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SECTION 16100 - ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 SCOPE OF WORK

A. Provide all labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electric work as indicated on Drawings, as described in Specifications or as reasonably inferred from either as being required in opinion of Architect.

B. Work shall include but shall not be limited to following:

1. Pad mounted transformers
2. Main switchboard
3. Ground fault protection on main breaker
4. Ground fault protection on mains and feeder breakers
5. Motor starters
6. Motor connections and controls
7. Disconnect switches
8. Combination motor starter/disconnect switches
9. Fuses
10. Panelboards
11. Fuse panelboards
12. Surge protection devices (SPD)
13. Emergency generator
14. Automatic transfer switches
15. Emergency lighting batteries and heads

16. Conduits and raceways
17. Conduit sealing bushings
18. Outlet boxes and accessories
19. Pull boxes
20. Wire and cable
21. MI cable for emergency feeders
22. Cable tray
23. Wireways
24. Wiring devices
25. Wiring device plates
26. Multi-outlet assemblies
27. Poke-thru wiring devices
28. Luminaires (including lamps and ballasts)
29. Site lighting
30. Lighting contactors
31. Relays
32. Time switches
33. Vibration isolation and seismic restraints
34. Fire alarm system
35. Integrated access control, CCTV and intrusion alarm system
36. Closing notification system
37. Terminal connecting cabinets
38. Door signal system
39. Cable TV service conduit and empty conduit system
40. Fireproofing of emergency feeders

41. Certified test reports

42. Equipment connections

43. Existing electrical equipment and systems

44. Short circuit and coordination study

45. Access panels

46. Grounding

47. Nameplates

48. Sleeving

49. Testing

50. Fan shutdown wiring from smoke detector(s) to respective starter.

51. Operating and maintenance instructions and manuals

52. Record Drawings

C. As used in this Section, "provide" means "furnish and install." "Install" means "put in place and connect."

D. Perform work and provide material and equipment as shown on Drawings and as specified in this Section. Coordinate work of this Section with work of other Sections to provide complete and functional installation.

E. Where Drawings or Specifications indicate discrepancies, or are unclear, advise Architect in writing before Award of Contract. Otherwise Architect's interpretation of Contract Documents shall be final. No additional compensation will be approved because of discrepancies or lack of clarity thus unresolved.

F. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

G. Where Drawings or Specifications do not agree with manufacturer's recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make necessary changes in installation as required by Architect within Contract Price.

H. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract. Information and components shown on riser diagrams but not on plans, and vice versa, shall apply or shall be provided as though expressly required on both. It is not intended that every junction box, offset, fitting or component be specified or shown on Drawings; however, Contract Documents require provision of all components and materials necessary for complete and operational Electrical installation, whether or not indicated or specified.

I. Prior to submitting bid, visit site and identify existing conditions and difficulties that will affect work of this Section. Renovation work requires careful site examination before bidding. No

compensation will be granted for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observers.

J. Prior to commencing work of this Section, examine site and conditions under which work will be performed. Determine exact locations of existing items shown diagrammatically on Drawings. Report in writing to Architect conditions that might adversely affect work. Commencement of work shall constitute complete acceptance of existing conditions and preparatory work.

K. Do not scale Drawings. Scale indicated on Drawings is for establishing reference points only. Actual field conditions shall govern all dimensions.

L. Provide items referred to in singular number in Contract Documents in quantities necessary to complete Work of this Section. Work to be performed under this Section is shown on Drawings numbered:

M. The listing of Contract Drawings above shall not limit responsibility to determine full extent of work of this Section as required by all Contract Drawings.

1.3 ITEMS TO BE FURNISHED ONLY

A. Furnish following items for installation under other Sections:

1. Access panels: Masonry, Lathing and Plastering, and Acoustical Tile.

2. Emergency generator critical exhaust silencer, flexible connections and fuel line solenoid valve: Heating, Ventilating and Air Conditioning.

3. De-stratification fans including controllers will be furnished and assembled by HVAC and installed and wired under this Section.

1.4 ITEMS TO BE INSTALLED ONLY

A. Install following items furnished under other Sections:

1. Motor starters and controls if indicated by special symbols on Electrical Drawings as being furnished under Plumbing.

2. Motor starters and controls if indicated by special symbols on Electrical Drawings as being furnished under Heating, Ventilating and Air Conditioning.

1.5 RELATED WORK

A. Staging, planking and scaffolding over 8 feet will be furnished, installed and maintained under Temporary Facilities.

B. Temporary light and power.

C. Excavation, backfill and resurfacing required for underground electrical systems.

D. Establishment of finished grades for site lighting and sports lighting.

E. Concrete work required for electric systems to include concrete envelope for electric, telephone and fire alarm services, housekeeping pads for equipment, conduits under floor slabs, emergency feeders and poured in place service transformer pad and pole base construction.

F. Concrete filled steel pipe bollards.

G. Cutting and patching. Including routing and patching of all existing walls for concealing new raceways serving devices for all systems.

H. Firestopping.

I. Concrete filling of space around conduits which penetrate floor slab.

J. Cutting of new and existing masonry for electrical outlets.

K. Structural steel required for electrical systems, including steel reinforcing rods.

L. Flashing of electrical conduits passing through roof.

M. Magnetic contact switches in doors for intrusion alarm system shall be furnished and wired under this Section, but will be installed flush in doors and door frames under another Section.

N. Electric door release units will be furnished and installed under Finish Hardware Section, but shall be wired under this Section.

O. Magnetic door holder units used in association with fire alarm system will be furnished and installed under Finish Hardware, but shall be wired under this Section.

P. Painting of exposed electric conduit, boxes, flush panelboards and exterior lighting standards where required.

Q. Fireproofing will be furnished and installed under Sprayed Fireproofing. Patching and repairing of fireproofing due to cutting or damage during course of work of this Section shall be performed by installer of fireproofing and paid for under this Section.

R. Cutouts in casework and furniture for mounting electrical devices and equipment where specified and indicated on architectural and/or Equipment Drawings. Prefabricated casework will be supplied with prewired lighting fixture, switch and other such electrical devices. Prewired casework shall be wired to 120V., 60 Hz. supply circuit under this section.

S. Elevator final motor connections and elevator control wiring.

T. Water-flow switches and valve supervisory switches for sprinkler system shall be wired to fire alarm system under this Section, but furnished and installed under Fire Protection Section.

U. Excess pressure pump on main sprinkler system line will be wired under this Section, but will be furnished and installed in sprinkler system under Fire Protection Section.

V. Except as shown on Drawings, automatic temperature control wiring for HVAC equipment.

W. Smoke detectors in HVAC ducts shall be furnished and wired under this Section, but installed under Heating, Ventilating and Air Conditioning Section.

X. Burner control wiring.

Y. Motorized equipment will be furnished complete with motors under other Sections.

Z. Telephone system wire, cable, equipment and instruments.

1.6 SHOP DRAWINGS

A. Submit complete Shop Drawings in accordance with provisions of General Conditions (Division 1).

B. Submit details of systems and equipment to Architect for review within THIRTY days after award of Contract. Submit six binders containing one copy each of Shop Drawings of following systems and equipment: Submission of Shop Drawings not in binders, but in loose sheet form, will be considered cause for rejection with resubmission in proper form required. Low tension systems shall each be submitted in separate binders. Manufacturer's cut sheets with multiple choices shall be clearly flagged to indicate which item is being submitted.

C. Shop Drawings shall include, but not necessarily be limited to, following items:

1. Main switchboard

2. Motor starters

3. Disconnect switches

4. Combination motor starter/disconnect switches

5. Fuses

6. Panelboards

7. Fuse panelboards

8. Surge protection devices (SPD)

9. Emergency generator

10. Generator full load test data

11. Automatic transfer switches

12. Emergency lighting batteries and heads

13. Conduits and raceways

14. Conduit sealing bushings

15. Wire and cable

16. Cable tray
17. Wireways
18. Wiring devices
19. Wiring device plates
20. Multi-outlet assemblies
21. Poke-thru wiring devices
22. Luminaires (including lamps and ballasts)
23. Lighting contactors
24. Relays
25. Time switches
26. Vibration isolation and seismic restraints
27. Fire alarm system
28. Intrusion alarm system
29. Terminal connecting cabinets
30. Closing notification system
31. Door signal system
32. Electric heating equipment
33. Fireproofing materials
34. Certified test reports
35. Short circuit and coordination study
36. Access panels

D. Submit for review complete wiring diagrams of systems prepared by equipment manufacturer showing connections and equipment. Standard wiring diagrams shall be modified where necessary to specific system. Provide adequate conduit raceways for adapting wiring diagrams to conduit system.

E. Intent of Shop Drawings and Product Data review is to check for capacity, rating and certain construction features. Ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction, and for coordination of work of this and other Sections.

F. Perform work in accordance with submittals marked "Reviewed" to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports, access, service and errors, nor for deviations from requirements of Contract Documents. Noting errors while overlooking others will not excuse proceeding in error. Requirements of Contract Documents are not limited, waived, nor superceded by Shop Drawing review.

G. Submittals of various systems shall indicate equipment supplier used and that all equipment of particular system is being furnished by same supplier. Supplier shall be qualified to supervise installation, connection and testing of system and have competent maintenance service for respective systems.

H. Shop Drawings submission of recessed luminaires will be interpreted to indicate that ceiling construction, type and material has been verified with Architect, for various areas in which luminaires will be mounted.

1. Shop Drawings shall be accompanied by written statement and date indicating such mounting arrangements have been verified with Architect.

I. Shop Drawings and samples will be reviewed with reasonable promptness and will be stamped indicating appropriate action as follows:

1. "REVIEWED" means that fabrication, manufacture, or construction may proceed providing submittal complies with Contract Documents.

2. "REVIEWED WITH COMMENTS" means that fabrication, manufacture, or construction may proceed providing submittal complies with Engineer's notations and Contract Documents. If, for any reason, notations cannot be complied with, resubmit as described for submittals stamped "RESUBMIT."

3. "RESUBMIT" means that submittal does not comply with Contract Documents and that fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with requirements of Contract Documents.

Note: Seismic design submission will be reviewed for general requirements only to verify that Contractor has retained a Qualified Seismic Consultant. This review does not constitute Approval.

J. If manufacturer changes his product after system submittal has been approved, submit new system in its entirety for approval.

1.7 SAMPLES

A. Submit all samples requested by Architect in accordance with Division 1.

1.8 RECORD DRAWINGS

A. Refer to General Conditions (Division 1) for Record Drawing requirements.

B. Refer to Section 01330 for requirements regarding use of Contract Drawing AutoCAD Files.

C. TMP will provide AutoCAD files for Contractor's use upon written request at a cost of $50.00 (fifty dollars) per Drawing, with minimum cost of $500 (five hundred dollars).

D. Purchase and maintain at job site complete set of blackline prints of Contract Drawings. As work progresses mark changes made, whether resulting from Addenda, formal change orders or other instructions issued by Architect. Color-in various conduits, wires, fixtures, apparatus and associated appurtenances as erected.

E. At completion of work prepare new set of reproducible Record Drawings, on mylar, of work as actually installed, incorporating changes, addenda and added data noted on marked-up prints, including dimensioned location of direct burial cable and underground conduit beyond limits of building.

F. Furnish Record Drawings with two sets of blueprints marked "Record Prints" to Architect for transmission to Owner. Furnish disks containing complete set of Record Drawings in latest AutoCAD format.

1.9 CODES, PERMITS, AND STANDARDS

A. Installation shall comply with electrical code, latest revisions, and prevailing local, federal and state regulations.

B. Material and equipment shall be UL listed where standard has been established.

C. Manufacturer names and nomenclature facilitate description of certain materials and equipment and establish type, quality and function.

D. Unless otherwise specified, furnish, install and test work in accordance with latest editions of applicable publications and standards of following:

1. ADA: Americans with Disabilities Act
2. ANSI: American National Standards Institute
3. ASTM: American Society for Testing and Materials
4. BOCA: Building Officials and Code Administrators
5. ICEA: Insulated Cable Engineers Association
6. IBC: International Building Code
7. IEEE: Institute of Electrical and Electronic Engineers
8. NEC: National Electrical Code
9. NEMA: National Electrical Manufacturers Association
10. NFPA: National Fire Protection Association
11. UL: Underwriters Laboratories, Inc.

E. Reference made to codes and standards shall be interpreted as minimum requirements. Where referenced codes and/or standards conflict, the more stringent shall apply. Architect may relax this requirement where such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing. Perform work in excess of codes and standards as indicated by Drawings or Specifications.

F. Obtain necessary permits, licenses, or certificates of approval required. Pay fees required by and conforming to local and state laws and regulations. At conclusion of work, furnish certificates of inspection to Owner from authorities having jurisdiction.

G. Perform tests required by Specifications, Architect's instructions, laws, ordinances or public authorities, approvals, and give Architect timely notice. Notify Architect of dates for inspection by other authorities.

H. Pay backcharges to electric and telephone companies, and city building and fire departments.

I. Backcharges from electric and telephone companies and from city (town) building and fire department shall be forwarded to Owner for payment.

1.10 TEMPORARY FACILITIES

A. Refer to requirements of Division 1 regarding temporary facilities.

1.11 SUBSTITUTION OF MATERIALS

A. Deviations from Contract Documents and substitution of materials and equipment for those specified shall be requested individually and in writing. Submit proposed substitution prior to purchase and/or fabrication and within 30 days after Award of Contract.

B. Submit comprehensive descriptive and technical data to establish quality. Do not submit for substitution material or equipment unless identical material or equipment has been operated successfully for at least three consecutive years.

C. When substitution is permitted, coordinate fully with related changes to work of other Sections. Ensure that related changes necessary for coordination are made within Contract Price.

D. Assume full responsibility for safety, operation and performance of altered system.

E. Proposed substitutions shall be subject to approval by Architect.

1.12 GUARANTEE AND WARRANTIES

A. In addition to specific guarantee requirements of General Conditions and Supplementary General Conditions obtain in Owner's name written equipment and material warranties offered in manufacturer's published product data without exclusion or limitation.

B. Guarantee Work of this Section in writing for not less than one year from date of Final Notice of Acceptance. Repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

C. Replace material or equipment that requires excessive service during guarantee period, as defined and as directed by Architect.

D. Submit guarantee to Architect before final payment.

1.13 QUALITY ASSURANCE

A. Experience: Manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than three years prior to the date of bid opening for this Project.

B. Experience List: Submit a list of installations where the following items have been in operation for not less than one year. Include project name and address, name and telephone number of owner's representative.

1.14 COORDINATION DRAWINGS

A. Conform to requirements of Division 1 – Project Coordination. Before commencing work in any area, submit Coordination Drawings to Architect indicating light fixtures, conduit runs and any other items to clear work of all other trades and to maintain required ceiling height and partition layout.

B. Coordination Drawings shall show relationship of new work to existing conditions and shall indicate how conflicts with existing conditions are to be resolved at no additional cost.

C. Work of this Section may be shown on HVAC Coordination Drawings, in AutoCAD format. Refer to paragraph RECORD DRAWINGS for information on obtaining AutoCAD files.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials and equipment necessary to make installation complete in every detail under this Contract whether or not specifically shown on Drawings or specified herein. Materials and equipment shall be new.

B. Intent of Specifications is that one manufacturer, not combination, be selected for particular classification of material. For example, wire of one manufacturer, switches of one manufacturer. Architect may give specific exemption from this requirement.

C. Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalogue number, such designation is only to establish standards of performance, quality, type and style.

2.2 PULL BOXES, WIREWAYS AND CHANNELS

A. Pull boxes shall be code gauge galvanized steel with screw covers to match. Pull boxes and wireways shall be as shown on Drawings and/or as required by NEC and/or job conditions, with steel barriers separating systems.

B. Wireways shall be code gauge galvanized steel, manufactured standard sections and fittings, with combination hinged and screw covers.

C. Steel channel supports shall be minimum 1-5/8 inch mild strip steel with minimum 12 gauge (0.105 inch) wall thickness, Unistrut P1000, Kindorf, Husky Products, or equal. Loadings shall be per manufacturer's recommendations.

2.3 RACEWAYS

A. Intermediate metal conduit shall be hot-dipped galvanized steel conforming to ANSI C80.6 and UL 1242. Conduit shall be as manufactured by Allied Tube and Conduit Corp., Wheatland Tube Co., LTV Steel Tubular products Co. or equal.

B. Rigid steel conduit shall be hot-dipped galvanized steel confirming to ANSI C80.1 and UL 6. Conduit shall be as manufactured by Allied Tube and Conduit Co., Wheatland Tube Co., LTV Steel Tubular Co., or equal.

C. Electric metallic tubing shall be hot-dipped galvanized steel conforming to ANSI C80.3 and UL 797. Tubing shall be as manufactured by Pyle National, Allied Tube and Conduit Corp., Wheatland Tube Company, or equal.

D. Flexible metal conduit shall be galvanized steel with separate copper grounding conductor. Liquid-tight flexible metal conduit shall be similar, but with extruded moisture and oil-proof outer jacket of polyvinyl chloride plastic.

E. Intermediate metal conduit fittings, couplings and connectors shall be threaded and galvanized or cadmium plated.

F. Couplings and connectors for electric metallic tubing shall be galvanized steel set-screw.

G. Steel support rods or support bolts for conduits shall be 1/8 inch diameter for each inch or fraction thereof of diameter of conduit size, but no rod or bolt shall be less than 1/4 inch in diameter. Support rods for steel channel shall not be less than 5/8 inch in diameter.

H. Expansion fittings for up to 2 inch movement in either direction, shall be O.Z. Gedney type 'TX' for EMT and type 'AX' for IMC, or equal by Appleton or Crouse-Hinds, size as required.

I. Waterproof conduit seals for rigid steel conduit entry shall be comprised of malleable iron seal with gland assembly and adjustable pressure rings and neoprene sealing grommets, O.Z. Gedney or equal, type WSK for poured concrete walls and type FSK for floors. For cored walls and floors, provide PVC coated steel discs, neoprene sealing ring and stainless steel screws and washers, O.Z. Gedney type CSML or equal.

J. Surface metal raceway shall be Wiremold V-700, V-2000, V-2400, V-3000 and V-4000 series or equal by Mono-Systems. Provide snap-on blank covers by raceway manufacturer, with no open cracks. Where industry standard device plates are installed on raceway, snap-on blank covers shall be accurately cut to avoid open cracks. Provide suitable fittings, elbows, clips, mounting straps, connection blocks, insulators and associated hardware, as required. Provide 1/2 inch or larger rigid concealed conduit to connect raceway sections that are not continuous. Ground raceway to metallic conduit system. Raceway and cover shall have ivory factory finish.

2.4 WIRE AND CABLE

A. Provide wire and cables and associated connectors, splices, and terminations for wiring systems rated 600V. and less. Wire and cable shall be as manufactured by American Insulated Wire Corporation, General Cable Corporation, Southwire Company, Senator Wire and Cable Company, Okonite or Pirelli.

B. Conductor material shall be soft drawn copper complying with NEMA WC 5. Wire size #12 AWG and larger shall be Class B stranded. Wire size smaller than #12 shall be solid.

C. Single conductor insulation shall be 600V. type THHN-THWN, THW, XHHW, UF, SO or USE complying with NEMA WC 5 or WC 7.

D. Multiconductor cable shall be 600V. metal-clad cable, type MC, #8 and smaller with THHN-THWN insulation type and full size insulated green ground conductor.

E. Provide conductors and splices of size, ampacity rating, material, type, and class for application and service indicated. Manufacturers shall be AFC Cable Systems, AMP Incorporated, Hubbell, O.Z. Gedney or 3M Company.

F. Provide mineral-insulated metal-sheathed fire-resistive cables (Type MI) where shown on Drawings consisting of factory assembly of one or more solid copper conductors insulated with highly-compressed and pure magnesium oxide with no additives or preservatives, and enclosed in seamless, liquid-and-gas-tight continuous copper sheath. Cables shall be rated for 600 volts or less. Cables shall comply with Article 330 of MEC. Cables shall be classified by UL as having 2-hour fire resistive rating. Cable termination shall be made with UL listed mineral-insulated cable termination kits. Provide 1/4 inch thick x 4 inch wide brass plates with drilled and tapped holes at equipment entry points. Cables shall be as manufactured by Pyrotenax USA, Inc. or approved equal. Provide electrical identification every 5 feet.

G. Conduit sealing bushings shall be comprised of segmented pressure discs and slit neoprene sealing ring, O.Z. Gedney type CSB or equal.

2.5 WIRING DEVICES

A. Provide wiring devices by Arrow-Hart, Bryant, Hubbell, Pass & Seymour or Leviton. Catalog numbers are those of Bryant Company except as noted. Color of devices shall be white with matching plates except devices mounted in woodwork shall be brown with non-lacquered bronze plates or as selected by Architect.

B. Toggle switches shall be rated 20A, 120-277VAC.

1. Single pole shall be No. 4901.

2. Double pole shall be No. 4902.

3. Three-way shall be No. 4903.

4. Four-way shall be No. 4904.

C. In damp locations, switches and receptacles shall be enclosed in Crouse-Hinds FS box with weather protective cover. In wet locations, provide weatherproof non-locking clear plastic cover, UL listed as weatherproof while in use.

D. Receptacles shall conform to NEMA standards.

1. Duplex receptacles rated 20A., 125V., 2P, 3W shall be No. 5362.

2. Duplex receptacles on emergency circuit shall be red melamine.

3. Heavy duty receptacles shall be as indicated on Drawings. Furnish cord and cap set connected to equipment with approved strain relief connector on cord.

4. Isolated ground receptacles shall be 20A., 125V., 2P, 3W., No. 5362-IG.

E. Special Devices:

1. Combination switch and pilot light shall be No. 4901-PLR120 (and/or No. 4901-PLR277.)

2. Duplex receptacles with ground fault protection shall be 20A, 125V. No. GFR53FT, manufactured per UL 943.

F. Occupancy Sensors:

1. Provide dual voltage, passive infrared, ultrasonic or dual technology: infrared and ultrasonic, occupancy sensors with light level sensor by Watt Stopper or equal with ceiling or wall bracket, mounted where recommended by manufacturer and where shown on Drawings. Provide isolated relay with Form C contacts for use with HVAC system. Provide 24V. power and slave packs with transformer and relay. Color shall be white.

2. Coverage Pattern shall be as recommended by manufacturer according to size and space usage.

3. Operating characteristics shall be 20 to 90 percent relative humidity, 32 to 85 degrees F.

4. Sensors shall be located at least six feet away from HVAC air registers.

5. Sensors shall be capable of normal operation when used with electronic ballasts, PL lamp systems and rated motor loads.

6. Sensor setting shall be readily accessible on the sensor for time delay and sensitivity and be recessed to limit tampering.

7. Provide bypass manual override on each sensor to allow lighting to remain on until sensor is replaced.

8. Time delay shall not be less than 15 minutes.

G. Digital Time Switches:

1. Provide dual voltage 120/277V digital time switch 0-800W for 120V, 0-1200W for 277V to turn lights off after a preset time. LCD shall display timer's countdown. Provide optimal beep warning every five seconds during last minute of countdown and one second light flash warning at one minute before timer runs out. Watt Stopper TS 200 or equal.

H. Poke-Thrus:

1. Provide round flush thru floor fitting with barriered raceway permitting both power and tel/data housed in single device. Service head shall accommodate duplex or quad 20 amp receptacle and/or duplex RJ-45 Category 5 jacks Wiremold RC3 Series or equal.

2.6 WIRING DEVICE PLATES

A. Provide Series N2170 high impact nylon device plates as manufactured by Bryant, Arrow-Hart, Hubbell, or equal. Plates shall be white where used on white devices and non-lacquered bronze for brown devices.

B. Telephone outlet plates shall be of similar material and finish as wiring device plates and shall conform to specific project requirements.

C. Device plates shall be by same manufacturer as devices.

D. Provide blank metal device plates for blank outlets plated with rust-inhibiting coating and painted with prime paint coat finish.

2.7 NAMEPLATES

A. Nameplates shall be two-ply, 1/16 inch thick, black phenolic material with 1/4 inch high white recessed letters and two (2) mounting holes. Nameplates shall be securely attached to equipment with galvanized screws or rivets. Adhesives or cements shall not be permitted.

B. Nameplates shown on Drawings or specified under "Wiring Device Plates" paragraph as engraved, shall be engraved on device plates and filled in black.

C. Nameplates shall be as manufactured by CAM Company of Warwick, RI or equal.

2.8 OUTLET BOXES AND ACCESSORIES

A. Provide galvanized sheet steel outlet boxes for all outlets unless otherwise noted. Outlet boxes and accessories shall be as manufactured by Steel City, Appleton, Raco, or equal. Steel City catalog numbers are used for reference.

B. Lighting outlets in concrete ceilings, walls and columns shall be four inch octagonal rings, four inch deep with round bottom plate. Where concrete slab is less than five inches thick, boxes shall be 2-1/2 inches deep.

C. For wood framing and furred ceilings, provide four inch octagonal outlet boxes, bar hangers and covers. Provide 4-11/16 inch boxes and covers where one inch conduit is involved.

D. Where outlets occur in beams or ribs of pan type concrete construction, provide four inch shallow pan outlet, 3/4 inch deep, with conduit entering back of box.

E. Fixture outlet boxes shall have 3/8 inch solid male fixture studs and auxiliary fixture stems shall be supported from 3/8 inch male fixture studs.

F. Wall outlets other than lighting outlets in concrete or stud partitions shall be Series 52171, four inch square boxes with single or 2-gang raised covers, Series 52C50, of proper depth required for particular wall construction and finish. Where wall construction or finish will not permit neat cut around raised cover, provide Series GW235 boxes.

G. Outlets in wood or metal stud partitions shall be four inch square boxes with single or two gang plaster ring or tile ring as required of proper depth for wall construction and finish.

H. Outlet boxes for weatherproof work and exposed rigid conduit work shall be suitable cast aluminum or cast iron, Crouse-Hinds Company, Appleton, or O.Z. Gedney, with threaded conduit hubs.

I. Floor outlets shall be adjustable, watertight, steel box, with threaded hubs and proper coverplate to accommodate device indicated on Drawings, as manufactured by Walker, Steel City, Lew, or equal. Provide carpet flanges as required on all floor boxes in carpeted areas.

J. Floor outlets for flush duplex receptacle shall be steel Walker 880 series, or equal, with duplex brass cover plate with flip lids.

K. Floor boxes for flush telephone or intercommunication system outlets shall be Walker No. 885 steel for watertight applications with brass cover plate for low tension use.

L. Floor outlets for pedestal duplex electric outlets shall be provided complete with Walker 500 Series surface fittings or equal.

M. Floor outlets for pedestal telephone of intercommunication system outlets shall be provided complete with Walker 501E surface fittings, or equal.

N. In areas with floating wood floors provide Lew Type FFB-2, or FFB-4 floor boxes, as applicable, with No. 539 hinged covers, or equal.

2.9 LUMINAIRES

A. Provide UL listed luminaires, equipment and components wired and assembled where shown on Drawings, as listed in Luminaire Schedule and as specified. Ballast and lamp combination shall be UL listed for intended use.

B. Provide special fittings and materials to support luminaires as necessary. Provide supports to secure surface or pendant mounted luminaires on suspended ceilings as necessary.

C. Tie wire supports shall be #12 acoustical ceiling tie wire. Tie wire shall be different color than ceiling support wire.

D. Except as indicated otherwise on Drawings, suspended fluorescent luminaires shall have conventional tubular steel stem sets and standard aligner canopies by manufacturer of luminaires. Exterior finish of stem and canopy sets shall be baked white enamel.

E. Suspended high intensity discharge type luminaires, shall be provided with Appleton Electric Products, type ALC cushion hanger Unilet, with rigid conduit fixture stem. Unit shall be malleable iron, cadmium finish and shall be securely supported from building structure.

F. Provide outlet boxes for surface mounted fluorescent luminaires mounted independent of fixture housing.

G. Provide recessed luminaires with trim gaskets as required to prevent light leaks on ceiling. Recessed luminaires shall be provided with mounting support bars as required.

H. Provide plaster frames for recessed luminaires as required by ceiling construction.

I. Fluorescent Lamp Ballasts:

1. Electronic ballasts for indoor fluorescent luminaires utilizing T8, 265 ma lamps shall be instant start for maximum efficiency and parallel wired so that if one lamp fails, remaining lamps stay lit. Ballast factor shall be 0.88 – 0.90 and total harmonic distortion shall not exceed 20 percent, with minimum power factor of 0.95. Ballasts shall be UL listed Class P with lamp current crest factor of 1.7 maximum and Class A+ sound rating.

2. Electronic ballasts for indoor fluorescent luminaires utilizing T5/HO lamps shall be programmed rapid start. Ballast factor shall be minimum 0.99 and total harmonic distortion shall not exceed 10 percent with minimum power factor of 0.95. Ballasts shall be UL listed Class P and Type CC with lamp current crest factor of 1.7 maximum, and Class A sound rating.

3. Electronic ballasts shall comply with FCC Part 18 Non-consumer Equipment, Class A for EMI (conducted) and (radiated). Ballasts shall provide transient immunity as recommended by ANSI C62.41.

4. Ballasts shall be manufactured by Advance, Osram Sylvania or Universal.

5. High efficiency T8 lamps shall have minimum CR1 of 81 and minimum lamp maintenance of 94 percent. Lamp wattage shall be either 32W or 30W. 32W lamps shall have minimum lumen output of 3,100 initial and 2,900 mean, and be rated for

24,000 hours at 3 hours per start. 30W lamps shall have minimum lumen output of 2,800 initial and 2,600 mean, and be rated for 18,000 hours at 3 hours per start.

6. High efficiency T8 electronic ballasts shall be dual rated 120V/277V instant start with power factor greater than 90 percent and THD less than 20 percent.

7. Instant start ballasts shall have minimum ballast factor of 0.87 and minimum Ballast Efficacy Factor (BEF) of 0.80 for 4 lamps, 1.06 for 3 lamps, 1.61 for 2 lamps, and 3.11 for single lamp.

8. Provide low temperature ballasts for use outdoors or in unheated indoor parking areas, designed for temperature as low as minus 20 degrees Fahrenheit.

9. Electronic ballasts that operate T5, T4 or smaller diameter lamps including compact fluorescent lamps shall have end-of-lamp life shut down circuit.

J. High Intensity Discharge Lamp Ballasts:

1. Metal halide and high pressure sodium lamp ballasts shall be constant wattage unless specified otherwise.

2. Ballasts shall be core and coil encapsulated core and coil.

3. Ballasts shall start lamps at temperature as low as minus 20 degrees Fahrenheit.

4. Allowable line voltage variation shall be plus or minus ten percent, except high pressure sodium ballasts shall be plus or minus five percent, unless otherwise indicated by Drawings.

5. Starting currents of ballasts shall be less than operating current.

6. Provide factory installed cartridge fuses and fuse holders for each ungrounded conductor.

a. Ampere rating of fuses shall be 500 percent of rated nominal current for 480 volt lighting circuits and 300 percent for lighting circuits operating at circuit voltages less than 480 volts.

b. Fuses shall be slow blow.

7. Ballasts shall have power factor of 90 percent or greater.

8. Provide pulse start ballasts and lamps for metal halide luminaires.

K. All recessed incandescent luminaires shall be thermally protected in accordance with UL.

L. Lamps:

1. Provide new lamps. Refer to Luminaire Schedule for lamp type, wattage, voltage and size.

2. Lamps shall be manufactured by Sylvania-Osram, General Electric, Philips, or equal.

3. Incandescent lamps shall have extended life of 2500 hours, where available. Otherwise, incandescent lamps shall be rated for 130V.

4. Furnish to Owner on date of final acceptance of project, one dozen spare lamps of each wattage and type of fluorescent and incandescent and 4 spares for each high intensity discharge lamp. Refer to luminaire schedule for lamp data.

2.10 ENCLOSED SWITCHES

A. Provide disconnect switches fused or unfused as shown on Drawings. Switches shall be NEMA KS-1, Type HD safety switches rated for heavy duty with interlocking cover, side operated with lockable handle. Switches exposed to weather shall have raintight enclosures. Switch enclosure shall be NEMA listed for location and atmosphere in which they are mounted. Current carrying parts shall be silver plated.

B. Provide auxiliary contacts for disconnect switches in elevator machine rooms.

C. Disconnect switches shall be as manufactured by one of following: General Electric, Eaton (Cutler-Hammer), Square D Co., or Siemens.

2.11 FUSES

A. Provide current limiting, non-renewable fuses, Bussmann, Chase-Shawmut Amp-Trap, or equal, UL Class J up to 600 amp. and Class L over 600 amp.

B. Fuses shall be rated 600V or less A.C., UL listed, and have minimum interrupting rating of 200,000 rms amperes with peak let-through current and maximum clearing values within prescribed UL limits. Fuses for motor feeders or motor circuits shall be Class RK-5 of voltage classification rated for motor with minimum interrupting capacity of 200,000 rms amperes and with minimum time delay of 10 seconds at 500 percent.

C. Provide one complete set of three spare fuses for each size used.

2.12 ENCLOSED CIRCUIT BREAKERS

A. Provide molded-case circuit breaker NEMA AB 1, with interrupting capacity to meet available fault currents by Eaton (Cutler-Hammer), GE, Square D or Siemens as follows.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller.

B. Provide molded-case circuit-breaker features and accessories as follows for standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application. Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

4. Auxiliary Switch: One SPDT switch with "a" contacts; "a" contacts mimic circuit-breaker contacts.

5. Provide adjustable magnetic trip units for circuit breakers rated 125A to 600A serving motors, with range of 5 - 10 times (10 percent tolerance) trip unit range.

C. Provide NEMA AB 1 and NEMA KS 1 enclosures to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.13 MOTOR STARTERS AND CONTROLS

A. Provide magnetic across-the-line or solid-state reduced voltage motor starters minimum NEMA size 0 except as specified or shown on Drawings by Eaton (Cutler-Hammer), GE, Square D, or Siemens.

1. 208V. motor starters shall be NEMA size 1 for 5 and 7.5 horsepower, size 2 for 10, size 3 for 15 thru 25, size 4 for 30 and size 5 for 50 horsepower.

B. Provide motor starters and controls with suitable metal enclosures to NEMA Industrial Control Standards.

C. Provide motor starters with individual running overcurrent protection in each phase and with two sets of auxiliary contacts, one normally open and one normally closed. Starters for single phase motors shall be two pole; starters for three phase motors shall be three pole. Starters shall have built-in combination fusible disconnect switch, motor circuit protector, selector switch, etc., as designated on Drawings.

D. Provide manual starters with toggle mechanism for full voltage starting.

E. Provide decelerating relays for two-speed motors larger than 1 horsepower.

F. Provide standard duty pilot lights, push buttons and controls. Pilots shall be red jewel, except two-speed pilots shall be red for high speed, amber for low speed and green for "OFF".

G. Starters and remote control stations furnished under this Section shall have laminated plastic engraved nameplates designating equipment controlled. Refer to "Nameplates" paragraph of this Section.

H. Magnetic motor starters furnished under this Section connected to circuits operating at more than 120V shall have built-in control transformers with 120 volt secondary control supply.

I. Provide self-powered, ambient insensitive, adjustable solid-state overload relays, selectable for motor running overload protection, selected to protect motor against voltage and current imbalance and single phasing.

J. For reduced voltage starters, provide solid-state, reduced voltage controllers, NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.

2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent of more above nominal line voltage.

3. LED indicators showing motor and control status, including control power available, controllers on, overload trip, loss of phase, and shorted silicone-controller rectifier.

4. Motor running contactor operating automatically when full voltage is applied to motor.

2.14 PANELBOARDS

A. Provide dead front lighting and power panelboards, arranged for 120/ 208V, three phase, four wire, solid neutral. Panels shall meet or exceed all requirements of NEMA PB-1 and UL 67. Panels shall be minimum 20 inches wide.

B. Provide bolt-on, molded case, circuit breakers with thermal-magnetic trips. Multiple pole breakers shall be single handle, common trip. Provide handle locks for emergency lighting circuits, fire alarm, security, or other similar functions. Circuit breakers rated 125A. or less shall be marked for 60 and 75 degrees C conductors.

C. Provide tin plated aluminum bus bars and full size for 120/208V. panels with insulated neutral bus. Panels with feed-thru bussing shall not be used. Provide anti-turn, solderless lugs suitable for copper or aluminum wire.

D. Provide fully rated or series rated circuit breakers equal to short circuit interrupting ratings as scheduled on Drawings. Where series ratings are used, manufacturer shall submit data sheets with series rated combinations for main (or upstream) device and branch device as tested in accordance with UL 67.

E. Provide adjustable magnetic trip units for circuit breakers rated 125A to 600A serving motors, with range of 5 - 10 times (10 percent tolerance) trip unit rating.

F. Provide separate equipment ground bus for each panel. Ground bus shall be bonded to enclosure.

G. Provide "door-in-door" construction for each panel with heavy duty door continuously hinged vertically to box section of panel for access to wiring gutters.

H. Provide galvanized code gauge steel surface metal boxes ready for painting. Provide two coats of factory-applied paint on trims of flush-mounted panels. Provide combination flush catch and lock with two keys. All keys to be keyed alike.

I. Provide 1/2 inch spacers for panels mounted at exterior walls below grade to establish air space behind panels.

J. Where two sections panels are shown on Drawings, bolt boxes together to form one unit. Trim shall be two-piece construction with hinged doors of equal size over each section. Provide double lugs on incoming line terminals for feed to second section in main lug only panels. Provide freed-thru lugs in two-section panels with main breakers. Provide equal number of poles in each section.

K. Panel buswork and lugs shall be rated for minimum 225A., except panels with feeders 100A. and less may be rated 100A.

L. Provide full bussing and hardware for spaces for future breakers indicated on Schedules.

M. Provide HACR listed circuit breakers where breakers serve HVAC packaged units.

N. Provide SPD as specified herein and where shown on Drawings.

O. Panel boxes, covers and interiors shall be by one manufacturer, Eaton (Cutler-Hammer), Square D, G.E. or Siemens.

2.15 EMERGENCY LIGHTING FUSE PANELBOARDS

A. Provide 208/120V., 3 phase, 4 wire emergency lighting panels with 200A copper main bus and 30A. single pole, fusible branch circuits with type CC fuse holders and fuses with open fuse indication. Provide NEMA Type 1 enclosure with full size neutral bus and ground bus. Panel shall be rated for 100 kA with upstream device with either Class RK1 or Class J fuses. Bussmann or equal.

2.16 DISTRIBUTION PANELBOARDS

A. Provide dead front distribution panelboards, arranged for 208/120V, three phase, four-wire, solid neutral as shown on Drawings. Temperature rise within distribution panels shall meet UL Standards.

B. Feeder protective device shall be quick-make, quick-break fusible switches as manufactured by Cutler-Hammer type "FDP."

1. Switches shall incorporate safety cover interlocks to prevent opening the cover with the switch in the "on" position or prevent placing the switch in the "on" position with the cover open. Provide defeater feature for safety.

2. Switches handles shall have provisions for padlocking in the "on" or "off" by position of operating handle.

3. Switches shall be clearly indicated to show if unit is "on" or "off" by position of operating handle.

4. Units' front cover door shall be pad lockable in the closed position.

5. Fusible switches 30 Ampere through 600 Ampere frame size shall be furnished with Class "J" UL-labeled fuse clips rated for 200,000 AIC for all loads except for elevators or motors where Class "RK5" UL-labeled fuse clips rated for 200,000 AIC shall be used.

6. Fusible switches 800 Ampere and 1200 Ampere frame size shall be furnished with Class "L" UL-labeled fuse clips rated for 200,000 AIC for all loads except for elevators or motors where Class "RK5" UL-labeled fuse clips rated for 200,000 AIC shall be used.

C. Provide tin plated aluminum bus bars and full size insulated neutral bus. Provide anti-turn, solderless lugs suitable for copper or aluminum wire.

D. Provide factory-installed, high-compression, bolt-on cable connectors for panel service lugs and all protective devices over 100 amps in capacity, for each cable.

E. Multi-section distribution panelboards shall be bus connected together. Bus shall be sized to amp capacity of unit Construction of equipment shall conform to Cutler-Hammer Pow R-C switchboard with a maximum depth of 20 inch and height of 90 inch.

F. Where provisions only are indicated, all necessary provisions including buss bars shall be provided for the future installation of protective devices.

G. Provide trims and doors with baked-on gray lacquer or enamel finish.

1. Trims and doors shall be constructed of code gauge steel, complete with all bracing, clamps, supports and locks for the installation of the panelboard.

2. Minimum cabinet size shall be 12 inches deep by 30 inches wide.

3. Back boxes shall be constructed of code gauge steel and have hot-dipped galvanized finish.

H. Provide 1/2 inch spacers for panels mounted at exterior walls below grade to establish air space behind panels.

I. Mount all surface-mounted panels on a steel frame of 12- gauge, hot-dipped, galvanized steel channel with a cross-section dimension of at least 1-1/2 inches by 1-1/2 inches.

1. Design frame to distribute weight evenly.

2. Secure to floor and ceiling slab at drywall partitions. Partitions are not to support channels.

3. Secure to floor and wall at masonry partitions.

J. Install all floor-mounted distribution panelboards on 4-inch concrete pad extending 6 inches beyond front and sides of equipment.

K. Provide SPD as specified herein and where shown on Drawings.

2.17 MAIN SWITCHBOARD

A. Provide UL Listed NEMA 1 Main Switchboard consisting of free-standing, dead-front type low-voltage distribution switchboards, utilizing group mounted circuit protective devices and accessories as specified herein, and as shown on Drawings by Eaton (Cutler-Hammer) Power Line C, Siemens, Square D or GE.

B. Low-voltage distribution switchboards and components shall be designed, manufactured and tested in accordance with latest applicable following standards:

1. NEMA PB-2

2. UL Standard 891

C. In addition to submittal requirements of Part 1 of this Section, following information shall be submitted to Architect:

1. Master Drawing index

2. Front view elevation

3. Floor plan

4. Single line

5. Schematic diagram

6. Nameplate schedule

7. Component list

8. Conduit entry/exit locations

9. Assembly ratings including:

   a. Short-circuit rating

   b. Voltage

   c. Continuous current

10. Major component ratings including:

    a. Voltage

    b. Continuous current

    c. Interrupting ratings

11. Cable terminal sizes.

12. Descriptive bulletins

13. Product sheets.

D. Following information shall be submitted for record purposes:

1. Final as-built Drawings and information for items listed above.

2. Wiring diagrams

3. Certified production test reports

4. Installation information

5. Seismic certification and equipment anchorage details.

6. Submit ten copies of above information.

E. Qualifications:

1. Manufacturer of assembly shall be manufacturer of circuit protective devices within assembly.

2. For equipment specified herein, manufacturer shall be ISO 9000, 9001 or 9002 certified.

3. Manufacturer of this equipment shall have produced similar electrical equipment for minimum period of five years. When requested by Architect, acceptable list of installations with similar equipment demonstrating compliance with this requirement.

4. Switchboard shall be suitable for and certified to meet applicable seismic requirements of International State Building Code. Guidelines for installation consistent with these requirements shall be furnished by switchgear manufacturer and be based upon testing of representative equipment. Refer to Seismic Requirements in this Section.

F. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with equipment at time of shipment.

G. Assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to power source having available fault current of 65,000 amperes symmetrical at rated voltage.

H. Switchboard shall consist of required number of vertical sections bolted together to form rigid assembly. Front Panels shall be hinged. Sides and rear shall be covered with removable bolt-on covers. Edges of hinged front panels shall be formed. Provide adequate ventilation within enclosure.

1. Sections of switchboard shall be front and rear aligned maximum 36 inch deep. Protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against wall.

2. Switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

I. Bus bars shall be tin-plated aluminum. Main horizontal bus bars shall be mounted with three phases arranged in same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over 40 degrees C ambient (outside of enclosure).

J. Main Breaker:

1. Main protective devices shall be molded case circuit breakers with microprocessor based RMS sensing with inverse time, adjustable instantaneous tripping characteristics

and ground fault, Eaton (Cutler-Hammer) Series C Type RD with Digitrip RMS 310 rating plug or approved equal rated for 125,000 AIC at 240V.

2. Circuit breakers shall be operated by toggle-type handle and shall have quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of breaker shall be clearly indicated by handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. Push-to-trip button on front of circuit breaker shall furnish local manual means to exercise trip mechanism.

3. Circuit breakers shall have minimum symmetrical interrupting capacity as indicated on Drawings.

4. Provide UL listed circuit breakers for applications at 100 per cent of their continuous ampere rating in their intended enclosure.

K. Feeder Devices:

1. Feeder protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics, Eaton (Cutler-Hammer) Series C or approved equal.

2. Circuit breakers shall be operated by toggle-type handle and shall have quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of breaker shall be clearly indicated by handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. Push-to-trip button on front of circuit breaker shall furnish local manual means to exercise trip mechanism.

3. Provide adjustable magnetic trip units for circuit breakers rated 125A to 600A serving motors, with range of 5 - 10 times (10 percent tolerance) trip unit rating.

4. Circuit breakers shall have minimum symmetrical interrupting capacity as indicated on Drawings.

5. Circuit breakers with 150, 250, 400 ampere frame ratings shall be Eaton (Cutler-Hammer) Series C with thermal-magnetic trip units and inverse time-current characteristics.

6. Ground fault protection shall be provided for feeder breakers, except fire pump.

7. Circuit breakers shall be UL listed for series application. Series ratings shall apply to all ampere ratings from 15A to 100A. Circuit breakers larger than 100A shall be fully rated. Furnish manufacturers data to substantiate series ratings.

8. Circuit breakers 400A. and larger shall have Digitrip RMS 310 rating plugs.

9. Where indicated, provide UL listed circuit breakers for applications at 100 per cent of their continuous ampere rating in their intended enclosure.

L. Owners Metering:

1. Provide digital line Meter Monitor and Protection (MM&P) device equal to Eaton (Cutler-Hammer) IQ DP-4100 having features and functions specified below. MM&P shall consist of single microprocessor-based unit capable of monitoring and displaying functions listed below with accuracy indicated; MM&P shall auto range between Units, Kilo-units and Mega-units. MM&P shall furnish adjustable protection functions indicated and capability to communicate data via twisted pair network. MM&P shall be UL listed, CUL and CE certified and also meet ANSI Standard C37.90.1 for surge withstand.

METERED VALUES (Accuracy % Full Scale)	ALARM FUNCTIONS
AC Phase Amperes +/- (0.3%)	Voltage Phase Loss
AC Phase Voltage +/- (0.3%)	(less than 50% RMS)
Watts +/- (0.6%)	Current Phase Loss
VA +/- (0.6%)	(1/16 largest phase)
Vars +/- (0.6%)	Phase Voltage Unbalance
Power Factor (+/- 1 digit)	(5 to 40% -- 5% steps)
Frequency +/- (0.1 Hz)	Phase Voltage Reversal
Watt-hours +/- (0.6%)	Overvoltage
VAR-hours +/- (0.6%)	(105 to 140% -- 5% steps)
VA-hours +/- (0.6%)	Undervoltage (95 to 60% - 5% steps)
Watt Demand with	Time Delay for Overvoltage,
10-, 15-, 20-, 25-, 30-	Undervoltage, and Phase
45-, 60-min interval)	Unbalance (0 to 20 sec. –
%THD (through 31st harmonic)	1-sec. steps)
Voltage -- minimum/maximum	
Current - minimum/maximum	
Power -- minimum/maximum	
Power Factor - minimum / maximum	
Frequency - minimum / maximum	
Peak % THD	
Peak Demand	

2. Input ranges of MM&P shall accommodate external current transformers with ranges from 5/5 through 12,800/5 amperes. Provide external current transformers sized for incoming service and wired to shorting type terminal blocks. Potential transformers shall be self included and fused up to 600 volts. Above 600 volts, provide fused external potential transformers.

3. Control power shall be capable of being supplied from monitored incoming AC line without need for separate AC supply control circuit or separate remote power source.

M. Engraved nameplates, mounted on face of assembly, shall be furnished for main and feeder circuits. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

1. Control components mounted within assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2. Provide vinyl mimic bus on front of switchboard.

3. Provide SPD as specified herein and as shown on Drawings.

N. Exterior and interior steel surfaces of switchboard shall be properly cleaned and provided with rust-inhibiting phosphatized coating. Color and finish of switchboard shall be ANSI 61 light gray.

O. Following standard factory tests shall be performed on equipment. Tests shall be in accordance with latest version of ANSI and NEMA standards.

1. Switchboard shall be completely assembled, wired, adjusted, and tested at factory. After assembly, complete switchboard shall be tested for operation under simulated service conditions to assure accuracy of wiring and functioning of equipment. Main circuits shall be given dielectric test of 2200 volts for one minute between live parts and ground, and between opposite polarities. Wiring and control circuits shall be given dielectric test of 1500 volts for one minute between live parts and ground.

2. Manufacturer shall furnish three certified copies of factory test reports.

P. Assembly shall have adequate lifting means and shall be capable of being moved into installation position. Provide necessary hardware to secure assembly in place. Bolted directly to floor sills and set level in concrete per manufacturer's recommendations.

Q. Perform field adjustments of protective devices as required to place equipment in final operating condition. Settings shall be in accordance with approved short-circuit study.

1. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with approved short circuit and protective device coordination study shall be performed at no additional cost.

R. Provide training session for up to 3 owner's representatives for 1 normal workday at jobsite location determined by Owner.

1. Training session shall be conducted by manufacturer's qualified representative. Training program shall consist of instruction on operation of assembly, circuit breakers, fused switches, and major components within assembly.

2.18 SURGE PROTECTIVE DEVICE (SPD)

A. General:

1. Provide UL listed Surge Protection Device (SPD) equipment, formerly referred to as Transient Voltage Surge Suppression (TVSS), having electrical characteristics, ratings and modifications as specified herein and as shown on Drawings.

2. Equipment shall be internally mounted and as manufactured by manufacturer of switchgear, Eaton (Cutler-Hammer), GE, Square D or Siemens.

B. References:

1. SPD units and components shall be designed, manufactured and tested in accordance with latest applicable standards of following:

   a. UL Listed under UL 1449 2nd Edition and UL 1283

   b. CSA certified per CSA 22.2

2. UL 1449 suppression voltage ratings (SVR) and CSA label shall be permanently affixed to TVSS unit.

C. Submittals:

1. Provide verification that SPD device complies with Second Edition of UL 1449 and UL 1283 SVR.

2. Provide actual let through voltage test data in form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.

3. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHZ and 200 kHZ verifying device's noise attenuation exceeds 50 dB at 100 kHZ.

4. Submit ten copies of above information.

D. Qualifications:

1. Manufacturer shall be ISO 9000, 9001 or 9002 certified.

2. Manufacturer of this equipment shall have produced similar electrical equipment for minimum period of five years. When requested by Architect, acceptable list of installations with similar equipment shall be supplied demonstrating compliance with this requirement.

E. Electrical Requirements:

1. Refer to Drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) shall be not less than 125 percent of nominal system operating voltage.

3. For Wye configured system, device shall have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G).

4. Maximum UL 1449 SVR for device shall not exceed following ratings:

Models	208Y/120
L-N; L-G; N-G	330 V
L-L	700 V

F. SPD Design:

1. Each unit shall include high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 55 dB at 100 kHZ using MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHZ shall be rejected.

2. No plug-in component modules or printed circuit boards shall be used as surge current conductors. Internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

3. Each MOV shall be individually fused with fuses capable of allowing suppressor's maximum rated transient current to pass through suppressor without fuse operation. Fuses, whether internal or external, shall be UL listed. If any external current limiting devices are required, those devices shall be detailed and included in submittal. If external device is to be included, its impact on surge current capability and clamping level shall be demonstrated. Overcurrent protection circuits shall be monitored with indication of suppression operability or failure.

4. Each unit shall provide following three levels of monitoring:

   a. Continuous monitoring of fusing system

   b. Thermal detection circuit shall monitor for overheating in modes due to thermal runaway.

   c. Provide solid state indicator light on each module. Absence of green light, shall indicate which modules have been damaged. Fault detection shall activate redundant trouble light. Units which can not detect open-circuit damage, thermal conditions and over current will not be accepted.

   d. Monitoring shall be isolated from damage by surges.

5. Provide full five year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electric code.

6. SPD devices shall be mounted such that they are seismically qualified.

7. Unit shall be equipped with transient event counter and audible alarm.

G. System Application:

1. SPD applications include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. Branch panel located SPD shall be tested and demonstrate they are suitable for ANSI/IEEE C62.41 Category C1 environments.

2. Minimum total surge current 8 x 20 microsecond waveform that device is capable of withstanding shall be as shown in following table:

Application	Minimum Surge Current Per Mode*
Service Entrance (Switchboards, Switchgear)	125 kA
Distribution Panelboards	80 kA
High Exposure Roof Top Locations	80 kA
Branch Locations (Panelboards, MCC's, Busway)	60 kA

*L-L, L-G, L-N and N-G (WYE system):

H. Panelboard Requirements:

1. SPD units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.

2. Each unit shall be capable of surviving more than 4000 category C3 transients without failure or degradation of UL 1449 Suppression Voltage Rating.

3. Panelboards rated 240 VAC or less shall have short-circuit ratings as shown on Drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

4. Panelboards rated 480 VAC shall have short-circuit ratings as shown on drawings or as herein scheduled, but not less than 14,000 amperes RMS symmetrical.

5. Panelboards shall be labeled with UL short-circuit withstand rating. When series ratings are applied with integral or remote upstream devices, label shall be provided. Series ratings shall cover trip ratings or installed frames. It shall state conditions of UL series ratings including:

   a. Size and type of upstream device

   b. Branch devices that can be used

   c. UL series short-circuit rating.

6. Branch panels shall be UL labeled as "suitable for non-linear loads".

7. Distribution and panel suppressors shall be installed inside panelboards at factory by panelboard manufacturer.

8. Direct bus bar connection shall be used to mount SPD component to panelboard bus bar to reduce impedance of shunt path, or shall utilize minimum #8 conductor between 3-20A, 1P, breakers to SPD of 14-inch in length maximum.

9. SPD panelboard shall be constructed using direct bus bar connection. Cable connection between bus bar and SPD device is not acceptable.

I. Switchboard Requirements:

1. Service entrance SPD shall be tested and suitable for ANSI/IEEE C62.41 Category C environments.

2. Service entrance suppressor shall be installed by assembly manufacturer.

3. Each unit shall be capable of surviving more than 6500 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of UL 1449 Suppression Voltage Rating.

4. Service entrance suppressors shall be installed in assembly.

5. Locate suppressor on load side of main disconnect device, as close as possible to phase conductors and ground/neutral bar.

6. Provide 30-amp non-fused disconnect to permit replacement of module under load. Disconnect shall be directly integrated to suppressor and assembly bus using bolted bus bar connections.

7. Suppressor and integral disconnect shall be installed to switchboard using direct bus bar connection (no cable connection between bus bar and TVSS device).

8. Monitoring diagnostics features such as indicator lights, trouble alarms and surge counter (if specified) shall be mounted on front of switchboard.

J. Accessories:

1. Push to test feature to verify operational integrity.

2. Form C dry contacts one NO, one NC for remote status monitoring

3. Provide audible alarm and surge counter

K. Factory Testing:

1. Standard factory tests shall be performed on equipment under this section. Tests shall be in accordance with latest version of NEMA and UL standards.

2.19 SHORT CIRCUIT PROTECTION AND COORDINATION STUDY

A. Provide overcurrent device time-current coordination analysis to determine appropriate ampere ratings and settings for overcurrent protective devices to effect time and current coordination among devices, for maximum system protection and electrical service continuity.

B. Short circuit study shall include:

1. Power company's system characteristics.

2. Base quantities selected.

3. Impedance source data.

4. Calculation method and tabulations.

5. One line diagrams and impedance diagram.

6. Conclusions and recommendations.

C. Short circuit tabulations shall include fault impedances, X/R ratios, asymmetry factors, cable data, transformer data, symmetrical and asymmetrical fault currents.

D. Short circuit momentary duties, when applicable, and interrupting duties shall be calculated on basis of assumed fault at each unit substation, switchboard, motor control center, distribution panel, lighting and/or power panel and other significant locations throughout system.

E. Coordination studies shall include time-current curves graphically indicating coordination proposed for several systems, and centered on full-scale log-log paper. Time-current coordination graphs shall include:

1. Complete Titles.

2. Representative protective device curves and legends.

3. Associated power company's relay or system characteristics.

4. Significant motor starting characteristics.

5. Complete parameters for power, network and/or substation transformers.

6. Complete operating bands for switchgear or switchboard, circuit breaker trip devices, for fuses, if applicable, and for associated system load protective devices.

7. Transformer damage curves and magnetizing inrush points.

8. Appropriate NEC and ANSI protection points.

F. Coordination plots shall define types of protective devices selected, proposed coil taps, time dial settings and pick-up settings required.

G. Whenever possible, low voltage circuit breakers shall be separated from each other and associated primary protective device by 16 percent current margin for coordination and protection from secondary line-to-line faults.

H. Ground fault coordination study shall indicate recommended time and current setting for each ground fault protective device and for proper coordination between mains and feeder protective devices, and between mains and tie breaker as applicable.

I. Provide additional specific characteristics of equipment furnished as determined by this study.

1. Shop drawings shall clearly identify equipment design discrepancies and indicate proposed corrective modifications.

2. Make adjustments, settings or modifications necessary for conformance.

3. Assume responsibility for equipment being released for manufacture prior to final approval by Architect of short circuit protection and coordination study.

2.20 CONTACTORS, RELAYS AND TIME SWITCHES

A. Provide single-coil, electrically operated, mechanically-held contactors arranged for two wire (three wire) control. Positive locking shall be obtained without use of hoods, latches or semi-permanent magnets.

B. Contactors shall have rating as shown on Drawings. Operating coil voltage shall be as required by control system. Contactors shall be by Asco, Square D, Russelectric or equal.

C. Provide electrically-operated, mechanically-held remote control lighting contactor in NEMA 1 enclosure rated 20 amperes at 600V with one Form C auxiliary contact and number of poles as shown on Drawings, Asco Bulletin 917 with 2-wire control, Russelectric or equal.

D. Provide 7-day, astronomic dial time switches with carryover in NEMA 1 enclosure, where shown on Drawings, by Tork, Intermatic, Paragon, or equal.

E. Provide electrically-held bypass relays or contactors for bypassing light switches controlling emergency lighting with number of poles as required, Square D Class 8903, Type L, rated for 30A at 600 VAC resistive, 20A for 480 VAC for tungsten and ballast loads. Short circuit rating when protected by circuit breakers shall be minimum 22,000 AIC at 240 V, 14,000 AIC at 480V. Relays shall be mounted in cabinets located adjacent to respective emergency lighting panels.

2.21 EMERGENCY LIGHTING BATTERY SYSTEM

A. Provide complete system of emergency lighting equipment and wiring as shown on Drawings. Battery shall be wet cell type with fully-automatic solid-state two-rate charger, complete with wall mounting shelf.

1. Provide fixtures as shown on Drawings complete with lamps. Provide flush wall outlet box and plate for remotely mounted projector type wall fixtures, as required.

2. D.C. emergency lighting circuits and A.C. supervisory circuits shall be connected to battery by means of direct flexible connections from outlet or relay cabinet to battery (flexible metal conduit). Receptacle and plug shall not be used.

3. Provide area protection relay cabinet to supervise A.C. circuits, with terminal blocks for connecting A.C. and D.C. circuits as shown on Drawings. Relays shall be electro-

mechanical with twin sets of contacts mechanically independent and U.L. listed for 38 amperes. Cabinet shall be heavy gauge steel with baked grey enamel finish for surface wall mounting.

B. Equipment shall be as manufactured by Dynaray, Prescolite, Dual-Lite, or equal.

C. Provide self-contained 6-volt emergency battery units with two 25 watt heads in Fire Command Room and in Emergency Generator Room with 120V. emergency circuit to each.

2.22 EMERGENCY POWER SYSTEM

A. Provide complete emergency power system by Caterpillar, Cummins, or Kohler. Engine generator set shall be UL listed per UL 2200. System shall consist of:

1. Diesel engine-driven generating set.

2. Start-stop control system.

3. Automatic transfer switches.

4. Accessories as specified.

5. Weatherproof housing.

B. Supplier shall have been regularly engaged in production of this equipment for at least five years. Furnish schematic wiring diagrams for engine-generator set, automatic transfer switches and interconnecting wiring diagram showing connections to individual components.

C. Provide all accessories needed for proper operation. Provide two copies of detailed operation and maintenance manuals, wiring diagrams and replacement parts manuals.

D. Responsibility for performance to this specification shall not be divided among individual component manufacturers, but shall be assumed solely by primary manufacturer. This includes generating system design, manufacture, test, and having local supplier responsible for service, parts, and warranty for total system.

E. Generator set mounted subassemblies such as cooling system, base, air intake system, exhaust outlet fittings, and generator set mounted controls shall also be designed, built, and assembled as complete unit by engine/generator manufacturer.

F. Engine generator set shall be product of ISO 9001 certified manufacturer. Design is based on Caterpillar. Any changes to design based on other manufacturers shall be provided at no additional cost to owner. Naming of specific manufacturer does not waive any requirements or performance of individual components described in this specification.

G. Engine generator set shall meet all applicable state and federal emission's regulations including Tier 2 and Tier 3 regulation levels in effect at time of installation.

H. System Rating:

1. Provide electric power generating system including engine mounted radiator with site capability of:

25	KW
50	kVA at 0.8 PF, standby rating
208	Volts AC, Wye connected, 3 Phase, 60 Hertz
500	Altitude (Feet)
122	Maximum Engine Ambient Temperature (degrees F)
20	Minimum Outside Temperature (degrees F)

I. In addition to requirements to Part 1, submittals for approval shall include but not be limited to:

1. Certification of Prototype Testing.

2. Component List, including breakdown of components and options.

3. Manufacturer produced generator set specification or data sheet identifying make and model of engine and generator, and including relevant component design and performance data.

4. Specification or data sheets, including switchgear, transfer switch, vibration isolators, and day tank.

5. General dimensioned drawings showing overall generator set measurements, mounting location, and interconnect points for load leads, fuel, exhaust, cooling and drain lines.

6. Wiring diagrams, schematics and control panel outline drawings published by manufacturer for controls and switchgear showing interconnect points and logic diagrams.

7. Warranty verification published by manufacturer.

J. Production Tests:

1. System manufacturer shall perform production tests on complete generator set supplied at generator set manufacturers facility. Certified report of these tests shall be available when requested at time of generator set order. These tests and controls shall include but not be limited to:

a. Operation at rated kW

b. Operation at rated kVA

c. Transient and steady state governing

d. Transient and steady state voltage regulation

e. Operation of alarm and shutdown devices

f. Single step load pickup of rated kW

g. Operation at 2250 rpm (125 percent overspeed) at room temperature

K. Prototype Tests:

1. System manufacturer shall certify that engine, generator, controls, and switchgear have been tested as complete system of representative engineering models (not on equipment sold). Prototype testing shall include:

a. Fuel consumption at 1/4,1/2, 3/4, and full load

b. Exhaust emissions

c. Mechanical and exhaust noise

d. Governor speed regulation at 1/4, 1/2, 3/4, and full load; and during transients

e. Motor starting kVA

f. Generator temperature rise in accordance with NEMA MG 1-22.40

g. Voltage regulation at 1/4**,** 1/2, 314, and full load; and during transients

h. Harmonic analysis, voltage waveform deviation and telephone influence factor

i. Generator short circuit capability

j. Cooling system performance

k. Torsional analysis

l. Linear vibration analysis

m. Generator revolving field assembly for 2 hours at 2700 rpm (150 percent overspeed) at 70 degrees C, and each production unit tested at 2250 rpm (125 percent overspeed) at room temperature.

L. Warranty/Service:

1. Manufacturer's and dealer's standard warranty shall be for minimum period of two years from date of initial start-up of system and shall include repair parts, labor, reasonable travel expense necessary for repairs at job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by defect) used during course of repair. Applicable deductible costs shall be specified in manufacturer's warranty. Running hours shall not be limiting factor for system warranty by either manufacturer or servicing dealer. Submittals received without written warranties as specified will be rejected in their entirety.

2. Generator set supplier shall have factory trained service representatives and tooling necessary to install, test, maintain, and repair equipment and shall be located within 50 miles of customers site.

3. Generator set supplier shall have sufficient parts inventory to maintain over-the-counter availability of at least 90 percent of any required parts and shall guarantee 100 percent parts availability within 48 hours from time order is entered with dealer.

M. System Performance:

1. Power generating system shall conform to following performance criteria at site conditions:

a. Engine brake horsepower shall be sufficient to deliver full rated generator set kW/kVA when operated at rated rpm and equipped with engine-mounted parasitic and external loads such as radiator fans and power generators.

b. Engines shall start, achieve rated voltage and frequency, and be capable of accepting load within 10 seconds when properly equipped and maintained.

c. With power generating system at normal operating temperature, it shall accept 100 percent block load, less applicable derating factors, in accordance with NFPA 110.

d. Frequency regulation shall be isochronous, regulated to within +/- 0.25 percent from no load to full load.

e. Voltage regulation shall be +/- 0.5 percent for any steady state load between no load and full load.

N. Engine:

1. Engine shall be stationary, liquid cooled, 1800 rpm, four-cycle design, vertical in-line, with dry exhaust manifolds. It shall have 5 cylinders with minimum cubic inch displacement of 167 and be manufactured in United States.

O. Engine Accessory Equipment:

1. Engine shall be cooled by engine mounted, vertical radiator with blower type fan, using 50 percent below antifreeze/coolant mixture. Antifreeze shall have service life of 3000 hours without maintenance. Radiator shall properly cool engine while engine is operating at full load and 0.25 inch H_20 external air restriction. Minimum ambient capability shall be 105°. Air flow total for combustion and cooling shall not exceed 10,000 CFM.

2. Provide following accessories:

a. Electric starting motor and control circuit capable of three complete starting cycles without overheating.

b. Mechanical, positive displacement lube oil pump with replaceable full flow filter, oil cooler, and dip stick.

c. Mechanical, positive displacement fuel transfer pump with replaceable full flow filter.

d. Fuel Filter and serviceable fuel system components, located to prevent fuel from spilling onto genset batteries.

e. Manually operated fuel priming pump.

f. Replaceable dry element air filter.

g. Engine mounted electrically powered, thermostatically controlled jacket water heater sized to ensure proper starting, including isolation valves and adjustable thermostat.

h. Flexible, stainless steel exhaust connector.

i. Flexible fuel lines

j. Battery charging alternator with regulator and charge rate ammeter.

P. Generator:

1. Generator shall be reconnectable, close coupled, drip proof and guarded, constructed to NEMA 1 and IP 22 standards, single bearing, salient pole, revolving field, synchronous type with amortisseur windings in pole faces of rotating field and skewed slator windings to produce optimum voltage waveform.

2. Generator shall be capable of delivering rated kVA at 60 Hz and 0.8 PF within +/- 5 percent of rated voltage.

3. Insulation systems shall meet NEMA MG-1 standards for Class H systems. Actual generator temperature shall be limited to Class F levels (130 degrees C rise by resistance over 40 degrees C ambient). Materials which support fungus growth shall not be used.

4. Revolving field coils shall be precision wet layer wound with epoxy based material applied to each layer of magnet wire. Revolving field assembly shall be prototype tested for 2 hours at 2700 rpm (150 percent over-speed) and 70 degrees C, and each production unit shall be tested at 2250 rpm (125 percent over-speed) at room temperature. Revolving field assembly shall be balanced to 0.5 mil peak-peak. Stator shall have two dips and bakes using Class H impregnating varnish.

5. Provide 3 phase permanent magnet (PMG) generator as source of excitation to exciter to increase immunity to non-linear loads and to maintain 300 percent of rated current for 10 seconds during short circuit conditions.

6. Provide automatic voltage regulator (AVR) to maintain generator output voltage within +/- 0.5 percent for any constant load between no load and full load. Regulator shall be totally solid state design which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over-excitation protection, loss of sensing protection, temperature compensation, voltage overshoot limitation on startup. Regulator shall be environmentally sealed.

Q. Circuit Breaker:

1. Provide three pole main line circuit breakers as shown on drawings to protect generator against external faults and provide positive disconnect device at generator output terminals. Breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be mounted on generator in NEMA 1P22 guarded drip-proof enclosure for direct access for cable from top or bottom.

R. Controls - Generator Set Mounted:

1. Control panel shall be designed and built by engine-generator manufacturer, mounted on generator set and incorporate 100 percent solid state microprocessor based control circuitry and digital instrumentation.

2. Electronic control components shall be mounted in sealed, dust tight, watertight, metal housings. Housings which must be opened for service or setup are not acceptable. Output circuits greater than 100mA shall be fuse or circuit breaker protected. Panel shall be labeled with ISO symbols and comply with IEC 144, IP 22, and NEMA 12 for external environmental resistance, and IP 44 and NEMA 12 for resistance of internal sealed modules. Control panel shall be capable of facing right, left, or rear and shall be vibration isolated.

3. Panel shall include following equipment / functions:

a. Automatic remote start capability with mode of operation selectable from panel-mounted 4-position switch (Stop, Manual, Automatic, Reset).

b. Cycle crank with adjustable "crank" and "rest" times.

c. Adjustable cool down timer.

d. Emergency stop pushbutton requiring manual reset.

e. Voltage adjustment potentiometer to adjust voltage +10, -25 percent of rated.

f. Provide communications adapter to allow RS-232 communications between generator set and remote Personal Computer or other RS-232 device. Use of adapter shall allow generator set to be remotely started or stopped and provide access to any of engine or generator operational parameters as well as alarms, shutdowns, or diagnostic codes. Provide windows based software package with adapter.

g. Provide individual flashing LED's. Use of common alarm or shutdown lamp which depend on separate display to determine alarm or fault condition is not acceptable. Provide separate LED annunciation for:

1) Overspeed (red)

2) Overcrank (red)

3) High coolant temperature (red)

4) Low oil pressure (red)

5) Emergency stop (red)

6) Low coolant level (red)

4. Provide NFPA 99 alarm module with common alarm and silence switch with separate LED annunciation for:

a. Approach high coolant temperature (amber)

b. Approach low oil pressure (amber)

c. Low water temperature (amber)

d. Low dc volts (red)

e. Low fuel (amber)

f. High fuel (amber)

g. Fuel tank rupture (red)

h. Ground fault (red)

5. Provide remote annunciator where shown on Drawings and provide conduit and wiring from generator terminals to annunciator. Provide audible and visual alarm indication with alarm silence switch, installed in enclosure suitable for flush or surface mounting. Panel shall monitor following:

a. Generator powering load (position signal from ATS)

b. Battery charger malfunction (red)

c. High jacket water temperature (prewarn-amber) (shutdown – red)

d. Low water temperature (prewarn-amber)

e. Low oil pressure (prewarn-amber) (shutdown-red)

f. Low fuel

g. High fuel

h. Overspeed (red)

i. Overcrank (red)

j. Fuel tank rupture

k. Low water level

l. Ground fault

m. Horn silence

6. Provide panel illumination lights (2) with on/off switch.

7. Provide separate digital displays for engine and generator parameters. These displays shall allow simultaneous display of AC parameters and at least one (selectable) engine parameter to be displayed at same time. Requirements for these displays shall be as follows:

8. Provide digital display and phase selector switch for generator operational parameters. True RMS sensing of these parameters shall be utilized to minimize distortion due to non-linear loads and ensure accuracy.

a. AC volts (+/- 0.5 percent accuracy)

b. AC amps (+/- 0.5 percent accuracy)

c. Hertz (+1-0.3 Hz accuracy)

d. Kilowatts (Total and per phase)

e. Kilovars (Total)

f. Kilovolt – Amps KVA (Total)

g. Kilowatt – Hours KWHR (Total)

h. Kilovar – Hours KVAR-HR (Total)

i. Percent of rated power (Total)

j. Power Factor (Average Total and per phase)

9. Provide digital display for:

a. Engine RPM (+/- 0.5 percent accuracy)

b. DC voltage (+/- 0.5 percent accuracy)

c. Oil pressure (+/- 0.5 percent accuracy)

d. Coolant temperature (+/- 0.5 percent accuracy)

e. Operating hours

10. Provide diagnostic capability with dual level diagnostics identifying both system level and component level. Diagnostic codes shall be maintained in history log specifying number of occurrences, and second/minute/hr at which they occur.

11. Provide protective relaying (programmable trip point and time delay) for:

    a. Overvoltage (alarm & shutdown)

    b. Undervoltage (alarm & shutdown)

    c. Overfrequency (alarm & shutdown)

    d. Underfrequency (alarm & shutdown)

    e. Overcurrent (alarm & shutdown)

    f. Reverse power (shutdown)

12. Provide sensors utilizing pulse width modulated output for oil pressure, coolant temperature sensing and shall be protected against fault to battery. Usable output range of sensor shall be limited to 5 percent to 95 percent duty cycle. Output outside usable range shall be diagnosed as fault condition and appropriate diagnostic shall be included. Provide separate speed sensing signals for overspeed protection and electronic governor.

13. Ambient parameters shall be:

    a. Operating temperatures: -40C to +70C (-40 F to +158 F)

    b. Storage temperatures: -55 C to +85 C (-67 F to +185 F)

    c. Humidity: 0 to 100 percent relative humidity

14. Sensors shall be impervious to salt spray, fuel, oil and oil additives, coolant, spray cleaners, chlorinated solvents, hydrogen sulfide and methane gas, and dust.

S. Weatherproof Housing (2120):

1. Provide weather resistant, sound attenuated, enclosure of pre-painted maintenance-free aluminum to house engine/generator and accessories. It shall consist of roof, underframe, side walls, and end walls of one-piece, stressed skin, semi-monocoque construction. Enclosure shall be manufactured by Pritchard-Brown (Div. of Enviro Industries), style 2120, or approved equal.

2. System shall include cooling and combustion air inlet silencer system, equipment enclosure section, and cooling air discharge silencer section. It shall be designed to reduce source noise by estimated average 25 dB(A) as measured at 1 Meter.

3. Roof and wall in mill structural members shall be extruded aluminum 6063-T6 alloy, or aluminized steel. Wall panels of 0.040 inch in mill-prepainted aluminum and roof panel of 0.040 inch mill finish aluminum shall be hard-riveted to framing. Minimum of six colors shall be available for enclosure exterior. Aluminum sheet, pop-riveted to steel frame is not acceptable. Roof bows shall be cambered to aid in rain runoff.

4. Insulation in walls and roof shall be semi-rigid, thermo-acoustic, thickness as required to meet noise criteria specified. Lining shall be perforated, mill-finish aluminum. Self-adhesive foam and loose or bat-type insulating materials will not be accepted.

5. Provide integral fuel tank underframe with floor of 300 gallon capacity as integral part of enclosure. It shall be contained in rupture basin of greater capacity. Tank shall be pressure tested for leaks prior to shipment, and have necessary venting per NFPA 30 and UL 142. Provide locking fill cap, D.C. analog reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact.

6. Provide lifting provisions at or near the enclosure base, with capacity suitable for rigging system. Estimated enclosure weight shall be provided on submittal drawings.

7. Provide access doors fabricated of same material as enclosure walls. They shall be reinforced for rigidity, gasketed, and set in welded frame to ensure proper operation. Handles shall be key lockable, all doors keyed alike, and continuous, aluminum hinges. Provide doors and/or hinged louver panels in sufficient quantity to allow access for necessary maintenance and operation, coordinated with generator set manufacturer.

8. Air handling shall be as follows: Air shall enter through removable hood(s). Provide motor-operated dampers, wired through genset control, for spring-open, power close operation. Intake openings shall be screened to prevent the entrance of rodents. Radiator discharge will be through gravity operated damper and into hood, as dictated by airflow. System shall be designed for 0.5 inch w.g. static pressure drop maximum through enclosure.

9. Provide necessary hardware to internally mount specified exhaust silencer and maintain weather resistant integrity of system. Silencer and exhaust flex shall be insulated.

10. Enclosure shall include D.C. incandescent lighting. D.C. lights shall have timer type switch. Devices in enclosure, including genset accessories, shall be prewired in E.M.T. by enclosure manufacturer. In addition, manufacturer shall perform system integration of enclosure components, both mechanical and electrical.

T. Base:

1. Engine and generator shall be assembled to base using vibration isolators which comply with seismic zone 2. Generator set base shall be designed and built by engine-generator manufacturer to resist deflection, maintain alignment, and minimize resonant linear vibration.

U. Battery Charger:

1. Provide dual rate 10 ampere battery charger which shall accept 120 volt AC single phase input to provide 24 volt DC output. It shall be fused on the AC input and DC output, incorporate current limiting circuitry, and include DC ammeter and voltmeter. Use of crank disconnect relay to protect charger during starting is not acceptable. Charger shall be housed in NEMA 1 enclosure vibration suitable for wall mounting.

2. Charger shall include LED annunciation for low battery voltage, high battery voltage, battery charger malfunction, and AC failure; and dry contacts for battery charger malfunction and low battery voltage.

V. Batteries:

1. Provide 24 volt starting batteries sized as recommended by generator set manufacturer to comply with starting and temperature specifications; battery cables, and base mounted battery rack. Batteries shall be warranted by genset manufacturer.

W. Fire Department Fuel Shut-Off:

1. Provide additional separate 24 volt DC, normally open solenoid at generator fuel supply line. Solenoid shall be powered closed and shall fail open upon loss of power.

2. Provide 24 volt DC wiring from generator batteries to break-glass station located outside generator room doorway to energize 24 volt DC solenoid upon actuation of station. Break-glass station shall be Allen-Bradley catalog number 800T-NX115 or approved equal with 2 N.O. - 2. N.C. contacts, NEMA type 13 enclosure, hammer, chain, and five extra glass disks with one button contact. Nameplate shall read "GENERATOR EMERGENCY FUEL SHUTOFF" and shall be red in color with engraved lettering.

3. Entire installation of emergency fuel shutoff shall comply with Fire Department regulations.

4. Provide fusing to protect 24 volt DC wiring.

X. Exhaust Silencer:

1. Provide critical exhaust silencer sized and supplied by engine supplier. Silencer and associated piping shall not impose more than 27 inches water restriction.

2. Silencer shall utilize high temperature coating system to prevent rusting and shall be mounted near engine to minimize noise and condensation. Provide means for draining moisture.

3. Silencer shall be mounted and insulated inside sound attenuated enclosure.

Y. Heaters:

1. Provide thermostatically-controlled engine jacket water heater rated 1500W, 208V, single phase, mounted, piped and prewired to terminal strip.

Z. Automatic Transfer Switch:

1. Provide automatic transfer switches of number and rating as shown on Drawings. Current rating shall be based on classes of loads including tungsten and inductive loads. Switch shall be electrically-operated, mechanically-held, with one or two electric operators, momentarily energized and connected to transfer mechanism by simple over-center linkage. Switch shall be inherently double throw, contactor design rated for continuous duty with power transfer section and control section interconnected to provide complete automatic operation. Switch shall be totally front accessible and mounted in lockable 12 gauge steel NEMA 1 enclosure. Switch shall meet NEMA and UL-1008 standards for use in emergency systems.

2. Automatic transfer switches with components of molded case circuit breakers or components not designed for continuous duty or repetitive load transfer will not be accepted.

3. Provide heavy duty, silver-tungsten alloy main contacts protected by arcing contacts with magnetic blowouts. Provide wiping action for main contacts. Main contact withstand rating shall not be less than 20 times continuous duty rating for minimum of three cycles.

4. Provide mechanical interlock to ensure only one of two possible positions, normal or emergency. Operating transfer time in either direction shall not exceed 30 cycles, except where longer period is permitted for motor load transfer.

5. Provide external, manual operator with same transfer speed as electrical operator.

6. In addition to requirements of Part 1, manufacturer shall include following:

    a. Descriptive literature.

    b. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.

    c. Schematic diagrams.

    d. Wiring diagrams.

    e. Accessory list.

7. Transfer switch shall be equipped with internal welded steel pocket, housing operations and maintenance manual.

8. Transfer switch shall be top and bottom accessible.

9. Main contacts shall be capable of being replaced without removing main power cables.

10. Main contacts shall be visible for inspection without any major disassembly of transfer switch.

11. Bolted bus connections shall have Belleville compression type washers.

12. When solid neutral is required, provide fully rated bus bar with required AL-CU neutral lugs.

13. Control components and wiring shall be front accessible. Control wires shall be multi-conductor 18 gauge 600 volt SIS switchboard type point to point harness. Control wire terminations shall be identified with tubular sleeve-type markers.

14. Switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.

15. Complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with specification requirements. Furnish copy of factory test report upon request.

16. Automatic Transfer Switch Operation

    a. Transfer switch shall be double throw, actuated by single electrical operator momentarily energized and connected to transfer mechanism by single over center type linkage. Total transfer time shall not exceed 30 cycles.

    b. Transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to transfer mechanism by simple over center type linkage. Minimum transfer time shall be 400 milliseconds.

    c. Normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both normal and emergency positions without use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided. Interlocked, molded case circuit breakers or contactors will not be acceptable.

    d. Transfer switch shall be equipped with safe external manual operator, designed to prevent injury to operating personnel. Manual operator shall have same contact to contact transfer speed as electrical operator to prevent flashover from switching main contacts slowly. External manual operator shall be safely operated from outside of transfer switch enclosure while enclosure door is closed.

17. Automatic Transfer Switch Controls

    a. Transfer switch shall be equipped with microprocessor based control system, to include operational functions of automatic transfer switch. Controller shall have two asynchronous serial ports. Controller shall have real time clock with Nicad battery back-up.

    b. CPU shall be equipped with self-diagnostics, which perform periodic checks of memory I/O and communication circuits, with watchdog/power fail circuit.

    c. Controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to master terminal with up to 4,000 feet of cable, or further, with addition of communication repeater. Serial communication port shall be RS422/485 compatible.

    d. Serial communication port shall allow interface to either manufacturer's or owner's furnished remote supervisory control.

    e. Controller shall have password protection required to limit access to qualified and authorized personnel.

    f. Controller shall include 20 character, LCD display, with keypad, which allows access to system.

    g. Controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

h. Controller shall be capable of storing following records in memory for access either locally or remotely:

1) Number of hours transfer switch is in emergency position (total since record reset).

2) Number of hours emergency power is available (total since record reset).

3) Total transfer in either direction (total since record reset).

4) Date, time, and description of last four source failures.

5) Date of last exercise period.

6) Date of record reset.

18. Sequence of Operation

a. When voltage on any phase of normal source drops below 80 percent or increases to 120 percent, or frequency drops below 90 percent, or increase to 110 percent, or 20 percent voltage differential between phases occurs, after programmable time delay period of 0-9999 seconds (factory set at 3 seconds) to allow for momentary dips, engine starting contacts shall close to start generating plant.

b. Transfer switch shall transfer to emergency when generating plant has reached specified voltage and frequency on all phases.

c. After restoration of normal power on all phases to preset value of at least 90 percent to 110 percent of rated voltage, and at least 95 percent to 105 percent of rated frequency, and voltage differential is below 20 percent, adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If emergency power source should fail during this time delay period, switch shall automatically return to normal source.

d. After retransfer to normal, engine generator shall be allowed to operate at no load for programmable period of 0-9999 seconds, factory set at 300 seconds.

19. Automatic Transfer Switch Accessories

a. Provide programmable three phase sensing of normal source set to pickup at 90 percent and dropout at 80 percent of rated voltage and overvoltage to pickup at 120 percent and dropout out at 110 percent of rated voltage. Provide programmable frequency pickup at 95 percent and dropout at 90 percent and over frequency to pickup at 110 percent and dropout at 105 percent of rated frequency. Provide programmable voltage differential between phases, set at 20 percent, and phase sequence monitoring.

b. Provide programmable three phase sensing of emergency source to set pickup at 90 percent and dropout at 80 percent of rated voltage and overvoltage to pickup at 120 percent and dropout at 110 percent of rated voltage programmable frequency pickup at 95 percent and dropout at 90 percent and over frequency to pickup at 110 percent and dropout at 105 percent of rated frequency. Provide programmable voltage differential between phases set at 20 percent and phase sequence monitoring.

c. Provide time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation), programmable for 0-9999 seconds and set at 3 seconds.

d. Provide time delay on transfer to emergency, programmable, set at 3 seconds. Time delay for each ATS shall be staggered.

e. Provide maintained type load test switch to simulate normal power failure, keypad initiated.

f. Provide remote type load test switch to simulate normal power failure, remote switch initiated.

g. Provide contact to initiate engine starting rated 10 Amps, 30 volts DC, to close on failure of normal source.

h. Provide contact for customer functions rated 10 Amps, 30 volts DC, to open on failure of normal source.

i. Provide light emitting diodes mounted on microprocessor panel to indicate switch is in normal position, switch is in emergency position and controller is running.

j. Provide plant exerciser in largest switch with (10) 7 day events, programmable for any day of week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period, keypad initiated.

k. Provide option to select either "no commit" or "commit" to transfer operation in event of normal power failure. In "no commit position," load shall transfer to emergency position unless normal power returns before emergency source has reached 90 percent of its rated values (switch will remain in normal). In "commit position" load shall transfer to emergency position after any normal power failure, keypad initiated.

l. Provide two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), mounted on main shaft, one closed on normal, other closed on emergency. Both contacts shall be wired to terminal strip for ease of customer connections.

m. Provide three phase digital LCD voltage readout, with 1 percent accuracy to display three separate phase to phase voltages simultaneously, for both normal and emergency source.

n. Provide digital LCD frequency readout with 1 percent accuracy to display frequency for both normal and emergency source.

o. Provide LCD readout to display normal source and emergency source availability.

20. Approval

a. As condition of approval, manufacturer shall verify that switches meet Standard UL-1008 with 3 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes 480 VAC

Amperes	Closing and Withstand	Current Limiting Fuse Rating
100-400	42,000	200,000

b. During 3 cycle closing and withstand tests, there shall be no contact welding or damage. 3 cycle tests shall be performed without use of current limiting fuses. Test shall verify that contact separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by UL.

c. When conducting temperature rise tests to UL-1008, manufacturer shall include post-endurance temperature rise tests to verify ability of transfer switch to carry full rated current after completing overload and endurance tests.

d. Microprocessor controller shall meet the following requirements:

1) Storage conditions – 25 degrees C to 85 degrees C.

2) Operation conditions – 20 degrees C to 70 degrees C ambient.

3) Humidity 0 to 99 percent relative humidity, non-condensing.

4) Capable of withstanding infinite power interruptions.

5) Surge withstand per ANSI/IEEE C-37.90A-1978.

e. Manufacturer shall furnish copies of test reports upon request.

21. Manufacturer

a. Automatic transfer switches shall be by Russelectric, Asco, Zenith or equal.

b. Transfer switch manufacturer shall employ nationwide factory-direct, field service organization, available on 24-hour per day, 365 days per year, call basis.

c. Manufacturer shall include 800 telephone number, for field service contact, affixed to each enclosure.

d. Manufacturer shall maintain records of each transfer switch, by serial number, for minimum of 20 years.

22. Provide adequate lifting means for ease of installation of wall or floor mounted enclosures.

23. Provide access and working space as indicated or as required.

24. Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization.

AA. Supplier shall maintain full time in-house parts and service organization. Suppliers that depend on others for service will not be accepted.

2.23 FIRE ALARM SYSTEM

A. General:

1. Provide complete power limited analog-addressable fire detection and alarm system with voice controls. System shall include, but not be limited to: Fire Alarm Control (FACP), alarm initiating, audio and visual notification appliances, enclosures and all other equipment necessary to furnish fully operational system. Provide complete system programming, installation, testing and documentation in compliance with all applicable contract documents.

2. Provide alarm detection, audio/visual evacuation signaling, status annunciation, municipal notification, and elevator and HVAC control per local requirements.

B. General Requirements:

1. Refer to Part 1 of this Section for information on Substitutions.

2. Final connections, testing, and adjusting of system shall be done under direct supervision of system supplier. Services of trained technician employed by system supplier shall demonstrate system to satisfaction of Owner’s representative, and make additional adjustments to system operation as required by Owner’s representative.

3. System shall be modular to allow future expansion with minimum of hardware additions.

C. Codes and Standards:

1. System design and installation shall conform to following standards:

a. Equipment shall be UL listed for its intended purpose.

b. NFPA Standards 70 (National Electric Code), 72, 90A, 92A, and 101.

c. Current State Building Code.

d. Americans with Disabilities Act (ADA).

e. Requirements of Local Authority Having Jurisdiction.

D. Quality Assurance:

1. Equipment supplier shall be UL certified fire alarm service company and have local offices, adequately staffed by factory trained engineers and technicians capable of providing pre-assembly, testing, instruction, maintenance and emergency service on system components.

2. Demonstrate minimum of ten years experience in successful design and installation of fire alarm systems similar in size and scope to that required.

E. Submittals:

1. In addition to requirements of Part 1 of this Section, furnish following:

a. Indicate type, size, rating, catalog number, manufacturer's names, and catalog data sheets for all items to ensure compliance with these specifications. Equipment shall be subject to approval and no equipment shall be ordered without prior approval. Equipment and devices are shown on contract drawings.

b. Furnish calculations to support size of power supplies, audio amplifiers and standby batteries submitted. Calculations shall accommodate voltage drop, wire size, and required spare capacity allowance.

c. Supply details of any special installation procedures.

d. Provide complete description of system operation.

e. Complete point-to-point riser diagram showing equipment and size, type and number of conductors and devices.

f. Provide signal circuit calculations that demonstrate 25 percent spare capacity, adequate wire size and proper consideration of voltage drop characteristics.

g. Large scale drawings of FACP and any other required hardware panels such as auxiliary power supplies, miniplex panels showing locations, dimensions and field wiring in full detail.

h. Devices and their corresponding addresses shall be shown on floor plans as part of the required as-built documentation. Point identification lists shall be provided during the submittal phase to ensure proper coordination of alarm message text assignments that include each device type, address number and corresponding LCD message text.

i. Operation and maintenance manuals (minimum 4 copies).

j. Confirmation that manufacturer's representatives that are factory-trained, certified, and properly licensed will provide job site supervision during system installation, perform final testing and documentation, and instruct Owner's operating personnel on system operation.

k. Complete description of system Sequence of Operation.

l. Provide a copy of the Original Manufacturer's Warranty Statement.

F. Equipment Manufacturers:

1. Manufacturer's model numbers are supplied to establish minimum standards of supplier qualification, performance, function and quality.

2. Catalog numbers specified are those of SimplexGrinnell and constitute type, product quality, material, desired operating features. Considered equals shall be Notifier, EST, or FCI.

G. General Requirements:

1. Fire alarm control panel (FACP) shall be microprocessor-based addressable panel approved per UL 864 for fire alarm applications. System shall support full analog functions, automatic system programming, alarm verification by individual device and serial interface to network panels, remote annunciators, printers, alphanumeric displays and color graphics terminals as applicable.

2. Provide microprocessor based addressable fire alarm system as described herein. Include main fire alarm control panel, remote network panels, annunciator, manual stations, automatic fire detectors, smoke detectors, alarm indicating appliances wiring, terminations, and other necessary materials for complete operating system. System shall be capable of on site programming to accommodate expansion and to facilitate changes in operation. Software operations shall be stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory. Full flexibility for selective input/output control functions based on ANDing, Oring, NORing, timing and special coded operations shall also be incorporated in resident software programming of system.

3. Network panels shall provide complete peer-to-peer operation, whereby each panel shall support standalone operation, as well as global annunciation and control of each point across network. To ensure survivability, the network shall provide Style 7 wiring for the communications loop, multi-channel audio riser, and fire-fighter telephone riser.

4. Standby batteries shall be capable of supplying system under full supervision for 60 hours. Following 60 hour period, system shall supply 100 percent general evacuation alarm output for minimum of 15 minutes.

5. Once system has operated on standby battery for one minute, fire door relay(s) shall be activated to remove power from door holders and conserve battery power.

6. When AC power is restored, system shall revert back to AC power without operator intervention or manual restart.

7. FACP shall permit overall system monitoring, testing, display, reporting, and firefighter controls to override automatic actions. Panel shall serve following functions:

a. Monitor initiating devices, annunciate device in alarm and its location, capture elevators, notify local authorities, transmit signals to activate smoke control or elevator recall functions, and initiate alarm notification by audio/visual (speaker/strobe) signaling.

b. Alarm initiating devices shall automatically respond with their condition. Control relays shall be programmed by system to respond automatically in event of

alarm of related sensors. After proper passcode clearance, operator shall be able to manually control outputs, review and acknowledge outstanding events, review FACP event log and review FACP status.

8. Components and systems shall be designed for uninterrupted duty. Equipment, materials, and accessories, shall be provided by single manufacturer, or division of the manufacturer, except as otherwise called for in Contract Documents. When multiple manufacturers are used, equipment shall be recognized as compatible in writing by both manufacturers.

9. Initiating and indicating circuits shall be as follows:

   a. Circuits and devices shall be electrically supervised. Addressable loop and monitor circuits shall be Class A - Style D. Signaling circuits shall be Class A - Style Z.

   b. Waterflow and Sprinkler Supervisory switches shall be monitored individually via an addressable monitor module.

   c. Programmable outputs shall enable required auxiliary control and manual override functions, with corresponding addressable inputs, which will support status feedback.

   d. FACP addressable loops, audio and ADA visual control portions of system shall accommodate initiating circuits, indicating circuits and devices shown, allowing minimum of 25 percent spare capacity throughout.

H. Sequence of Operation:

1. Operation of addressable station or activation of any addressable alarm initiating device (smoke, heat, waterflow) shall automatically:

   a. Sound code 3 temporal pattern evacuation signal throughout building, except in designated areas of assembly. In such areas, pre-recorded voice evacuation message shall sound repeatedly until silenced. Manual audio evacuation shall override automatic audible signals, and be provided in every area in accordance with state and local requirements.

   b. Activate synchronized ADA visual alarm strobes throughout building. Upon operation of system silence, audible signals shall silence while visual signals shall continue to operate until system is reset.

   c. Display device address, type and location or circuit of initiation via LCD display located at main FACP, remote network panels and system annunciators.

   d. Recall building elevators in following manner:

      1) Smoke detectors in elevator lobbies on all floors and in elevator machine room, shall recall elevators (in that respective bank) to designated primary recall level, or to alternate level if designated level is in alarm.

   e. Open power to motorized damper at top of elevator shaft (via Control ZAM).

f. Initiate transmission of alarm to local municipal fire department via local energy master box.

g. Initiate transmission of trouble and/or supervisory signals to approved UL listed Central Station.

h. Visually annunciate via LED's building, zone, floor, and device type (per floor).

i. Automatically shut down HVAC units.

j. Operate prioritized outputs to release magnetically held smoke doors and magnetically locked doors in building after 15 second time delay. Release stair door locks and access controlled door locks.

k. Activate exterior strobe/beacon.

l. Upon activation of any analog addressable smoke sensor, system shall reset detector for period of 10 - 15 seconds. After reset, second detector activation during verification period shall initiate alarm response as descried previously with addition of following actions.

m. Operation of system silence switch shall silence all connected audible appliances. In event of subsequent alarm after system silence, FACP shall resound building alarm signals.

n. Audible trouble signal shall be capable of being silenced with trouble signal acknowledge button, but lamp shall not be capable of being extinguished until circuits are normal. Restoring circuits to normal after acknowledge button has been operated shall cause lamp to extinguish. Trouble signal shall resound every time new trouble (or supervisory) condition is reported.

I. Fire Alarm Control Panel:

1. Provide Addressable Fire Alarm Control Panel (FACP). Construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during fire alarm condition. Each panel shall support minimum of 400 analog/addressable points, 500 event history log and have RS485 and RS-232 interface. System shall be capable of complete on-site programming and be equipped with WALK-TEST feature. System shall be equipped with four operator access levels. Simplex 4100 Series or equal.

2. Provide complete audio evacuation controls integral to main FACP. The voice evacuation controls shall provide pre-recorded voice messaging to all areas of assembly, as well as manual voice paging and tone generation throughout entire facility. Each audio amplifier shall provide minimum of 50 watts of power-limited 25 or 70 volt audio power, to supervised speaker circuits. Controls shall include Audio Controller, one-way paging microphone and audio select switches for selective and all-call paging throughout.

3. Using proper password level, operator shall be capable of monitoring and adjusting analog value of system smoke detectors. Operator may also print log of current smoke detector obscuration ranges.

4. System shall include summary printouts, initiated by operator command, that include:

   a. Analog values of all points including instantaneous value and long term average value.

   b. Points isolated.

   c. Points tested/failed test.

   d. Points out of sensitivity compensation. This will permit end user ability to clean only devices that are dirty as opposed to all devices.

5. Addressable Peripheral Network

   a. System shall supply communication with initiating and control devices individually. Devices shall be individually annunciated at control panel. Annunciation shall include following conditions for each point.

      1) Alarm

      2) Trouble

      3) Open

      4) Short

      5) Ground

      6) Device Fail/or Incorrect Device

   b. Addressable devices shall have capability of being disabled or enabled individually.

   c. Up to 250 addressable devices may be multi-dropped from single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.

   d. Communication format shall be poll/response protocol to allow t-tapping of wire to addressable devices and be completely digital.

   e. Each detector shall be identified by unique address. Use of jumpers or special programming tools to set device address, or extract device data will not be acceptable.

   f. Base shall be common to smoke or heat heads. System shall allow Owner to replace detector heads without need to verify address.

   g. System shall allow up to 2,500 foot wire length to furthest addressable device. Provide Class A (Style 6 Signaling Line Circuit as defined by NFPA-72)

communications. Wire shall be routed to maintain sufficient distance between forward and return loop as required by NFPA 72.

6. Provide line fault isolator modules installed in manner that shall limit performance degradation in event of short signaling line circuit. In event of failure of one loop section, balance of circuit shall continue to operate. Provide one isolator module per 25 devices on each addressable loop.

J. Audio Evacuation Control:

1. Provide audio evacuation control equipment to include tone generated signal, pre-recorded voice message and one-way voice paging throughout facility as shown and required.

2. Provide audio amplifiers with adequate power to operate all speakers set at 2 watts each, and additional power for future devices calculated at no less than 25 percent of original device load.

3. Provide minimum of two speaker circuits per floor, alternately wired so that loss of one circuit will not affect the other.

K. Control Configuration:

1. Main fire alarm and audio control portions of system shall be housed in locking, semi-flush mounted enclosures. Status indicators shall be visible through clear Lexan windows. Access to control panels shall be by keys issued to Fire Department and authorized personnel. Enclosure shall incorporate adequate mother boards, individual plug in modules, power supply/batteries, and required control switches and status indicators as described herein.

L. System Annunciation:

1. Provide primary annunciator with 80 character LCD display integral to FACP. In addition, provide dedicated alarm, supervisory, and trouble LED indications and local tone-alert.

a. Under normal condition, front panel shall display "SYSTEM NORMAL" message and current time and date.

b. Should abnormal condition be detected, appropriate LED (Alarm, Supervisory, or Trouble) shall flash. Panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.

c. Panel shall display following information relative to abnormal condition of point in system:

1) Custom location label (40 characters minimum).

2) Type of device (i.e. smoke, pull station, waterflow).

3) Point status, as a minimum provide LED's for:

a) AC Power On

b) Alarm

c) System Trouble

d) Supervisory

e) Ground Fault

f) Signal Silenced

g) Power Fault

h) NAC Circuit Fault

4) As minimum, provide alarm LED's for:

a) Manual stations

b) Smoke detectors

c) Heat detectors

d) Duct smoke detectors

e) Sprinkler flow switches

5) Provide supervisory indications for:

a) Municipal box reset required

b) Sprinkler supervisory valves

c) Emergency generator running

d) Low Water Pressure

6) Provide status indications for:

a) Elevators recalled to first floor

b) Elevators recalled to alternate level

c) Stair doors unlocked, access controlled doors unlocked.

d) Elevator shaft damper release.

7) Provide individual zone disconnect switches for each floor for:

a) Manual stations

b) Smoke and heat detectors

c) Duct smoke detectors

d) Sprinkler water flow switches.

e) Soft switch disconnects shall have corresponding LED to annunciate operation.

8) Provide following switches and status indicators to allow owner and testing company to test facility with minimal disruption while allowing full flexibility to maintain certain operations: manual control disconnect switches for:

a) Audio circuits

b) Visual circuits

c) Elevator recall bypass

d) Door holder/release bypass

e) Automatic fan and damper control bypass.

M. Auxiliary Controls:

1. Provide discreet input/output points and building control or relay modules for auxiliary control and status indication for HVAC override or related damper control functions. Auxiliary output contacts shall be rated for 10 amps each at 30 VDC or 250 VAC. These controls are intended for use by Fire Department during event, or by authorized personnel during testing periods. Keypad entered commands for auxiliary control functions shall not be considered acceptable. Provide minimum of 8 three-position HOA switches with corresponding status LED's, and I/O modules and programming to accomplish required status indication and control as described herein.

N. System Power Supplies:

1. Provide notification appliance power in each panel of system. Power supplies with battery charger and standby batteries shall be integral to each fire alarm control panel. Battery charger shall support lead acid batteries of up to 65 AH. Provide power supplies to operate system under alarm full load condition with 25 percent spare capacity.

O. System Devices:

1. Provide analog/addressable devices where shown and required. Each device shall communicate with fire alarm control panel via digital data communications. Where ambient conditions preclude use of addressable devices, equivalent conventional devices shall be used. In this instance, each device shall be monitored by dedicated addressable module which shall be installed in appropriately heated/ventilated space.

a. Addressable temperature sensors shall sense within temperature range of 32 degrees F to 158 degrees F. Control panel will be capable of sensing either set point of 135 degrees F, or rate-of-rise of 20 degrees F per minute for fire sensing. For utility sensing, set point may be chosen within stated range and

control panel programming will be capable of using that information to determine specific response such as warning of failure of local temperature controls.

b. Sensors shall be listed to UL Standard 268 and shall be documented as compatible with control equipment to which they are connected. Sensors shall be listed for both ceiling and wall mount applications.

c. Sensor base shall contain LED that will flash each time it is scanned by control panel (once every 4 seconds). When control panel determines that sensor is in alarm or trouble condition, control panel shall command LED on that sensor's base to turn on steady indicating abnormal condition.

d. Provide analog smoke detectors with sensitivity continuously monitored. Control equipment shall evaluate sensitivity data for determination of sensitivity change and shall automatically provide environmental compensation to maintain constant detector sensitivity. It shall be possible to automatically or manually adjust analog detector sensitivity from any network node.

e. In sensor bases used to recall elevators, provide delay driver output to be controlled either automatically or manually from control panel.

f. Sensors shall contain magnetically actuated test switch for easy alarm testing at sensor location. Sensor's electronics shall be immune from false alarms caused by EMI and RFI.

g. Sensors shall be scanned by control panel for its type identification to prevent inadvertent substitution of another sensor type. Control panel shall operate with installed device but shall initiate "Wrong Device" trouble condition until proper type is installed or programmed sensor type is changed.

h. Provide duct sensor housings where shown. Provide remote test and indicating station near each detector. Provide sampling tubes sized according to duct width. Provide two 10A. 24 VDC contacts in detector. Provide auxiliary relay rated for minimum 7A at 28 VDC or 10A at 120 VAC.

1) Wire NC contacts in relay to fan motor starter.

i. Where possible, duct detector will be mounted in straight runs of ductwork at least six duct widths downstream from ductwork bends. Coordinate physical location of detector with HVAC and with system equipment representative.

2. Provide double action addressable pull stations with integrated electronics that communicate station's status (alarm, normal) to control panel over two wires which also supply power to pull station. Address shall be set on each station. Stations shall be manufactured from high impact red Lexan. Lettering shall be raised and painted white. Station shall mechanically latch upon operation and remain so until manually reset by opening with key common to all system locks. Simplex 4099-9001 or equal.

a. Provide tamperproof clear Lexan covers with clear frame and spacer, and audible trouble alarm for pull stations in designated areas. Where pull stations is surface mounted, total depth shall not exceed 4 inch from wall.

3. Provide Class A addressable monitoring module where required to supervise conventional initiating devices such as waterflow, tamper switches or beam detectors. Modules shall also be used for status monitoring of related systems such as HVAC units.

4. Provide remote addressable control modules, where required to conduct remote control functions or outputs. Remote control modules shall provide form C contact output rated for 2 amps at 24 VDC.

5. Provide combination audio/visual signaling appliances. ADA strobe only shall be used to augment combination units where indicated. Specific audible and visual characteristics are as follows:

   a. Provide combination speaker/strobe light units or visual only units where indicated. Visual units shall consist of 24V with Xenon Flasher in clear lens. Word "FIRE" shall be imprinted in bold white lettering. Light output shall be field adjustable with following settings: 15 cd, 15/75 cd, 30 cd, 75 cd, 110 cd, as defined by ADA and UL1971. Units shall produce minimum of 0.037 foot-candles in each room required. Where two or more strobes are within common field of view, all strobes shall be synchronized. Simplex 4903 Series or equal.

   b. Speaker appliances shall have multiple taps of .25W, .50W, 1.0W and 2.0W taps. Audible signals shall have minimum sound level of 75dbA at 10 feet or 15db over ambient, whichever is greater.

P. System Accessories:

1. Provide flush mounted local energy Municipal Master Box Gamewell M34 Series or equal. Ensure proper coding, timing and master keying to municipal system. Provide micro-switch in master box with connection to alarm circuit control panel.

   a. Provide type 44630 grounding assembly complete with 1/2 inch x 8 feet ground rod, clamps and staples and 3/8 inch x 5 feet grounder with clamping nuts and staples. Provide ground connection from ground terminal of fire alarm box to building electrical ground.

   b. Provide Type 44551 Lightning Arrestor.

   c. If required, notify Fire Alarm Division or Police Department 48 hours in advance so that representatives may be present to supervise cable installation.

   d. Locate master fire alarm box where approved by fire department.

   e. Provide addressable monitor module for micro-switch monitoring.

2. Coordinate following to ensure that required installation and wiring of waterflow and sprinkler supervisory switches will result in complete operable and tested sprinkler system.

   a. Waterflow switches shall activate building alarms. (Water flow retard time delay shall be set at 45 seconds or as required by local authority.)

   b. Sprinkler supervisory switches shall activate supervisory trouble condition.

3. Provide graphic map depicting architectural layout of each floor adjacent to annunciator. Graphic map and message nomenclature shall be coordinated with and approved by Owner, Architect and Local Authority prior to installation.

4. Provide auxiliary strobe power supplies where system power requirements exceed that which is provided by main fire alarm control panels. Each auxiliary supply shall be fully supervised and shall support four style Y/Z signal circuits rated for two amps each. Auxiliary power supplies shall have dedicated AC circuits, standby batteries, and be located in rated electric rooms. Power supply shall have combined total power output of 8 amps, serving 4 individual circuits.

5. Provide 24 VDC linear beam smoke detector transmitter/receiver set where shown. Linear Beam Detectors shall have range of up to 350 feet at 60 foot spacing, and shall utilize adjustable sensitivity and environmental compensation circuitry. Each beam detector set shall be monitored by addressable monitor module and shall have remote test and indicator plate.

   a. Provide wall mounting kit with swivel lock feature or provide ceiling mount kit with 1/2 inch NPS threaded box cover for ceiling mounting.

6. Provide (red) remote LED indicator for detectors located behind locked doors and for elevator shafts. Each LED shall be mounted on stainless steel plate and have permanent label identifying actual device location.

7. Provide flashing weatherproof strobe where shown. Device shall mount to standard weatherproof box with 1/2 inch NPT pipe mount. Operating range shall be -10 degree to 122 degree F to be suitable for New England weather conditions.

8. Wire flush mounted electromagnetic door holders where shown and indicated. Device shall operate on power supplied from fire alarm control panel. Under normal conditions, magnets shall hold door open. Upon activation of building fire alarm system, devices shall be de-energized, thus releasing doors on circuit. Devices shall be designed for wall or floor mounting as required by location shown on drawings, complete with matching door plate, material and finish to match door hardware. Electromagnet shall operate from source, and require no more than 0.07 watts to develop 25 lbs. holding force.

9. Provide surge protection TII Model 317 or equal for 120 VAC circuit to fire alarm control panel.

Q. Remote Annunciator:

1. Provide Space Age Electronics XL8 or equal tabular style red flush mounted serial wired remote annunciator where shown on Drawings. Unit shall be back-lighted with lamp assemblies of egg crate type mounted behind translucent Plexiglas. Zone windows shall be 1-1/2 in X1-3/4 inch to allow film positive of exact zone nomenclature as shown on Drawings. Wiring shall be supervised. Provide 48 annunciation zone windows.

2. Annunciator shall be constructed of weatherproof Lexan face panel and aluminum enclosure, hinged cover, and keyed lock. Provide rain guards for key switches.

3. Provide auxiliary momentary key reset switch, two step drill switch, trouble lamp, trouble buzzer and spring action acknowledge key switch. Momentary acknowledge key switch

shall silence trouble buzzer while leaving the lamp illuminated. Subsequent trouble conditions will resound trouble buzzer.

4. Annunciator wiring termination's shall be made on terminal strips.

R. System Programming:

1. System shall be software configured on site via laptop computer. Complete software configuration shall be constructed on computer without need for connection to system.

2. Fire detection and alarm system shall permit system revision and expansion to be completed on site. Under no circumstances shall system's site specific configuration program be required to be returned to manufacturer for modification as result of system expansion or revision.

3. Configuration shall be stored on standard floppy disk for subsequent downloading to Fire Alarm Control Panel (FACP). Floppy disk configuration file shall contain installation name and specific configuration revision number. Revision number shall allow for tracking of system modifications throughout life of system. Each revision of system configuration on floppy disk shall include following information;

   a. Date/time of modifications to configuration.

   b. Description of changes made to system.

   c. Identification of programmer who input program revisions.

4. It shall be possible to request and view configuration revisions on FACP display after entry of appropriate passcode.

5. Configuration software shall have ability to compare any two revisions of site configuration and furnish printed report of differences in two revisions. This function shall allow user to readily identify areas necessary to be re-tested to ensure full integrity of system after any program changes or additions.

6. Manufacturer shall furnish evidence showing that configuration software has been submitted and approved by UL.

7. Installation shall be supervised and tested by equipment supplier. Work shall be performed by skilled technicians under direction of experienced engineers, all of whom shall be properly trained and qualified.

S. Municipal Service:

1. Provide municipal fire alarm service as indicated on Drawings.

2. Service conduit size shall be as indicated on Drawings enclosed in concrete envelope. Terminate conduit in manhole in manner as directed by Fire Department and Verizon.

3. Cable for underground service shall meet requirements of International Municipal Signal Association Specification 19-6. Number of conductors in cable shall be determined by Fire Department but shall not be less than 4 conductor No. 14 AWG.

    a. Provide fire alarm service cable under this Section.

    b. Provide cable from fire alarm master box to municipal fire alarm circuit point of connection via underground telephone manholes as directed by Fire Department.

    c. Provide additional service cable if required and directed by Fire Department.

4. Provide supervision of alarm, trouble and supervisory signals to UL Listed Central Station Service in accordance with NFPA 72 and the State Building Code.

T. Wiring:

1. Wire and cable for fire alarm systems shall be solid, color coded, copper conductors, as recommended by manufacturer.

    a. Signaling Line Circuits (Addressable Loop): Twisted, unshielded pair, minimum No. 18 AWG as recommended by system manufacturer.

    b. Strobe Circuits: Unshielded pair, minimum No. 14 AWG, as recommended by system manufacturer.

    c. Audio Circuits: Twisted, shielded pair, minimum No. 18 AWG, as recommended by system manufacturer.

2. Wiring for system shall be in accordance with Articles 760, 725, and 800 of National Electrical Code and local electrical codes.

3. Fire alarm wiring shall be in conduit.

4. Where cable is run in pipe or tubing, pull boxes shall be painted red, and four inch wide red stripe shall be painted on pipe or tubing every ten feet such pipe ort tubing is exposed. Fire alarm cable in raceways shall be tagged every 20 feet.

5. Provide MC cable for runs in accessible hung ceilings. Cables shall be power limited, UL listed type FPL, plenum rated, 75 degrees C, with red jacket and labeled as complying with NFPA 70, Article 760. Cables may be run longitudinally or laterally throughout the ceiling. Provide raceways where run exposed, where run within walls or in inaccessible ceilings.

6. Wiring of audio circuits shall maintain minimum 12 inch separation between supply and return circuits.

7. Provide rigid steel conduit at exterior locations and for all vertical runs between floors.

8. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon and terminations made in UL boxes. Wiring splices and transposing or changing of colors will not be approved.

9. Junction boxes shall be painted red with gasketed cover, and labeled as 'FIRE ALARM SYSTEM'.

10. Fire alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized for proper service. Circuits shall be labeled 'FIRE ALARM'.

U. Final Test (Pre-acceptance Test):

1. Speakers shall be set at 1-watt tap upon initial installation. During final testing, sound level and intelligibility measurements shall be taken and recorded in each occupied space. System shall produce 75dbA, or 15dbA above ambient (whichever is greater) [and have Intelligibility level of .07 on CIS Scale in accordance with NFPA 72 requirements]. Following initial measurement, necessary adjustments shall be made to each speaker setting to ensure compliance with Contract Documents and applicable code.

2. Perform complete final test of system indicating proper functioning of system. Furnish copies of completed NFPA 72 system Certificate of Completion in accordance with NFPA 72 to Owner and Architect for documentation and record purposes.

3. In addition to pre-acceptance test, Contractor shall provide for complete and final Fire Department Acceptance Testing in accordance with requirements of Authority Having Jurisdiction and applicable code.

V. Fire Alarm Inspection and Testing Contract:

1. Provide Certificate of Completion indicating proper functioning of system as well as certification/acceptance by Fire Department, in accordance with NFPA 72.

2. Prior to making final connections to Municipal Alarm System, system supplier shall furnish contract to Owner, at no additional cost, for fire alarm system inspection and testing contract in compliance with NFPA-72. Testing Contractor shall be trained and certified by original manufacturer to be a holder of a certificate of competency as Fire Alarm System Contractor from Fire Department, and be responsible for inspection, testing, and maintenance of interior fire alarm system for duration of original manufacturer's warranty period. Contract shall be for guarantee period with option to extend by Owner.

3. Submit to Fire Department signed and executed documentation verifying that entire fire alarm system has been tested in accordance with NFPA 72 and Underwriters Laboratories guidelines. Also, copy of signed and executed contract for periodic testing shall be provided to Fire Department prior to requesting their services for acceptance testing.

4. Each manual station or transmitter shall be tested at least twice annually. During quarterly test of each system at least 25 percent of alarm initiating devices shall be tested on each alarm circuit. Report of each month's test shall be forwarded to Superintendent of Fire Alarm.

5. Detectors associated with interior fire alarm system shall be tested once every 12 months, with one quarter number being tested in each monthly test.

6. Self-restoring detectors shall be exposed either to heat or smoke to test ability to initiate alarm.

7. Beam detectors shall be tested annually with proper test filters.

8. Fusible link type detectors shall be unscrewed from holders to test ability to initiate alarm. Every three months one fusible link shall be exposed to heat, to test ability of fusible link to respond to heat.

9. Quarterly test reports shall include following information:

   a. Date of test

   b. Name and location being tested

   c. Number of interior alarm circuits

   d. Number of devices tested and type

   e. Condition of emergency standby power supply

   f. Conditions of analog sensors - report shall identify any analog smoke detectors that are contaminated and approaching a trouble (dirty) state. After first year of operation, each and every analog sensor shall be cleaned and recalibrated in accordance with NFPA 72 testing and maintenance guidelines.

   g. Name of company conducting test

   h. Name and signature of person conducting test

10. Testing agreement shall not cover:

    a. Damage resulting from accidents, fire, storm, water, negligence, misuse, vandalism, defective or improper wiring.

    b. Actual flow test and timing of water flow switches on sprinkler system.

    c. Testing or repair of door release mechanisms.

    d. Testing or repairs of dampers, smoke hatches, elevator controls, or other peripheral equipment not furnished by fire alarm supplier.

W. Training:

1. Provide services of manufacturer's representative for period of 4 hours, during normal business hours, to instruct Owner’s designated personnel on operation and routine maintenance of system.

X. Provide complete set of as-built documentations, and "As-built Drawings and Telephone Cabinet" to house system drawings, floor plans and working telephone with direct outside line.

This cabinet shall be installed adjacent to main Fire Alarm Control Panel or in otherwise approved location.

2.24 TERMINAL CONNECTING CABINETS

A. Terminal connecting cabinets and hinged trims shall be galvanized steel, complete with 3/4 inch thick soft plywood backboard having two coats of insulating varnish, terminal blocks and identification of all systems and wiring.

B. Terminal connecting cabinets shall match panelboard cabinets in style and color and be of same manufacturer. Cabinets shall be sized as shown on Drawings.

C. Provide cardholder framed under plastic on inside door indicating cabinet number and system designation.

D. Terminal connecting cabinets shall have barrier type terminal blocks with number of terminal blocks as required to strip and make up connections of all conductors entering and leaving cabinet. Conductor splices shall not be made in cabinets. Cabinets for telephone company use will not require terminal blocks included under this Contract.

E. Connect stranded conductors to terminal blocks by use of compression type terminals of ring tongue type.

F. Where terminal strip cabinets form part of empty conduit system for future wiring, terminal blocks may be omitted.

2.25 DOOR SIGNAL SYSTEMS

A. Provide door signal system as specified herein and as shown on Drawings.

B. Door signal system shall consist of one-note chime, transformer and push buttons at either end of Reading Room. System shall be wired so that operation of push buttons shall sound one-note chime. Conduit and wire shall be in accordance with "Raceways" and "Wire and Cable" paragraphs. Low voltage wiring may be No. 14 A.W.G. Provide outlet boxes at all equipment locations except push buttons.

C. Equipment shall be Edwards Company, or approved equal. Catalog numbers are those of Edwards Company and indicate type, quality, and function.

1. Transformer: Catalog No. 592.

2. Push buttons: Catalog No. 1786-B.

3. Chime: Catalog No. (two-note and one-note).

2.26 ACCESS PANELS

A. Provide access panels for electrical equipment above hung ceilings which are not readily removable.

B. Access panels shall be prime painted, with cylinder lock and two keys, as manufactured by Inland Steel Products Milcor, Miami Carey, Walsh-Hannon Gladwin Way Locktor, or equal. Provide Milcor Type A for acoustical ceilings; Milcor type K for plastered surfaces and Milcor type M for masonry construction.

2.27 VIBRATION ISOLATION AND SEISMIC CONTROL SYSTEM

A. General:

1. Provide vibration isolation and seismic control system for equipment listed herein.

2. Intent of seismic restraint is to provide restraint of non-structural building components. Restraint systems are intended to withstand stipulated seismic accelerations applied through component center of gravity.

3. The term "equipment" will be used throughout this Specification and it includes ALL non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on grade within five (5) feet of the foundation wall. Equipment buried underground is excluded but service entries through the foundation walls are included. Equipment referred to below is a partial list of equipment for reference. (Equipment not listed is still included in this Specification.)

4. Work includes following:

a. Vibration isolation elements for equipment.

b. Equipment isolation bases.

c. Seismic restraints for isolated equipment.

d. Seismic restraints for non-isolated equipment.

e. Equipment support stands.

f. Certification of seismic restraint designs and installation supervision.

B. Definitions:

1. Equipment referred to below is partial list; (equipment not listed is still included in this specification).

a. Light fixtures

b. Panelboards

c. Switchboards

d. Conduit

e. Motor control centers

f. Battery chargers

g. Automatic transfer switches

h. Emergency generator

i. Cable trays

j. Bus ducts

2. Life Safety System Definition

a. Systems involved with and/or connected to emergency power supply including generator, transfer switches, transformers and raceways to fire protection, smoke evacuation and/or emergency lighting systems.

3. Positive Attachment

a. Positive attachment is defined as support location with cast-in or wedge type expansion anchor, double sided beam clamp, welded or through-bolted connection to structure.

4. Transverse Bracing

a. Restraint(s) applied to limit motion perpendicular or angular to centerline of conduit, cable tray or bus duct.

5. Longitudinal Bracing

a. Restraint(s) applied to limit motion along centerline of conduit, cable tray or bus duct.

C. OEM Equipment Isolation Packages:

1. Substitution of original equipment manufacturer's internally or externally isolated and restrained equipment in lieu of isolation and restraints specified is acceptable provided all conditions are met. Equipment manufacturer shall furnish letter of guarantee stamped and certified stating that seismic restraints are in full compliance with these specifications.

2. Costs for converting to specified vibration isolation and/or restraints shall be born by equipment manufacturer in event of non compliance with preceding.

3. In event that equipment is internally isolated and restrained, entire unit assembly shall be seismically attached to structure. Attachment and certification thereof shall be under this Section.

D. Submittal Data Requirements:

1. Submittals

a. Submit catalog cuts or data sheets on specific vibration isolations and restraints to be utilized detailing compliance with specification. Reference "Types" according to those specified in this paragraph.

b. Submit itemized list of all isolated and non-isolated equipment. Detailed schedules showing isolator and seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers.

2. Shop Drawings

a. Show base construction for equipment. Include dimensions, structural member sizes and support point locations.

b. When walls and slabs are used as seismic restraint locations, details of acceptable methods for conduit, cable tray or bus duct with supporting certified calculations shall be submitted.

c. Indicate isolation devices selected with complete dimensional and deflection data before condition is accepted for installation.

d. Submit specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

e. Coordination drawings shall be marked-up with specific locations and types of restraints indicated for conduits, cable trays and bus duct. Rod bracing and assigned load at each restraint location shall be clearly delineated. Any tributary loads shall be considered for proper restraint sizing.

f. For ceiling suspended equipment provide minimum/ maximum installation angle allowed for restraint system, as well as braced and unbraced rod lengths at each allowable installation condition.

E. Seismic Certification and Analysis:

1. Submit seismic restraint calculations for connections of equipment to structure. Performance of products (such as; strut, cable, anchors, clips, etc.) associated with restraints shall be supported with manufacturer's data sheets or certified calculations.

2. Seismic restraint calculations must be based on the "G" Forces criteria shown in Table A.

3. For roof mounted equipment both the seismic acceleration and wind loads (30 psf) shall be calculated, the highest load shall be utilized for the design of the restraints and isolators.

4. Certification of calculations to support seismic restraint designs shall be stamped by Registered Professional Engineer in Maine.

5. Analysis shall indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure. Analysis shall detail anchoring methods, bolt diameter, embodiment and/or weld length.

6. Submit copy of, in force, $1,000,000.00 coverage limit Seismic Design Errors and Omissions insurance certification to accompany submittals. Manufacturer's product liability insurance certificates are not acceptable.

F. Manufacturer's Responsibility:

1. Manufacturer of vibration and seismic control equipment shall have following responsibilities:

a. Determine vibration isolation and seismic restraint sizes and locations.

b. Provide equipment vibration isolation and seismic restraints as specified.

c. Guarantee specified isolation system deflections.

d. Supply installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

e. Certify correctness of installation upon completion.

G. Related Work:

1. Housekeeping Pads

a. Housekeeping pad attachment shall be designed by Structural Engineer. Material and labor shall be under Section 03300.

b. Housekeeping pads shall be coordinated with Seismic Restraint vendor and sized for minimum edge distance of 13 bolt diameters of clearance around outermost anchor bolt to allow for use of full anchor ratings.

2. Supplementary Support Steel

a. Provide supplementary support steel and connections for equipment as required.

3. Attachments

a. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps as directed by Seismic Restraint Manufacturer.

TABLE A "G" FORCES FOR VARIOUS CONDITIONS (SEISMIC ZONE 2 - AV > 0.1 < 0.2)			
Conduit	Rigidly Mounted Equipment	Flexibly Mounted Equipment	All Life Safety
.25	.40	.40	.60

H. Products:

1. Devices

a. Vibration isolation and seismic devices described herein shall be the product of a single manufacturer. Mason Industries is the base manufacturer of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Base Manufacturer.

I. Seismic Restraints and Vibration Isolation Types:

1. Isolation and seismic restraint devices shall be capable of accepting, without failure, "G" forces as determined by seismic certification and calculations, as described in Submittals requirements above.

2. Corrosion resistance for outdoor applications shall be as follows:

a. Springs shall be cadmium plated, zinc electro-plated, or powder coat.

b. Hardware shall be cadmium or zinc plated.

c. Other metal parts shall be hot-spray, hot dipped galvanized or zinc electro-plated.

3. Seismic Restraint Devices

a. Shall maintain equipment in captive position and not short circuit isolation devices during normal operating conditions.

b. Shall have provisions for bolting and/or welding to structure.

4. Welding of springs to isolator housing, base plates, etc. will not be accepted.

J. Seismic Restraint Types:

1. Type I: Same as Type B isolator, type SLR, SSLFH.

2. Type II: Each corner or side of equipment base shall incorporate seismic restraint snubber having all directional resilient neoprene pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing, type Z-1225, Z-1011.

3. Type III: Restraints for suspended systems.

   a. Isolated systems braced with multiple 7x19 strand galvanized cable rope, with approved devices, such as thimbles and wire rope clips, to equipment and structure, type SCB.

   b. Non-isolated systems shall be braced with structural steel strut or cables with approved fastening devices to equipment and structure, type SSB.

   c. Provide steel angles to prevent rod bending of hung equipment where indicated by Seismic Restraint Supplier's submittals. Steel angles shall be attached to rods with minimum of three ductile iron clamps at each restraint location, type SRC. Welding of support rods to angles is not acceptable.

4. Type IV: Double deflection neoprene isolator. Mountings shall be fabricated to resist wind or seismic forces, type RC or BR.

5. Type V: Rigid attachment to structure utilizing wedge type expansion anchors for bolting and steel plates, either cast in or anchored with wedge type expansion bolts for welding. Power shots are not acceptable. Concrete anchor bolt spacing shall be in accordance with anchor manufacturer's published standards.

K. Vibration Isolator Types:

1. Type A: Spring Isolator - Free Standing.

   a. Spring shall have minimum outside diameter to overall height ratio of 0.8:1 at rated deflection.

   b. Reserve deflection (from published load ratings to solid height) of 50 percent of rated deflection.

   c. Ductile top cup with adjusting bolt tapped for equipment attachment locking cap screw.

   d. Minimum 1/4 inch thick neoprene acoustical base pad or cup on underside, unless designated otherwise.

   e. Mason Industries type SLF.

2. Type B: Spring Isolator - Restrained, type SLR, SSLFH

   a. Shall be same as Type A with following additional features:

      1) Integral restraining bolts with elastomeric cushions preventing metal-to-metal contact.

      2) Internal spring adjusting nut or bolt with leveling capability.

      3) Built-in all-directional limit stops with minimum 1/4 inch clearance under normal operation.

3. Type C: Spring Hanger Isolator, Type 30

   a. Spring element (same as Type A) with steel upper spring retainer and lower elastomer retainer cup with integral bushing to insulate lower support rod from hanger box.

   b. Steel hanger box shall be capable of 30-degree misalignment between rod attachment to structure and connection to supported equipment. Hanger boxes shall withstand three times rated load without failure.

4. Type D: Double deflection neoprene, Type RC or BR

   a. Mountings shall be fabricated to resist wind or seismic forces.

5. Type E: Elastomer Hanger Isolator, Type HD

   a. Molded neoprene element with bushing to insulate lower support rod from hanger box.

   b. Steel hanger box shall withstand three times rated load without failure.

6. Type F: Combination Spring/Elastomer Hanger Isolator, Type 30N

   a. Spring and neoprene elements in steel hanger box with features as described for Type C and E isolators.

7. Type M: Flashable Restrained Isolator, Type FRS

   a. Shall have all features of Type B isolator.

   b. Shall have galvanized steel spring covers for adjustment or removal of springs.

   c. Unit shall have structural top plate for welding or bolting of supplementary support steel.

   d. Isolator shall accept 1 inch roofing insulation and be flashed directly into waterproofing membrane.

   e. Isolator shall be complete with wood nailer, plywood sides and flashing.

8. Type P: Elastomer Isolator, Type ND

   a. Double deflection neoprene compression mountings.

   b. Non-skid top and bottom surfaces.

   c. Threaded bolting sleeves shall be embedded in isolator.

   d. Drilled tie-down bolt holes shall be provided in base plate.

L. Equipment Bases:

1. Curbs and roof rails shall be bolted or welded anchored to the structure by Electrical to attain specified acceleration criteria and shall also be capable of resisting minimum 30 psf wind load (non-simultaneous).

M. Installation:

1. Isolation and seismic restraint systems shall be installed in strict accordance with manufacturer's written instructions and submittal data. See Table B at end of this paragraph.

N. Seismic Restraints:

1. Floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to structure. Calculations that determine that isolated equipment movement may be less than operating clearance of snubbers (restraints) do not preclude need for snubbers. Equipment shall be positively restrained to structure.

2. Suspended equipment shall be two or four point independently braced with Type III restraints. Install cable braces taut for non-isolated equipment and slack with 1/2 inch cable deflection for isolated equipment. Rod bracing shall be installed per approved submittal. Equipment weighing less than 75 pounds is excluded.

3. Horizontally suspended cable trays, bus duct and conduit shall use RESTRAINT TYPE III. Spacing of seismic bracing shall be per TABLE C.

4. For trapeze-supported conduit, individual conduits shall be transversely and vertically attached to trapeze support at designated restraint locations.

5. For overhead supported equipment, overstress of building structure shall not occur. Bracing may occur from:

   a. Flanges of structural beams.

   b. Upper truss chords in bar joists.

   c. Cast in place inserts or drilled and shielded inserts in concrete structures.

6. Risers

   a. Where conduits pass through cored holes, holes shall be packed with resilient firestop material or firestop as specified elsewhere. No additional horizontal seismic bracing shall be required at these locations.

7. Lighting fixtures in lay-in ceilings in compliance with seismic zone requirements shall use earthquake clips or other approved means of positive attachment to secure fixtures to T-bar structure.

8. Rigid conduit, cable tray or bus duct system shall not be braced to dissimilar parts of building or two dissimilar building systems that may respond in different mode during

earthquakes. Examples: Wall and roof; solid concrete wall and metal deck with lightweight concrete fill that cross building expansion joint.

O. Exceptions:

1. Exceptions for seismic restraints on non-life safety systems.

a. Conduit less than 2-1/2 inch diameter.

b. Clevis or trapeze supported conduit, cable tray or bus duct suspended by hangers with positive attachment to structure that are less than 12 inches in length as measured from top of conduit, cable tray or bus duct to point of attachment to structure. If any hanger in run exceeds 12-inch limit, seismic bracing is required for entire run.

2. Exceptions for seismic restraints on life safety systems:

a. Critical, standby or emergency power conduit less than 1 inch nominal diameter.

P. Inspection:

1. Upon completion of installation of vibration isolation and seismic restraint devices, the owner may elect to contract an outside consultant at owner's expense to review installation. Any deficiencies in installation shall be corrected immediately.

TABLE B VIBRATION ISOLATION AND SEISMIC RESTRAINT REQUIREMENTS FOR **ELECTRICAL** EQUIPMENT			**EQUIPMENT INSTALLATION** **ATTACHMENT POINT**						
			ON GRADE				**ABOVE GRADE**		
EQUIPMENT	**SIZE**	**MOUNTING**	**ISOL**	**DEFL**	**BASE**		**ISOL**	**DEFL**	**BASE**
GENERAL PURPOSE TRANSFORMERS - DRY TYPE	ALL	FLOOR	D	0.30	- -		D	0.30	- -
		CEILING	E	0.30	- -		E	0.30	- -
GENERATORS	ALL	FLOOR	B	0.75	- -		B	1.50	- -

TABLE C **SEISMIC BRACING TABLE**		
EQUIPMENT	**ON CENTER SPACING**	
	TRANSVERSE	**LONGITUDINAL**
CONDUIT	40 Feet	80 Feet
BUS DUCT	30 Feet	60 Feet
CABLE TRAY	40 Feet	80 Feet

2.28 CLOSING NOTIFICATION SYSTEM

A. Provide closing notification system as specified herein and as shown on Drawings.

B. Closing notification system shall consist of a two-note chime, transformer and push buttons. Conduit and wire shall be in accordance with "Raceways" and "Wire and Cable" paragraphs. Low voltage wiring may be No. 14 AWG. Provide outlet boxes at all equipment locations except push buttons.

C. Equipment shall be Edwards Company, or approved equal. Catalog numbers are those of Edwards Company and indicate type, quality, and function.

1. Transformer: Catalog No. 592.

2. Push buttons: Catalog No. 1786-B.

3. Chime: Two-note style.

2.29 INTEGRATED ACCESS CONTROL, CCTV & INTRUSION ALARM SYSTEM

A. General:

1. The security system designed for this project shall be capable of integrating the specified security components into a highly efficient and user friendly security system. All access control and event processing shall be accomplished through the use of intelligent field panels. The system shall be capable of supporting multiple card reader technologies for access control, as well as alarm input devices and control outputs. In addition, the system should be expandable to incorporate additional readers or functions at the facility. The system must be fully installed by one security contractor (in accordance with the manufacturers' installation instructions and these specifications) with all wire, cables and necessary parts for interfacing with the different modules of the system. In addition, the security contractor shall provide conduit for any exposed wires or cables and make connections to ensure the proper operation of the system. It shall be the responsibility of the contractor to provide power to all devices with the direction of the Designer. In addition, it will be the responsibility of the contractor to provide trenching for cables when required. The security contractor will also illustrate and describe in detail the type of equipment and components to be utilized, the cable and wire required and supply point-to-point wiring diagrams. Finally, the security contractor shall include all labor, material, equipment, services, licenses and fees and miscellaneous costs necessary to furnish and install, complete and in place, the specified security systems and components.

B. General Requirements:

1. Make submittals in accordance with aforementioned requirements at execution of contract with contractor or awardee.

2. Submit complete shop drawings for approval, including:

a. System architecture showing all devices and components

b. Data sheets for all equipment

c. Security console/rack drawings

d. Wiring diagrams including panels, console and device power and sources

e. Cable and termination schedule

f. Equipment lists of all proposed devices and equipment

g. Software design data

3. Test reports

C. Quality Assurance:

1. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of five years experience.

2. Supplier/Installer: Authorized distributor/installer of specified manufacturer with a minimum of five years experience and service.

3. The system shall be installed by competent, licensed technicians, regularly employed by the manufacturer or supplier, with full responsibility for the proper operation of the security system, including debugging and proper calibration of all system components. Supplier shall have in-place a support facility within 50 miles of the site with technical staff, spare parts and loaner equipment inventory and all necessary test and diagnostic equipment.

D. Security Management Information System (SMIS):

1. The contractor will install an integrated Security Management Information System to control personnel, monitor doors, all intrusion devices, and control access with proximity card readers as specified and shown on the drawings.

2. Related work specified in other sections includes, but is not limited to:

a. Raceways

b. Conductors

c. Boxes

d. Electrical identification

e. Hangers and supports

f. Door strikes

g. Interface with fire alarm system and all applicable codes

3. System Characteristics

a. For consistency in quality, this specification is based on the capabilities of the Simplex Time Recorder Company NT 3400 Security Management Information System (SMIS). Acceptable alternates include Honeywell and Johnson.

b. The Security System Host shall provide an integral solution through the use of a pre-planned suite of hardware and software modules for Access Control, Proprietary Alarm Monitoring, Remote Site Monitoring, Elevator Control and Video Badging. The system shall be capable of supporting passive 36 bit proximity card technology.

c. The SMIS shall be based on the Windows NT protocols NetBEUI or TCP/IP. Network limitations shall be determined by the network topology used.

d. The Security System Host shall reside on a standard Ethernet LAN technology.

e. This Security System Host shall provide a true multi-tasking capability and shall be based upon Windows NT operating system version 4.0 or higher.

f. The Security System Host shall provide a high level of operating system security. Operator interaction shall be a Windows NT 4.0 Graphical User Interface (GUI).

g. The Security System Host computer shall operate as a stand-alone computer.

h. The Security System Host shall be capable of controlling up to 256 doors; 20,000 cardholders; monitoring up to 1,536 supervised input points; and activating up to 768 output points.

i. Entry control must be accurate, rapid and highly flexible in establishing authorized entry zones, time of access, length of access and include anti-passback features.

j. Communications between the central controller and the readers shall be a redundant, bi-directional path such that a loss of communications in one direction, caused by a single open or break, automatically establishes communications in the other direction, thus maintaining communications to all readers.

k. The system shall provide for at least ten level alarm priorities as well as for chronological queuing. Individual cards may be programmed for special privileges to override access level and time period parameters.

l. System operators shall, from the keyboard, be able to manually unlock or lock controlled doors for a variable time period, or program an event to automatically unlock and lock doors during a particular time period.

m. The operator shall be able to display the real-time status of any alarm point.

n. Each alarm input shall be user-programmable with event messages to provide English text instructions to personnel during alarm conditions.

o. The system shall provide output relays to control external devices, such as electrical door locks, by either/or: manual commands from the controller keyboard; in response to a fire alarm condition; or automatically at a preset date and time.

p. The system shall automatically transmit security alarm conditions to the main workstation in the Campus Main Security Room (Public Safety Office).

4. Cardholder Database and Screen Designer

a. The System shall provide an industry-standard database management system that provides an integrated Cardholder screen design application. The Cardholder database / screen designer (DSD) shall allow the designer to create, edit, and delete database tables and data entry as required. In addition, the system administrator shall use the DSD to specify data entry screen validations and enable a card record history audit trail. The DSD shall allow for the set up of a unique database structure to the customer's exact specifications, to include at a minimum, allowing cards to be programmed individually or in blocks, and shall rapidly add, delete, display or change cards. In addition, each card file record shall include card number, employee name, department, title, room and telephone numbers.

b. The following capabilities shall be provided:

1) A sample default database and screen design to help with initial start-up.

2) All captions and controls will be available for dynamic viewing and rearranging.

3) Up to five pages shall be available for the placement of fields.

4) Ability to drag-and-drop the data fields within each page.

5) Alignment options shall be available to quickly line up all fields in any arrangement.

6) As a minimum, the following special card data fields:

a) Expiration date/time

b) Activation date/time

c) Custom access privileges

d) Name of operator last editing card

e) Date/time of last edit

f) History of most recent accesses by cardholder

5. Security

a. A password protection function shall allow the system administrator to assign access privileges and permit access to modules within the system. The password protection shall be linked with user status to permit or deny access to

various system functions and levels. The Cardholder Database Screen shall have the following password security levels:

1) Ability to restrict up to six unique operator viewing levels on each Cardholder database field.

2) Ability to allow displaying only of up to six levels of operator viewing on each Cardholder database field.

3) Ability to restrict operator viewing on any of the five individual Cardholder database screens.

b. The Security System Host shall allow the following maximum capacities within the definition of the Cardholder Database:

1) Up to 20,000 Cardholder Records

2) Up to 43 unique customer defined fields.

3) Up to five pages for database fields.

4) Up to 60 characters per field.

5) Up to 16 look-up tables

6. Cardholder Import/Export

a. The Security System Host shall allow for the manual import of all or specific cardholder data. Updates shall be by a repeat of the original import with updated files. Cardholder data, excluding the video image, shall be supplied to the Security System Host as an ASCII Delimited Text File. Video images shall be supplied to the Security System Host in one of the following formats: Bitmap, TIFF, PICT, GIF, JPEG, TGA, Sun Raster.

b. The Security System Host shall allow for the manual export of all or specific cardholder data. Updates shall be by a repeat of the original export with updated files. The export of both database information and video images shall be available in the same forms as described above for import.

7. Access Policies

a. The Security System shall support the configuration of "policies" to provide specialized access control for a region of the facility, personnel, or sequencing through doors. The System shall contain the following policies as a minimum:

1) Occupancy Restrictions Policy

2) Anti-Passback Policy

3) n-Man Rule

8. Alarm Priorities

   a. The Security System Host shall provide an alarm priority queue from 1 to 99. Each alarm condition may be defined as 1 of the 99 priorities.

9. Alarm Routing

   a. The Security System Host shall be capable of routing alarms as programmed to system workstations by time of day, individual workstation or by user password.

10. Break-Through Alarms

    a. The Security System Host shall interrupt the current program being run and present the Alarm Display Screen automatically regardless of system activity when an alarm of a designated priority range or higher is generated.

11. Activity Printer

    a. Provide a compatible parallel dot matrix printer for hard copy activity reports.

12. Report / History Printer

    a. Provide a compatible parallel laser printer for hard copy activity reports.

13. Training

    a. Training shall consist of not less than 8-hours from a factory Microsoft Windows NT certified instructor.

14. Operation

    a. When a card is read at a reader, the card number and the access level shall be sent to the central controller.

    b. The central controller, which shall be programmed to control access by both location and time periods, shall verify all information and immediately record directly to diskette each transaction to include cardholder name, date, time, location and transaction type. Transactions may also be displayed and/or printed as they occur.

    c. The system shall maintain a history file on the hard disk:

       1) The history data shall be organized into a logically circular file such that the most recent transactions are accessible directly from the hard disk without having to resort to archival media. In addition, the system shall store data in compact form, and not as text. Each history entry shall be marked with the date and time of its occurrence, the name of the system operator involved and the terminal from which the event was initiated.

2) The system shall provide a method by which incremental sections of the historical journal may be backed up on magnetic tape media. The system journal archive method shall be sufficient to ensure that no events are lost in the transfer from hard disk to the archive media.

3) The system shall be capable of producing the following reports of historical events over a specified period of time, both individually and in any combination with the historical journal:

a) Reports for accesses for a selected cardholder or cardholder group

b) Reports of rejected access attempts for cardholders cardholder groups

c) Report of accesses through a selected door or group of doors

d) Report of alarm activations for selected alarm or group of alarms

e) Report of alarm acknowledgments for selected alarm or group of alarms.

f) Report of operator comments

g) Report of manual override actions

h) Report of automatic system actions (i.e. automatic door unlocks, etc.)

i) Report of guard tour activities

j) Report of intelligent failures

k) Report of cardholders accessing a particular location over a specified period of time

l) System shall have the capability to customize reports in the field in accordance with the needs and requirements of the users. These reports should be available only at the primary computer.

m) Cardholder data records shall allow the user to select sorting by card number, cardholder name or other field identifiers.

E. Hardware:

1. Network Controller Hardware

a. The Simplex #3500 Intelligent System Controller (ISC) shall be modular in design and have an ISA passive backplane bus with two reserved slots and 6-(8) bit expansion slots.

b. The ISC Controller shall be an Intel 386 EX microprocessor-based design with on-board time and date generation, and an on-board rechargeable battery to allow a minimum of 48 hours data and event buffer integrity. Controllers without the minimum on-board specifications listed above are not acceptable. The event buffer shall have a minimum capacity of 3,000 standard events (expandable to 15,000). The Security System Host shall be capable of communicating to up to 98 ISC controller addresses.

c. The ISC shall utilize flash ROM for program storage. Program updates shall be made via download through the ISC service port and shall not require chip replacement.

d. Controllers shall be 4 hour backed-up with additional battery support time available within the same cabinet.

e. Each ISC shall have all the necessary provisions to implement and support access control for up to twelve readers.

f. Any Security System Host system which reverts to a degraded mode, using a facility code/site code or other lower security technique only shall not be accepted.

g. Each reader module shall be capable of interfacing with most major card reader technologies without the necessity of special interfacing. Systems requiring additional logic panels, interface cards or personality modules to provide this interface are not acceptable. These peripheral devices shall be connected to the reader module through snap-in plugs for servicing. The following Simplex reader technologies shall be supported:

1) Proximity #3209-9719

2) Proximity #3209-9666

3) Magnetic Stripe #3209-9905

4) Wiegand #3209-9801

5) Bar Code #3209-9948

6) Keypad Only #3209-9701

7) Biometric #3209-9970

8) Proximity with Integrated Keypad #3209-9671

h. Each input, including Door Switch and Request to Exit (REX) inputs shall have supervision capabilities and shall allow a minimum 500 foot, 22 gauge, TSP wire run to each input device.

i. The card reader to be supported shall be the Simplex Model #3209-9511, or similar, proximity device.

j. The reader module and I/O modules shall be 8 bit ISA plug-in style cards compatible with an ISA passive backplane bus.

k. A minimum of 500 Proximity cards, Simplex Model #3209-9760, or similar, shall be furnished by the security contractor.

l. Each Remote Access Controller (RAC) (and/or ISC) shall be an intelligent component of the distributed, intelligent access control system. Each RAC shall be U.L. listed and independently monitor and control its associated card readers, door monitoring sensors, electric door strikes and magnetic holders, request to exit devices, reader tamper alarms, glass break and motion detectors, etc.

m. The RAC shall operate the door control circuit within one second of presentation of a valid card at a connected reader using its resident database to make the access granted/denied decision. The one second response time shall not be exceeded regardless of the number of simultaneous requests at its controlled doors.

n. The RAC shall contain the necessary power supplies and standby batteries to operate the RAC and all connected card readers and door strikes. Standby batteries shall be appropriately sized to provide a minimum of four hours of normal or intermittent reader/door operation.

o. The RAC shall provide door control via for the minimum following commendable states:

1) Secure (valid card required for access)

2) Access (door unlocked, door alarm shunted)

3) Unlocked (door unlocked, door alarm active)

4) Timed access (door unlocked for preprogrammed door strike time, door alarm shunted for preprogrammed shunt time)

5) Lockout (door is locked, no valid access allowed)

p. The RAC shall use its resident database to make all cardholder access granted or Denied decisions. If communication is lost between the Central Controller and the RAC, the RAC shall automatically operate as an independent system with full security maintained. Off-line operation shall be user-defined as one of the following:

1) Use resident database

2) Access only to selected card holders in resident database

3) Command all doors to access (on individual door basis)

4) Command all doors to lockout (on an individual door basis)

q. In order to accommodate card holders who require additional time to move through a controlled door, such as those with a physical disability, the RAC shall be able to identify those card holders in its resident database. The intent is to allow specific cardholders extra time without having to compromise security by allowing all card holders extra time to enter/exit.

r. System software shall support the operation of a door magnetic switch monitor and a request to exit monitor. The door switch monitor shall detect the opening of an access controlled door, and shall have the following operation:

1) When the door is opened following an authorized access, the magnetic switch shall be shunted by the software for a user-defined time period.

2) When the door is opened following the activation of the exit device, the input of the magnetic switch shall be shunted by the software for a user-defined period of time adjustable from the Host computer.

3) When a door is opened without a valid access at the associated reader, or an activation of the exit device input, then the system shall declare an alarm because the door has been forced open.

4) When the door is held open past a user-defined time period following a valid access or activation of the exit device input then the system shall declare an alarm as the door has been held open for too long a period of time.

5) When an alarm is recorded on an access controlled door, it shall be required that any CCTV camera in proximity to the door in the alarm state to pan/tilt/zoom as necessary in order to record the person(s) in close proximity to the door when the alarm is first recorded.

2. Security Devices

a. For purposes of equipment selection, the listing of some manufacturers of security equipment which is suitable for this installation is not intended to limit selection of similar products available from other manufacturers but rather to establish a standard of minimum quality or performance. In fact, the security contractor will be required to select and install those components throughout the project which are the best pairing for the other system components, building environment, client uses, etc. Similar equipment utilized or manufactured by major security system contractors, such as Simplex, are considered equal but is not intended to limit selection of products which are similar but are from different manufacturers.

b. All magnetic door contacts, motion sensors, glass break devices and/or other intrusion components shall be fully addressable devices and must be wired by security contractor accordingly.

3. Door Contacts & Request to Exit Devices

a. All doors as noted on the drawings to be monitored by the SMIS shall be contacted to provide real time door status. Door contact switches shall be

concealed devices. Request to exit signal shall be provided by motion sensors and request to exit pushbutton at each card reader controlled door. These devices should be passive infrared sensors, body heat sensitive, with an adjustable pattern and latch time. Security contractor shall be responsible for ensuring that devices are installed in a manner which prevents unauthorized or unnecessary activation of the locking mechanisms. Such sensors must also be suitable for single and double door applications. Use Simplex #2760-9118 and #2750-9813.

4. Card Readers

   a. The readers shall be proximity type and shall read a card when presented to the surface readers without physical contact. Read range shall be two to six inches with a card. The reader shall contain a visual indication to the user that access has been either granted or denied. When access is being granted the central controller shall send a signal to illuminate a green visual indicator and activate the locking mechanism within the specified one-second time frame after reading the card. If access is to be denied, the central controller shall send a signal illuminating the red visual indicator within the one-second time frame and not activate the locking mechanism granting entrance.

   b. The readers shall be flush mounted when necessary and mullion mounted whenever possible. Use Simplex #3209-9666.

5. Door Contacts

   a. The security contractor shall utilize concealed magnetic contacts when possible and shall be responsible for all supplying all conduit and wiring for these devices. All wiring for these devices shall be concealed.

6. Security Cards

   a. The security contractor will supply an initial quantity of 500 cards. The cards shall be constructed of top quality, highly durable and resilient material designed for use with passive proximity readers. Each card shall be encoded only with a code unique to the security system, an individual card number, and one of eight issue level numbers. Use Simplex #3209-9462.

F. CCTV/Video Monitoring System:

1. As an integrated part of the SMIS, furnish and install an integrated Simplex br108/as CCTV system to monitor and record activity at various locations inside and outside of the buildings as shown on the drawings.

2. The CCTV system, and its component parts, shall have the capability to be configured to automatically survey and record on tape at locations where associated door alarm devices, and other intrusion components, have been activated.

3. Security contractor shall be responsible for employing lens/camera selection which provides excellent resolution and video quality in various interior/exterior lighting and environmental conditions.

a. Cameras

1) Interior fixed cameras are to be 1/3 inch format, black and white CCD, high resolution 24VAC with a minimum 576 lines of resolution. Use with 3.5mm-8mm Vari Focal lens. Use Simplex 350 Series or similar.

2) Interior pan tilt 200m cameras shall be similar to above except pan tilt 200m operation.

b. Matrix Switcher

1) Control of the speed domes shall be by a single keyboard with integral joystick through a full, cross point matrix switch. Use Simplex CM9760 series matrix switch or similar.

c. Common Area Ceiling Enclosures

1) Drop ceiling enclosures for common areas are to be 5 inch flush mount dome style. Use Simplex DF5 series or similar.

d. Multiplexers

1) Video multiplexing devices, capable of duplex recording of up to 16 black and white or color cameras, one multi screen monitor output, one general spot monitor output and VCR output. Use Simplex MX4016CD duplex multiplexers or similar.

e. Digital Video Recorders

1) Digital video recorders shall be state-of-the art, hi-density recording devices, compatible with the Simplex multiplexers and be capable of time lapse/real time recording with Time/Date search capability.

f. Monitors

1) A rack mountable 20 inch Color monitor for multi screen viewing and a rack mountable 17 inch color monitor for spot camera viewing shall be provided for each multiplexing unit. Use Simplex LTC 2921 and Simplex LTC 2917 or similar.

g. CCTV Power Supplies

1) Interior cameras shall be powered by a common power supply capable of powering up to (16) 24VAC cameras with fused outputs. Exterior cameras are to be powered by internal step down transformers appropriately designed and manufactured specifically for the cameras being installed. Third party power devices are not acceptable.

h. CCTV Integration

1) Integration of the CCTV system with the SMIS shall be a true RS232 communications. It shall be possible to call cameras as needed

through software on the SMIS for alarm events. There shall be no hardwired connections allowed to call cameras on identified alarm events.

i. Rack Equipment

1) All processing equipment and monitors are to be rack mounted in a single rack.

G. Execution:

1. Installation

a. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.

b. Install all wiring in accordance with manufacturer's [and U.L.] recommendations.

c. All wiring shall be stranded copper and installed in accordance with MEC open wiring requirements as a separate and segregated system.

d. Provide #18 AWG four conductor cable as recommended by the equipment supplier. Minimum #14 AWG for audible and locking devices. All wiring shall be in conduit.

e. Provide a dedicated 120-volt circuit in separate conduit as a source of primary power for the master control/communicator.

f. Supply, install, and wire recommended transformers DC power sources recommended transformers and DC power sources to the master control/communicator. For use with the control/communicator, the transformer shall be dedicated. The transformer shall not be shared with anything else.

g. Perform walk tests and set-up procedures for each detector as specified by the manufacturer to ensure that all boundaries of coverage are sufficient to detect intruders in each secured area.

h. The alarm contractor shall provide complete wiring diagrams to the electrical contractor as part of the shop drawing submittal, and shall supervise the installation in order to ensure a complete operating and trouble-free system.

2. Control panels and equipment cabinets shall be mounted on 3/4 inch plywood.

3. Wiring for door contacts and motion detectors shall be #16 AWG stranded copper or larger. Solid conductors will not be accepted. Wiring shall be tagged and identified. Cable wiring may be 4, 8, 12 and/or 24 conductors. Telephone type cable conductors shall not be used.

4. Wiring shall not be installed in raceways with existing conductors of other systems (fire, phone, etc.)

5. Riser conductors feeding power for motion detectors and transformers shall be #16 AWG.

6. Maximum number of cables or conductors within raceways shall not fill more than allowed by Massachusetts Electrical Code.

H. Testing:

1. Contractor shall submit a written test report that the system has been 100 percent tested and approved. The final test shall be witnessed by the owner and performed by the contractor. The final test report must be received and acknowledged by the owner prior to request for final payment.

2. Provide instruction to the owner's satisfaction with regard to proper use and operation of the system.

I. Warranty:

1. The entire system shall be warranted against failure and installation defects for a period of one (1) year from the date of the acknowledged owner acceptance of the final test.

J. Central Station Tie-in:

1. Provide at no cost to the owner monitoring of the above specified system for a period of one year. Central station shall be UL listed, provide documentation in submittal.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless specifically noted or shown otherwise, install all equipment and material specified in this Section or shown on Drawings whether or not specifically itemized herein. PART 3 covers particular installation methods and requirements peculiar to certain items and classes of material and equipment.

3.2 PANELBOARDS AND TERMINAL CONNECTING CABINETS

A. Provide flush or surface mounted panelboards and terminal connecting cabinets as shown on Drawings. During construction period, support panels and cabinets on steel channels independent of walls and partitions. Where mounted on stud wall, provide horizontal pieces of unistrut fastened to minimum of three studs.

B. Wiring in terminal cabinets shall be bound and tied together in neat and orderly manner by use of plastic cable ties. Also wiring shall be grouped by use of snap-slot plastic ducts with snap-on covers mounted in cabinet gutters similar to Panduit "Panduct" or equal.

C. Turn branch circuits and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

D. Provide two spare 1 inch conduits for flush panels. Conduits shall extend from top of each panel to one foot above hung ceilings, turned out from wall toward panel access side and terminate with cap. Where hung ceilings do not exist, terminate conduits in surface wall mounted junction box located at ceiling line above panelboard at height as approved by Architect.

3.3 PULL BOXES AND WIREWAYS

A. Provide bolts or galvanized steel rods to support pull boxes of minimum thickness equal to rod or bolt size required on largest size conduit entering pull box, as defined under "Raceways" paragraph in this Section.

B. Identify conductors passing through pull boxes and wireways to indicate origin and termination. Provide nameplates for pull boxes.

3.4 RACEWAY WORK

A. Install wire and cable in approved raceways as specified and as approved by authorities having jurisdiction. Raceways shall be run concealed except as indicated on Drawings. All raceways within existing building shall be concealed in channels routed in existing wall construction. (All devices.)

B. Install wiring in electric metallic tubing, unless otherwise noted below.

C. Panelboard feeders shall be run in electric metallic tubing except underground feeders which shall be run in Schedule 40 PVC (rigid steel) (IMC).

D. Provide intermediate metal conduit for exposed conduit below 8 feet from floor in areas such as mechanical rooms or where subject to physical abuse. There shall be no exposed conduit

except in Mechanical, Electrical, and Tel/Data Rooms. In renovation areas, conduit shall be recessed into existing walls. See Renovations in Division 1.

E. Provide flexible metal conduit with separate grounding conductor for branch circuit and signal system extensions in metal partitions and above existing furred ceilings.

F. Homerun from panel to first outlet shall be minimum 3/4 inch EMT or IMC. These homeruns shall contain no more than six conductors or 3 phase conductors. First outlet shall be located in ceiling of room with first device.

G. Emergency wiring shall be run in electric metallic tubing (EMT) or intermediate metal conduit.

H. Provide conduit expansion fittings wherever building expansion joints occur. Refer to Architectural and Structural Drawings for locations of building expansion joints. Flexible metal conduit is not acceptable at expansion joints.

I. Make connections to generators, transformers, and motors with flexible metal conduit. Flexible connections shall be minimum of 18 inches and maximum of 3 feet long with grounding conductor. Flexible connections shall be used prior to attachment of conduit to equipment housing.

J. Raceways run in concrete shall be intermediate metal conduit.

K. Adapt plastic conduit in concrete ductbanks or below slabs to intermediate metal conduit sweeps prior to turning out of slab. All sweeps at exterior equipment pads shall be rigid steel.

L. Minimum size plastic conduit shall be 3/4 inch trade size.

M. Do not run conduits for feeders or branch circuits in concrete slabs without approval of Architect. Submit layout drawings for approval prior to installation of any imbedded conduits in concrete slabs. Provide conduits within concrete as allowed and recommended by latest revised issue of ACI - 318. Conduit within concrete and in fill underneath on-grade floor slabs shall be spaced minimum of three diameters on center, or as shown on Drawings.

N. Where branch circuit conduits turn up out of concrete slab in open areas, provide threaded couplings flush with floor line for extending exposed conduit to equipment, outlet, fitting or box.

O. Carefully clean and dry all conduit before installation of conductors. Do not pull wires into conduit system (or install cables) until building roof and walls are weather-tight. Plug conduit ends to exclude dust, moisture, plaster, or mortar while building is under construction. Lubricants or cleaning agents which might have deleterious effect on conductor coverings shall not be used for drawing conductors into raceways.

P. Intermediate metal conduit ends shall be cut square, threaded and reamed to remove burrs and sharp edges. Field threads shall be of same type and same effective length as factory-cut threads. Turns in exposed conduit runs shall be made by use of factory-made bends, or field-made bends equivalent in radius and consistency with factory-made bends, as approved. In event of multiplicity of conduits making same turn, provide conduits or steel junction box with removable steel cover. Route conduits so as not to interfere with operation or maintenance of any equipment. Offsets and bends shall be made in concealed conduits as required by job conditions. Perform work in neat and workmanlike manner, as approved by Architect. Steel

supports or racks shall be galvanized steel channel and fittings, Unistrut, Kindorf, Husky Products Company, or equal.

Q. Install conduit to keep exposed threads to an absolute minimum.

R. Provide support rods and clamps to support conduits as required.

S. Provide offsets prior to entrance into outlet boxes and other electrical equipment for proper adjustment to finished building surfaces. Exercise care when roughing-in conduits which turn up or down to surface mounted panelboards or cabinets, so that conduit extensions to cabinet will be fitted close to wall. Where possible, provide back entry into surface mounted boxes or equipment items.

T. Conduit routing shown on Drawings is diagrammatic. Run conduits to coordinate with building structure. Concealed conduit shall be as short and direct as possible. Exposed conduit shall be run in straight lines parallel to walls, beams and columns with right angle bends.

U. Provide minimum 3/16 inch diameter twisted nylon fish cord in all empty raceways. Provide tag on each end indicating location of other end. Fish cord shall have minimum of 200 pounds tensile strength.

V. Conduit bodies shall only be used for wire sizes No. 2 AWG and smaller.

W. Telecommunications Raceway Design Considerations:

1. Fabricate bends free of indentations or elliptical sections.

2. The bend radius is 6 times the conduit inner diameter for a 2-inch conduit or less.

3. The bend radius is 10 times the conduit inner diameter for a conduit greater than 2 inches.

4. Below grade conduit should extend 4 inches above finished floor with a bushing.

5. Sleeves should extend 3 inches above finished floor with a bushing.

6. Ceiling conduit or sleeves should extend 4 inches below finished ceiling with a bushing.

7. Provide 12 AWG steel wire with greater than 200 lb. pulling tension in the entrance conduits.

8. Do not install trade size 2-inch or less conduit in continuous conduit sections longer than 100-feet (provide pull or junction box for greater distances). For conduit greater than 2-inch continuous sections shall not exceed 200-feet without a pull or junction box.

9. There should be no more than two 90-degree bends between conduit pull boxes. Properly size pull boxes per BICSI TDMM.

10. Terminate conduit in sheet metal enclosures, furnished with threaded hubs. Make side penetrations in the lower 1/3 of the enclosure.

11. Make changes in direction of conduit with elbows or fittings. Do not use pull boxes unless specifically designated otherwise.

12. Conduit shall be electrically continuous for the purpose of grounding.

13. Provide inner duct in all 4 inch backbone conduits. Size inner duct as designated on drawings.

X. Telecommunications Installation:

1. Tag/Label conduit on both ends and at every 100-feet of the run. The label shall note the conduit origin and destination.

2. Protect conduit terminations from mechanical damage, and prevent entry of moisture and foreign matter into the conduit system by properly capping terminations.

Y. Communications Cable Pathway Clearances:

1. Motors or transformers: 4 feet.

2. Power cables and conduit: 1 foot.

3. Fluorescent lighting: 5 inches.

4. Above the ceiling tiles: 3 inches.

5. Access above the cable tray: 1 foot.

3.5 WIRING METHODS

A. Branch circuit conductors shall be THHN-THWN when installed indoors or run in raceways below floor slabs.

B. If approved by local Authorities and where permitted by code, provide metal-clad cable for branch circuit wiring (except homeruns and emergency circuits) above accessible ceilings, within furred spaces or in hollow framed partitions, dry locations only.

C. If approved in writing by local fire department and where permitted by code, provide metal-clad fire alarm cable with red stripe for fire alarm circuit wiring above accessible ceilings. Wiring within walls or in exposed areas shall be run in EMT. Vertical risers shall be run in rigid conduit.

D. Branch circuit conductors for site lighting circuits shall be XHHW-2 or THW run in raceways.

E. Indoor feeders shall be THHN-THWN, except XHHW where run in raceways under slab in ground or in concrete ductbanks.

F. Service entrance conductors shall be type USE-2/RHH/RHW-2. Underground feeders outside of building shall be type XHHW.

G. Cord drops and portable appliance connections shall be type SO.

H. Wiring shall be minimum #12 AWG, except motor control circuit wiring and fire alarm system wiring may be #14. Branch circuits longer than 75 feet for 120V. shall be at least #10 from panel to center of load. Wiring for 120V. lighting branch circuits with three-way switching in corridors and stairs shall be #10, minimum.

I. Provide color coding for secondary service, feeders and branch circuits as follows:

1. 208/120V., 3-phase, 4-wire, wye:

PHASE	COLOR
A	BLACK
B	RED
C	BLUE
NEUTRAL	WHITE
EQUIP. GROUND	GREEN

2. Make connections to terminals from left to right arranged Phase A, B, and C.

3. Color code wiring for signal systems differently from power wiring described above. White and green colored insulation shall only be used with color tracer. Provide one of following methods for single or multi-conductor cables:

a. Spiral or longitudinal color stripe (tracer), running full length of cable.

b. Printed numbers stamped every 12 inches on cable insulation.

c. Numbered wire markers, Brady or equal, at junction boxes and termination points.

4. Provide same color coding for switch legs as corresponding phase conductor.

5. Provide colored plastic tape of specified color code identification for large size conductors available only in black. Wrap tape three complete turns around conductor at ends and at connections and splices.

J. Branch circuits for lighting are in general arranged as multi-wire branch circuits, with one neutral conductor serving as "common" for 2- or 3-phase wires.

K. Homeruns to any piece of HVAC equipment (excluding individual motor feeders unless noted otherwise) shall be 3 phase with neutral. If neutral wire is not used, tape off at both ends and label as spare.

L. Multi-wire branch circuits shall not be used for 120V. circuits. Multiple circuits combined in single raceway shall utilize separate neutrals for each circuit. Circuit numbers assigned on Drawings are for convenience only.

M. Phase wires shall be connected to phase supply mains in proper rotation to assure balanced condition on panel. Circuit numbers assigned on Drawings are for convenience only.

N. Splices and Terminations:

1. Make splices and terminations equivalent electrically and mechanically to conductor insulation.

2. Make splices in branch circuit wiring with solderless, screw-on connectors Ideal, Scotchlok, T&B or equal, rated 600 V., of size and type required by manufacturer's recommendation, with temperature ratings equal to those of cable insulation. Insulate splices with integral covers or with plastic, rubber, or friction tape, Permacel, or equal, to maintain integrity of cable insulation.

3. Make splices and terminations to conductors #8 and larger with corrosion-resistant, high conductivity , pressure indent, hex screw or bolt clamp connectors, with or without tongues, designed specifically for intended service. Connectors for cables 250 kcmil and larger shall have two clamping elements or compression indents. Terminals for bus connections shall have two bolt holes. Splitbolt connectors, Burndy or equal, shall be acceptable for all splices of conductors #8 and larger.

4. Make splices at motor junction boxes with pressure indent connectors or split-bolt connectors as specified herein.

5. Provide standard bolt-on lugs with allen or cap screws to attach copper wire and cable to disconnect switches and other electrical equipment.

O. Branch circuit wiring may not be graphically shown on Drawings and may be shown by circuit numbers beside fixtures, devices and equipment. Provide complete wiring system whether or not shown graphically. Wiring is shown by conduit runs on Drawings where specific routing is required, or for other special reasons. Only rooms with multiple switching have "switch control letters" assigned.

P. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

Q. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

R. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

S. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

T. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

U. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

V. Install conductors at each outlet with at least 6 inches of slack.

W. No more than three phase conductors shall be run in same conduit except where shown on Drawings.

3.6 WIRING DEVICE PLATES

A. Set plates so that all edges are in contact with mounting surface. Provide common device plate for multi-device locations.

B. Provide plates of proper design for use with surface boxes.

3.7 NAMEPLATES

A. Provide nameplates to designate equipment and function on switchboards, motor control centers, panelboards, cabinets, special purpose switches, motor disconnect switches, remote control stations, motor starters, variable frequency drives, and other controls furnished or installed under this Section.

B. Provide nameplates on outside of each section of pull boxes and junction boxes sizes 6 inch x 6 inch x 4 inch and larger, to designate system wiring contained therein.

3.8 FLOOR BOXES AND ACCESSORIES

A. Prior to roughing of all floor boxes, check Architectural Drawings for areas to be covered by carpet. Provide individual floor boxes within these areas (even if shown as ganged on Drawings).

3.9 LUMINAIRES

A. Provide complete wired and assembled installation of all luminaires, equipment and components necessary and as shown on Drawings, and specified herein.

B. Support ceiling luminaires from structural members only. In no case shall luminaires be suspended or supported from hung ceiling, conduit, piping or ductwork.

C. Provide proper mounting arrangement compatible with ceiling construction for recessed luminaires.

1. Mounting arrangement shall be changed from that specified or shown on drawings to conform to this requirement at no additional cost.

D. Exact mounting height of stem supported luminaires and wall mounted luminaires shall be determined by Architect.

E. Provide steel channels supported from structural members from which to hang luminaires where locations coincide with duct runs or piping. Provide threaded rods to support channels. Maximum length of span shall be 10 feet except as approved by Architect.

F. Remove lamps used during construction period and replace with new.

G. For luminaires with dimming ballasts, lamps shall be burned in at full 100% output for minimum of 12 hours prior to dimming.

H. Replace defective luminaires, or parts thereof (including lamps) upon completion of electrical installation at no additional cost.

I. Exit lights shall not be switch controlled.

J. Architectural reflected ceiling plans shall take precedence over locations of luminaires shown on Electrical Drawings. Locate light switches to conform to door swings shown on Architectural Drawings.

3.10 MOTORS, CONNECTIONS, AND CONTROLS

A. Check electrical connections and sizing of motor circuit protection and prevent damage to motor and equipment from incorrect direction of rotation.

B. Verify size, speed and operation of motors furnished under other Sections. Motors 1/2 hp and larger shall be 3 phase; motors less than 1/2 hp shall be 115V, single phase.

C. Provide mounting for motor and equipment disconnect switches adjacent to motor and supported independent of motor.

D. Motor starters furnished under other Sections shall be installed and wired under this Section. Motor starters for motor control centers shall be furnished complete under this Section. Refer to schedules on Drawings.

E. Provide all motor disconnect switches, motor starters and remote control stations, except as otherwise shown on Drawings. Provide motor disconnect switches at motor location sized for nameplate rating of motor.

F. Motor starters, where grouped, shall be mounted on 3/4 inch thick exterior grade plywood mounting board painted with fire-resistant paint of color to match starter enclosures.

G. On multi-speed or part winding motors, isolating switches at motor locations shall simultaneously open all conductors to motor.

H. Consult Drawings, Specifications and Shop Drawings for verification of voltage, size, speed and operation of motors. Provide wiring to motors.

I. Provide power service and fused disconnect switches for air conditioning units and other packaged units as required.

J. Provide interlocking wiring where shown on Electrical Drawings.

K. Coordinate work with Automatic Temperature Controls (ATC). Make provisions at electrical panelboards for connections to ATC controllers by ATC Contractor for 115V. single phase motors.

L. Provide 120V. power on dedicated circuits and telephone modem lines to ATC panels as required.

3.11 COOPERATION AND WORK PROGRESS

A. Perform work so that progress of project, including work of other Sections is not delayed.

B. Coordinate work of this Section with work of other Sections to complete work as soon as conditions permit and minimize interruptions of building functions. Assume additional costs incurred due to lack of or improper coordination with work of other Sections.

C. Remove waste material promptly from premises. Store material and equipment in dry location, in neat and orderly fashion. Ensure adequate security for electrical material and equipment stored at job.

D. Obtain detailed information from manufacturer of equipment provided under this Section as to proper methods of installation.

E. Provide necessary safeguards for protection of life and property of Owner, workers, staff and public.

F. Coordinate exact mounting arrangement and location of equipment shown on Drawings. Allow for proper space requirements for equipment access, operation and maintenance. Particular attention shall be given to group installations. If insufficient space or conflict with work of other Sections will prevent proper installation, access, operation or maintenance of shown equipment, immediately notify Architect and do not proceed with this part of Contract work until directed by Architect.

G. Coordinate delivery of electrical equipment to project prior to installation. Such equipment stored for extended period of time prior to installation may be subject to rejection by Architect.

3.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to requirements of Division 1 for specific instructions relating to operating and maintenance instructions.

B. At completion of work and at time acceptable to Architect, furnish operation instruction brochures and parts manuals, keys to all systems, warranties, and instruct Owner's representative as to arrangement, locations and operation of equipment and systems. Furnish instruction brochures and parts manuals in duplicate, as required by Architect, that describe operation and suggested maintenance program for all systems and equipment. Provide spare parts list and name, address and telephone number of manufacturer's representative and service company for each system or equipment category.

C. Furnish copies of final amended Shop Drawings and catalog data sheets of electrical materials and equipment, with wattage and type lamp of each lighting fixture clearly shown. Shop Drawings shall reflect any revisions or changes as result of review process.

3.13 SLEEVING AND FIRESTOPPING

A. Provide intermediate metal conduit sleeves as required.

B. Lay out conduit and openings in advance to permit provisions in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.

C. Extend sleeves in horizontal surfaces 2 inches above finished floor. Provide threaded caps on both sides of telephone sleeves and other unused sleeves.

D. Firestop all penetrations made in fire rated walls or floors with UL approved materials to prevent passage of fire and smoke and maintain original fire rating of floors or walls.

E. Firestop sleeves after cables are installed by telephone company.

3.14 SPECIAL REQUIREMENTS

A. Bundle wiring passing through pull boxes and panelboards in neat and orderly manner with plastic cable ties. Cable ties shall be Ty-Raps as manufactured by Thomas & Betts, Holub Industries, Inc., Quick-Wrap, Burndy Unirap, or equal.

B. Mount duplex convenience and power receptacles vertically with grounding posts at top of device, except locate grounding post to left for horizontal mounting.

C. Provide inserts, hangers, anchors and steel supports required for installation of electrical equipment.

D. Mount groups of electrical equipment or devices in same area (i.e., switches, receptacles, clocks, etc) on common horizontal or vertical centerline.

E. Where steel support channels are cut or unprotected steel is exposed, apply two coats of aluminum, zinc chromate or other approved rust preventive paint to bare surfaces after proper cleaning.

F. Provide miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

G. Unload electrical equipment and materials delivered to site. Pay costs for rigging, hoisting, lowering and moving electrical equipment on site, in building or on roof. During construction provide additional protection against moisture, dust accumulation and physical damage of electrical equipment. Provide temporary heaters within units, as approved to evaporate excessive moisture and provide ventilation as required.

H. All equipment including switchboards and panelboards shall be cleaned and vacuumed. Equipment with damage to painted finish shall be repaired to satisfaction of Architect.

I. Provide typed directories in panelboards based on final Owner approved room names and numbers.

3.15 GROUNDING

A. Provide stranded copper grounding conductor from main switchboard to street side of water meter in intermediate metal conduit, sized as shown on Drawings. Provide conductor of same size as service grounding conductor, bonded to water pipe on both sides of water meter. Bond to both sides of non-metal connectors to make metal water pipe continuous underground for minimum of 10 feet. Provide No. 4 grounding electrode conductor from main panel or switchboard to foundation or footing and bond to steel reinforcing bars.

B. Provide complete grounding system in conformance with National Electrical Code and any special rules which may govern such installation. Seal threads of feeder conduits to maintain conduit equipment grounding conductivity. Make joints of conduits mechanically tight.

C. Provide separate green insulated equipment grounding conductor in feeder circuits, branch circuits and motor circuits.

D. Connect grounding pole of receptacle devices to circuit equipment grounding conductor. Bond grounding conductor at outlet boxes, cabinets, panelboards and equipment to form continuous equipment ground of noncurrent-carrying electrically conductive parts.

E. Where non-metallic sheathed cable or metallic sheathed cable is allowed for branch circuits under "Raceway Work" paragraph in this Section, secure equipment grounding conductor to outlet box. Make grounding connection to outside of box where required by local Authority.

3.16 INSTALLATION OF OUTLETS

A. Verify exact locations of outlets with Architect prior to roughing. Make reasonable changes, as defined by Architect, in location of outlets and equipment prior to roughing, at no additional cost. If not defined by Architect, reasonable changes shall mean that up to 10 percent of total outlets for project shall each be moved up to 10 feet.

B. Center outlets in ceiling tiles.

C. Provide minimum 12 inch horizontal separation for outlet boxes mounted on opposite sides of common wall. Back to back or thru-wall boxes will not be permitted.

D. Provide knockout plugs in boxes with unused openings.

E. Provide bar hanger outlets in hollow framed partitions with bar hanger secured to metal partition studs with self-threading metal screws, or drill through hangers with Caddy or equal clips.

3.17 TELEPHONE UTILITY COMPANY EMPTY CONDUIT SYSTEM

A. Provide system of empty conduits, mounting boards, terminal cabinets, and junction boxes as shown on Drawings. Provide 3/4 inch thick fire-rated plywood mounting boards painted with two coats of paint. Provide 3/16 inch diameter nylon pull cord in empty conduits.

B. Provide telephone service as shown on Drawings. Consult with Verizon regarding service and perform work in accordance with their requirements and coordinate use of empty raceways provided under Contract for Telephone Company wiring systems.

C. Provide 3/4 inch conduit and 1#6 from MDP Room to water service for ground cables.

3.18 EQUIPMENT CONNECTIONS

A. Make final connections to equipment. Where not furnished by manufacturer, provide cord and plug on equipment for connections to receptacles shown on Drawings.

B. Adjust method of connection and connection devices for equipment (direct connection, receptacle device, disconnect switch, flexible connection) to conform to manufacturer's wiring diagrams and equipment data sheets as directed by Architect and at no additional cost.

C. Connections to relocatable wired partitions from floor boxes shall be made with liquid-tight flexible metal conduit.

3.19 CONCRETE WORK

A. Concrete housekeeping pads will be required for switchboard, motor control centers, emergency generator, and other electrical equipment as shown on Drawings. Floors of electric closets shall be built up four inches over adjacent finished floor.

B. Concrete work will be provided under Division 3. Coordinate with concrete work to ensure boxes, conduit, grounding cable, rods are located properly.

3.20 CORE DRILLING

A. Provide core drilling required for installation of Electrical systems. Carry all costs for core drilling. Locate and coordinate all required openings. Do not disturb existing systems. Thoroughly investigate existing conditions in vicinity of required opening prior to coring. Be responsible for damages to building and its systems from coring operations. Disturbances from coring shall be kept to minimum.

3.21 CUTTING AND PATCHING

A. Cutting and patching required for Electrical Work shall be by others.

B. Raceways for devices on all systems shall be concealed in channels routed in existing walls.

C. Give notification in advance to other trades of openings required for Electrical Work. Furnish accurate details of location and size. When this requirement is not met, bear cost of cutting and patching for work under this Section.

D. Obtain written approval of Architect before cutting any openings through structural members.

3.22 EXISTING ELECTRICAL EQUIPMENT AND SYSTEMS

A. Refer to alteration notes on Drawings.

B. Drawing notes refer to existing and new electrical materials and equipment. Existing electrical equipment and materials noted to remain shall be left complete and operational.

C. Disconnect, cap, make safe and drop to floor existing equipment, raceways and wiring which do not form active part of new and renovated electrical system.

D. Reuse designated portions of existing equipment as specifically shown on Drawings. Disconnect, resupply and reconnect equipment as shown on Drawings.

E. Protect designated equipment from damage during construction.

F. Remove existing equipment shown on Drawings and turn over to Owner as directed.

G. Remove abandoned cables in accessible locations.

3.23 EXISTING SERVICES

A. Do not interrupt existing services without Owner's and Architect's approval.

B. Schedule interruptions to electric service, feeders, subfeeders, branch circuits and electrical equipment and systems as directed by Owner and to minimize impact on Owner's operations. Include costs for overtime hours to perform such interruptions, connections and reconnections in bid. Submit proposed methods for minimizing interruption, and request for interruption in writing to Architect.

3.24 TESTING AND INSPECTION

A. Test and inspect work of this Section as required by Contract Documents, codes, standards and authorities that have jurisdiction, to satisfaction of Architect. Tests specified in this Section shall be construed as minimum requirements. Notify Architect and Authorities at least two working days prior to testing.

B. Furnish Architect with proof of megger tests of all branch circuits and feeders.

C. Furnish Architect with certificates of testing other than manufacturer of equipment, and inspection of electrical systems by independent testing company, indicating approval of Authorities having jurisdiction, and conformance to Specifications. Testing company shall perform all testing in accordance with National Electrical Testing Association (NETA) and test results shall be submitted on NETA forms. Test results shall indicate recommended test values as well as recommended action for below average test results. Testing data shall be certified by Registered Professional Engineer.

D. Perform all required adjustments and settings. Verify and correct deficiencies as necessary including voltages, tap settings, trip set-tings and phasing of equipment from distribution system to point of use. Voltage settings shall be tested and adjusted as necessary at locations of distribution system, when building is complete and operational.

E. Furnish necessary testing equipment.

F. Failure or defects in workmanship or materials revealed by tests shall be replaced and subsequently retested to satisfaction of Architect.

G. Remove and replace any transformer, ballast, dimmer, reactor or solenoid found to have noise output exceeding specified level of identical devices.

H. Owner will not be responsible for material and equipment prior to testing and acceptance.

I. Test buswork, and connections for continuity and grounds by "megger" test.

J. Test conductors for panelboard feeders, other feeders 400A. and larger and motor feeders 100A. and larger

1. Minimum insulation resistance between conductors and ground shall be: 250,000 ohms

K. Switchboards:

1. Perform tests on switchboards and circuit breakers in switchboards for operation under simulated service conditions including:

a. Test insulation resistance of each bus section phase to phase and phase to ground for one minute at 1000V.

b. Check switchboard bus bars and circuit breaker bolts for proper torque as specified by manufacturer.

c. Test molded case and insulated case circuit breakers with low voltage, controlled current source consisting of primary injection test on each pole at three times rating and at pick-up setting to determine long time and instantaneous characteristics. In addition, testing shall provide optimum setting for instantaneous trip for breakers with adjustable trips.

d. When Short Circuit Protection and Coordination Study is specified, all recommended settings for pick-up and time delay, as approved by manufacturer, shall be implemented.

e. Ground fault setting shall be set at the factory or by the Contractor in the field prior to energizing as follows:

1) Main breaker - 1,200A at 30 cycle delay (maximum setting).

2) Feeder breakers - set at trip rating with 20 cycle delay.

These settings shall be adjusted by Contractor and Testing Company according to approved settings in Short Circuit and Coordination Study.

f. Ground fault system and test panels shall be performance tested, and any malfunctions shall be corrected.

2. Test switchboard meters and instruments for calibration and proper operation. Verify all multipliers.

L. Grounding:

1. Main ground electrode system shall not exceed 5 ohms unless specified otherwise.

2. Verify ground resistance by ground continuity test between main ground system and equipment frame system neutral and/or derived neutral point.

3. Perform ground continuity test by passing minimum of ten amps DC between ground reference system and ground point. Calculate resistance by voltage drop method.

M. Luminaires:

1. Test luminaires with specified lamps in place for 100 hours (fluorescent and HID lamps) and 10 hours (incandescent and quartz).

2. Lamps shall not be operated, prior to final inspection by Architect, except for testing.

3. Replace lamps that fail within 90 days after final acceptance at no additional cost.

N. Lighting Controls:

1. Demonstrate in presence of Architect or owner the proper operation of the following:

a. Occupancy sensors.

b. Luminaires and lamps.

c. Lighting controls including time clocks and photocells.

O. Receptacle Polarity:

1. Receptacle polarity connections shall be tested with appropriate testing device after energization.

P. Emergency Generator:

1. Emergency Generator shall be tested and shall include following minimum requirements:

a. Dielectric absorption test on generator winding with respect to ground

b. Phase rotation test

c. Function test of engine shutdown devices

d. Full load test per NFPA 110, 2002 Edition, "Installation Acceptance", two hours of building load and two hours of load bank. The following describes some but not all of these requirements:

1) Provide minimum two hour test which utilizes all building emergency and standby loads. Test shall be initiated by simulated power failure and cold start of engine - generator. In addition to requirements of NFPA 110, verify in presence of Architect, and building officials if requested, that all emergency luminaires, transfer switches, equipment, etc. are powered by generator and in proper working order.

2) After building load test, and after engine has been allowed to cool down for five minutes, provide two hour full load test either by resistive load bank or by utilizing building load and supplementing with resistive load bank. Load shall equal nameplate rating of generator set.

3) Verify proper operation of generator alarms, remote annunciator alarms, and remote fuel pumps (if applicable).

4) Prior to generator test, test proper operation of overflow by manually overriding float controls and high fuel alarm and run pump(s) for 30 minutes after initial overflow occurs.

5) All test data shall be submitted to Architect.

6) Provide sufficient fuel for all testing.

e. Record voltage, frequency, load current, oil pressure and coolant temperature and battery charge rate. Make necessary adjustments.

f. Voltage regulation, frequency stability and maximum temperature shall be calculated.

g. Verify generator is properly grounded.

Q. Automatic Transfer Switches:

1. Upon request of Architect, provide verification of testing by manufacturer under UL 1008 for withstand and close-in values for automatic transfer switches.

2. Automatic transfer switches shall have following three-cycle short circuit closing and withstand ratings (RMS symmetrical amps at 480 VAC). Tests shall be performed without current-limiting fuses or breakers.

Switch Rating	Closing and Withstand
100-400A	42,000A

3. Automatic transfer switches shall have closing and withstand current rating of 200,000A when coordinated with current limiting fuses.

3.25 UNDERGROUND CONDUITS

A. Conduits for feeders run below slab on grade shall be PVC encased in concrete, and attached to slab by approved method to ensure monolithic condition. Prior to pouring of slab, consult with Architect for coordination and approval of size, spacing and method of conduit installation in slabs and walls. Particular attention shall be given to installation of conduits at grouped areas, such as switchboards, panelboards, cabinets and pull box entrances. Provide separate equipment grounding conductor in plastic conduits effectively grounded to metallic raceway.

B. Conduits for feeders run below slab on grade, if run more than 24 inches below bottom of slab, shall be rigid steel (PVC Schedule 40) with steel sweeps supported from concrete floor slab with epoxy-coated hangers).

C. Where underground conduit enters building and continues inside to pull box, cabinet switchboards or other electrical apparatuses, portion through wall or floor shall be steel . Provide adapter below floor or outside wall to connect plastic and steel conduit.

D. Raceways for underground systems outside of building footprint shall be type EB PVC conduit installed in concrete duct envelopes. Branch circuits for lighting shall not be encased in concrete unless noted otherwise on Drawings.

E. Joints in conduits and fittings shall be watertight and shall meet requirements of manufacturer's installation recommendations. Connections between conduits of different types shall be made in approved manner, using adapters and other materials and methods recommended by conduit manufacturers.

F. Where underground conduit enters building through membrane-waterproofed wall or floor, provide weatherproof conduit seals. Secure to masonry or concrete construction with one or more integral flanges. Membrane waterproofing shall be secured to device in watertight manner.

G. Completely seal active and spare cables in conduit at building entrance or at first termination with conduit sealing bushings. Cap spare conduits entering building.

H. Envelope installed over extensive area of disturbed earth shall have separate 2500 psi concrete base.

3.26 CABLE TRAY

A. Install cable tray system in neat and workmanlike manner. Provide straight runs wherever possible.

B. Provide 30 degrees, 45 degrees and 60 degrees inside and outside cable tray sweeps where required to avoid physical obstructions, or change elevation.

C. Coordinate mounting heights with work of other trades. Provide lengths and quantities required for complete installation. Lengths and quantities of fittings shown on Drawings are diagrammatic only. Verify equipment quantities prior to ordering.

D. Where steel support channels are cut and unprotected steel is exposed, apply two coats of approved rust preventive paint to bare surfaces after proper cleaning. Color and type of rust preventive paint shall be as directed by Architect. In general, paint for galvanized metals shall be aluminum and others will be zinc chromate type, or as otherwise approved.

E. Miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws, and other such items, shall be galvanized or cadmium plated finish, or of other approved rust-inhibiting coatings.

F. Cable tray shall be supported from ceiling structures or walls as approved by Architect.

G. Cable trays shall terminate on each side of fire rated partitions. Provide conduit sleeves at each partition and terminate conduits with bushed ends. After cables are installed, conduits shall be fire-stopped.

3.27 MAIN ELECTRIC SERVICE

A. Provide main electric service as herein specified, as indicated on Drawings and as required by Central Maine Power Company. Any reference to "Company" in this Section shall mean Central Maine Power Company.

B. Electric service shall consist of new primary underground service which shall be from Brown Street, to new utility company pad mounted transformer. Secondary service shall be 208 volts, three phase, four wire from pad mounted transformer to main switchboard.

C. Metering will be at secondary voltage with meter located where required by Company.

D. Company will provide:

1. Pad mounted transformer.

2. Meter and meter wiring.

3. Primary service connections at transformer.

4. Primary cables.

E. Provide following:

1. Underground ductbanks as shown on Drawings.

2. Complete equipment grid grounding system around perimeter of transformer pad, consisting of continuous copper cable and ground rods joined together by thermal fusion process, as approved by Company. Leave slack cable leads above grade at transformer for equipment grounding connections by Company.

3. Secondary service cables and conduits.

4. Secondary service cable connections at transformer secondary under the direct on-site supervision of Company.

5. Meter conduit.

6. Plywood backboard with fire-retardant paint for Company meter.

7. Lugs for terminating cables at transformer.

8. Meter socket as approved by utility company.

F. Adapt all conduits to rigid steel before passing under transformer pad and prior to passing through building foundation wall.

G. Consult with the Company regarding service and advise Company in writing as to when new permanent service will be required.

END OF SECTION 16100