submit the following in accordance with Section 16010.

A. Product data for each type panelboard, accessory item, and component specified.

B. Shop drawing from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

C. Provide U.L. category and file number for products.

D. Panel schedules for installation in panelboards. Submit final versions after load balancing.

E. Maintenance data for panelboards components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

F. Manufacturer's installation instructions.

G. Warranties.

H. Submittals in this Section shall also be signed by Division 13 and 15, subcontractors to verify over-current devices are acceptable where applicable.

I. Submit one original copy of NEMA PB1.1.

1.4 QUALITY ASSURANCE: Comply with the following.

A. NEMA Standard: Comply with NEMA PB1, "Panelboards" and NEMA AB1 Molded Case Circuit Breakers and NEMA PB1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards rated 600 volts or less.

B. U.L. Standards: Comply with U.L. 67, "Panelboards," U.L. 50, "Enclosures for Electrical Equipment," U.L. 489, "Circuit Breakers" and U.L. 943 "Ground Fault Circuit Interrupters."

1.5 EXTRA MATERIALS

A. Keys: Furnish six spares of each type for panelboard cabinet locks.

B. Touch-up Paint for surface-mounted panelboards: One half-pint container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. General Electric Co.
2. Square D Co.
3. Cutler Hammer

2.2 BRANCH CIRCUIT PANELBOARDS

A. NEMA PB1, U.L. 67 circuit breaker type, 40 degree ambient.

B. Bussing: Tin-plated copper, ratings as indicated. Provide non-insulated copper ground bus in each panelboard. Provide isolated copper ground bus in panels where indicated.

C. Molded Case Circuit Breakers: NEMA AB 1, U.L. 489 bolt-on type thermal magnetic trip circuit breakers with common trip handle for all poles. Construct with over-center, trip-free, toggle type operating mechanism with quick-make, quick-break action and positive handle trip indication. Provide breakers U.L. listed as type SWD for lighting circuits. Provide U.L. 943 Class A type 1 ground fault interrupter breakers where indicated. Provide HACR breakers for air conditioning equipment. Do not use tandem circuit breakers. Provide lugs rated at 75 degree C, AL/CU. Series rated main or branch circuit breakers are not acceptable.

D. Cabinet: Surface cabinet front code gauge minimum steel, unless recessed indicated concealed hinge, flush lock all keyed alike, finish in manufacturer's standard gray enamel. Panel door shall be hinged. ALL panels shall be installed in NEMA 3R enclosure.

E. Provide feed-through lugs or sub-feed lugs for two and three section panels.

F. Provide service entrance labeled equipment where required.

G. Provide interior circuit directory frame and card with clear plastic covering.

H. All circuit breakers serving security equipment shall have handle locks.

I. Provide nameplates as indicated in Section 16195.

J. Square D NQOD and NEHB or equal as a minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturer's written installation instructions. Provide NEC working clearance in front of panelboards assuming they will require examination while energized.

B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. Mounting Heights: Top of trim 6'-10" above finished floor, except as indicated.

D. Install surface mounted panels with a minimum of six anchors.

E. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

F. Provide steel channel supports to stand panels one inch off walls in wet locations.

G. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

H. Install filler plates in unused spaces.

I. Provision for Future Circuits at Flush Panelboards: Stub four 1" empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future. Stub four 1" empty conduits into raised floor space.

3.2 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification."

3.3 GROUNDING

A. Connections: Make equipment grounding connections for panelboards.

B. Provide ground continuity to main electrical ground bus indicated.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in U.L. 486A and U.L. 486B.

3.5 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.6 FIELD TESTING: Provide in accordance with Section 16950

END OF SECTION

SECTION 16510

EXTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Exterior fixtures mounted to buildings.
B. Lamps.
C. Accessories.

1.3 SUBMITTALS**:** Submit the following in accordance with Section 16010.

A. Product Data: Submit manufacturer's data on lighting fixtures, including photometric data (optical performance rendered by independent testing laboratory), such as coefficients of utilization, visual comfort probability, candlepower data and curves, zonal lumens, etc. Submit manufacturer's data for all louvers, lenses and other products determined necessary by the Architect.

B. Shop Drawings: Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in fixture "type" alphabetical order with proposed fixture and accessories clearly indicated on each sheet. Submit additional types where fixtures vary (voltage, ballasts, trim, etc.).

1. Submittal of fixtures listed by manufacturer's name and catalog number shall include the following:

a. A current manufacturer's data sheet (two sets must be manufacturer's original data sheets. Other sets may be copies) or construction drawing for each light fixture type. Duplication of types on a single data sheet or drawing is not acceptable.
b. Fixture options, finishes, electrical characteristics, and lamp type clearly called out on submittal.
c. Construction or installation drawings, to scale, illustrating mounting procedures within each ceiling or wall construction type on project when occurring.
d. A separate lamp submittal with fixtures types in which they are used clearly indicated.

2. Submittal of fixtures shall include all of the above in addition to the following:

a. Fixture photometric test report issued by an approved independent testing laboratory. Tests shall have been conducted in accordance with the recommended testing procedures of the Illuminating Engineering Society of North America and include the following information.
b. Candlepower data, presented both graphically and numerically, in 10 degree increments (0 degree, 5 degree, 15 degree, 25 degree, etc.). Data shall be developed for both up and down light, normal, parallel and at 22.5 degree, 45 degree and 67.5 degree when light output is asymmetrical.

c. Zonal lumens stated numerically at 0-30 degrees, 0-40 degrees, 0-60 degrees, 0-90 degrees and where applicable 90-120 degrees, 90-130 degrees and 0-180 degrees.
d. Coefficients of utilization in numeric form.
e. Total fixture efficiency.

C. Provide UL category and file number for products.

D. Special Finishes: Submit chips for all finishes and colors noted on the schedule to be other than manufacturer's standard finish, to specifically match another project finish, or to be selected by the Architect. Chip shall be minimum 4" x 4" and shall be a true sample of the finish on the fixture material and not merely the color. Submittal shall include a complete description of the finishing process.

E. Lighting Fixture Schedule:

1. Fixture Schedule on the drawings includes type designation, description, application, lamp information, manufacturer's model or series number and special requirements such as finishes, built-in receptacles and switches, control devices, etc.
2. Model or series number specified in the schedule is for identification of type of fixture only to establish basic quality and construction. Exact mounting lens, ballast type, and other components and features shall meet the requirements of this section of the specifications and the intent of the drawings.

F. Warranties.

1.4 QUALITY ASSURANCE: Comply with the following:

A. Manufacturers: Firms regularly engaged in manufacture of lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 500 as applicable to installation, and construction of interior and building mounted exterior lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub/No.'s LE 1 and LE 2 pertaining to lighting equipment.
3. UL Compliance: Comply with UL standards, including UL 486A and UL 1570 fluorescent lighting fixtures, UL 1571 incandescent lighting fixtures, UL 1572 high intensity discharge lighting fixtures, UL 935 fluorescent lamp ballast, UL 1029 high intensity discharge lamp ballasts, UL 1989 standby batteries, UL 542 lamp holders, starters and starter holders for fluorescent lamps pertaining to interior lighting fixtures. Provide interior lighting fixtures, building mounted exterior fixtures and components which are UL-listed and labeled.
4. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

5. ANSI and ANSI/IES: Comply with applicable requirements of ANSI and ANSI/IES Standards pertaining to interior and building mounted exterior lighting fixtures.
6. ANSI C78.1: Fluorescent lamps - rapid start type dimensional and electrical characteristics.
7. ANSI C78.180: Specifications for fluorescent lamp starters.
8. ANSI C82.1: Specifications for fluorescent lamp ballast.
9. ANSI C82.4: Specifications for high-intensity-discharge and low pressure sodium ballasts.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver building lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.
B. Store building lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity, lay flat and blocked off ground.

C. Handle building lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of interior lighting fixtures with other work.
B. Sequence interior lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.7 EXTRA MATERIALS

A. Provide extra lamps of each type installed amounting to 5% of installed quantities but no more than 300 nor fewer than one per lamp type. Deliver to Owner in original packages.

B. Provide 2% of each plastic lens but no less than two of each.

C. Provide 2% of each ballast but no less than two.

PART 2 - PRODUCTS

2.1 FIXTURES AND LAMPHOLDERS

A. Manufacturers: Provide products of manufacturer listed for each fixture in fixtures schedule on the Drawings or approved equal.

B. Description: Provide products meeting requirements listed for each fixture and lampholder in fixture schedule.

C. Service Conditions: Provide products suitable for use under service conditions listed for each fixture and lamp holder in fixture schedule.

D. Accessories: Provide required accessories for mounting and operation of each fixture as indicated.

2.2 LAMPS

A. Manufacturers:

1. General Electric.
2. Sylvania.
3. Phillips.

B. Description:

1. HID Lamps: Phosphor coated.

2.3 HIGH-INTENSITY-DISCHARGE-LAMP BALLASTS

A. Provide HID lamp ballasts, externally fused, capable of operating lamp types with ratings indicated and of starting lamps between -20 degrees F and 105 degrees F; constant wattage auto-transformer type, high power factor, core an coil assembly encapsulated in non-melt resin; provide non-PCB capacitor outside ballast encapsulation for easy field replacement; enclosed assembly in drawn aluminum alloy or cast housing with necessary compartments and with provisions for electrical connections; mount assembly with necessary hardware and vibration dampers.

B. Provide Type M-101 ballasts for low-wattage (75/70E-17) medium screw base metal halide lamps. Encase ballasts for outdoor use in weather-tight enclosures and provide proper outdoor type wiring devices.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Examine adjacent surfaces to determine that surfaces are ready to receive work.

3.2 INSTALLATION

A. Install fixtures and accessories in accordance with manufacturer's instructions.

1. Install lamps in fixtures and lamp holders.
2. Support surface-mounted fixtures from structure. Provide support as shown on drawings.
3. Use seal-tight conduit for connection to the light fixtures.

3.3 ADJUSTING AND CLEANING

A. Align fixtures and clean lenses at completion of work. Thoroughly clean and polish reflectors and photometric surfaces; remove all fingerprints, smudges, and other deficiencies.

B. Clean paint splatters, dirt and debris from installed fixtures.

C. Touch up fixture finishes at completion of work.

D. All fixtures shall have new lamps at completion of work.

END OF SECTION

SECTION 16709

COMMUNICATIONS CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Communications conduit with innerducts.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1 This item will be measured by the linear foot of “Communications Conduit” installed. Each linear foot shall include: conduit (HDPE and Rigid Steel), inner duct, tracer wire, pull tape, marking tape / posts and all incidentals. Conduit shall be measured horizontally along the surface from center of communications service box to center of communications service box or other terminating point. Risers shall be measured as the amount of conduit extending from the ground surface.

2 Payment for the work performed and materials furnished in accordance with this item will be paid for at the unit price bid for “Communications Conduit.” The price shall be full compensation for furnishing and installing conduit; for trenching, boring, excavating, furnishing and placing backfill, replacing pavement structure, sod, riprap, curbs or other surfaces; for marking location of conduit (when required); for furnishing and installing all fittings, junction boxes, special radius sweeps, and expansion joints, conduit straps; and for all labor, tools, equipment and incidentals necessary to complete the work.

PART 2 PRODUCTS

2.01 MATERIALS

Provide new materials that comply with the details shown on the plans and the requirements of this specification.

A. High Density Polyethylene (HDPE) Conduit

Conduit for fiber optic cable shall be Schedule 80 HDPE conduit having a 4 inch internal diameter. The outer HDPE conduit provides a shell of high tensile and compression strength. The outer conduit is orange in color. Conduit shall terminate

without bends if possible. Bends shall be rigid steel conduit; having a minimum radius of 10 times the nominal

HDPE conduit shall be joined by solvent-weld method in accordance with the conduit manufacturer's recommendation. No reducer couplings shall be used unless specifically indicated on the drawings.

B. Inner duct

All HDPE Conduit shall be installed with four (4) one inch (1") polyethylene innerducts. These inner ducts shall be smooth on both the inside and outside to facilitate pulling the inner duct into the conduit and pulling future fiber optic cable into the inner duct. One (1) inner duct shall be provided in each of the following colors: green, blue, red, and yellow. Three feet of the inner duct shall extend beyond the end of the conduit, and coiled inside of the communications service box. The inner duct shall have 900 lb. pull tape.

C. Marking Tape / Posts

Underground marking tape will be used in all areas where trenching is utilized to install underground conduit. Use marking tape in conjunction with marking posts and marking discs.

The technical specifications of underground marking tape are identified below, along with applicable testing methods necessary to establish that a cable submitted for approval meets these specifications.

TEST THRESHOLD PROPERTY SPECIFICATION REQUIREMENTS Standard Weight ASTM D2103 20 lbs/100 feet Thickness – Overall ASTM D210 4 mil 3 in. Tensile Break – MD ASTM D882 35 lbs/ft 3 in. Tensile Strength – MD ASTM D882 4 kpsi 3 in. Tensile Break – TD ASTM D882 38 lbs/ft 3 in. Tensile Strength – TD ASTM 882 5 kpsi Elongation – MD – MD ASTM 882 530 % Elongation – TD – TD ASTM 882 660 % Tear Strength ASTM D2261 1.5 lbs/ft

Underground marking tape will be a 3-inch wide, tear resistant, corrosion resistant elastic PVC orange tape, imprinted with the legend "CITY OF HOUSTON BURIED CABLE – CALL TRAFFIC OPERATIONS at 713-881-3172". This legend will be printed every three (3) feet in black letters.

Underground cable marking posts will be used everywhere feasible and practical in all areas where fiber optic cable is installed in underground conduit. This is the preferred method of marking, since it is very visible. Marking posts should be placed every 500 feet in urban area, and every 1000 feet in suburban areas, as well as at every intersection corner and every change in direction. Exception would be locations like downtown where all surfaces are paved, where discs would be more practical.

Use marking discs set in concrete or pavement where the use of marking posts is not feasible and practical, i.e., areas such as downtown where everything is paved and for aesthetics.

Technical specifications of underground marking posts are identified below.

1 Line Markers will be made from ultraviolet-stabilized High Density Polyethylene (HDPE)
2 Minimum 3-1/2" O.D. tubular design
3 Text will be hot-stamped into the fittings with an extra u-v clear coat.
4 Crossing casing vents will be used to help maintain atmosphere conditions.
5 Line markers will require no maintenance after installation

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

A. General

Place conduit in accordance with the lines, grades, and details shown on the plans or as directed. Conduit shall be buried a minimum of 30 inches deep underground unless otherwise shown on the plans. Fit conduit terminations with bushings or bell ends

Prior to installation of innerduct/cables, pull a spherical template of at least 75% of the inside diameter of the conduit/inner duct through the conduit/innerduct to ensure that it is free from obstruction. Cap or plug empty conduit places for future use

Conduit shall have 30 degree sweeps into communications service boxes or cabinets. Conduit bends shall have a minimum radius of 18 inches.

When installing the multiduct conduit, the outer shell and innerduct shall be continuous (without splices) up to 800 feet from communication service box to communication service box.

Where existing surfacing is removed for placing conduit, repair by backfilling with material equal in composition and density to the surrounding areas. Immediately repair any damaged

Any obstructions to the trenching / boring operation such as utilities, structures, sprinkler systems, etc. are to be protected from damage by the contractor during construction and until the work is completed. In the event of damage, the contractor shall be responsible for the repair / replacement at his expense with materials and methods which leave the damaged items in as good or better condition than original. Immediately after installation of conduit, backfill pits, excavation or trenches.

B. Trenching

No trenching shall be allowed within 5 feet of a tree. Where the depth of conduit changes, the trench bottom shall have a slope of 3 / 1 (horizontal / vertical) to accommodate the depth change

C. Boring / Jacking / Directional Drilling

Boring shall be the preferred method of excavation unless specified otherwise in the plans. When indicated on the plans, conduit crossing existing pavement shall be placed by jacking and boring methods. The boring and jacking method used shall be approved by the Engineer prior to commencing work

Excavate suitable pits for conducting boring operations (clearly mark/protect excavation to avoid injury by public). Pits shall be kept 2 feet clear outside of the pavement edge. Install conduit so there is no interference with street operation or no structure is weakened or damaged.

Unless otherwise specified in the plans, the method and equipment used in jacking casing or pipe shall be optional with the contractor, provided that the proposed method is approved by the Engineer. Heavy duty jacks suitable for forcing pipe through the embankment shall be provided by the contractor. Uniform pressure shall be applied from all jacks. Pressure shall be transmitted evenly around the ring of the pipe through an approved jacking head.
Once boring / jacking operations have begun, the boring / jacking shall be continuous, without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment

Material excavated ahead of the pipe shall be removed through the pipe. Jetting will not be permitted except as approved by the Engineer. The diameter of the excavation shall conform as closely as practicable to the outside diameter and circumference of the pipe being jacked.

D. Tracer Wire

One (1) No. 6 AWG Green, unspliced THW/XHHW wire shall be installed in each conduit. The Tracer Wire shall be pulled inside of the fiber optic conduit in the voids outside of the innerducts. Lubricants used in pulling the tracer wire shall be water soluble. A minimum of 5-feet of wire shall be coiled, and secured, in the communications service box. The ends of all tracer wire within a communications service box shall be connected to a common lug to allow for locating multiple segments of conduit run with one setup of the detection equipment

E. Pull Tape

No pull ropes, twine, or pull strings will be used on this project for the purpose of installation. Further, if the plans and specifications indicate pull tape for future use do not substitute pull ropes, twine or pull strings for pull tape.

Pull tape will be prefabricated woven polyester tape made from low friction, high abrasion resistant yarns providing a low coefficient of friction. Pull tapes will be prelubricated. Pull tapes will be printed with sequential footage markings for accurate measurement. Pull tapes will be ½ inch wide and have a minimum tensile strength of 1,250 pounds.

F. Sealing

After installation of cables and wires the conduits shall be sealed / plugged with a suitable compound so as to prevent the entrance of moisture or gases.

G. Submittals

Manufacturers' cut sheets / specifications for all equipment proposed under these specifications shall be submitted to the City of Houston's Traffic Signal and Operations branch at Houston TranStar (713-881-3172) prior to construction.

END OF SECTION

SECTION 16710

PULL BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pull boxes of the various types and sizes required complete with lids

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1 Payment for this item will be measured as each ground box and or extension by type, complete in place. Concrete aprons, if required, will be measured as each pull box with concrete apron, complete, in place.

2 Payment for the work performed and materials furnished in accordance with this item will be paid for at the unit price bid for "Pull Boxes" of the various types and sizes specified. The price shall be full compensation for excavating and backfilling; for constructing, furnishing and installing the pull boxes and concrete rings when required; for concrete and reinforcing steel; and for all labor, tools, equipment and incidentals necessary to complete the work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide new materials that comply with the details shown on the plans and the requirements of this specification

B. All pull boxes shall be constructed of polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement may be provided by means of steel, fiberglass, or a combination of both. Chopped fiberglass, polyethylene, or polystyrene are not allowed for internal reinforcement.

C. The material used to shall have the following minimum allowable properties: Compressive Strength: 10,000 psi Flexural Strength: 7,000 psi Tensile Strength: 1,500 psi

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Installations shall be in commercial and residential sidewalks and behind curbs where no deliberate traffic is planned.

2. Pull boxes and extensions shall be furnished in the following nominal sizes (Width X Length X Depth)

3. Each enclosure shall be designed and constructed flush to grade with the cover fitting flush to the box.

4. Each enclosure shall be suitable for installation in either direct or buried native soil, embedded in concrete or embedded in asphalt surfacing. A concrete collar shall be furnished for each installation in asphalt, or where called for on the plans

5. All enclosures shall withstand shipping and installation practices without chipping, cracking, or structural damage. Any pull box damaged, or cracked, during installation shall be replaced by the Contractor

6. All pull box covers shall be equipped with a minimum of two stainless steel lockdown mechanisms. Multiple piece covers shall be equipped with a means of interlocking with each other, or each section shall be secured with two stainless steel lockdown mechanisms. Tools to unlock the covers shall be furnished. A minimum of one (1) tool shall be furnished with each ten (10) pull boxes supplied. All covers shall have a logo recessed into the cover with the legend, “TRAFFIC SIGNAL” in two-inch minimum height letters, or other as specified by the City of Houston.

7. All covers shall have a recessed access point to allow removal of the cover with a special lifting tool. One lifting tool shall be furnished with each ten (10) pull boxes. The access point shall be located and designed to allow the maximum amount of leverage and safety possible

8. Pull boxes shall be designed and suitable for installation and use through a temperature range of –40 degrees C to 60 degrees C.

9. Material Safety Data Sheets (MSDS) must be attached in a weather tight vessel on each order

10. A certified copy of all test reports shall be signed and sealed by a registered State of Texas Professional Engineer and submitted prior to receipt of shipment

11. All pull boxes and covers shall be rated for a static vertical design load of 15,000 pounds, minimum. All pull boxes must pass a minimum static vertical load test of at least 22,500 pounds. A physical description of the testing methods shall be included with the test reports. Load versus deflection curves shall be provided

12. All pull boxes shall be capable of supporting a lateral load, design bearing pressure, of 600 pounds per square foot. Lateral load testing shall be applied to the longest dimension. The load shall be transmitted by a flat, rigid plate 24 inches wide by the depth dimension of the enclosure, bearing against any suitable medium which will conform to the shape and angle of the enclosure sidewall to achieve uniform loading.

13. Pull box Vertical Load Testing: The 15,000 pounds design load and 22,500 pounds testing load shall be distributed over a 5 inch by 10 inch area. All covers shall be tested, installed on a typical pull box. The loading pad shall be centered on the part of the cover that will produce the maximum deflection under load. A deflection-measuring device shall be used to measure deflection. Deflection under design load shall not exceed:

    Cover ½ inch Pull box ¼ inch per foot of pull box length.

14. Permanent deflection of the cover or pull box shall not interfere with the placement or removal of the cover.

15. All covers shall be skid resistant and should have a minimum coefficient of friction of 0.50 on the top surface of the cover.

16. Any point on the cover must be able to withstand a 70 foot-pound impact with a 12pound weight having a “C” Tup (ASTM D-2444) without puncturing or splitting.

3.02 CONDUIT ENTRANCE TO PULL BOX

A. Hydraulic conduit entrance punchout tools or equivalent shall be used to provide necessary entrances to pull boxes leaving a clean surface area for the insertion of conduit.

END OF SECTION

SECTION 16902

ELECTRICAL CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Cabinets.

B. Contactors.

C. Time clocks.

D. Power supplies.

E. Terminal blocks.

F. Plastic wiring troughs.

G. Miscellaneous.

1.3 SUBMITTALS**:** Submit the following in accordance with Section 16010.

A. Shop Drawings: Provide complete point to point wiring diagrams inside low voltage panels and from panels to control/switching sources. Provide shop drawings indicating all conduit sizes and locations required for switching system.

B. Product Data: Provide for each device specified. Indicate coil and contact ratings, dimensions, cabinets and accessory items.

C. Provide category and UL file number for products.

D. Warranties.

E. Submittals for this section shall also by signed by the subcontractor responsible for Division 13 controls.

PART 2 - PRODUCTS

2.1 CABINETS

A. Factory mount time clocks, power supplies, terminal blocks, wiring troughs and accessories in a NEMA 1 cabinet conforming to Section 16112 Boxes, Cabinets and Metal Wireways by a UL 508 listed manufacturer unless otherwise directed.

B. Contactors shall be individually identified with name tags. All wiring within cabinets shall be pre wired through plastic wiring troughs and brought to terminal blocks for field connections. Wires at terminal blocks and contactors/relays shall be identified by contactor/relay and pole number.

C. Low voltage control wiring shall conform to Section 16123 600V wires and cables.

D. Provide 1/4" minimum spacing between non power limited wiring and power limited wiring.

E. Cabinet and components shall be suitable for installation and operation in a non air conditioned space.

F. Contactor coil power shall be 120 volts or as otherwise indicated.

G. Cabinets shall be lockable, keyed alike. Furnish two (2) keys for each cabinet.

H. Provide wire bending space, clearances, construction, etc. in accordance with NEC-312.

2.2 CONTACTORS

A. Provide mechanically held, electrically operated contactors with quantity of poles indicated, of voltage, and current rating conforming to NEMA requirements.

B. Control coil shall be Class 2 power limited with solid state control accessories as required.

C. Line and low voltage terminals shall be screw type.

D. Contactors shall be manufactured by ASCO, General Electric, Square D, or Westinghouse /Cutler-Hammer.

2.3 TIME CLOCKS

A. Provide 24 hour clock timer manufactured to NEMA ICS 2 and UL 917 "Clock Operated Switches" with two (2) stronomic time setting and 12 hour spring wound reserve power carry over.

B. Manufacturers: Intermatic, Dayton, Paragon, Tork.

2.4 POWER SUPPLY

A. Provide low voltage power supply in conformance with NEC Article 725 Class 2 and UL 1585 "Class 2 and Class 3 Transformers."

B. Provide transformer size, primary, secondary fusing and accessories as required.

C. Manufacturers: General Electric, Square D, Westinghouse, Dormeyer, White Rodgers.

2.5 TERMINAL BLOCKS

A. Conform to NEMA ICS 4 and UL 486A "Wire Connectors and Soldering Lugs for use with Copper Conductors."

B. Provide phenolic, channel mount, screw type terminals.

C. Manufacturers: General Electric, Square D, Westinghouse, Cutler/Hammer, Buchanan, Allen-Bradley, Entrelec, Pass & Seymour/LeGrand, Thomas and Betts, Marathon, Ilsco.

D. Provide UL listed copper ground terminal.

2.6 PLASTIC WIRING TROUGHS

A. Provide open slot vinyl wiring duct with snap on cover conforming to NEMA ICS 6 of width and height as required.

B. Manufacturers: Gould Shawmut, Panduit, Rob Roy, Tyton, Electrovert, Pass & Seymour/LeGrand, Leviton.

2.7 MISCELLANEOUS

Provide miscellaneous items (diodes, solid state relays, logic chips, fuse holders, etc.) as required for a complete operating system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish all labor, materials, tools, equipment, and services for interface with lighting controls, and other control systems as indicated and required by contract

documents. Conduit, wiring and accessories required shall be provided and installed.

B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Mount control panels where indicated on drawings and provide proper NEC working clearance assuming panel will require examination while energized.

D. Use manufacturer's recommended cable size for length of run and relays served.

E. Provide conduit and wire between control panels, power panels, relays and low voltage switches as required to achieve the sequence of operation indicated.

F. Inside relay cabinets, provide 1/4" minimum spacing between non-power limited wiring and power limited wiring. Otherwise, power limited wiring shall be in separate enclosures from non-power limited wiring.

3.2 DEMONSTRATION

A. Provide system demonstration under provisions of contract closeout.

END OF SECTION

SECTION 16950

FIELD ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES

A. Testing by Installing Contractor

1.3 SUBMITTALS**:** Submit the following in accordance with Section 16010.

A. Contractor shall submit experience of individuals who will be performing and evaluating tests before any tests are done.

B. Contractor shall submit in writing at least 24 hours in advance notification of the occurrence of any test described in this section.

C. Contractor shall record all test data and submit three (3) copies for review. In addition to the test data, each record shall include; date of test, ambient temperature, climate conditions, instruments used, names of test personnel and witnesses and identification of items tested.

D. The contractor shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

1.4 QUALITY ASSURANCE**:** Comply with the following.

A. All tests shall be done in accordance with all applicable codes and standards.

PART 2 - PRODUCT (Not Used)

PART 3 - EXECUTION

3.1 RESPONSIBILITY

A. All tests indicate in this specification section shall be done by the contractor including the following:

1. The contractor shall perform routine insulation-resistance, and continuity tests for all distribution and utilization equipment.
2. Balancing Loads: After Substantial Completion conduct load-balancing measurements on panelboards and circuit changes as follows:

    a. Perform measurements during period of normal working load as advised by the Owner
    b. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
    c. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
    d. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

B. Contractor shall supply a suitable and stable source of electrical power to each test site.

C. Work shall be coordinated to expedite project scheduling.

D. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Owner/Engineer's representative replaced or repaired by the Contractor at no cost to the Owner, and retested.

E. An electrical system will not be accepted until tested in its entirety and results reported to the Owner.

3.2 TESTING**:** Contractor shall test the following equipment as indicated in each section:

A. 600V Wire and Cables

B. Panelboards

C. Grounding and Bonding.

3.3 INFRARED SCANNING

A. Provide thermal scanning for panelboards and contactors.

B. After Substantial Completion, but not more than two months after Final Acceptance, contractor shall perform an infrared scan of each panelboard and contactor. Remove fronts to make joints and connections accessible to a portable scanner.

C. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.

D. Record of Infrared Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected and corrected by contractor, remedial action taken, and observations after remedial action.

END OF SECTION

END OF TECHNICAL SPECIFICATIONS

SECTION BB
(List of locations for installation)

Electric Vehicle Charging Stations Level 2 installations- (208/240v- 30amp)

Important Note:

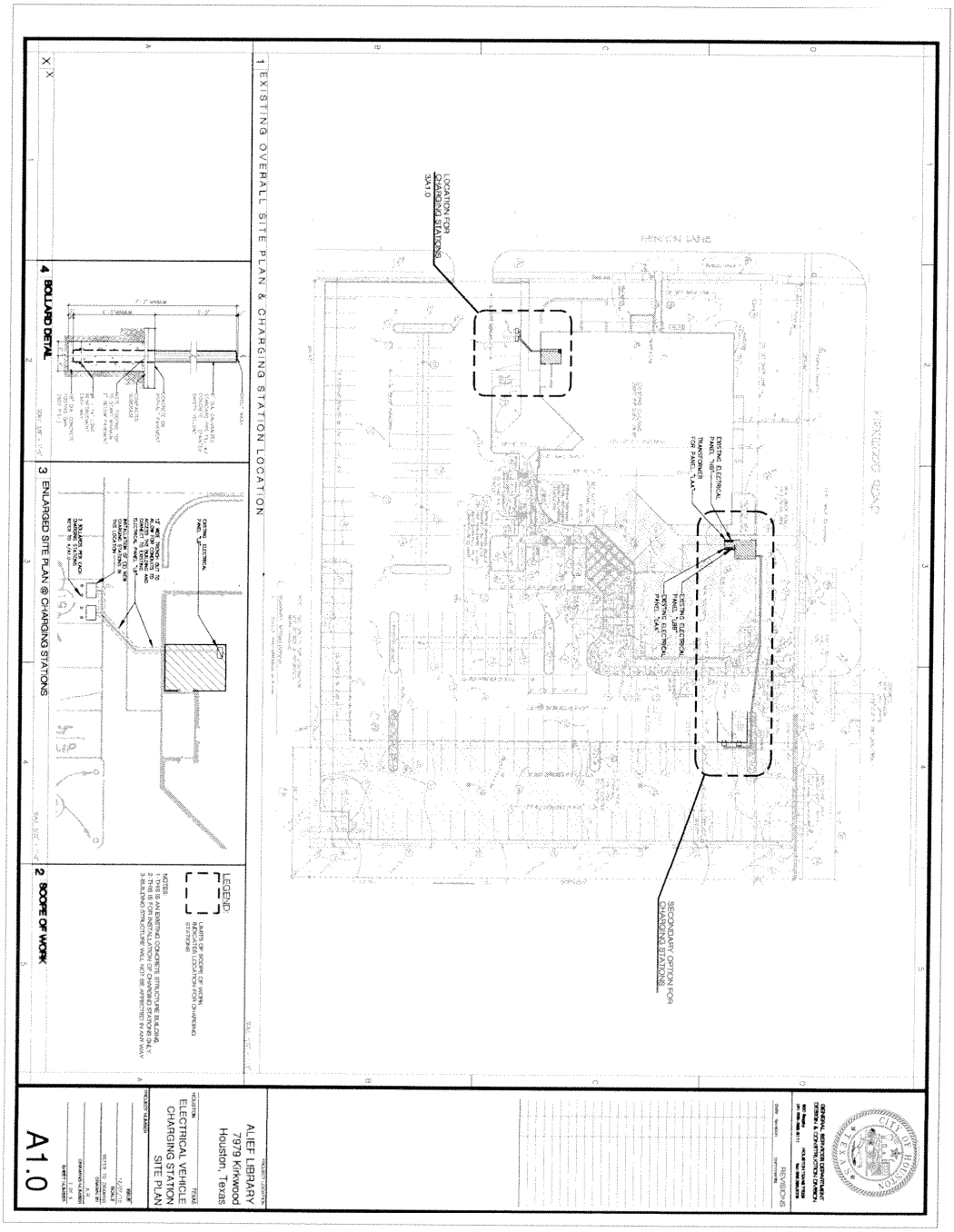
- **All panels shown in this table are only suggestion by City of Houston, General Contractor to by responsible for final decision after field inspection for each of these sites.**
- **All locations to be set up with access to conduit/power source for additional EV units for future use.**

	ADDRESS	CHARGING LOCATION	NO. OF EV UNITS	SUGGESTED PANELS
1	Henington-Alief Regional 7979 South Kirkwood, 77072	SE parking lot adjacent to electrical room	2	LB
2	Robinson Westchase 3223 Wilcrest, 77042	N side of parking near NE corner	4	LD
3	McGovern-Stella Link 7405 Stella Link, 77025	S side near SE corner of bldg	2	L2 or new house panel
4	Central Library 500 Mckinney, 77002	SE end of lower level below electrical room	4	CLCA
5	Park Place Library 8145 Park Place Blvd. 77017	2 parking spaces near water chillers	2	LA
6	Kendall Library 609 N. Eldridge 77079	1st 2 parking spaces at left of entry	4	1LA or 1LA section-2
7	Scenic Woods Regional 10677 Homestead 77016	SW parking lot near bldg	2	LC, LA section-1, LA section-2 & HA
8	Memorial Park W. Memorial Loop Dr.	Northside of park near Tennis Courts	4	Possible new panel
9	Herman Park 6201A Golf Course Dr.	Employee Parking area near staff building	2	Existing panel see plans
10	Houston Transtar	E parking lot near curb	2	E1-LB

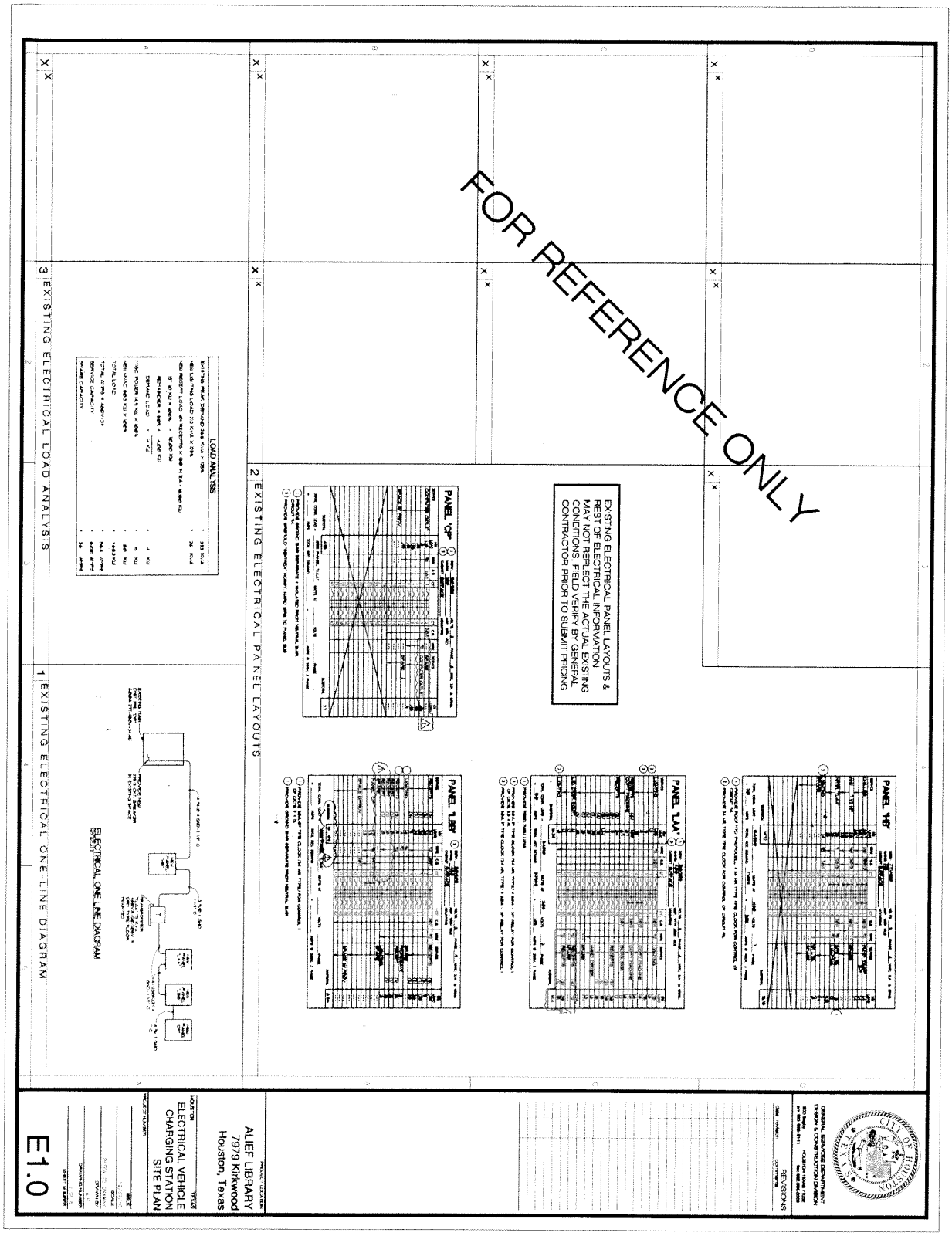
Site installation location drawings provided beginning on page 123.

A PDF version of the Installation Site Drawings can be viewed on the following web link:
https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

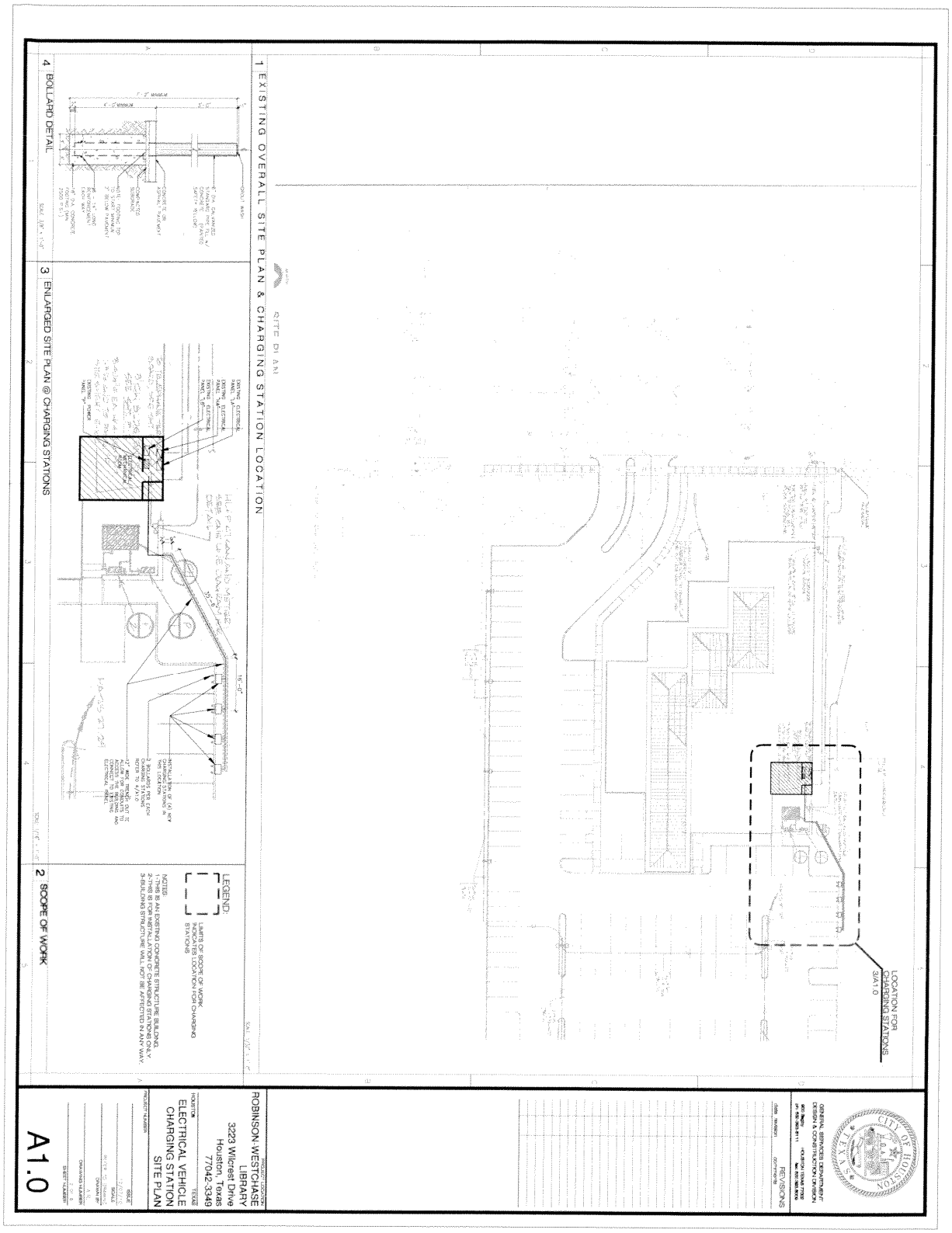
1. Henington – Alief Regional Library Installation Site



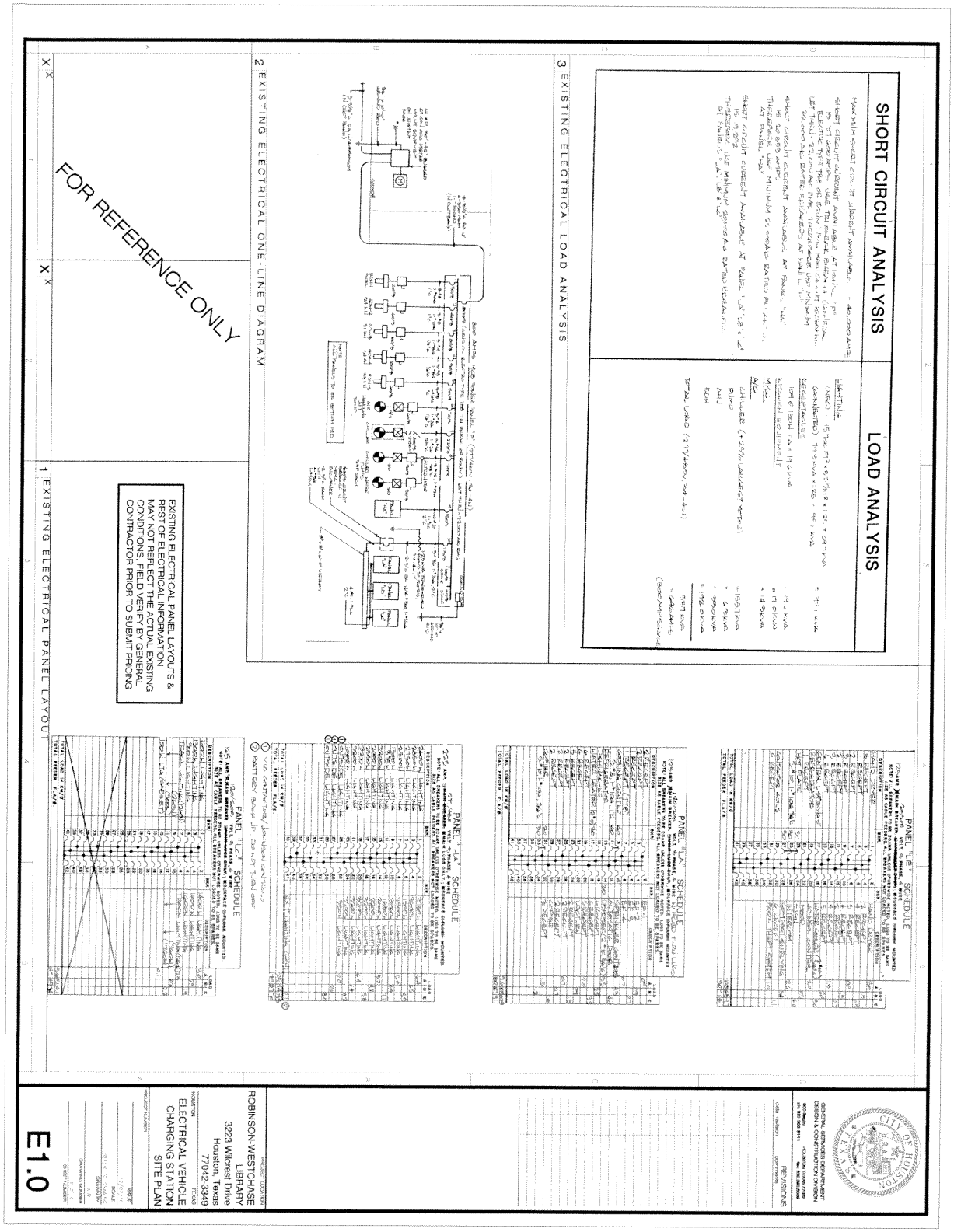
Henington – Alief Regional Library Supplemental Drawing



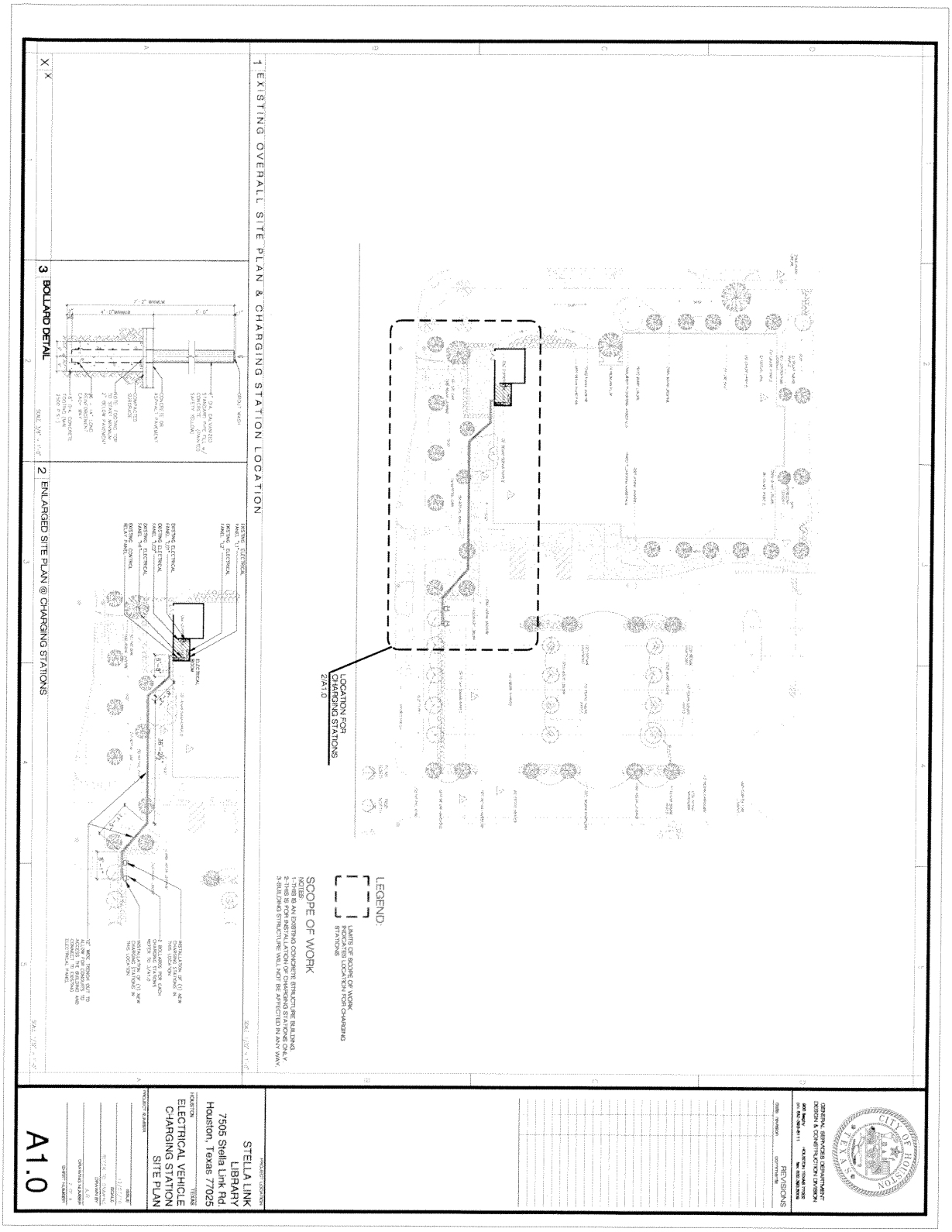
2. Robinson Westchase Library Installation Site

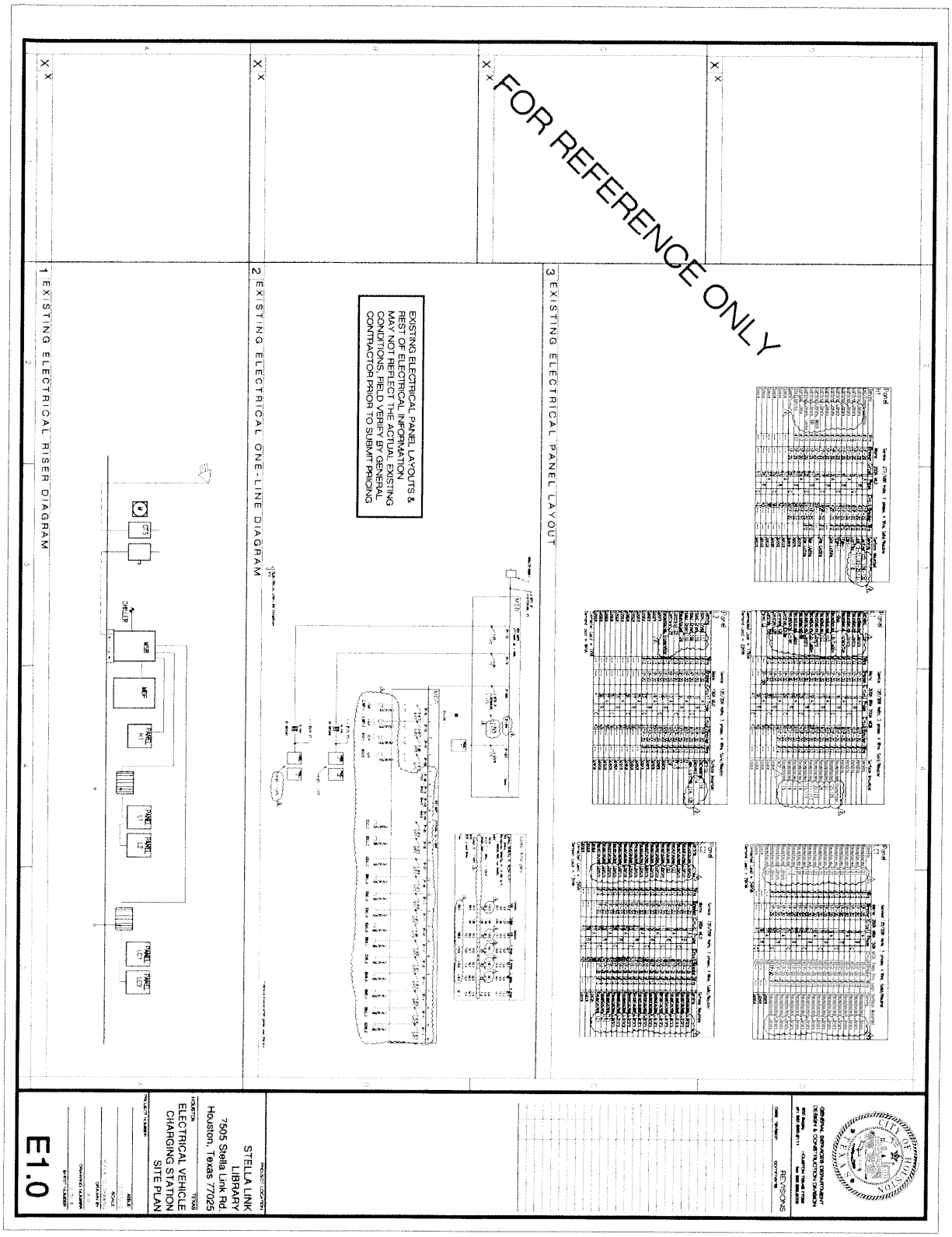


Robinson Westchase Library Supplemental Drawing

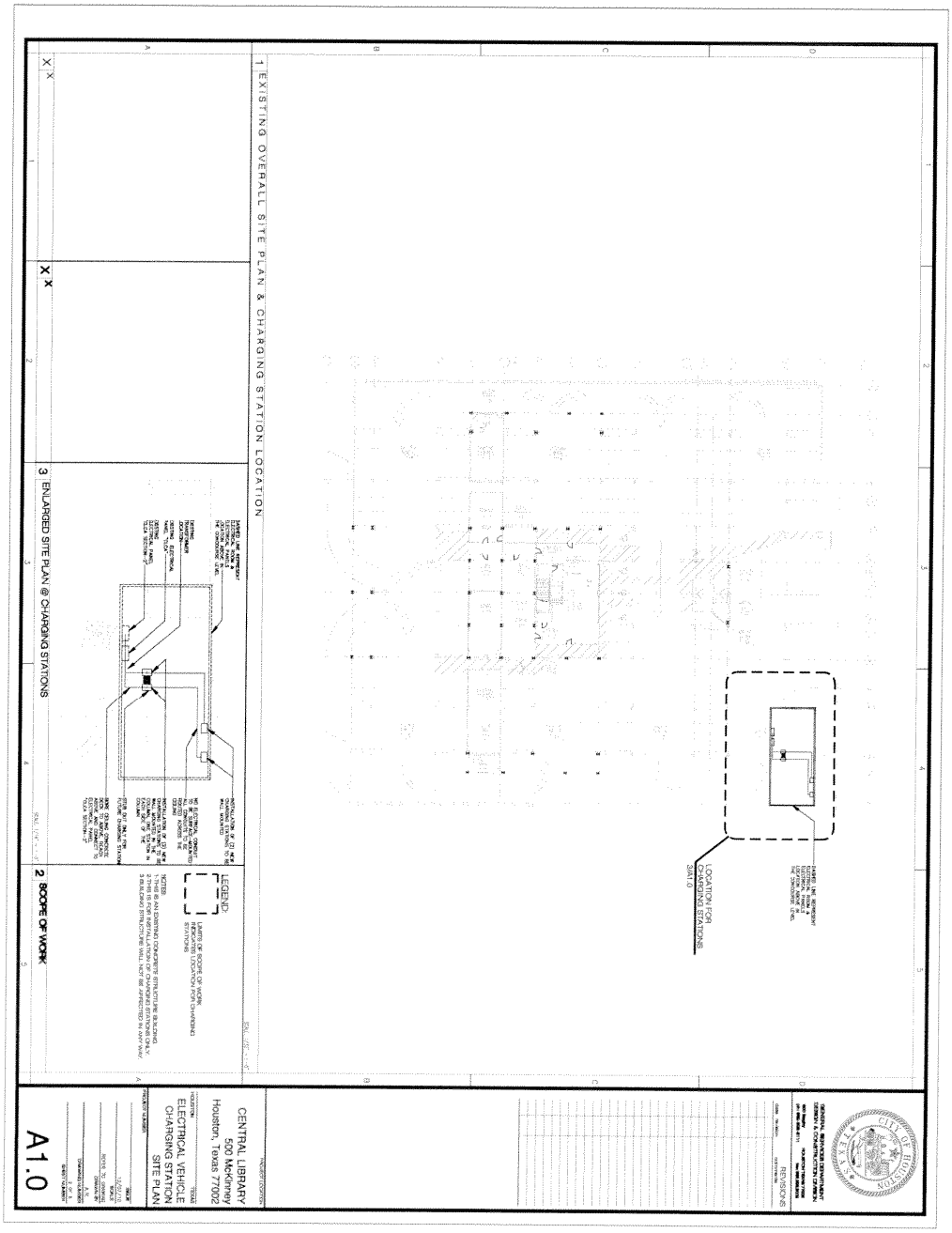


3. McGovern – Stella Link Library Installation Site

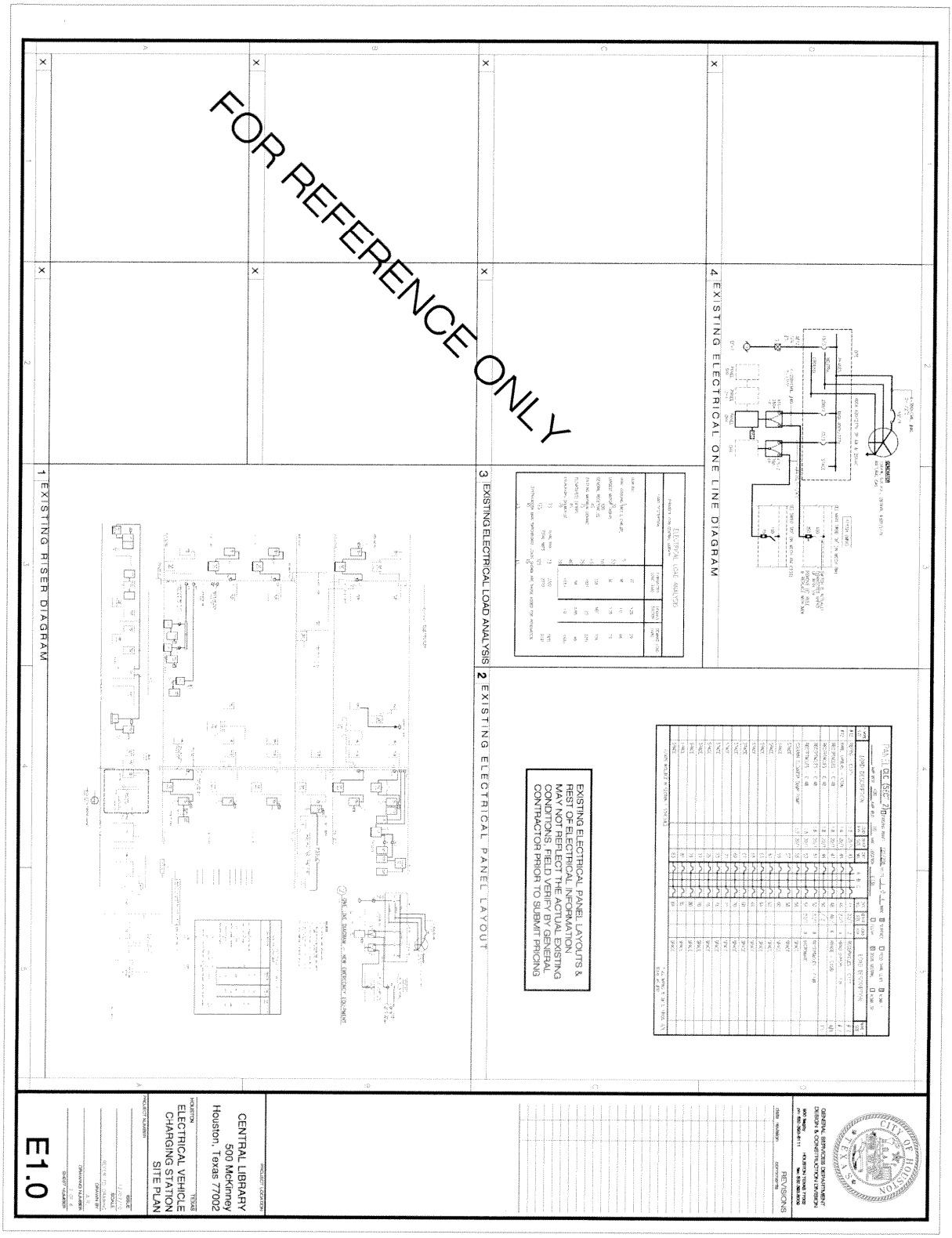



FOR REFERENCE ONLY
EXISTING ELECTRICAL PANEL LAYOUTS & REST OF ELECTRICAL INFORMATION MAY NOT REFLECT THE ACTUAL EXISTING CONDITIONS, FIELD VERIFY BY GENERAL CONTRACTOR PRIOR TO SUBMIT PRICING
1 EXISTING ELECTRICAL RISER DIAGRAM
2 EXISTING ELECTRICAL ONE-LINE DIAGRAM
3 EXISTING ELECTRICAL PANEL LAYOUT
REVISIONS
STELLA LINK LIBRARY
7505 Stella Link Rd.
Houston, Texas 77025
ELECTRICAL VEHICLE CHARGING STATION SITE PLAN
E1.0

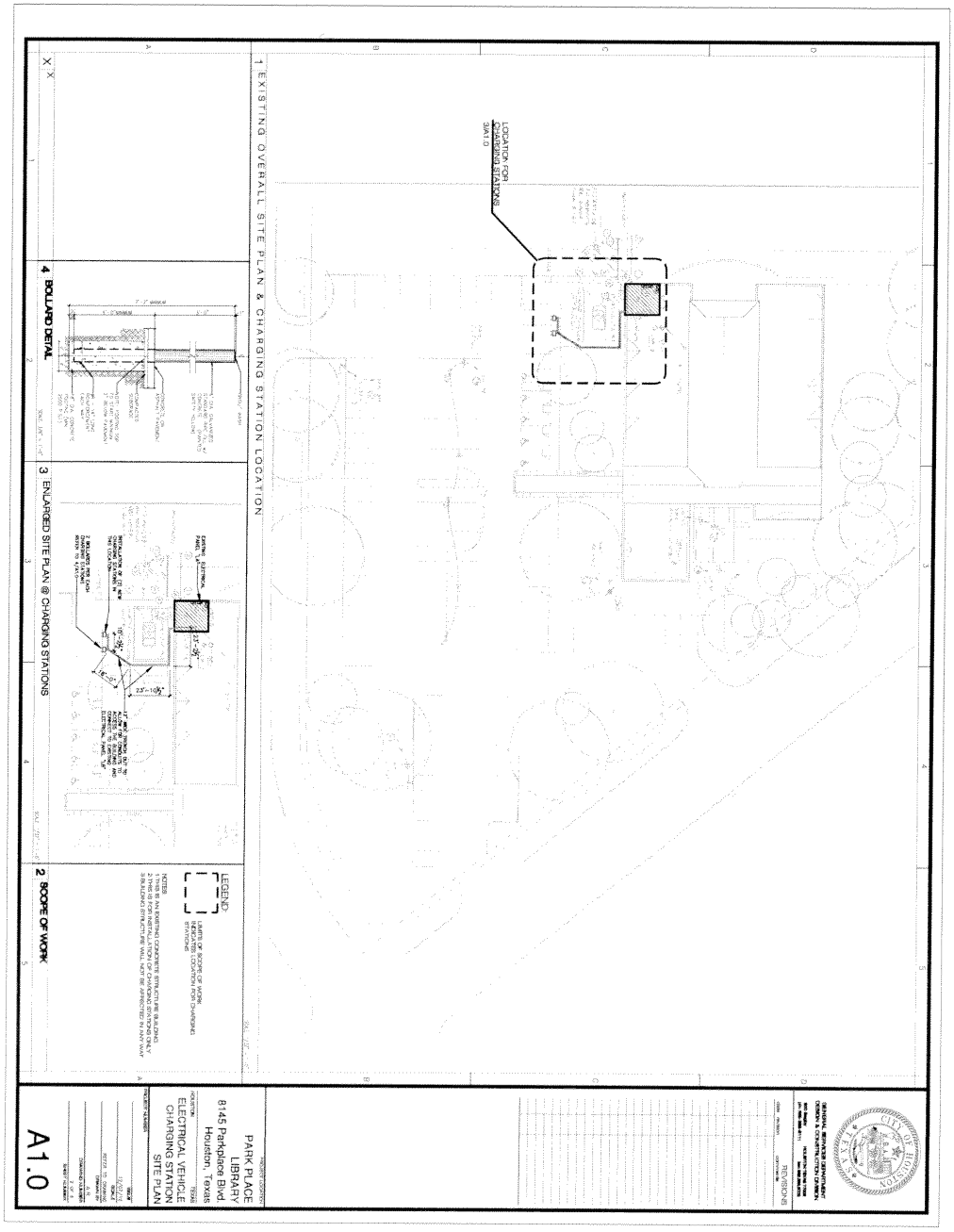
4. Central Library Installation Site

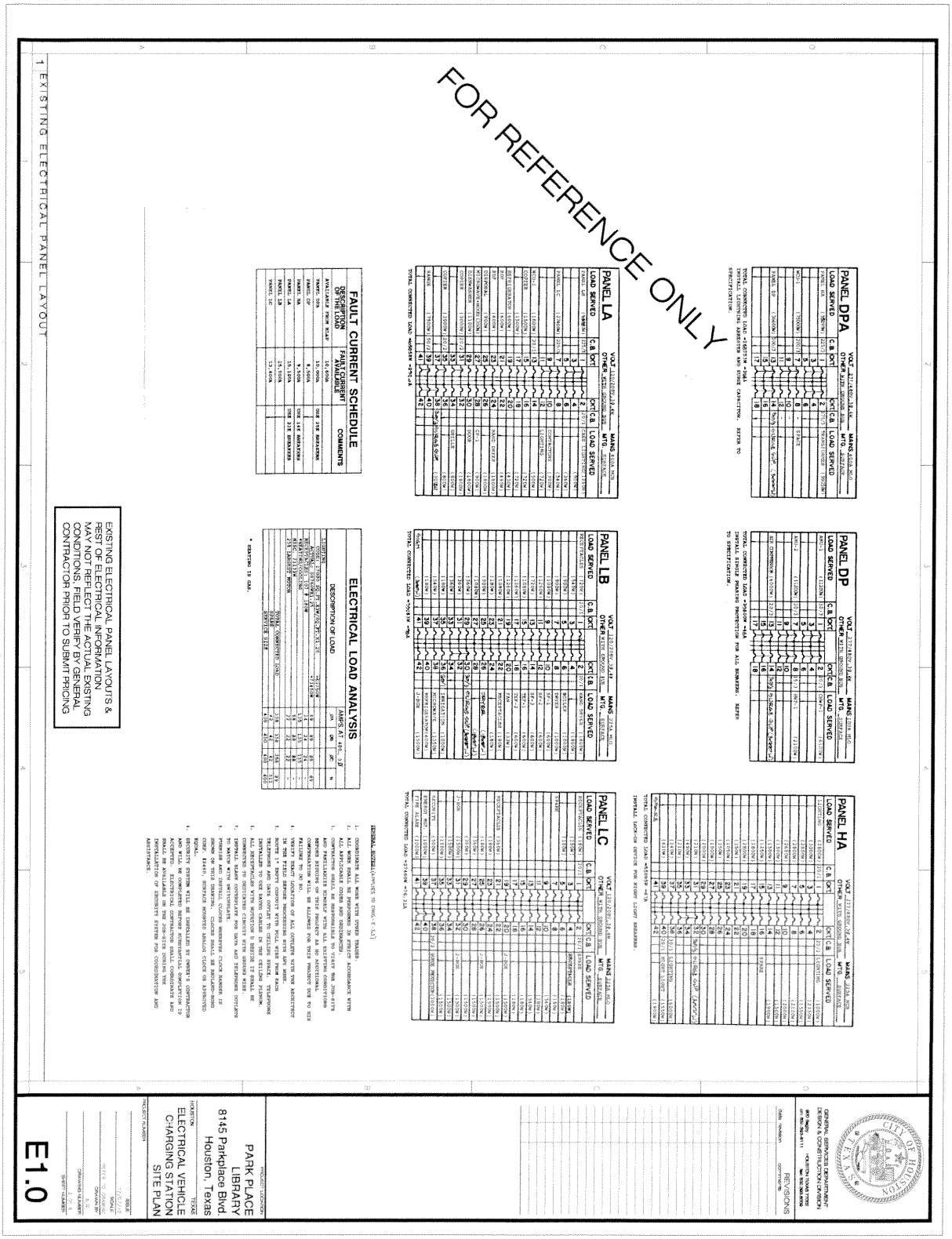


Central Library Supplemental Drawing

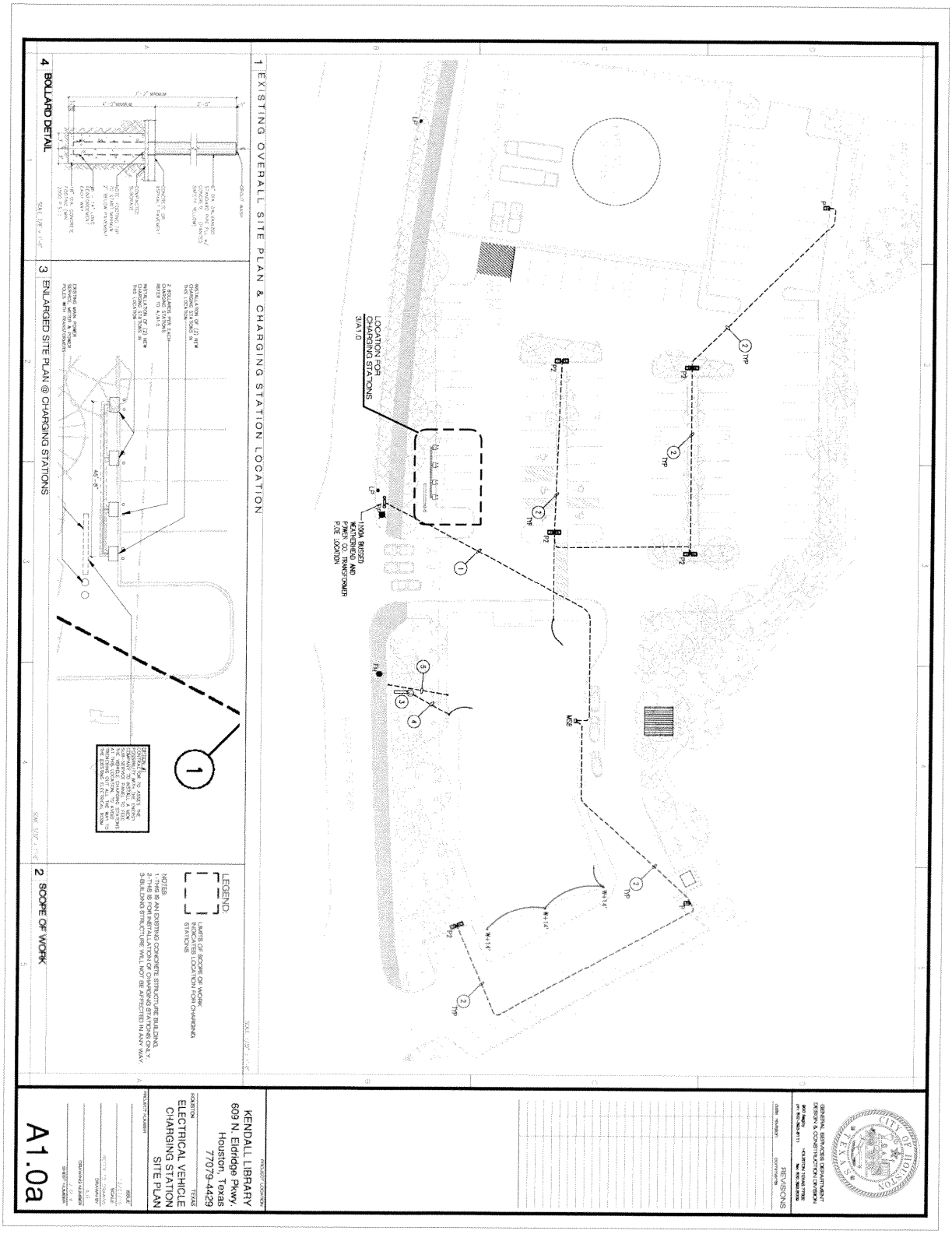


5. Park Place Library Installation Site

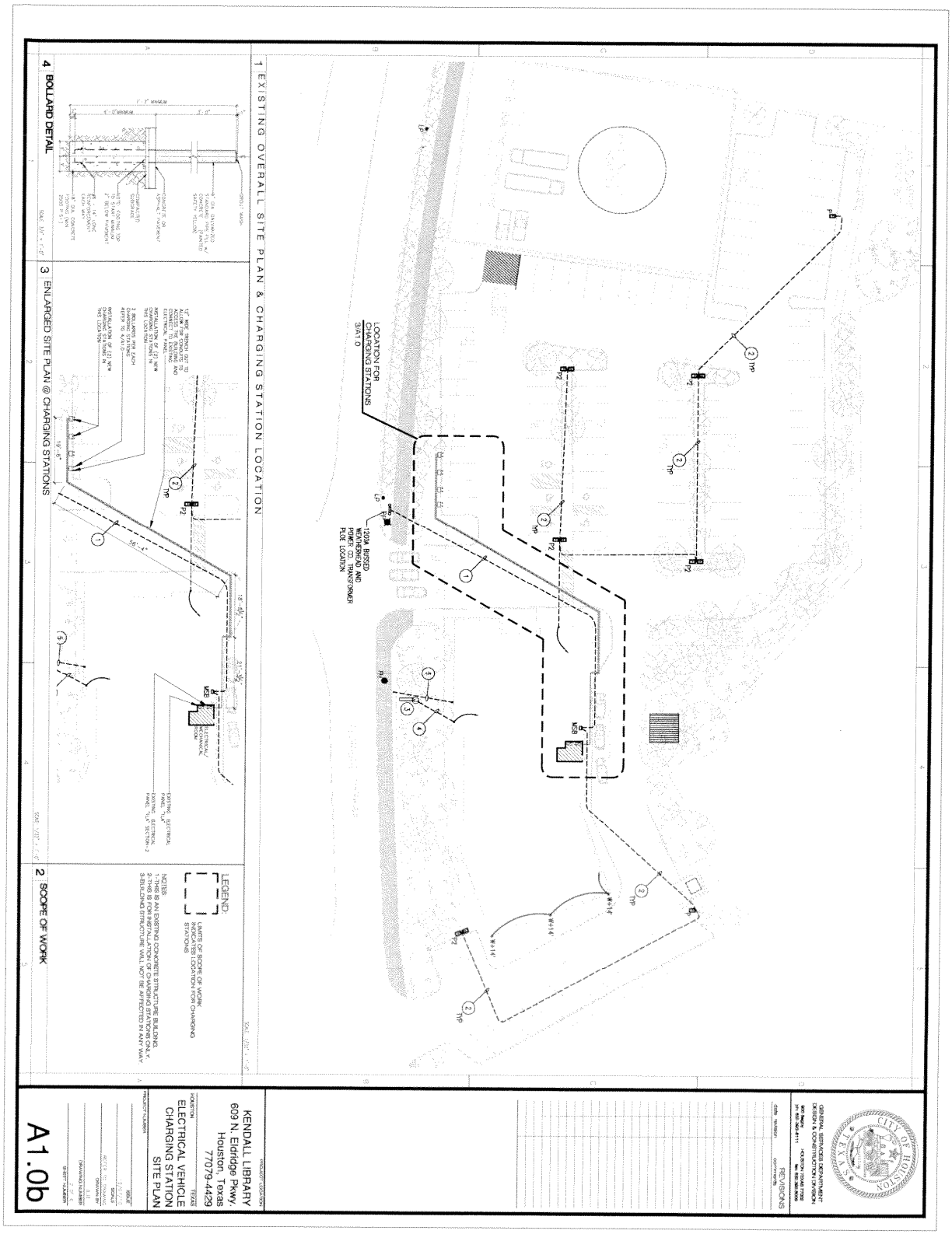



FOR REFERENCE ONLY
PANEL DPA
PANEL DP
PANEL LA
PANEL LB
PANEL LC
PANEL HA
FAULT CURRENT SCHEDULE
ELECTRICAL LOAD ANALYSIS
EXISTING ELECTRICAL PANEL LAYOUTS & REST OF ELECTRICAL INFORMATION MAY NOT REFLECT THE ACTUAL EXISTING CONDITIONS, FIELD VERIFY BY GENERAL CONTRACTOR PRIOR TO SUBMIT PRICING
1 EXISTING ELECTRICAL PANEL LAYOUT
PARK PLACE LIBRARY
8145 Parkplace Blvd.
Houston, Texas
ELECTRICAL VEHICLE CHARGING STATION SITE PLAN
E1.0

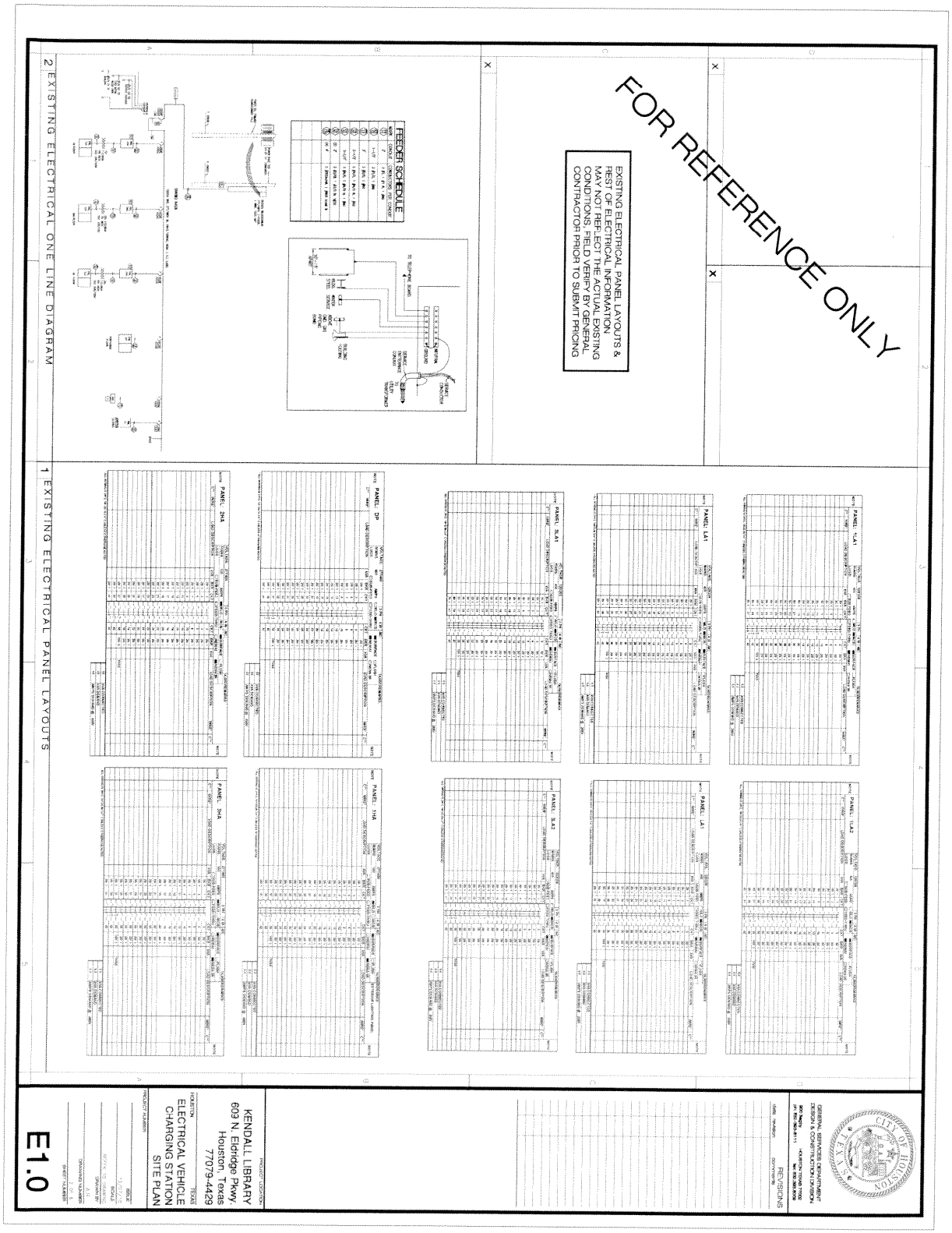
6. Kendall Library Installation Site (a)



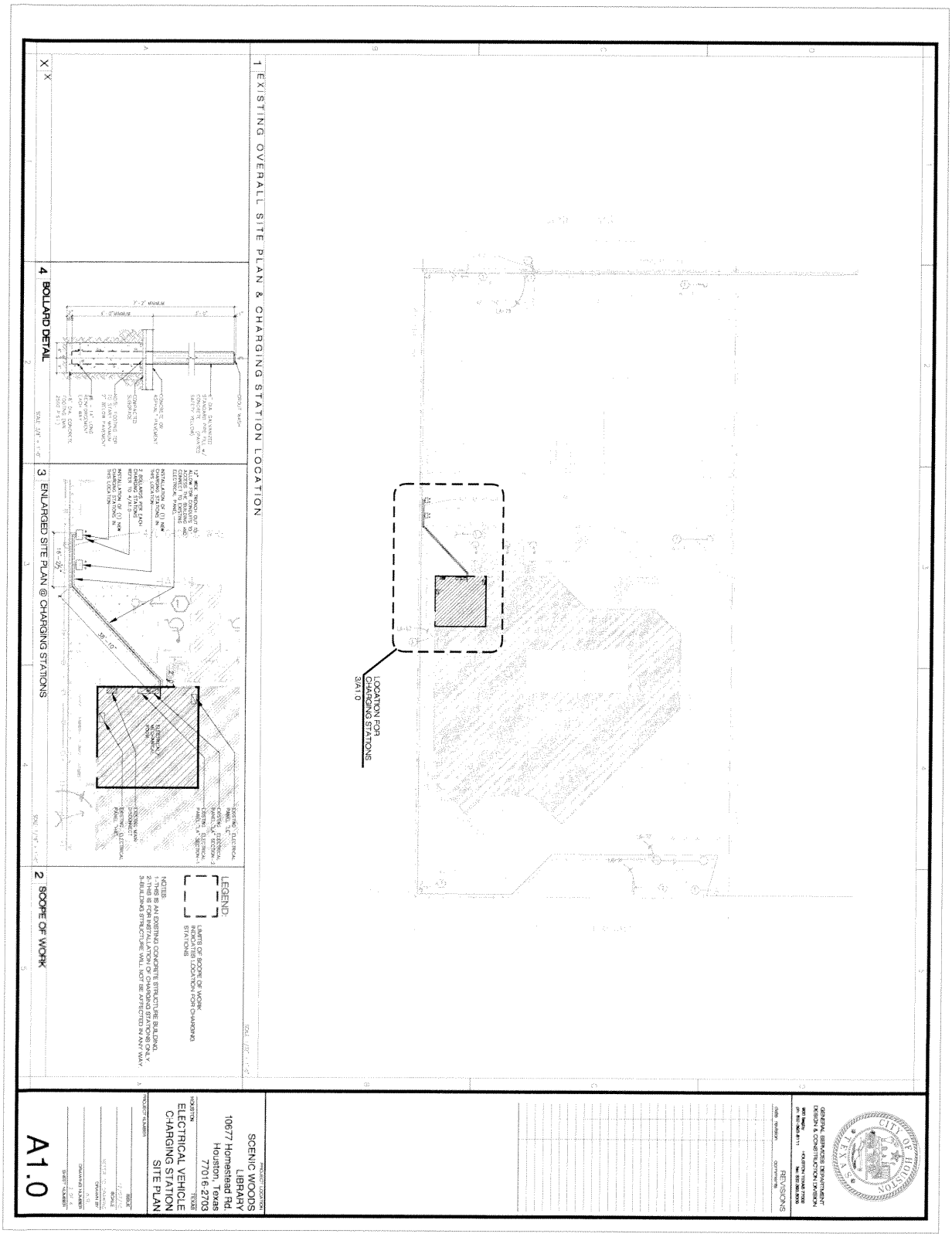
Kendall Library Installation Site (b)

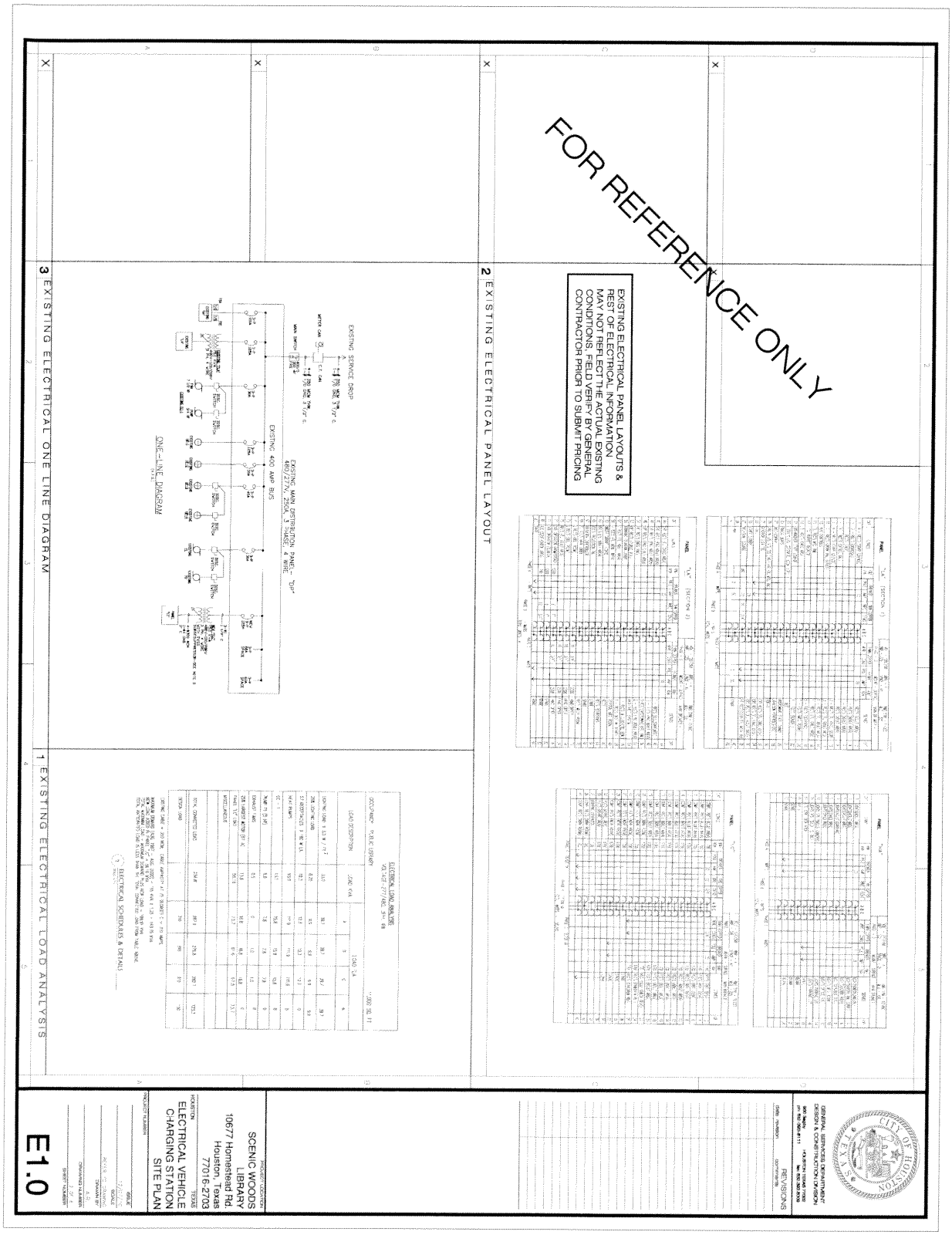


Kendall Library Supplemental Drawing

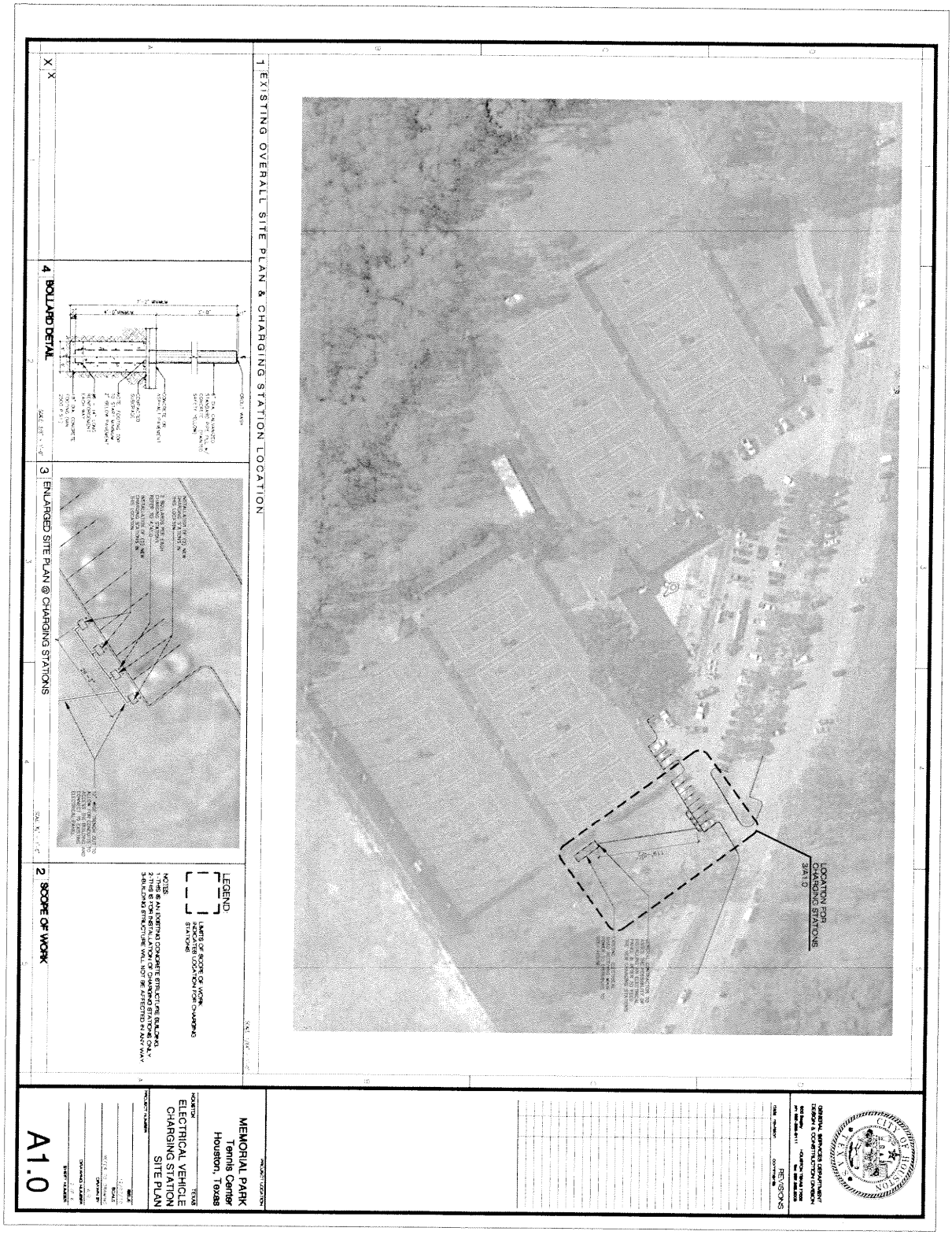


7. Scenic Woods Regional Library Installation Site

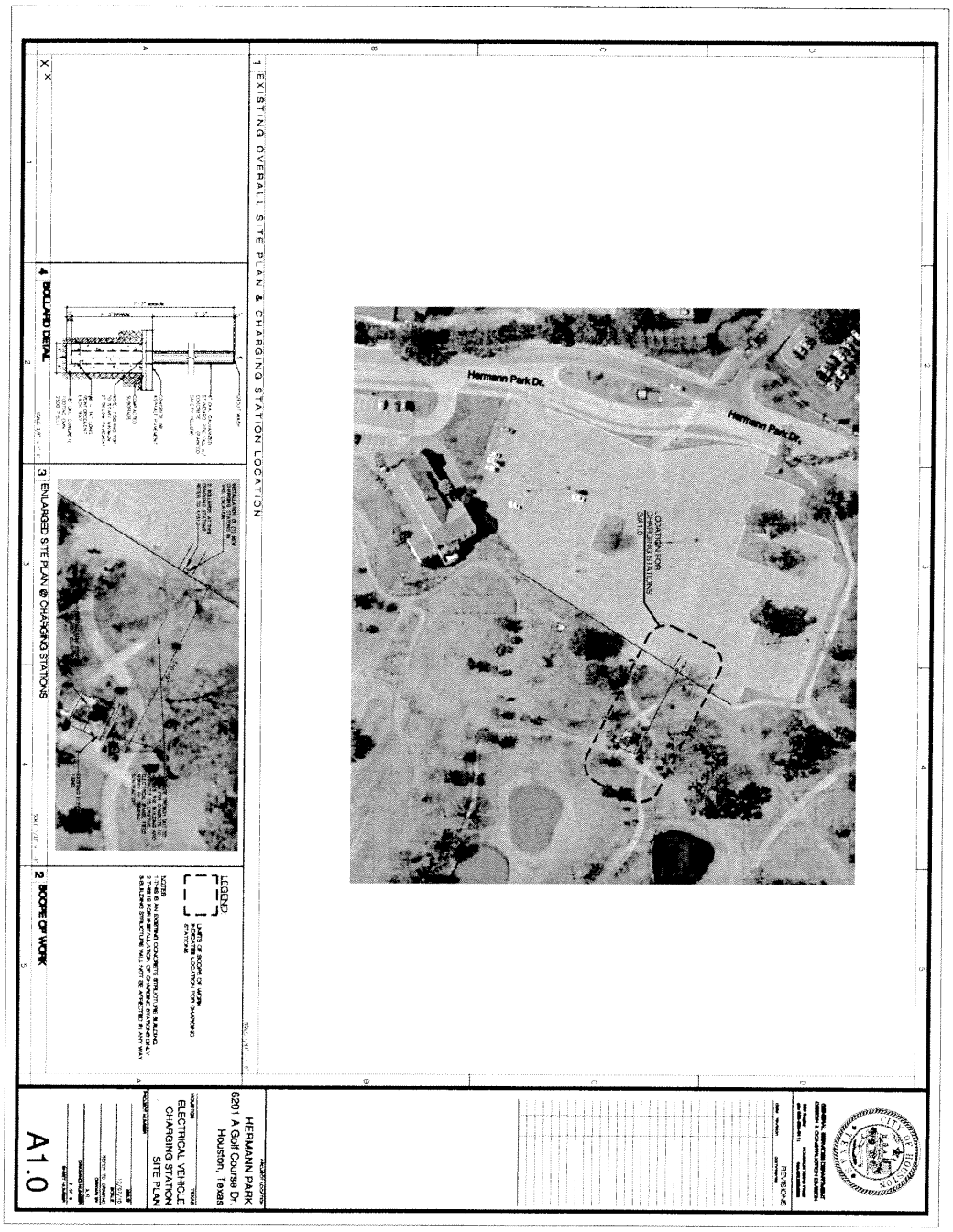



FOR REFERENCE ONLY
EXISTING ELECTRICAL PANEL LAYOUTS & REST OF ELECTRICAL INFORMATION MAY NOT REFLECT THE ACTUAL EXISTING CONDITIONS. FIELD VERIFY BY GENERAL CONTRACTOR PRIOR TO SUBMIT PRICING
2 EXISTING ELECTRICAL PANEL LAYOUT
3 EXISTING ELECTRICAL ONE LINE DIAGRAM
1 EXISTING ELECTRICAL LOAD ANALYSIS
ONE-LINE DIAGRAM
EXISTING SERVICE DROP
EXISTING 400 AMP BUS
EXISTING MAIN DISTRIBUTION PANEL- "DP"
480/277V, 250A, 3-PHASE, 4 WIRE
ELECTRICAL SCHEDULES & DETAILS
CITY OF HOUSTON
GENERAL SERVICES DEPARTMENT
DESIGN & CONSTRUCTION DIVISION
REVISIONS
SCENIC WOODS
LIBRARY
10677 Homestead Rd
Houston, Texas
77016-2703
ELECTRICAL VEHICLE
CHARGING STATION
SITE PLAN
E1.0

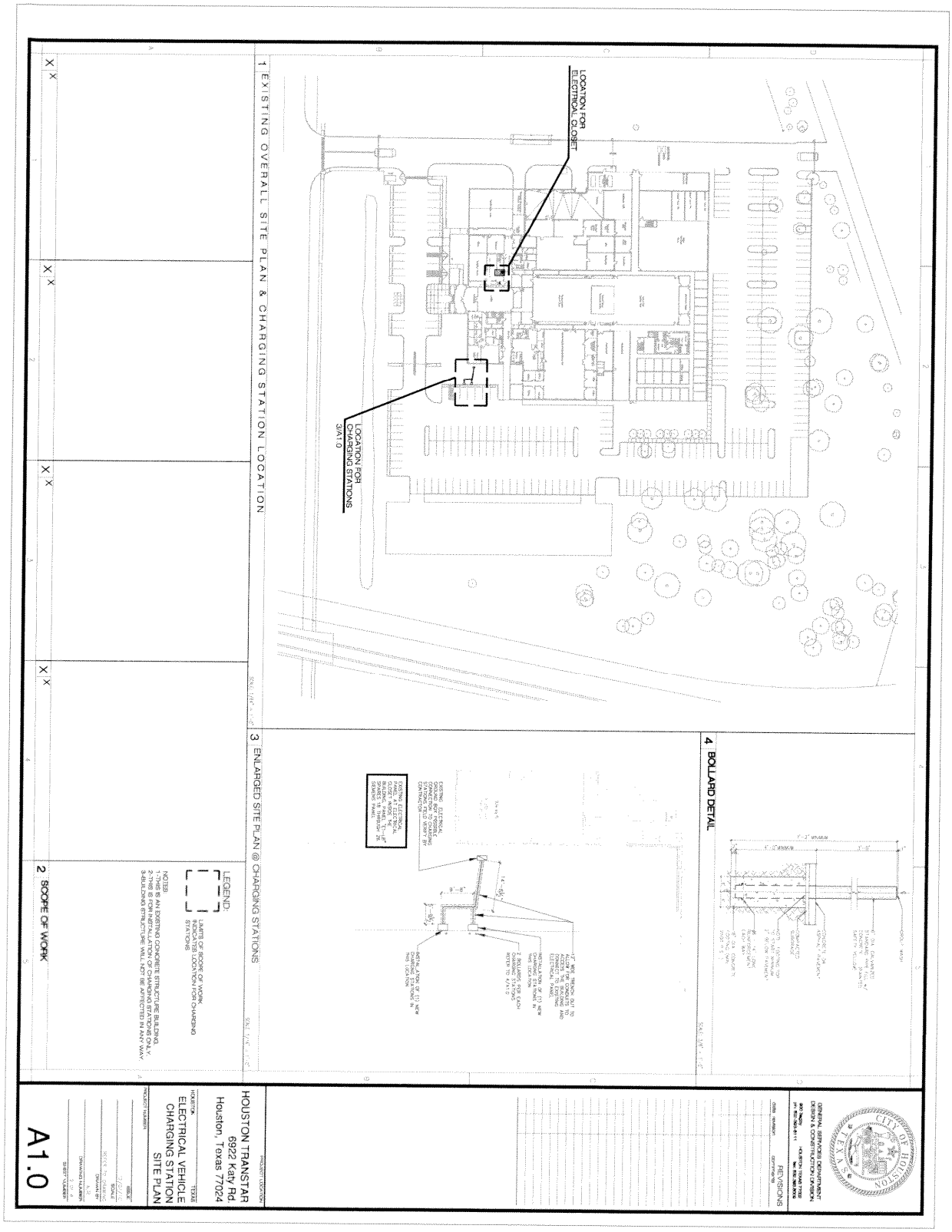
8. Memorial Park Installation Site



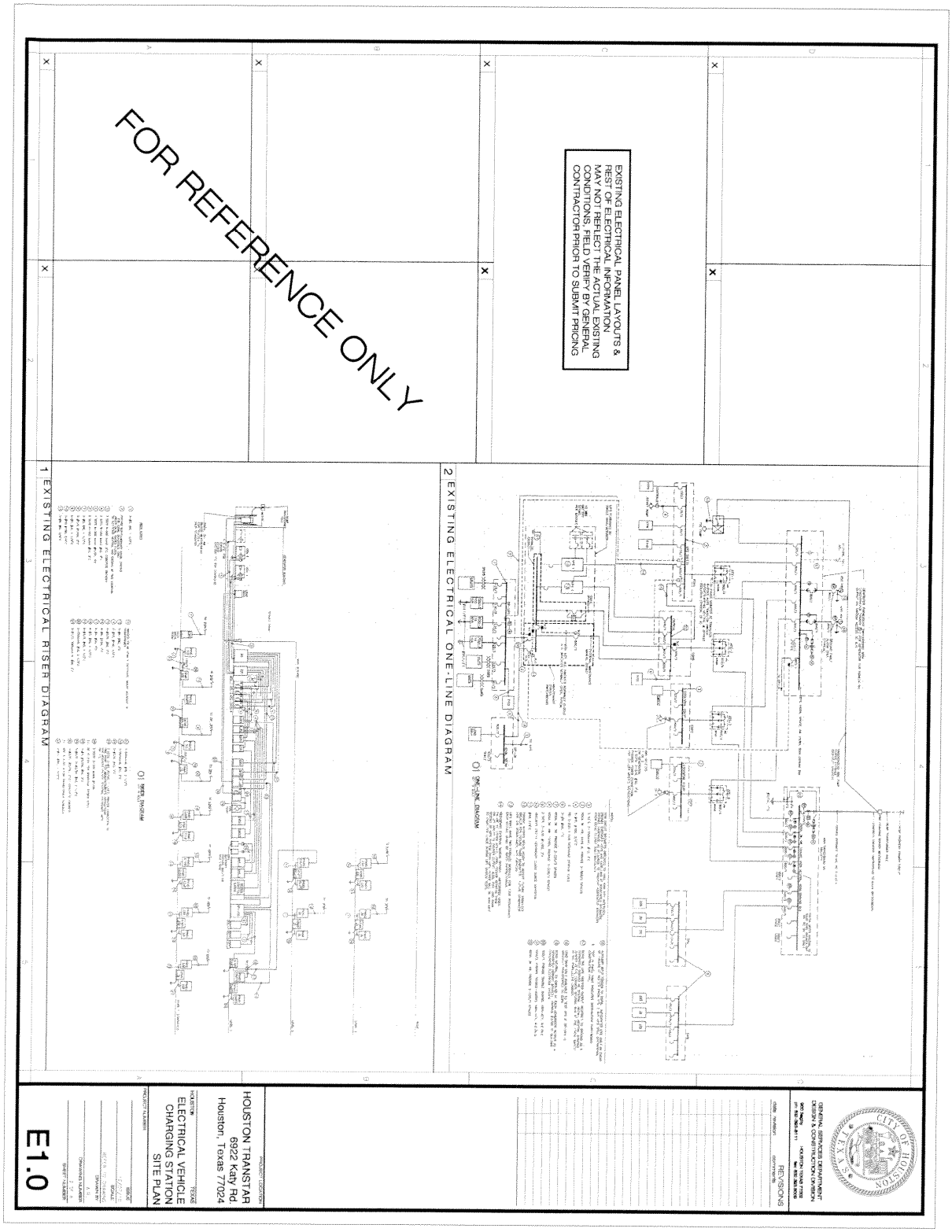
9. Herman Park Installation Site



10. Houston Transtar Installation Site



Houston Transtar Supplemental Drawing



A PDF version of the Installation Site Drawings can be viewed on the following web link:
https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

SECTION C

DAVIS-BACON HIGHWAY WAGE DECISSION
A PDF version of the 2011 Davis/Bacon Highway Wage Decisions can be viewed on the following web Link
https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

GENERAL CONDITIONS
A PDF version of the General Conditions can be viewed on the following web link:
https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23736

Document 00800
SUPPLEMENTARY CONDITIONS

The following Paragraphs amend and supplement the 2005 edition of General Conditions. Unaltered portions of General Conditions remain in effect.

ARTICLE 3 - THE CONTRACTOR

3.5 *LABOR*: *Insert the following Paragraph 3.5.3.1.1.*

3.5.3.1.1 Contractor shall make good faith efforts to comply with the City ordinances regarding Minority and Women Business Enterprises (MWBE) and Persons with Disabilities Business Enterprises (PDBE) participation goals which are as follows:

.1 the MWBE goal is 0 percent, and

.2 the PDBE goal is 0 percent.

3.28 *CONTRACTOR DEBT*

3.28.1 IF CONTRACTOR, AT ANY TIME DURING THE TERM OF THIS AGREEMENT, INCURS A DEBT, AS THE WORD IS DEFINED IN SECTION 15-122 OF THE HOUSTON CITY CODE OF ORDINANCES, IT SHALL IMMEDIATELY NOTIFY CITY CONTROLLER IN WRITING. IF CITY CONTROLLER BECOMES AWARE THAT CONTRACTOR HAS INCURRED A DEBT, IT SHALL IMMEDIATELY NOTIFY CONTRACTOR IN WRITING. IF CONTRACTOR DOES NOT PAY THE DEBT WITHIN 30 DAYS OF EITHER SUCH NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS IN AN AMOUNT EQUAL TO THE DEBT FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE THEREFORE.

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION: Delete Paragraph 8.1.6. and replace with the following 8.1.6.*

8.1.6.1 Contractor shall credit the City by Change Order for inspection services for overtime work or work performed on Sundays or Legal Holidays. The amount Contractor credits the City will be **$50.00 per hour** per inspector for inspection services.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 *UNIT PRICE WORK*: *Delete Section 9.1 in its entirety and insert the following Section 9.1.*

9.1 References to Unit Prices in individual Specification sections are not applicable to the Contract. Include payment for portions of the Work required by these sections in the Stipulated Price for the Contract.

9.12 LIQUIDATED DAMAGES: Insert the following Paragraph 9.12.1.1.

9.12.1.1 The amount of liquidated damages provided in General Conditions Paragraph 9.12.1payable by Contractor or Surety for each and every day of delay beyond Contract Time, are *$500.00 per day.*

ARTICLE 11 - INSURANCE AND BONDS

11.2 *INSURANCE TO BE PROVIDED BY CONTRACTOR: Delete Paragraph 11.2.8. and replace with the following 11.2.8.*

11.2.1.4 Contractor shall provide Owners and Contractor's Protective Liability Insurance only if the contractor's bid price is equal to or greater than $100,000.00.

11.2.8 *Endorsement of Primary Insurance:* Each policy except Workers' Compensation Insurance must contain an endorsement that the policy is primary insurance to any other insurance available to additional insured with respect to claims arising under the Contract.

CITY OF HOUSTON -- BIDDER'S BOND

(Must be in an amount at least 10% of the bid. If the bid is upon alternates this bond must be for at least 10% of the highest amount for which the bidder offers to do any or all the work bid upon.)

THE STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF HARRIS §

THAT WE, _____ as principal and the other subscriber hereto as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation in the sum of $_____ Dollars ($_____).

The condition of this obligation is that: ---

WHEREAS, the said principal is submitting to the City of Houston his or its bid for the doing for the City of Houston of certain work and construction of which the following is a brief description, to-wit: ---

Bid No. S50-C23736

FURNISH AND INSTALL ELECTRIC VEHICLE SUPPLY EQUIPMENT STATIONS

in accordance with the plans and specifications for such work upon which such bid is made, to which plans and specifications reference is made for a more full description of the work and construction referred to.

NOW, THEREFORE, if the said bidder is awarded the contract for such work, the said bidder will, within the time provided in the specifications, enter into a contract with the City therefore upon the form and to the purpose and intent provided in the specifications, will furnish insurance as required in the specifications and will furnish a good and sufficient construction surety bond executed by said bidder and one corporate surety organized under the laws of the State of Texas or authorized to do business in the State of Texas and having a fully paid up capital stock of not less than $100,000.00 and duly licensed and qualified by the Board of Insurance Commissioners of the State of Texas, which bond shall be for an amount equal to 100 percent of the contract price and shall be conditioned in accordance with the requirements stated in the specifications upon which such bid is being submitted.

In the event said bidder is unable or fails to execute said contract for the work proposed to be done, is unable or fails to furnish insurance as specified or is unable or fails to furnish said construction bond in the amount and condition as aforesaid, the undersigned principal and surety shall be liable to said City of Houston for the full amount of this obligation which is here and now agreed upon and admitted as the amount of the damages which will be suffered by the City of Houston on account of the failure of such bidder to so comply with the terms of this bid.

Executed this _____day of _____, A.D. 20__.

PRINCIPAL

By_____

By_____

_____
Surety

ONE-YEAR MAINTENANCE BOND

THAT WE, _____, as Principal, hereinafter called Contractor, and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of $_____, for the payment of which sum well and truly to be made to the City of Houston and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Houston for _____

_____,

all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall comply with the provisions of Paragraph 11.5.1 of the General Conditions, and correct work not in accordance with the Contract documents discovered within the established one-year period, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

WITNESS: (if not a corporation)

Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

PERFORMANCE BOND

THAT WE, _____, as Principal, (the "Contractor"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston (the "City"), a municipal corporation, in the penal sum of $_____ for the payment of which sum, well and truly to be made to the City, its successors and assigns, Contractor and Surety do bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City for _____

_____,

all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall faithfully and strictly perform the Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Contract documents referred to therein and shall comply strictly with each and every provision of the Contract and with this Bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect. Should the Contractor fail to faithfully and strictly perform the Contract in all its terms, including but not limited to the indemnifications thereunder, the Surety shall be liable for all damages, losses, expenses and liabilities that the City may suffer in consequence thereof, as more fully set forth herein.

It is further understood and agreed that the Surety does hereby relieve the City or its representatives from the exercise of any diligence whatever in securing compliance on the part of the Contractor with the terms of the Contract, and the Surety agrees that it shall be bound to take notice of and shall be held to have knowledge of all acts or omissions of the Contractor in all matters pertaining to the Contract. The Surety understands and agrees that the provision in the Contract that the City will retain certain amounts due the Contractor until the expiration of 30 days from the acceptance of the Work is intended for the City's benefit, and the City will have the right to pay or withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by Surety that the City or its representatives are at liberty at any time, without notice to the Surety, to make any change in the Contract documents and in the Work to be done hereunder, as provided in the Contract, and in the terms and conditions thereof, or to make any change in, addition to, or deduction from the Work to be done hereunder; and that such changes, if made, shall not in any way vitiate the obligation in this Bond and undertaking or release the Surety there from.

It is further expressly agreed and understood that the Contractor and Surety will fully indemnify and save harmless the City from any liability, loss, cost, expense, or damage arising

out of Contractor's performance of the Contract.

If the City gives Surety notice of Contractor's default, Surety shall, within 45 days, take one of the following actions:

1. Arrange for Contractor, with consent of the City, to perform and complete the Contract; or

2. Take over and assume completion of the Contract itself, through its agents or through independent contractors, and become entitled to the payment of the balance of the Contract Price.

If the Surety fails to take either of the actions set out above, it shall be deemed to have waived its right to perform and complete the Contract and receive payment of the balance of the Contract Price and the City shall be entitled to enforce any remedies available at law, including but not limited to completing the Contract itself and recovering any cost in excess of the Original Contract Price from the Surety.

This Bond and all obligations created hereunder shall be performable in Harris County, Texas. This Bond is given in compliance with the provisions of Chapter 2253, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

EXECUTED in multiple originals this_____ day of_____, 20_____.

ATTEST/SEAL: (if a corporation)
WITNESS: (if not corporation)

_____
(Name of Principal)

_____
(Address of Principal)

By: _____
Name:
Title:
Date:

By: _____
Name:
Title:
Date:

ATTEST/SEAL
SURETY WITNESS:

_____
(Name of Surety)

_____
(Address of Surety)

By: _____
Name:
Title:
Date:

By: _____
Name:
Title:
Date:

REVIEWED:

This Bond has been reviewed as to form by the undersigned Paralegal and has been found to meet established Legal Department criteria.

_____
Date

_____
Paralegal

STATUTORY PAYMENT BOND

THAT WE, _____, as Principal, hereinafter called Contractor and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound unto the City of Houston, a municipal corporation, in the sum of $_____ for the payment of which sum, well and truly to be made to the City of Houston, and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Houston for _____ _____, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall pay all claimants supplying labor and materials to him or a Subcontractor in the prosecution of the Work provided for in the Contract, then, this obligation shall be void; otherwise the same is to remain in full force and effect;

PROVIDED HOWEVER, that this Bond is executed pursuant to the provisions of Chapter 2253, Texas Government Code, as amended, and all liabilities on this Bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date