SECTION 260000

ELECTRICAL WORK

1.1 GENERAL

A. All work of this section shall be governed by the requirements of the Conditions of the Contract, and the entire Division #1, General Requirements.

B. Due to the nature of the work and the rigid time schedule required, the utmost cooperation between Contractors must be maintained.

C. Removals and Relocations Work shall be as specified in Section 235000.

D. Cutting and rough patching work is as defined in Sections 235000.

E. Submittal requirements are as outlined in Section 235000 and General Conditions.

F. Record drawings are as outlined in Section 235000 of the Conditions.

G. EC shall visit the site to ascertain existing conditions relative to the work.

H. All work shall be in strict accord with the National Electric Code (NEC) and the Electrical Contractor shall furnish the owner with Underwriters Electrical Certification upon completion of work.

I. The Electrical Contractor shall obtain all permits and pay all fees.

J. All components shall bear U.L. labels.

K. EC shall be a firm regularly engaged in the installation of electrical systems for a period of at least five (5) years and shall have the licenses and certificates required by local, county and state regulations. License/Certificate holder shall be an officer of the firm and have a minimum of five (5) years employment with the firm.

L. The following abbreviations shall apply:

- G.C. - Contractor for General Construction
- PC - Plumbing Contractor or Sub-Contractor
- HC - Heating Contractor or Sub-Contractor
- EC - Electrical Contractor or Sub-Contractor

1.2 QUALITY ASSURANCE

A. Requirements given herein may be affected by other related requirements of the project specifications. Correlation of contract requirements is the responsibility of the Contractor.

B. All Electrical Work on this project shall be governed by this specification.

1.3 SCOPE OF WORK

A. EC shall provide all labor, material and appliances required for a complete electrical installation as shown on drawings and hereinafter specified, including but not limited to the following principal items:

1. Removal and Relocations
2. Grounding and Bonding

3. Hangers and Supports
4. Motor Protection Wiring
5. Testing
6. Service (Existing)
7. Panels
8. Raceways and Pull Boxes and Outlet Boxes
9. Overcurrent Devices
10. Wires and Cables
11. Devices
12. **Call for Aid**
13. Disconnect Switch and Motor Controllers
14. Lighting Fixtures, Exit and Emergency Lights
15. Telephone and Data Facilities
16. Fire Alarm System
17. Temporary Light and Power
18. Shop Drawings
19. Guarantees

1.4 REMOVALS AND RELOCATIONS

A. Refer to Section 235000.

1.5 WORK NOT INCLUDED

A. The following work is not included unless otherwise specified hereinafter:

1. Furnishing of motors, motor controllers, temperature controls.

2. Painting: Finished painting of exposed conduits, apparatus, etc.

1.6 GROUNDING AND BONDING

A. Grounding as required by governing codes and/or indicated for grounding distribution systems, conduits, panels, motors, wiring devices, and non-carrying metal parts.

B. Use grounding type bushings on feeder conduits. At receptacles the ground terminal is connected with #14 copper wire to screw lug or "jiffy" terminal on outlet box.

C. Inaccessible and permanent connections made by Exothermic Process grounding terminal fastened to equipment brazed with the metal being thoroughly cleaned, and bolted connections silver plated.

D. At panelboard cabinets and switchboards connect the grounding bushings to ground lug with copper conductor, sized per NEC based on current carrying capacity of largest conductor or feeder entering panel board. Minimum size #12 AWG.

E. Wire all raceways, conduit, cabinets, outlets, etc. so that they are mechanically jointed into continuous electrical conductor. At service board, raceway shall be bonded with a bare copper wire to service equipment enclosure. At boxes, fittings and enclosures, lock nuts and bushing shall be used to provide mechanically secure connections.

F. Only threaded fittings shall be used on rigid conduit; compression fittings on EMT.

G. Equipment grounding shall be in accordance with NEC.

H. Equipment Grounding: Equipment grounding conductors commonly described as a "green wire" shall be provided for feeders and branch circuits protected by over current devices rated 30A and over and all motors, and also in raceways buried in earth or using flexible conduit regardless of size of overcurrent protection. Equipment ground will consist of metallic connection to ground of non-current carrying metal parts of wiring system or apparatus connected to system, including metal raceways, busways, outlet boxes, cabinets, switch boxes, motor frames, transformer cases and metallic enclosures for electrical equipment. The primary objective of equipment grounding is greater safety and assurance of clearing a fault.

I. Metallic conductor shall be enclosed in same raceway as phase conductors and shall be insulated. Where multiple raceways are required, separate grounding conductor shall be provided for each raceway.

1.7 HANGERS AND SUPPORTS

A. Support conduits on "Kindorf" wall bracket or ceiling trapeze hangers with "Kindorf" #C105 straps secured by toggle bolts on hollow masonry units. "Kindorf" concrete inserts or A & J shields to suit conditions in concrete or brick, machine screws on metal and wood screws on wood.

B. Nails will not be permitted. Support suspended conduits by "Kindorf" lay in type hangers when run singly and "Kindorf" trapeze hangers in groups. Grouped runs, symmetrical where bends occur, nest to a uniform radius. Support lateral runs of piping securely on hangers, brackets, etc., and in manner to allow for expansion and elimination of vibration.

C. Brace and support risers and other vertical pipe runs with split ring hangers having threaded rods and wall plates, friction clamps or other approved means suitable for location and requirements. Do not support conduit from another conduit of piping or mechanical system. Spacing of supports shall be according to the NEC. Space limitations in hung ceiling spaces and conditions in other locations may require use of other type of hangers than those specified above. Provide suitable and approved hangers for such job condition.

D. In areas of the buildings where wood beams were employed, hanger rods shall be supported from side beam brackets bolted through the beam similar to ITT Grinnell Figure 202.

E. As required, where rods can be supported to steel beams use a beam clamp.

F. Inserts for small work - Ackerman - Johnson, for large work, expansion shields. Wooden plugs not permitted.

G. Equipment hung from Overhead Construction: Have weight of equipment distributed by use of angle and channel iron to beams used for building structural support.

H. Hanger Rods: Steel, threaded with nuts and lock nuts, sizes in accordance with the following schedule:

Conduit Size	Rod Size
3/4" to 2" inclusive	3/8"
2-1/2" to 3-1/2" inclusive	½"
4" to 5"	5/8"

I. Where the hanger rod supports more than a single run of conduit, use the following:

Rod Size - inches	3/8	½	5/8
Loading Rate - pounds per pair	800	1512	2424

J. Manufacturer: Kindorf, ITT Grinnell, Unistrut, or Globe.

1.8 WIRING IN CONNECTION WITH OTHER TRADES

A. Provide conduit, wiring, appurtenances and make all connections to motors, etc., to make systems operate as intended in accordance with the requirements of the specifications and as hereinafter specified. GC, HC, and PC will furnish (after review) detailed wiring diagrams, shop drawings, instructions and equipment for installation.

B. Provide wiring and conduits to all equipment furnished under other contracts and provide a complete system. Do all wiring and make all connections.

C. Refer to shop drawings of all equipment furnished by others for proper equipment sizes, voltage, phase characteristics, space requirements, etc., and verify with requirements on drawings.

D. Notify Architect in writing of any discrepancies before roughing for equipment. Provide receptacles and connections to each and every piece of equipment, and replace cords with new of proper type and size, with plugs to suit receptacles provided.

E. GC, HC, and PC to furnish all electrical equipment for completion of their contracts to include all combination motor starters, electrical thermostats, relays, limit controls, transformers, etc. All electrical equipment attached to piping or ductwork shall be installed by HC/PC.

F. Operational faults found in inter-connecting of mechanical and electrical equipment shall be corrected and shall be the responsibility of the Contractor responsible for same. In the event of dispute, the Architect will make final decision as to responsibility for correction.

G. Motor Controls will be furnished by others. Installation and all wiring shall be included in work by EC; HC to provide wiring diagrams.

H. Temperature control wiring by HC, except for 120v wiring to equipment. 120v wiring shall be by the EC.

I. In addition to the control devices requiring wiring, specifically shown or scheduled on the drawings, EC shall allow for the wiring of ten (10) additional devices, to allow for variations shown on final shop drawings. Included shall be 45'-0" of ¾" 4#14 for each device and the necessary connections.

1.9 WORK IN CONNECTION WITH EQUIPMENT FURNISHED BY OTHERS

A. EC shall be responsible for handling of all electrical equipment which may be furnished by others, from curb side loading dock to point of use, for setting and wiring of same and for final installation.

B. Prior to installation, EC shall review equipment shop drawings and roughing to verify locations, devices, outlets, and advise Architect of any discrepancies.

C. EC shall inspect materials furnished by Equipment Suppliers and advise Architect, prior to installation of any shortages of, or damage to, materials or non-code complying items.

1.10 MOTOR PROTECTION AND WIRING

A. Be responsible for the installation of proper size thermal overload, fuse and circuit breaker protect ion of motor (3 overloads to be provided for 3 phase equipment).

B. Upon completion of connections to any motor and when all mechanical features permit operation of motor, operate said motor and determine that its direction of rotation and method of operation is correct. Take ammeter readings on all motor leads to determine starting current and steady state full load operating current, record these readings, and determine the following:

1. Proper value of heaters for thermal overload protection.

2. Proper value of time-delay fuses to provide safe motor operation without unnecessary blowing on starting currents but sized as close as possible to the steady state running current.

3. The proper setting of circuit breakers for motor protection as in above.

4. Insert proper heaters, proper fuses and make proper settings on circuit breakers. Furnish to the Architect a record of the following for each motor:

a. Starting current of motor.
b. Full load steady state running current.
c. Size of heater in thermal protective device
d. Size of fuses.
e. Trip rating of circuit breakers.

C. Make motor connections with short length (18" minimum) flexible metallic conduit (neoprene jacketed) to allow free movement of motor vibration.

1.11 TESTING

A. Upon completion of new and existing portions of electrical systems changed by EC, systems shall be tested for short circuits and grounds, including but not limited to insulation resistance testing on feeders.

1.12 ELECTRIC SERVICE

A. Existing service shall remain and be extended to serve the renovated building.

1.13 BRANCH CIRCUIT PANELS

A. Provide service rated branch circuit panels per plans.

B. General: UL labeled and rated for voltage supplied, with bolt-on circuit breakers as scheduled; dead front construction with mains of ampere rating not less than frame size of circuit breakers feeding same.

C. Style Surface or flush mounted as indicated. Panels to conform to physical requirements listed in balance of this Section.

D. Internal Mounting and Bussing: Back pan flanged entire length of angle iron, securely fastened for rigidity; screws, bolts, and lock washers only for copper connections, copper bus bars securely fastened to base independent of breakers for support. Main and branch circuit connections of copper cross-section based upon NEMA standards; main busses and back pan arranged so branch circuits may be changed without machining, drilling or tapping.

E. Cabinets and Boxes: NEC gauge steel, completed galvanized or bonderized with gutter size prescribed by code as minimum. Back boxes construction with welded or riveted lapped corners.

F. Cabinet exterior finished in gray enamel over rust inhibiting primer. Interior finished with one coat rust inhibiting primer.

G. Provide ground lug welded or brazed to panelboard box for connection of ground wire from ground bushing.

H. Trim and Doors: NEC gauge steel, finished as described in previous paragraph with fronts having adjustable indicating trim clamps, welded trim rest plate, accurately typed circuit directory index under or heavy clear plastic in frame behind door, flush catch and lock with 2 keys per panel. Panel shall have full piano hinge and door – in - door construction. Keys for all panels on project to be alike.

I. Spaces indicated on panelboards are for future installation of circuit breakers with busses, drilled and tapped so that single pole, double pole or three pole circuit breakers can be installed.

J. Provide wire markers over wiring for phase and neutral wires indicating associated circuit breakers pole number.

K. Provide linen tags around wiring where circuit exits cabinet to indicate circuit breaker pole number and termination point of wiring.

L. Where indicated, provide NEMA 4x enclosure and fittings.

M. Manufacturer: Cutler Hammer, GE, Square D, Westinghouse, ITE

1.14 BUS BAR RATINGS

A. Copper used in distribution centers, panelboards, (both light and power) or whatever purpose to meet NEMA standard for purity. Capacity ratings to equal or exceed indication on plans.

1.15 RACEWAYS AND PULL BOXES

A. General: Raceway system shall be continuous, concealed or exposed as indicated, for feeders, branch circuits, systems of all voltages, etc., to afford complete removability of all conductors and accessibility of junction boxes in accordance with codes. Manufacturer's name and UL label to appear on each length of conduit (3/4" minimum unless otherwise noted)

B. Type of raceways shall be as follows for all feeders, distribution, branch light and power circuits and all low-tension systems (See plans for additional requirements):

Application	Type of Conduit
Buried in Concrete	Galvanized rigid steel
Buried in masonry	Galvanized rigid steel
In hallow partitions or hung ceilings	EMT, galvanized rigid steel, Greenfield or MC cable, where permitted by code
Exposed in unfinished areas	EMT, Galvanized rigid steel, Rigid aluminum conduit

Exposed in finished areas	Wiremold surface raceway, with extent and routing reviewed with Architect prior to installation
In or below floor slabs	PVC with metallic elbows were turned up.
Conduit for ground conductors	Rigid galvanized conduit
Underground	Galvanized rigid steel or Schedule 80 PVC encased in concrete (with rigid steel elbows)

C. Run conduit or Wiremold and install outlets carefully and coordinate with other trades to avoid piping, ducts and other mechanical equipment. Where possible Wiremold shall be run up against existing molding strips. Do not cross pipe shafts or ventilation duct openings. Exact location of wall and floor outlets are to be determined from architectural drawings of other trades having work in the area. In no case will any extras be allowed due to failure or neglect to determine exact locations before installation.

D. All conduits shall be reamed, burrs removed, and conduits cleaned for the proper introduction of wire. All conduit ends shall be capped and plugged with standard conduit accessories as soon as some have been permanently installed in place.

E. Conduit to be bent as required without flattening or scarring conduit finish. Conduit distorted and/or scarred will be rejected and replaced at no expense to Owner.

F. No conduit to run either directly above or below heating pipes or directly under water pipes. Maintain at least 3" between raceway and parallel pipe covering and at least 1" at right angle crossing.

G. Avoid traps conducive to collection of moisture. Insert sealed fittings where conduits leave building interior above ground or enter refrigerated or hazardous areas.

H. Underground conduits to slope away from building. Conduits entering or leaving building above or below grade shall be sealed with duct seal.

I. No chasing of exposed block walls permitted. Conduits to run in voids of blocks.

J. Where conduits occur in groups in slabs or partitions, care must be taken not to weaken the structure. Where such a condition occurs, consult Architect before work progresses.

K. Where metallic raceways pass thru expansion joints, provide "OZ" type AX or DX expansion fitting, within raceways system per manufacturer approved installation method.

L. No wiring is to be installed before conduits and outlets are permanently secured in place; in concrete pours before concrete is poured and set; in concealed conduits located in plastered rooms before brown scratch has been applied to walls and ceilings.

M. Provide insulating bushings and double locknuts on all conduits.

N. Compression raintight connections shall be used on EMT.

O. No set screw type connectors allowed in any conduit work. Use threaded joints and paint all underground conduits two (2) coats of asphaltum paint.

P. Install all sleeves and box openings in walls and floors required for installation.

Q. Provide "OZ" type CB metal closing caps on empty conduits that remain empty after final inspection and approval.

R. Provide minimum #12 AWG drag line in empty conduits.

S. Flexible conduit shall be used when running in voids of structural planking and in making up short flexible connections to rotating or vibrating machinery or equipment, or as otherwise indicated on drawings.

T. Mechanically join together all wire raceways, conduit, etc., into a continuous electrical conductor. At sub distribution panel, raceways must be bonded with bare copper wire to service equipment enclosures. Provide grounding bushings on all conduits entering the panelboards, distribution panels, switchboards, etc.

U. Install Wiremold and conduit runs parallel with or at right angles to walls and ceilings. Run along molding and trim where possible.

V. Test all conduits installed and left empty for clear bore and correct installation with ball mandrel, brushes and snake, before installation will be accepted. Ball mandrel to be approximately 85% of internal diameter of raceway to be tested. Mandrel assembly to include two short brushes. Snaking of raceways to be done in presence of representative of Architect. Any conduit which rejects the mandrel must be cleared at once. All work such as chopping concrete, etc., replacing defective conduit and restoring surface to original condition is to be done at no expense to Owner.

1.16 OUTLET BOXES

A. General: Plans show conditions as accurately as possible to indicate them in scale, but do not necessarily show all the fittings, etc. necessary to suit building conditions. Locations of outlets, appliances, etc. are approximate. Responsibility remains with the EC for proper locations in order to make them fit with architectural details and instructions from Architect's representative at job site. Before installation of conduit for switches, receptacles, ceiling lights, or motors, the Architect and Engineer reserve the right to move each outlet location to better adapt them for usage prior to installation, within a distance of 5'-0" as presently indicated, at no additional cost to Owner.

B. Type: Hot dipped galvanized of size to accommodate devices and wiring installed, provide with covers to suit function. Wherever boxes are located in exposed masonry walls, use only straight composition type with hub conduit entries and gaskets. Boxes and covers for exposed work, cast aluminum with suitable cover plate. All floor box outlet locations must be verified by Architect prior to installation. Surface Wiremold raceway system shall contain proper Wiremold fittings and boxes as required for a complete installation.

C. Location: Heights are indicated above finished floor to center of devices and are for estimating purposes only. Exact locations shall match existing or as noted on drawings.

Receptacles	General 18", where at counters, 6" above counter.

Lighting Switches	48"
Panels	Not higher than 6'-0" to top breaker or switch.
Fire Alarm Pull Stations	48"
Fire Alarm Signals	80" or 1'-0" below ceiling

D. Where height of wall outlets is not given locate as best suited for extension to equipment supplied and as directed. Where special conditions exist, locate outlets as directed.

E. In center outlets, allow for overhead pipes, ducts, etc. and variations in arrangement and thickness of fireproofing and plastering also window trim, paneling, etc. Any inaccuracy resulting from failure to do this must be corrected without expense to Owner.

F. Coordinate location of electrical equipment with work of other trades. Verify all door swings before roughing for switches, etc. Outlets set in exposed block wall to be set vertically and line up with joints in coursing.

G. Installation: Securely fasten outlet boxes. Use hangers to support outlets in hung ceilings. Use galvanized bar irons attached through openings inside of the outlet box for outlets in hung ceilings. Out lets to be accessible by removal of fixtures or access panel. Equip outlets with fixture stud. Fixture out let boxes must be set so the edge of outlet box comes flush with finished surfaces except where cast in slab, outlet boxes may then be set flush with slab. Erect wall and switch outlets in advance of furring and fireproofing and firmly secure to steel work with metal straps. Make necessary adjustment to work so outlets are properly centered after interior finish is erected. Set outlets to line up with joints in ceiling tile or in center of one tile block.

H. For terminating conduit at all boxes, fittings, and enclosures, use Thomas & Betts #3870 series insulated grounding and bonding bushings, or equivalent. Always use double locknuts.

I. Exterior boxes to be cast aluminum, weatherproof with all required gaskets.

J. Manufacturer: Crouse-Hinds, Raco, Steel City, Hubbell, Wiremold.

1.17 HANDHOLES and SPLICE BOXES

A. Handholes: For all underground electrical, telephone and cable to service. Provide precast handholes with heavy duty metal traffic rated covers. Covers shall be labelled for services and voltages. Handholes for utility services shall also meet utility requirements. Provide Quazite brand, or equivalent with metal covers.

1.18 WIRES AND CABLES

A. General: Conductors #8 and larger - copper stranded, #10 and smaller, solid copper, 600V insulation. Insulation to be as follows: lighting fixtures - AF or THWN, all others - THWN or XHHW, except where otherwise specified on plans.

B. Where permitted MC armored cable with THWN conductors may be used for branch circuit wiring.

C. Maintain consistent phase identification throughout utilizing colored insulation or braids; colors used for identification shall match existing.

D. Colored tapes, paints, or tags will not be acceptable.

E. Control Wiring: Terminal strips marked in black on a white background, and wires consistently color coded to avoid confusion and permit easy identification of conductors. Use IPECA color code wherever possible, no two wires in the same raceway to be the same color. Control wiring - #14 minimum installed in conduit.

F. Installation: Interior of raceway into which wire or cable is installed shall be cleaned of all burrs, dirt and obstructions before wire is pulled. Use lubricant designed for pulling wires.

G. Connect stranded copper conductors with solderless connecting lugs drilled the full diameter of the conductor, or Thomas & Betts compression type. Lugs for cables larger than #2/0 to have to bolts mounting with heavy copper washers for copper lugs. No splices on feeders will be permitted, except by special permission.

H. Taps in stranded conductor where permitted "OZ" type PT cable tape with type PTC Bakelite covers. Splices in branch circuits to occur only where such circuits divide. No screw caps or wire nuts will be permitted.

I. Connect branch circuits to panels in such a manner that load balance is within 10% with all circuits in operation.

J. Circuit numbers indicated on drawings are shown as a guide only and should not be followed when connecting branch circuits to panel.

K. Tagging of Wires and Cables: Identify all wiring in pull boxes, panels, cabinets, wiring troughs and other enclosures, and at all terminal points, with laminated tags. Clearly tag each wire to indicate origin and circuit number of piece of equipment or circuit it feeds.

L. Manufacturers: Hatfield, General Cable, Anaconda, Circle, Crescent, Okonite, Triangle.

1.19 WIRE SPLICING AND TERMINATING OF 600 VOLT CONDUCTORS

A. Splices of wires up to 3 #8 conductors shall be made with pressure type connectors. Wire nuts or screw caps will not be permitted. Splices above this size shall be made with approved mechanical connectors, Scotchfill and Scotch #88 vinyl tape.

B. Splices in cables #6 gauge and larger shall be made with cast sleeve type connectors with set screws, Scotchfill and Scotch #88 vinyl tape.

C. Copper conductor terminations shall be made with mechanical set screw, pressed copper lugs. Two bolt lugs shall be used if necessary to obtain sufficient contact surface of 200 amperes per square inch, or to maintain rigidity in terminating large cable.

D. Small wire splices shall be made with Thomas & Betts, Sta-Kon or equivalent pressure connectors.

E. Large wire splices shall be made with OZ type XW and OX type XTP or equivalent connectors.

F. Terminal lugs shall be pressed copper screwlugs as made by MAC or equivalent.

G. Splices in manholes, handholes, and other damp or wet locations shall be made with suitable kits to form a watertight and waterproof splice. Splice kits shall be

Anaconda, Buchanan, Line Materials, Minnesota Mining and Manufacturing or Thomas & Betts.

1.20 DEVICES AND PLATES

A. Provide at every indicated outlet, the proper devices and plates as specified in electric legend. Where more than one device is indicated in one location, gang together in one box and under one plate as required.

B. All devices to be Specification grade, color as selected by Architect.

C. Receptacles were installed outside, exposed to weather or in places subject to spray or unusual conditions to be equipped with weatherproof type covers, gaskets, and must have ground fault type protection.

D. All receptacles shall be child tamper resistant shutter type.

E. Plates – Heavy gauge nylon of color selected by Architect. For exposed work cast aluminum suitable for cast box utilized. On tile or block walls use rubber gaskets between wall and plate.

F. Manufacturer: Hubbell, Bryant, Arrow Hart, Salter and G.E.

1.21 CALL FOR AID

A. Where indicated on the plans, provide a Call For Aid kit, including:
   - Pull cord(s)
   - Pull cord switch with plate
   - Transformer
   - Strobe(s) with circuitry and sensors

B. Device shall be Edwards signal CFA series, 6538-G5 kit with clear lens, or as submitted and approved equal.

C. Transformer shall be 120VAC to 24VAC.

D. Provide line and low voltage circuitry.

E. Strobe shall be UL 1638 compliant.

F. Mount per ADA requirements.

G. Device shall be capable of being combined to light multiple strobes from one switch.

1.22 DISCONNECT SWITCHES

A. Where required by code and/or noted on drawings, provide safety switch (fused or unfused as required up to 60A size or enclosed circuit breaker with trip as indicated for 100A and over) to disconnect all circuit to motors or appliances.

B. Style: Totally enclosed type with cover interlocked with operating mechanism to prevent opening by unauthorized personnel when switch is closed. Include provisions for locking switch in "off" position with a means provided for defeat of this feature. Mechanism to be quick make-quick break. All copper surfaces to be tin plated. Line terminals to be provided with insulating shield to protect against accidental contact.

C. Fused switches to be provided with cartridge fuse and pole for each ungrounded leg. Neutrals to be solid unless otherwise specified or required. Do not fuse switches in excess of 80% of rated capacity.

D. Switches in equipment spaces shall be H.D. Heavy Duty enclosure type. Switches exposed to the weather or within 10'-0" of sinks, etc. shall be in NEMA 4x enclosure.

E. Motor Disconnect Switches: Where not indicated to be provided in other sections of specifications and where required by code, provide disconnect switches as described.

1.23 MOTOR CONTROLLERS

A. Furnished under respective trade sections.

B. Obtain all required information for equipment being supplied from Contractor supplying same and install controller and all wiring and make all connections as required for proper operation.

1.24 LIGHTING FIXTURES

A. General: Provide fixtures as indicated and further specified. Fixtures to bear label of Underwriters' Laboratories and to be installed true and plumb, left clear and free from grease and fingerprints. Damage to ceilings or walls to be repaired/replaced at no cost to Owner. Lighting fixtures to be complete with all necessary mounting hardware, lamps, ballasts, starters, and other necessary equipment. Provide lighting fixtures for each indicated light outlet of type required. Where fixture type is not noted, furnish the same type noted in similar areas. Mount individually or continuous as indicated. Where fixtures are mounted in continuous rows, 8' fixture bodies are allowed, lamps to remain 4'.

B. Use of catalog numbers describing types of fixtures does not necessarily include all the required accessories for a complete installation. All accessories for a complete installation must be provided. Install pendant type fixtures in the same room at a uniform height from the floor and hang plumb. Make adjustment of height during installation. In cases where conditions make this impractical, refer to the Architect for a decision.

C. Firmly and independently fasten fixtures to building structure and not from or by the suspended ceiling system. In areas with no finished ceiling, suspend fixtures from construction by approved brackets or chains. Fixtures shown on drawings are to designate quantities only. Install fixtures, conduit and boxes after all duct work, piping, etc. have been installed and locate as directed by Architect's representative in field.

D. Ballasts: Shall be electronic type with less than 10% THD for fluorescent and compact fluorescent lamps, high power factor or electronic type with less than 10% THD for H.I.D. fixtures.

E. Emergency ballasts shall be Bodine or equivalent.

F. Lamps: Provide all lamps of size and voltage as specified. All lamps shall be LED.

G. EC shall provide all lamps of size and voltage as specified.

H. All plastic diffusers shall be 100% virgin acrylic, and shall meet the following flame and smoke rating when tested in accordance with ASTM test criteria:

Flame Spread (ASTM E-84)	25 Maximum
Smoke Developed (ASTM E-84)	450 Maximum
Burning Test (ASTM D-635)	1.5 in/min. Maximum

I. EC shall consult the lighting fixture schedule for fixture types shown on the drawings and shall be furnished from the list of manufacturers noted thereon. EC shall be responsible for the proper fixture for the type ceiling which will be used on the job.

J. Provide for each exposed fluorescent lamp in fixtures that have no light diffuser, clear plastic lamp guards and safety clips over sockets as manufactured by Laduby Company or McGill Company.

K. LED fixtures shall comply with the following:

1. UL Standard 8750 "Light Emitting Diode Equipment for Use in Lighting Products", IES Standard LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products", IES Standard LM-80 "Measuring Lumen Maintenance of LED Light Sources", and IES Standard TM-21 "Projecting Long Term Lumen Maintenance of LED Light Sources".
2. ANSI C78.377 "Specifications for the Chromaticity of Solid-State Lighting Products" with LEDs binned within a maximum three-step MacAdam Ellipse to ensure color consistency amongst luminaries of the same type.
3. LM-70 listed for 50,000-hour minimum life.
4. Fixtures, lamps, drivers, and components, provide a complete warranty for parts and labor for a minimum of five years from the date of Substantial Completion.
5. Fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.
6. Dimmable LED fixtures shall have either a 0-10 volt, or 3-wire dimming driver, line voltage, as shown on the drawings. 10% dimming for daylight only. 1% dimming for manual dimming.
7. Retrofit LED lamps shall comply with NEMA SSL 4 "SSL Retrofit Lamps: Suggested Minimum Performance Requirements". Provide base to match designated fixture.
8. Drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
9. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.

L. Allowances and Spare Parts: In addition to the work shown on the drawings, provide the following items to be wired to nearest circuit with spare capacity at locations as selected by the Architect. If some units are not required to be installed, they shall be turned over to the Owner for spare parts.

1. Provide two (2) combo exit/emergency fixtures, two (2) utility fixtures, and two (2) two-head EM battery packs.

1.25 TELEPHONE AND DATA FACILITIES

A. Conduit System: Complete system to include empty raceways to terminal panel and outlet boxes as indicated. All wiring will be furnished and installed by the Owner's vendor.

B. Conduit to have no more than two (2) right angle bends. Minimum 6"radius bends and all bends shall have a radius equivalent to at least 8 times the nominal size of the conduit.

C. Provide a nylon drag rope of #12 gauge drag wire in empty conduits to facilitate the installation of wiring.

D. Outlet boxes to be single gang 4" square 2-1/2" deep unless noted otherwise on plans, with satin finished stainless steel single hold bushed plates.

E. Provide 4' x 4', 3/4" painted fire proof plywood backboard at terminal board locations.

1.26 FIRE ALARM SYSTEM

A. General:

1. A new fire alarm system for the building.

2. All equipment shall be UL listed and shall meet or exceed the requirements of NFPA 72 NEC Article 760 and State and Local Fire Marshalls.

3. Items of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc., U.L. and shall bear the U.L. label. Control equipment shall be listed under U.L. category UOJZ as a single control unit. Partial listings shall NOT be acceptable.

4. Provide devices, circuitry and programming to match system. Provide batteries with calculations for entire system.

5. Upon completion of work, all detectors and devices shall have addresses labeled to accurately indicate space designation.

B. System Description:

1. System shall be electronically operated, addressable type with annunciation, and shall include: control equipment, battery back-up, remote station tie via telephone line, stations, detectors, signals, speakers and strobes remote annunciation, exterior speaker/strobe, remote annunciation with trouble station, and Knox box with tamper switch.

2. The system shall be provided with standby battery and charger. The battery shall be Gel sealed cell type capable of operating the system under supervisory condition for sixty (60) hours and alarm for fifteen (15) minutes. System shall automatically transfer to the standby batteries upon power failure. Battery discharging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in 12 hours.

3. Circuits requiring system-operating power shall be 24V DC and shall be individually fused at the control panel.

C. Fire Alarm Control Equipment:

1. All modules shall be factory assembled into an operating control panel, prior to shipment.

2. The control equipment shall be factory tested and approved complete with appropriate UL label.

D. The quantity of modules shall be determined by the circuit requirements of the job. All modules shall be mounted in a surface cabinet with hinged, locked trim. Trim shall have a plastic window, which shall show all zone lights, system reset and alarm silence switch, and alarm supervision trouble and power on all lights.

E. All addressable initiating devices shall be individually annunciated via the 80-character minimum display, at the fire alarm control panel and the remote annunciator. All signals to sound continuously and all visual alarm devices to flash. A module for City connection via lease telephone line shall be activated. All of the above functions shall remain "on" until initiating device is restored to normal and the system is reset.

F. Should trouble occur on the system, an internal trouble buzzer shall sound. Each addressable Initiating device shall have a trouble indication via the 80-character (minimum) display via the annunciator so an interruption in that circuit can be identified quickly.

G. All addressable devices are to have the capability of being disabled or enabled individually. Up to 127 addressable devices may be multi-dropped from a single pair of wires.

H. The communication format must be a poll/response protocol to allow T-tapping of the wire of addressable devices and be completely digital.

I. Standby Power

1. A surface mounted, locked cabinet shall be provided to house the standby power supply.

2. Submit battery sizing calculations as part of system shop drawings.

J. Communication with Addressable Devices:

1. The system shall provide communication with initiating and control devices individually. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

   Alarm
   Trouble
   Open
   Short
   Device missing/failed

2. Addressable devices shall have the capacity of being disabled or enabled individually.

K. Operation:

1. Activation of manual or automatic initiating device after verification shall provide following operation throughout system:

a. Device in alarm shall be indicated at the fire alarm control panel. Once acknowledged, the indication light will remain latched ON until the system has been reset. A subsequent alarm will flash the appropriate indication on the control panel.
b. Appropriate code compliant horn sounding throughout.
c. Pulsing alarm tone shall occur within control panel.
d. Alarm signaling devices shall sound and flash.
e. Address description shall be at annunciator.
f. Signal shall be sent to Fire Department via telephone.
g. Co (Carbon monoxide) detector shall have unique tone and unique reporting.

L. Supervision

1. Control circuits plus the external alarm indicating and alarm initiating circuits shall be electrically supervised. Any open or ground fault, or loss of circuit power shall cause the panel trouble signal to sound. Trouble signal operating power shall be provided by a separate power circuit feed.

2. System shall provide independently supervised initiation circuits so that fault in any one loop or address shall not affect any other loop or address. Alarm activation of any initiation loop address or circuit shall not prevent subsequent alarm operation of any other initiation circuit.

3. Auxiliary manual controls shall be supervised so that switches must be returned to normal automatic position to clear system trouble.

4. Each independently supervised circuit shall include discrete amber “Trouble” LED to indicate disarrangement conditions per circuit.

5. Control panel batteries shall be supervised so that disconnection of battery shall be audibly and visually indicated at control panel and annunciator.

M. Directory

1. Provide adjacent to the fire alarm control panel and the remote annunciator panel a surface mounted directory, plastic laminated, in a weatherproof aluminum frame, containing a graphic plan of the building with each device and address clearly indicated. Furnish two (2) additional unframed laminated directories to Owner.

N. Wiring

1. Number and size of conductors shall be in strict accord with manufacturer’s wiring diagram as required for proper operation. Manufacturer’s wiring prepared diagrams for this system shall be submitted for review prior to installation minimum wire size shall be #18.

2. Where required due to length of run, the size of conductors shall be increased in accord with manufacturer’s recommendations.

3. Provide wiring from tamper switch in Knox Box to control panel.

4. Wiring shall be fire rated Teflon, copper THHN, solid.

5. Raceways shall be provided for wiring run in Mechanical Rooms, Attics, crawl spaces and where run exposed.

6. All outlet boxes and covers for fire alarm system shall be painted red and all new or accessible existing raceways shall be banded with red paint at 10'-0" intervals and each side of partitions.

7. Conductors not having connections within a box shall pass through without interruption.

O. Peripheral Devices

1. General: The system control panel, must be capable of communicating with the addressable devices. Addressable devices shall be located as shown on the drawings. The location of addressable devices shall be selected along with conventional devices to optimize the system layout in order to provide the level of protection, address or zone identification and control as shown on the drawings.

2. Signals: Signals shall be audio/visual type with speaker and strobe conforming to ADA requirements. Where noted, provide visual only signals. Provide white devices to match system.

3. Addressable Detector Bases: All addressable smoke and heat detector heads shall be plugged into their bases. The base shall contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Different detector heads (smoke or heat) shall be interchangeable. Upon removal of the heat, a trouble signal shall be transmitted to the control panel.

P. PhotoElectric Detector Head:

1. The photoelectric type detector shall be a plug-in unit, which mounts to a twist-lock base, and shall be UL approved.

2. The detectors shall be of the solid-state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear airflow entry.

3. The detector shall fit into a base that is common with both the heat detector and ionization type detector and shall be compatible with other addressable detectors, addressable manual stations, and addressable zone adapter modules on the same circuit. The detector shall also fit into a non-addressable base that is capable of being monitored by an addressable zone adapter module.

4. There shall be no limit to the number of detectors or zone adapter modules, which may be activated, or "in alarm" simultaneously.

Q. Addressable Thermal Detector Head:

1. Thermal detector heads shall be UL listed. They shall be a combination rate-of-rise and fixed temperature (135ºF) type, automatically restorable.

R. Addressable Pull Stations:

1. Addressable pull stations shall contain electronics that communicate the station's status (alarm and normal) to the transponder over two wires, which also provide power to the pull station. The address shall be set on the station. They shall be manufactured from high impact red Lexan. Station shall mechanically latch upon operation and remain so until manually resent by

opening with a key common to all system locks. Pull stations shall be (double action).

2. The front of the station shall be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations, which use Allen wrenches or special tools to reset, will not be accepted. The station will consist of high impact Lexan plastic, red in color.

3. The addressable manual station shall be capable of field programming of its "address" location on an addressable initiating circuit. The manual station shall be fitted with screw terminals for field wire attachment.

4. There shall be no limit to the number of stations, detectors or zone adapter modules, which may be activated or "in alarm" simultaneously.

5. The addressable manual station shall be Underwriters' Laboratories, Inc.

S. Addressable Intelligent Combination Smoke/CO Detectors:

1. Detector shall cause system to sound unique tone for fire or unique for CO.

T. Equipment submission include as a minimum the following:

1. Complete descriptive data indicating U.L. listing for all system components.

2. Complete sequence of operations for this project system.

3. Complete system wiring diagram specific to this project.

4. Interconnection diagrams indicating specific wiring connections required, including specific terminal designations for this project.

5. Final determination of compliance with these specifications shall rest with the Architect and Engineer, who at their discretion, may require proof of performance.

U. Addressable Device Supervision:

1. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed).

2. Should a device fail, it shall not hinder the operation of other system devices.

3. Testing and instruction: Manufacturer's authorized agent shall perform a quality inspection of final installation, and in the presence of the EC., Owner, Architect and Engineer, program the addressable system, and perform a complete functional test of the system. Test shall include activating of each device. A written system certification verifying the type, location and individual testing of all system components, as supplied by manufacturer, shall be required prior to acceptance. Manufacturer's authorized agent shall instruct Owner in the operation and maintenance of the system.

V. System Test: Manufacturer's authorized agent shall perform a quality inspection of final installation, and in the presence of the EC, Fire Marshall, Owner, Architect, and Engineer, perform a complete functional test of the system. Tests shall verify operation and zoning of all initiation devices, operation of all signals, fan shutdown, elevator operation and remote tie. A written system certification

verifying the type, location and individual testing of all new and existing system components, as supplied by manufacturer, shall be required prior to acceptance. Manufacturer's authorized agent shall instruct Owner in the operation and maintenance of the system. Test report shall include a table listing each device, individual test results and associated remediation where required.

W. Service:

1. Provide a one (1) year complete service contract for the entire fire alarm system. Service contract shall provide for all maintenance, testing, cleaning and adjustments necessary to maintain system in top operating condition. Included shall be a minimum of four (4) scheduled service visits to check normal system operation and emergency service, which shall be available 24 hours of every day. Response time for emergency service shall be four (4) hours or less. Work under this Service Contract shall be performed by Manufacturer's factory trained service personnel. Provide the telephone numbers for regular and emergency service to the Owner and post on Fire Alarm panel. The one-year service period shall start on date of Certificate of Completion.

2. Included in the one-year full-service contract, shall be any necessary change out of detectors causing nuisance alarms. This shall include labor and materials required for reprogramming and to change smoke detector type or change to heat detector.

3. Each of four scheduled service visits shall include testing of every component, and ringing out all stations. This shall be done during non-building use hours at a time approved by the Owner in advance.

4. Scheduled service testing shall be documented by a full report indicating each test done, results, repairs, or adjustment accomplished, name of service personnel, date and time of testing, and any other pertinent information.

5. Reports shall be reviewed with the Maintenance Supervisor before leaving the building and shall be submitted in writing to the Owner within three (3) days of the inspection.

X. Allowances and Spare Parts:

1. In addition to the work shown on the drawings, provide the following items to be wired and connected to adjacent zones at locations as selected by the Architect. If some units are not required to be installed, they shall be turned over to the Owner as spare parts.

2. The Contractor shall provide two (2) audio/visual signal units, two (2) visual signals, one (1) pull station, two (2) photoelectric ceiling smoke detectors, one (1) fixed temperature heat detectors and one (1) combination smoke/CO detectors.

Y. System shall be silent knight, fire lite, or equivalent.

1.27 TEMPORARY LIGHT AND POWER

A. EC shall furnish, install, maintain and remove upon completion a temporary lighting and power system for use of all Contractors.

B. Existing service may be used for temporary power, however, use shall not in any way impair the Owners normal use of the service.

C. Temporary system shall provide outlets spaced to that all parts of building may be reached with one-hundred-foot extension.

D. Where building is roofed, provide temporary lighting throughout building consisting of #12 wire strung in areas with rubber covered pigtail sockets and LED temporary light fixtures spaced a maximum of 20 feet apart. Provide lighting outlets as required in all areas of construction.

E. Any Contractor requiring service for equipment of 208 volts or more than 15 amperes at 115 volts shall have separate feeder installed from temporary panels, all such installation to be made by EC and paid for by Contractor requiring service.

F. No space heating equipment using electricity as a heat source shall be allowed.

G. Upon completion of work, all temporary tie-ins, feeders, wiring, outlets, panels and supports shall be removed in their entirety.

H. Ground fault protection shall be provided for temporary light and power in accord with the National Electrical Code.

I. EC shall coordinate shutdown for service changes to permanent with other Contractors. A minimum of three (3) days' notice shall be given for any disruption of temporary light and power.

1.28 SHOP DRAWINGS

A. All manufactured items shall be submitted for review before installation of same. Submission shall be in form of manufacturer's standard printed sheets, pamphlets or bulletins and shall be clearly indicated thereon as to size, type, etc.

B. Review of submission shall mean review of equipment and/or fabrication as to design and performance only. Contractor shall be responsible for scheduling quantities, physical size to suit allowable space, electrical characteristics, etc.

C. Any additional costs incurred due to substitution of equipment shall be borne by E.C.

D. The following items require a submission of shop drawings:

1. Panels
2. Lighting fixtures
3. Disconnect switches
4. Devices and plates
5. Call for aid
6. Raceways
7. Bonding and Grounding Devices
8. Fire alarm system including wiring diagrams

1.29 ALTERNATES

A. Alternate #1:

1. Remove feeder between meter and 200 Amp panel.
2. Provide new 200 Amp feeder in trough.
3. Splice trough for new 3P-60 Amp CB to feed new water heater panel. See drawing E-102.
4. Provide 2P-30 Amp CB's for each point of use hot water heater fed from new ATL#1 panel WH for Family Restrooms 103, 106 111 and 112.

1.30 GUARANTEE

A. Refer to Sections 235000.

END OF SECTION