E. Panel, junction and pull boxes shall be located clear of other trades. Conceal junction and pull boxes in finished spaces. Where necessary, reroute raceways or make other arrangements for concealment. Boxes shall be accessible. Provide access doors as required for accessibility. Support boxes from building structure, independent of conduit. Provide floor-to-ceiling channels for mounting on drywall and lightweight construction. Outlet boxes for fixtures recessed in hung ceilings shall be accessible through opening created by removal of fixture. Secure to black iron support. Motor terminal boxes: coordinate with motor branch circuit conduit and wiring; add box volume where required.

F. Fire sealants: Provide for raceways and wire passing through floor slots, sleeves or openings in fire-partitions.

G. Perform continuity tests of resistance of feeder conduits from service to point of final distribution using 1 conductor return. Maximum resistance shall be 25 ohms.

12. WIRE AND CABLE:

A. Provide wire and cable complete with accessories. Size reference shall be AWG except as noted.

B. Conductors shall be copper, ASTM standard solid (No. 10 and smaller) or stranded (No. 8 and larger). General use cabling shall be No. 12 minimum. At 120 volts and over 100 ft circuit length, provide No. 10 minimum. At 265 volts and over 200 ft circuit length, provide No. 10 minimum.

C. Control and alarm cabling, except as noted, shall be No. 14 minimum. At 120 volts and over 200 ft circuit length, provide No.12 minimum.

D. Other voltages and phases: adjust cable sizing as required to maintain code acceptable voltage drop. Increase raceway sizes for larger wire as required.

E. Insulation shall be rubber and thermoplastic meeting ASTM and ICEA standards. Type THHN/THWN shall be utilized for feeders and branch circuits except as noted. SFF-2 shall be used for branch circuits located in wiring channels of continuous fluorescent fixtures and in ambient temperatures over 90 Deg. C rated for 600V. Underground service entrance cabling shall be TYPE XHHW/XHHW-2. Provide cross-linked polyethylene insulation (Type XHHW) in exterior locations including underground non-service cables.

F. Metal-clad cable (MC) with ground wires shall be utilized as described in "Raceway and Cable Installation". When used in lieu of wiring in conduit, state in proposal that price is based upon the use of MC cable. BX cable shall not be used. Metal clad type MC cable is to have galvanized steel armored jacket with solid copper conductors in sizes #12 AWG through #8 AWG and stranded for sizes #6 AWG through #1 AWG. An insulated internal green ground conductor is to be provided. Interior conductors are to be wrapped with a moisture and fungi resistant paper. MC cable is to be as manufactured by AFC or equal.

H. Fire alarm cable is to be type MC cable with a galvanized steel red armored jacket. Conductors are to be solid copper in sizes #18 AWG and #16 AWG with two to eight conductors per cable. Twisted shield pairs are to be sizes #18 AWG and #16 AWG per cable. Insulation is to be type TFN rated for 105 degrees C for a power limited fire protective signaling cable applications. Provide an insulated ground conductor. Cable to be rated for 600V. Fire alarm cable to be as manufactured by AFC or equal.

J. Color coding shall be as follows:

1) 120/208 volt system:
   Black for A phase
   Red for B phase
   Blue for C phase

2) 277/480 volt system:
   Brown for A phase
   Orange for B phase
   Yellow for C phase

3) Neutral wire shall utilize white outer covering throughout. Equipment ground wire shall utilize green outer covering throughout.

4) Where color-coded cable is not available, certify in writing and request permission to overlap conductors with 6 in. of color taping in accessible locations.

K. Provide flameproof linen or fiber tags in accessible locations. For feeders indicate feeder number, size, phase and points of origin and terminations. For control and alarm wiring, indicate type (control or alarm), size of wire, and points of origin and terminations. Similar to Stranco Products, Inc.

L. Terminations, splices and taps under 600 volts: Copper conductors No. 10 and smaller shall utilize compression-type of twist-on spring-loaded connectors and clear nylon-insulated covering. Copper conductors No. 8 and larger shall utilize mechanical bolted pressure or hydraulic compression type using manufacturer's recommended tooling. Cable lugs and connectors shall utilize compression type of same metal as conductor. Provide to match cable, with marking indicating size and type. Copper lug connections to bus bars: use antiseize compound on tang.

M. Not more than 3 lighting or convenience outlet circuits shall be installed in one conduit unless otherwise indicated. If more than three circuits, derate wire current carrying capacity and maintain code requirements on conduit fill. Neutral conductor shall be counted as a current carrying conductor. Submit to engineer for review prior to installation.

N. Pull no thermoplastic wires at temperatures lower than 32 deg F. Provide separate raceways for conductors of normal and emergency, 120/208 and 277/480 volt systems, except 480 volt motor branch circuit wiring and related 120 volt control wiring. Thermoplastic wires hall not be installed in computer area raised floors.

O. Leave wires with sufficient slack to permit making final connections.

P. Perform continuity and insulation tests. Megger test 100 percent of feeders, 10 percent of branch circuits and motor branch circuits over 25 hp. Perform tests prior to connecting equipment and in presence of authorized representatives. Submit written report of results. Correct or replace cable testing below manufacturer's standards.

13. GROUNDING

A. An equipment grounding conductor commonly described as a "green wire" shall be provided for all branch circuits protected by overcurrent devices except for lighting branch circuits. Green wire ground shall also be provided for flexible conduit and motor circuits. Metallic raceway continuity shall be maintained with a bare No. 6 wire. Where isolated grounding branch circuits are used, provide a separate and distinctly marked green ground wire. Each Grounding conductor shall serve a maximum of three circuits/poles.

B. Run insulated ground conductors in rigid steel conduit or EMT with conductor connected to conduit, through ground fitting at each end.

C. Ground noncurrent carrying metal parts of distribution panels, switchboards, transformer enclosures, raceways, busway enclosures, controller enclosures, motor frames and other electrical equipment.

D. Miscellaneous:

1) Ground the following:

   a) Telephone system.
   b) Fire alarm system.

14. POWER WIRING

A. Provide all power wiring to all motors and equipment furnished under all contracts on the project. Include extensions from controllers to motors and motor connections. Mount and wire all contactors and power devices furnished under all contracts.

15. CONTROL WIRING

A. Provide all control wiring for motors and equipment furnished under all contracts and as specifically shown on the drawings, except as noted for mechanical/plumbing equipment. Include mounting and wiring of all control devices furnished with equipment.

B. Control wiring less than 120 volts for motors, alarms for equipment furnished under mechanical/plumbing will be provided under mechanical/plumbing specifications.

16. DEVICES:

A. Provide complete material and accessories as noted by Leviton, Hubbell, or equal.

B. Local wall switches shall be specification grade, totally enclosed, toggle, quiet type, rated 20 amp, 120/277 volt, AC. All switches shall be ganged with multi device plates, in areas where dimmers are specified with wall switches; all switches shall match dimmer series and shall be ganged together. Switches shall have screw type terminals and shall be of the white phenolic compound finish, unless otherwise directed by the Architect (coordinate with Architect prior to bid). Toggle switches shall be manufactured as follows:

HUBBELL
1) 20A, 120/277V Single Pole, Hubbell No. HBL 1221I
2) 20A, 120/277V Double Pole, Hubbell No. HBL 1222I
3) 20A, 120/277V Three Way, Hubbell No. HBL 1223I
4) 20A, 120/277V Four Way, Hubbell No. HBL 1224I
5) DIMMER SWITCHES: LUTRON NOVA T SERIES

C. Receptacles shall be minimum specification grade type duplex convenience 125 volts, 2 pole, 3 wire, U ground slot. Grounded, except as noted. Meeting NEMA standards, publication WD-6. Receptacle finish shall be of the white phenolic compound type unless otherwise directed by the Architect (coodinate with Architect prior to bid). Receptacle shall be manufactured as follows:

HUBBELL SPECIFICATION GRADE
1) 20A, 120V Standard Duplex, Hubbell No. HBL 2162WA
2) 20A, 120V Isolated Ground Duplex, Hubbell No. IG-2162
3) 20A, 120V Ground Fault Duplex, Hubbell No. GF-5362W

D. Device plates: Coordinate with Architect for type. For receptacles other than 120 volt, inscribed voltage available.

1) Reinforced thermoplastic by same manufacturer of devices.

2) All device plates shall be have an approved label (Dymo or equal) with its panelboard of origin and circuit designation. Label shall be located on device plate and inside receptacle box.

E. Colors: Coordinate colors with Architect.

F. Mounting orientation of receptacles (horizontal or vertical): Coordinate with Architect.

17. LIGHTING FIXTURES:

A. Lighting fixture schedule: Lighting fixture schedule shown on engineer's drawings are for information purposes only. Lighting fixtures shown are those selected by architect. Engineer shall not be responsible for information shown related to fixture selection and overall lighting design. Refer to architectural drawings for further information.

B. Provide Lighting Fixtures, lamps and components as per lighting fixture schedule. Fixtures shall be completely factory assembled, wired and equipped with all necessary sockets, ballasts, supporting hardware, plaster rings, backboxes, conduit, etc. as required for a complete and satisfactory assembly. Listed catalog numbers do not necessarily denote required mounting equipment or accessories.

C. Fixtures shall be completely wired and constructed to comply with all MA Codes and Underwriters Laboratories Standards for electrical lighting fixtures and the State and Local Energy codes.

D. All fixtures shall be independently mounted from black iron or building structure by a minimum of (2) independent mounting chains as required and not from ceiling grid. Electrical contractor shall be responsible for all coordination of ceiling construction types with lighting fixtures. Fixtures shall be provided for operation with proper voltage characteristics. Refer to plans for information.

E. Refer to Architectural plans for exact locations and quantities of lighting fixtures.

F. Fluorescent lighting fixtures shall comply with IES standards RP-1 and RP-24 and NEMA Standard Publication LE-1. Industrial fixtures shall comply with RLM standards institute and shall bear the RLM label.

G. Furnish all fluorescent, incandescent, HID and tungsten halogen lamps as indicated on lighting fixture schedule and as required for each fixture. All fluorescent lamps shall be T8, SPX35 RS (Min. CRI 80+) unless otherwise noted. All HID lamps shall be color corrected. Lamps shall be supplied by Philips, General Electric, Osram/Sylvania.

H. Ballasts shall be RTC Gold Label, indicating approved integral ballast protection. High ballast factor (90% or greater). Type 'E' (Ballast efficiency factor) with internally protected capacitors shall be utilized. Fluorescent ballast shall be quiet operating ETL and CMB certified electronic ballasts with THD<10% as manufactured by Universal, Advance, EBT or Valmont with a min. 3 year warranty against any defects in workmanship and/or material and shall include payment of all labor charges for replacement of any ballast. Ballasts for each fixture within a fixture type shall be identical. Wherever dimmers are shown on plans, fixtures shall be provided with compatible dimming ballast equal to Lutron "Hi-Lume" matching local or central dimming system.

I. Emergency battery shall be: capable of operating (2) lamps. For T8 lamp, battery shall be Bondine #B50 for compact fluorescent lamps – 4 pin battery shall be Bodine #B94C.

J. Refer to architectural documents for Lighting Fixture Specifications.

K. Continuous row fixtures shall have lamps staggered.

18. TELEPHONE/DATA CONDUIT SYSTEM:

A. Provide complete system of: empty conduit, pull boxes, outlets, sleeves and fish wires.

B. Equipment and installation shall conform to requirements of Telephone Company and telecommucation specifications.

1) Outlets shall be:

   a) Wall: 4 in. square with reducer ring. Cover plate provided integral with outlet device. Blank off where no device is installed.

   b) Floor: in-floor cast iron with low-tension fitting or as specified for poke thru floor assemblies.

C. Provide fishwires, in raceways over 10 ft long and at all drops to outlets.

D. Provide riser pull boxes at a minimum of 50 feet intervals.

E. Conduit shall be 3/4 in. minimum. Furnish empty conduit from outlet to nearest accessible hung ceiling or as noted. Terminate open end with insulated bushing.

19. SECURITY SYSTEM

A. For each security system outlet, provide an outlet box with plate where required (plates to be same type as wiring devices but to match security system equipment).

B. From each security system outlet, provide 1 in. empty conduit terminated vertically three inches above hung ceiling or at closets accessible ceiling with approved bushing and with fish wire.

C. All conduits shall be minimum EMT and installed concealed in finished areas or as noted.

D. All security system equipment shall be provided by others.

22. FIRE ALARM SYSTEM

A. The building is served by a base building fire alarm system. The system will remain and be expanded to accommodate the renovations to the building. During the construction phase the existing system shall be protected from damage.

B. Work included:

1) Work under this section includes the installation of components to form a complete and operative fire alarm system, including removal of the existing fire alarm system devices that are not to be retained.

2) Work shall include, but not limited to, the following:

   a) Installation of new Fire Alarm System components and associated equipment

   b) Disconnection, removal and disposal of existing fire alarm quipment and wiring

   c) Testing

3) Furnish and install Fire Alarm System components to work in conjunction with the existing base building fire alarm system as described herein and as shown on the plans; to be wired, connected, and left in first-class operating condition. The system shall include manual station (fire alarm boxes), automatic fire detectors, audio/visual devices, strobes, beacon, door holders, electric door strikes, all wiring, conduit, connections to devices, connections to sprinkler flow and tamper switches, zone modules, SNAC panels, outlet boxes, junction boxes and all other necessary material for a complete operating system. The new fire alarm system components will be as manufactured by the base building system manufacturer.

4) The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials and performance of all operations in connection with the installation of the Fire Alarm System as shown on the drawings and as herein specified.

5) The complete installation is to conform to the applicable sections of NFPA-72, Local Code Requirements and Massachusetts Electrical Code.

6) The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.

7) The electrical contractor is to coordinate the installation, final connections and testing with the building manager/owners fire alarm system contractor/service company. All costs associated with the building manager/owners contractors as it relates to this project will be paid by this contractor as part of his base bid.

23. ELECTRICAL TESTING

A. Provide all necessary meters, instruments, temporary wiring and labor to test and adjust all equipment and wiring installed and/or connected under this contract, including electrical equipment furnished by others, to determine proper polarity, phasing, freedom from grounds and shorts and operation of equipment. All measuring instruments must be properly calibrated.

B. Whenever the authorities having jurisdiction require that any work be tested or approved, Contractor shall provide proper facilities for access for inspection.

C. Check all lighting fixtures and receptacles for proper operation.

D. Motors:

1) Make the following tests on the motors before starting up:

   a) Check motor nameplate for horsepower, speed, phase and voltage.

2) Make the following tests on all motors during or immediately after start up:

   a) Check shaft rotation: Check bearing temperature: Check motor for smooth operation.

   b) Take a current reading of full load using a clamp on ammeter. If ammeter reading is over the rated full load, current, determine the reason for the discrepancy, and take the necessary corrective action.

   c) Following established procedures equipment shall be energized after certifications by the Contractor that the installation's satisfactory. All motors and equipment shall be tested for proper operation.

   d) Overload elements in motor starters shall be adjusted and checked for suitably to the motor characteristics. Contractor shall replace any overloading element that is inadequate. The cause of any motor operating above full load rating should be investigated and the cause should be removed instead of increasing the overload relay trip rating. These operational tests shall determine that the installation is correct.

E. After all adjustments are complete, take current readings at full load using a clamp on ammeter and submit to Engineer for review and approval.

F. Check all system and equipment grounds for proper value of resistance using the Megger ground tester in accordance with manufacturers standard instruction. Test insulation resistance of all new and affected existing feeders prior to energizing.

26. FIRE STOPPING

A. Drawings and general provisions of contract, including general and supplementary conditions and division specification sections, apply to work of this section.

B. Provide all required fire-stopping. Work includes fire stopping penetrations of fire-resistance rated floors, walls and partitions in new construction, as well as pre-existing penetrations in renovation areas of existing construction.

C. Product data: Submit manufacturer's product data for each fire-stopping produce required, including instructions for substrate preparation and fire-stopping installation.

D. Fire resistant joint sealers: Provide manufacturer's standard fire-stopping sealant with accessory materials, having fire resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

E. Materials – Provide the following:

1) One-part fire-stopping sealant: One part latex based intumescent sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors. Acceptable products/manufacturers include the following:

   a) Spec Seal LC150 Series

   b) Hilti FS One

27. DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS

A. Submit written certification that electrical systems are complete and operational. Submit certification with Contractor's request for final review.

1) At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration. The various tests shall be witnessed by the Owner or his Representative.

B. The Contractor shall furnish all test equipment, materials, labor, and temporary power hook-ups to perform start-up and all tests as required obtaining final field acceptance from Owner. All tests shall be conducted in the presence of the Owner or his Representative. All test procedures shall conform to this specification and applicable standards the ANSI, IEEE, NEMA, OSHA, NEPA, etc.

C. The Contractor shall be responsible for all tests and test record. Testing shall be performed by and under the immediate supervision of the Contractor. Test record shall be kept for each piece of equipment. Copies shall be furnished to the Engineer for review and/or approval.

D. A visual inspection of all electrical equipment, to check for the foreign material, tightness or wiring and connection, proper grounding, matching nameplate charts with specification, etc., shall be made prior to actual testing.

E. A complete operational test shall be made on the revised life safety fire alarm system. The Contractor shall consult with the equipment vendors and then submit for approval a step-by-step procedure describing the method of making the tests, the equipment to be utilized and the feature to be checked by the test. All interlocks and protective features shall be checked out.

29. DESIGN MODIFICATIONS

A. The drawings show electrical systems that supply, control, and/or monitor systems specified elsewhere. The electrical system shown has been based on specific manufacturers data or information conveyed to the electrical designer. Where any agreement or change is made to supply equipment of larger capacity or different electrical characteristics, the Contractor shall be responsible for providing the electrical system to effect such changes within the intent of these specifications and to inform the Engineer, in writing, of such change. For example, if HVAC compressors and/or motors are allowed to be changed to 230 volts rather than the originally specified 208 volts, boosting or bucking transformers shall be supplied, installed, and wired to accommodate the change at no additional cost.

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Issues and Revisions

Mark	Date	Description
–	09-29-15	ISSUED FOR PERMITTING

STATE OF MAINE
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Drawing Scales
N.T.S.

0 4' 8' 12'

PA / PE: ***
Drawn By: ***

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ELECTRICAL SPECIFICATIONS SHEET 2 OF 2

E80.2