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 ELECTRICAL**

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***Notes to Specifier/Designer:**

Note 1 - Remove the section if not applicable to the specific project to create the project specific specification. The table of contents is to be edited to reflect the sections included under the revised specification. The sections not identified by a Note 1 shall not be removed unless reviewed and approved by VPTC Management Partners, LLC.

Note 2 - Specific sections within this specification can be edited. Review the section and create the project specific specification where text is [**bracketed and bold type**]. All sections edited are to be reviewed and approved by VPTC Management Partners, LLC.

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Section 16010 – Basic Electrical Requirements

Part 1 General

A. Drawings and Specifications:

1. It is the intent of these Design Criteria Plans and Specifications to form a guide for the complete Electrical installation. The successful Contractor shall be responsible for the proper design and installation of all Electrical work, to provide a complete workmanlike installation. Where capacities, sizing styles, equipment, and similar items are indicated, this Specification shall be considered minimum requirements.
 - a. The basis for design of the building is the VPTC Management Partners, LLC Master MEP Specification (latest edition prior to the issuance of these specifications). The job specific specifications have been selected to include only those sections applicable to this particular project. In the event that changes result in the addition of work not covered by these job specific sections, the additional work will be governed by the VPTC Management Partners, LLC Master MEP Specifications.
 - b. Since the VPTC Management Partners, LLC Master MEP Specifications are written to accommodate many different buildings, not every item mentioned in the specifications will be used on this project. The specifications are intended to establish the criteria necessary to furnish and install a complete and operational mechanical/electrical system.
2. The Architectural, Structural, Civil, Mechanical, Plumbing, and Electrical Criteria Drawings and Specifications are hereby incorporated into and become a part of this Contract Document for work under this Division. This Contractor shall examine all Criteria Drawings and Specifications contained therein and otherwise available for his review.
3. This criteria establishes the minimum acceptable quality of equipment, material and workmanship, and the Criteria Drawings are shown for criteria only.
4. The Contract will not be awarded solely on the basis of price. Other important criteria, such as system design, economy of operation and maintenance, space requirements, flexibility and comfort, will be evaluated. However, the systems, equipment, and methods described in this Specification and shown on the Criteria Drawings shall constitute the "Base Bid" requirements for this Contract.
5. The Criteria Drawings and Specifications are intended to supplement one another. Any materials or labor called for in one but not the other shall be furnished as if both were mentioned in the Criteria Specifications and shown on the Criteria Drawings. Labor and/or materials neither shown nor specified but obviously necessary for the completion and proper functioning of the system shall be furnished by the Contractor.

1.02 Coordination of Electrical Work:

- A. General: It is recognized that the available scope documents are diagrammatic in showing certain physical relationships which must be established within the electrical work, and in its interface with other work including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor.
 1. Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of the building construction, and with a

minimum of 7' overhead clearance in equipment spaces where possible. Conduit shall be routed a minimum of 7½ inches above finished ceilings (or above the anticipated height of future ceilings) to facilitate installation and relocation of light fixtures and other ceiling mounted equipment.

2. Locate operating and control equipment properly to provide easy access, and arrange entire electrical work installed under this contract with adequate access for operation and maintenance of all building systems, and for proper Code clearances.
 3. Maintain a minimum of 36" clearance for access panels and equipment control panels.
 4. Do not install conduits in a manner that will prevent the removal of equipment without removal or rework of the conduits.
 5. Advise other trades of openings required in their work for the subsequent move-in of large units of electrical work (equipment).
 6. Where connections are made to equipment furnished by others, the Contractor shall obtain exact location of connections and electrical requirements of equipment from parties furnishing said equipment, as this Contract includes furnishing and installing electrical work required by such parties.
- B. Coordination Drawings: For locations where several elements of electrical (or combined mechanical and electrical) work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare and submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.

1.03 Codes, Permits, and Fees:

- A. Comply with the most recently revised versions of all applicable laws, rules, regulations, and ordinances of federal, state, and local authorities. Modifications required by the above said authorities shall be made without additional charge to the Owner. Where alterations to and deviations from the Contract Documents are required by said authority, report the requirements and secure approval before starting work. Obtain all applicable permits by above authorities.
- B. This Contractor shall prepare complete, professionally sealed, Plans and Specifications that shall be submitted to VPTC Management Partners, LLC for review.
- C. It is the Contractor's responsibility to obtain all approvals necessary as well as to provide all fees necessary for permits, tests, and approval by the municipality or any other authorized agency of his design and installation of the Electrical system. Any and all work necessary, whether or not shown or specified, but as required by the authorized building

codes for general building, or any other code-required work not shown or specified, shall be included.

- D. Hook-up charges based on assessments or usage are not the responsibility of the Contractor.
- E. Where Design Criteria Documents requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern.

1.04 Site Visit and Familiarization:

- A. General: Become familiar with the Criteria Drawings and Specifications and examine the premises and understand the conditions under which the Contract shall be performed.
- B. Site: Be informed of the utility companies from whom service is supplied; verify locations of utility services and determine the exact requirements and provisions for connection.

1.05 Coordination:

- A. This Contractor shall coordinate his work with other trades as required to provide the best overall systems installation.
- B. In case of conflict, VPTC Management Partners, LLC shall decide the proper location or arrangement, and any costs in revisions or relocating equipment or material shall be at the expense of the Contractor responsible for the work.

1.06 Discrepancies:

- A. Clarification: Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents, or questions as to the intent thereof.
- B. Contractor Agreement: Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full agreement of the items and conditions specified, shown on the Criteria Drawings, and required by the nature of the project.

1.07 Project Record Documents:

- A. General: Maintain project record documents at the site and as work progresses, record (with red pencil) on one set of electrical drawings, all changes from the installation originally indicated. Record final location of underground line by depth from finished grade and by distance in feet and inches to surface improvements such as buildings, curbs, or edges of walks.
- B. Accuracy: The project record documents shall indicate exact locations of all concealed raceways installed and all pull and junction boxes that are not installed at locations shown.
- C. As Built: Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified "Record Drawings" to VPTC Management Partners, LLC for review and shall make changes, corrections, or additions as VPTC Management Partners, LLC may

require to the "Record Drawings". Upon approval, the Contractor shall have all data transferred to the original CADD files.

1.08 Quality Assurance and Standards:

- A. Compatibility: Provide products which are compatible with other products of the electrical work and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearance as required by applicable codes, and for adjustment, repair, or replacement.
- B. Materials/Methods: Manufacturers, materials, and methods described in the various sections of the Specifications, and indicated on the Drawings are intended to establish a standard of quality. It is not the intention of this Criteria Specification to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. Further, it should not be assumed that the listing of a specific manufacturer as an acceptable manufacturer means that the manufacturer's standard product will meet the requirements of the project design, Specifications and space constraints.
- C. Alternative Products/Materials/Methods: Products by other reliable manufacturers, other materials, and other methods may be accepted provided they have equivalent capacity, construction, and performance. Under no circumstances shall any substitution be made without the prior written approval of VPTC Management Partners, LLC. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of VPTC Management Partners, LLC that the specified product, material or method is the only one that shall be used without prior approval. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be provided, it is the intention of VPTC Management Partners, LLC that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without prior written approval.
1. For an alternative product/material/method to be considered, the Contractor must provide VPTC Management Partners, LLC with sufficient information to make a determination. The information should include a description of the product/material/method, drawings or sketches showing the impact on the physical constraints of the project, indications of the affect on the construction schedule and any cost implications. VPTC Management Partners, LLC will review the information with the Owner or Owner's representative and VPTC Management Partners, LLC's engineering consultant. The Contractor shall provide at least four copies of the information he wants to be considered.
- D. Alternative Equipment: Where substituted or alternative equipment is used on the project, it shall be the responsibility of the Contractor involved to verify that the equipment will fit in the space available, including all required Code and maintenance clearances, and to

coordinate all equipment requirements and provisions with the Electrical Design and all other Contractors.

- E. Standards: This Work shall meet the standards set forth in the applicable portions of the following recognized codes and standards:
1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE),
 2. Association of Edison Illuminating Companies (AEIC),
 3. Certified Ballast Manufacturers (CBM),
 4. Factory Mutual (FM),
 5. Institute of Electrical and Electronics Engineers (IEEE),
 6. Illuminating Engineering Society (IES),
 7. Insulated Cable Engineering Association (ICEA),
 8. National Electrical Code (NEC),
 9. National Electrical Contractors' Association (NECA),
 10. National Electrical Manufacturers' Association (NEMA),
 11. National Fire Protection Association (NFPA),
 12. Underwriters' Laboratories, Inc. (UL), and
 13. Any applicable state and local building codes.

1.09 Submittals:

- A. Shop Drawings and Product Data Brochures: Submittals shall contain all necessary information for review, including additional information when requested. Product Data Brochures shall contain only information relevant to the particular equipment or materials to be furnished. Unless all irrelevant information is deleted or unless relevant information is clearly marked, including accessories, ratings, appurtenances, and dimensions as required, submittals will be returned marked "Resubmit". Product Data Brochures are not required for cable, wire, connectors, raceway, boxes, wiring devices, disconnect switches, or transformers unless products of manufacturers other than those listed are proposed as substitutions. Submittals for the Work shall include, but not be limited to:
1. Cable, wire, and connectors.
 2. Electrical raceways and fittings.
 3. Electrical Boxes and Fittings: Include dimensioned drawings of special electrical boxes showing the accurately scaled boxes, their layout, and relation to associated equipment.
 4. Panelboards and Enclosures: Include dimensioned drawings of panelboards and enclosures showing accurately scaled layout of enclosure and required unit sections, including but not necessarily limited to, circuit breakers, fusible switches, and accessories. Submit, if requested, transparencies of circuit breaker characteristics

with unlatch times and fuse characteristics with melting/clearing times for use by VPTC Management Partners, LLC in verifying coordination of these devices.

5. Electrical gutters, wireways and troughs.
6. **[Service and Distribution Busway and Busway Plugs:]** Include dimensioned drawings of busway showing the accurately scaled duct and system layout, including, but not necessarily limited to, offsets, transitions, busway plugs, reducers, supports, and transformer connections.
7. Wiring devices.
8. Safety and Disconnect Switches: Include dimensioned drawings of electrical safety and disconnect switches which have a rating of 100 amperes or larger, showing the accurately scaled switches, their layout, and relation to associated equipment.
9. Transformers.
10. Switchboards: Include dimensioned drawings of switchboards showing accurately scaled basic units, including but not necessarily limited to, auxiliary compartments, unit components, and combination units. Submit, if requested, transparencies of fuse characteristics with melting/clearing times and circuit breaker time/current curves for use by VPTC Management Partners, LLC in verifying coordination of devices.
11. Fuses.
12. Grounding Products: Include a complete grounding system diagram with materials and ground conductor sizes.
13. Motor Starters: Include dimensioned drawings of motor starters which have a NEMA Size 3 or larger starter, accurately showing the scaled controllers and switches, their layout and relation to associated equipment.
14. Motor Control Centers: Include dimensioned drawings of motor control centers showing accurately scaled units and including, but not necessarily limited to, auxiliary components, unit components, and combination units.
15. Miscellaneous Electrical Controls and Control Wiring: Include control wiring diagrams for all miscellaneous electrical controls.
16. Lighting fixtures (including electronic ballasts).
17. Lamps.
18. Specialty lighting fixtures.
19. **[Standby Emergency Generator Set:]** Include manufacturer's data on all generator set, accessories, and automatic transfer switches. Submit dimensioned drawings of generator set and accessories, including, but not necessarily limited to, NEMA 3R enclosure (where installed outdoors), automatic transfer switches, remote start-stop station and instruments, and showing relation to associated equipment, and connections to remote equipment, including work of other Divisions, including but not limited to exhaust system piping. Include certification that this Division has fully coordinated all emergency power system control connections to work of this Division and other Divisions, including but not limited to elevators.
20. Fire Alarm System: Include shop drawings showing fire alarm system riser and wiring diagrams and dimensioned drawings of Fire Alarm Control Panel. Include certification that this Division has fully coordinated all fire alarm system signal and control

connections to work of other Divisions, including but not limited to, automatic temperature controls, fire pump, fire sprinkler system and elevators. Complete shop drawings shall be submitted to the authority having jurisdiction for approval. Shop drawings submitted for review shall bear the approval stamp of all authorities having jurisdiction.

21. **Lightning Protection System:** Include manufacturer's data completely describing:
 - a. Air terminals, braces and mounting base,
 - b. Main conductors,
 - c. Branch (secondary) conductors,
 - d. Ground electrode (rod, wing plate or ground plate),
 - e. Bimetal splicers,
 - f. Clamps, fittings and connectors, and
 - g. Method of roof flashing.
 - h. Submit dimensioned drawings in plan view (and riser) showing accurately scaled air terminal layouts, main and branch conductor routing, down conductor locations, ground electrode and inspection pit locations, counterpoise routing and all bodies of conductance and inductance connected to the system.
 22. **CCTV Surveillance System:** Include an overall system layout and drawings showing monitoring station configuration and equipment information.
 23. **Coordination Drawings:** As required by Section 16010, "Basic Electrical Requirements".
 24. **Housekeeping Pads:** Include location and dimensions of housekeeping pads, including blockouts and anchor bolts for coordination with the Structural Engineer.
 25. **Firestops:** Include all firestop materials for the project, indicating intended use and UL fire rating where applicable.
- B. **Shop Drawing Submittal Review:** Shop Drawings will be reviewed for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown in review comments is subject to the requirements of the Contract Documents. The submitting Contractor is responsible for: dimensions that shall be confirmed at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
1. The Shop Drawing review time in VPTC Management Partners, LLC's office will be a minimum of two weeks per review, exclusive of transmittal time, and this review time shall be considered by the Contractor when scheduling his work on the project.
 2. The Architect's review or approval and VPTC Management Partners, LLC's review of Shop Drawing shall not relieve the Contractor of the responsibility for errors, omissions or deviations that may be contained in the submittals. If the Contractor proceeds on the basis of undetected errors, omissions or deviations in reviewed Shop Drawings, it shall be at his sole responsibility and the review does not allow deviations from the requirements of the Contract Documents. Noting some errors, omissions, and deviations but overlooking other errors, omissions, and deviations does not grant the Contractor permission to proceed in error. Regardless of any information contained in

the Shop Drawing or VPTC Management Partners, LLC's review thereof, the Contract Documents shall govern the Work and are neither waived nor superseded by the Shop Drawing review.

3. At the time equipment and materials are delivered to the job site, it shall be the responsibility of the submitting Contractor to check all equipment and materials for conformance with the Contract Documents and submittals including comments and revisions made to the submittal during the submittal process. If equipment or materials are determined by the contractor to be in non-conformance, it shall be the responsibility of the contractor to bring equipment and materials into conformance with the Contract Documents. The contractor shall also notify the Construction Manger of any corrections that need to be made.
 4. Inadequate or incomplete Shop Drawings will not be reviewed by VPTC Management Partners, LLC and will be returned to the Contractor marked "NOT ACCEPTED" for completion and re-submittal.
 5. Shop Drawings will be marked "REVIEWED", "REVIEWED WITH COMMENT", "REVISE AND RESUBMIT", or "NOT ACCEPTED" when reviewed by VPTC Management Partners, LLC. The definitions of these terms for review purposes are as follows:
 - a. **REVIEWED** - The Shop Drawing was reviewed and no deviations from the general conformance with the design concept and general compliance with the information given in the Contract Documents were noted.
 - b. **REVIEWED WITH COMMENTS** - The Shop Drawing was reviewed and found to have either minor deviations from the requirements of the Contract Documents or information missing from the submittals. A complete Shop Drawing re-submittal is not required; however, a written response to all review comments shall be submitted in the format used for a re-submittal.
 - c. **REVISE AND RESUBMIT** - The Shop Drawing was reviewed and major deviations from general conformance with the design concept and general compliance with the information given in the Contract Documents were observed as noted. The Shop Drawing shall be revised to eliminate the deviations noted and resubmitted.
 - d. **NOT ACCEPTED** - The Shop Drawing was reviewed and is not in general conformance with the design concept or in compliance with the information given in the Contract Documents, as noted. A revised Shop Drawing submittal for the specified equipment or materials shall be resubmitted.
 6. Materials and equipment which are purchased or installed prior to Shop Drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by VPTC Management Partners, LLC for any reason, shall be at the expense of the Contractor.
 7. Shop Drawings shall be complete and checked prior to submission to VPTC Management Partners, LLC for review.
- C. Certifications and Test Reports: Submit four copies of all certifications and test reports adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems. Necessary tests and certifications are described under the appropriate section of this Division 16 unless set forth herein below. Certifications and test reports to be submitted in conjunction with the 16995,

16996 Commissioning Specification requirements and shall include, but not necessarily be limited to:

- a. Combination fire alarm system,
- b. Wire and cable tests for short circuits and insulation resistance values,
- c. Grounding system tests,
- d. Ground fault protection system test, including factory and field test results,
- e. Insulation resistance testing for distribution and equipment feeders,
- f. Switchboard and motor control center insulation resistance test,
- g. Busway insulation resistance test, and
- h. Standby Power System Test.
- i. Voltage Readings

- D. Warranties (Guarantees): Submit three copies of all warranties and guarantees for systems, equipment, devices, and materials (this includes two copies for maintenance manuals).
- E. Maintenance Manuals: Submit three copies, including wiring diagrams, maintenance and operating instructions, parts listings, and copies of all other submittals required by this Division 16. Organize each maintenance manual with Table of Contents, Index, and thumb-tab marked for each section of information. Bind in 2", 3-ring binders, vinyl covered, with pockets to contain folded sheets. Properly label contents on spine and face of binder.
- F. Samples: Submit two samples, upon request, of electrical devices and materials for review by VPTC Management Partners, LLC. Samples will be returned upon written request of the Contractor.
- G. Approval: Materials installed or work performed without approval of material shall be done at the risk of the Contractor and the cost of removal of such material or work which is judged unsatisfactory for any reason, shall be at the expense of the Contractor.

1.10 Product Delivery, Storage, and Handling:

- A. General: Ensure that all electrical equipment, devices, and materials arrive at the site in good condition, intact in factory package or crate. Any equipment found to be damaged shall be removed from the project site.
- B. Storage: Store all electrical equipment, devices, and materials in factory containers or package until ready for use. Storage facility shall be a clean, dry, indoor space which provides protection against weather. Avoid damage by condensation by providing temporary heating when required.
- C. Handling: Handle all electrical equipment, devices, and materials carefully to prevent breakage, denting, or scoring of the finish. Damaged materials shall be removed from the project site.

1.11 Scope Specifications:

- A. These Specifications are issued in conjunction with the Criteria Drawings which indicate the general scope of the Project in terms of the architectural design concept, the

dimensions of the building, the type of structural, mechanical, electrical and utility systems, and outline notes of major architectural elements of construction. As "Scope" documents, the Drawings and Specifications do not include or describe all work required for the full performance and completion of the Work.

- B. Contracts may be let on the basis of such documents, only if approved by VPTC Management Partners, LLC with the understanding that the Contractor is to furnish all items required for proper completion of the Work without adjustment to Contract Price. It is intended that the Work be of sound and quality construction and the Contractor shall be solely responsible for the inclusion of adequate amounts to cover installation of all items indicated, described, or reasonably implied.
- C. Decisions of VPTC Management Partners, LLC as to the items of work reasonably included within the "scope" of these Specifications shall be final and binding on the Contractor.

Part 2 Products

2.01 **Electrical System Identification:**

- A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces, to distinguish each run as either a normal power, emergency power, or signal/communication conduit. Use paint, permanent markers, or provide self-adhesive or snap-on type plastic markers. Indicate voltage ratings of conductors exceeding 250 volts. Mark at ends of conduit runs on junction box covers, near switches and other control devices, and near items of equipment served by the conductors at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50' along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than one inch.
- B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit or direct buried. Locate each directly over cables, 6 to 8" below finished grade.
 - 1. Cable/Conductor Identification: Coordinate a uniform and consistent scheme of color identification throughout the building system. Identification shall be by the permanent color of the selected covering. On large conductors, secure identification by means of painted color banding or plastic tape.
- C. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
 - 2. A laminated plastic engraved identifying nameplate color as indicated below shall be secured by screws to each switchboard, distribution panel, motor control center, panelboard, disconnect, and individual motor starter. Identifying nameplates shall have 1/2" high engraved letters. Each switchboard, distribution panel, panelboard,

motor control center device, individual motor starter, and disconnect switch shall have a nameplate showing the load served and voltage in 1/4" high engraved letters.

- a. Normal Power Color: Black-White-Black.
 - b. Emergency Power Color: Red-White-Red.
3. An embossed plastic tape identifying label shall be affixed to each safety switch, disconnect switch, busway plug, wireway, and terminal cabinet.
 4. Any equipment requiring multiple means of power disconnect shall be clearly labeled on the equipment that "This Equipment is serviced by more than one electrical feed and each feed must be de-energized to make the equipment safe" the note all disconnection locations.
 5. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served.
- D. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories), and approval labels are exceptions to this requirement.
- E. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
- F. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING".

2.02 Openings, Cutting and Patching:

- A. General: The Contractor shall be responsible for coordinating openings in the building construction for installation of electrical systems. Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as individually authorized by VPTC Management Partners, LLC, cutting and patching of electrical work to accommodate the installation of other work is not permitted.
- B. Cut and Patch: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- C. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to VPTC Management Partners, LLC. Impact-type equipment shall not be used except where specifically

acceptable to VPTC Management Partners, LLC. Openings in precast concrete slabs for conduits, outlet boxes, etc., shall be core drilled to exact size.

- D. Approval: If holes or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no change in Contract amount. Undertake no cutting or patching without first securing written approval from VPTC Management Partners, LLC. Patching shall create a surface which is structurally and aesthetically equal to the surface surrounding the area patched and shall be performed by the trade whose work is involved, at no change in the Contract amount.
- E. Protection: Openings through exterior walls or roofs shall be provided with suitable covers while they are left open to protect the property or materials involved. Any openings through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.
- F. Restoration: All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes. Restoration work shall be performed by the trades who originally installed the work being restored and shall be performed at no cost to the Owner or Architect/Engineer.
- G. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to VPTC Management Partners, LLC.
- H. Plaster: All electrical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- I. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

2.03 Excavating, Trenching and Backfilling:

- A. General: The work hereunder includes whatever excavating and backfilling is necessary to install the electrical work. Coordinate the electrical work with other work in the same area, including excavating and backfilling, dewatering, floor protection provisions, other temporary facilities, other underground services (existing and new), landscape development, paving, structural foundations, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.
- B. Standards: Except as otherwise indicated, comply with the applicable provisions of Division 2 for electrical work excavating and backfilling. Refer instances of uncertain applicability to VPTC Management Partners, LLC for resolution before proceeding with the Work.
- C. The bottoms of trenches shall be excavated to required depths, slope and grade. The bottom of the trench shall be accurately excavated to provide firm, uniform bearing for the bottom of the raceways and ductbanks. Where mud or unstable soil is encountered in bottom of trench, it shall be removed to firm bearing and the trench shall be backfilled with bedding sand to proper grade and tamped to provide uniform firm support.
- D. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2" of sand fill at

every point along its entire length. In general, grading for electrical ductbanks and conduits shall be from building to manhole, and from a high point between manholes to each manhole.

- E. Exercise care not to excavate below required depth, leaving a flat bed of undisturbed earth, firm and secure, before laying cable, and ductbanks. In the event rock is encountered, excavate 6" below required depth and backfill to required depth with bedding sand, and compact to minimum 95% compaction.
- F. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the site and properly disposed of.
- G. The Contractor shall be fully responsible for the safety of persons, materials and equipment in or near trenches or other excavations and provide all required sloping, shoring, railings and other protective provisions.
- H. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify VPTC Management Partners, LLC and wait for his instructions before proceeding.
- I. If such unknown utilities are encountered and work is continued without contacting VPTC Management Partners, LLC for instructions, and damage is caused to said utilities, the Contractor shall repair at his own expense, such damage to the satisfaction of the owner or utility company concerned.
- J. Trenches shall not be backfilled until all required tests have been made by the Contractor and approved by VPTC Management Partners, LLC and any local authorities having jurisdiction.
- K. Backfill shall be provided as recommended in the geo-technical report included elsewhere in these Contract Documents or in the absence of a geotechnical report, as required by site conditions. Refer to Division 2 or elsewhere in Contract Documents for additional trenching and backfill requirements.
- L. Opening and Reclosing Pavement, Landscape Areas and Lawns: Where excavation requires the opening of existing walks, street, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new conduit and to make new connections to existing conduits. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched or replaced, using materials to match those cut out or removed. Patches shall thoroughly bond with the original surfaces, shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas. All removed work shall be replaced by craftsman who regularly installs the types of work being replaced.
- M. Excavation in Vicinity of Trees: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5' to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb radius shall be brought to the attention of the Architect before they are cut or damaged in any way. VPTC Management Partners, LLC will give immediate instructions for the disposition of same. All stumps and roots encountered in the excavation, which are not within the outermost limb radius of existing trees, shall be

cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped.

2.04 Access Doors:

- A. General: This Contractor shall provide wall or ceiling access doors for installation in finished surfaces for unrestricted access to all concealed items of electrical equipment.
- B. Types: Doors shall be factory-finished as noted below and turned over to VPTC Management Partners, LLC for installation. Refer to finish painting requirements specified herein below. Doors shall be as manufactured by Inryco/Milcor or an approved equal in the following styles:
 - 1. Drywall Construction Inryco/Milcor Style DW with gray prime finish.
 - 2. Finished Plaster Ceiling or Walls Inryco/Milcor Style WB-PL with door designed for finish plastering.
 - 3. Masonry Walls Inryco/Milcor Style M with gray prime finish.
 - 4. Fire Rated Construction Inryco/Milcor Fire Rated Access Door with gray prime finish.
 - 5. Fire Rated Ceiling or Ceiling Inryco/Milcor Style ATR with door assembly designed for tile insert.
- C. Selection: Access doors shall be furnished with a continuous piano hinge with screwdriver-operated flush locks and shall be a minimum of 12" x 12". Larger sizes shall be furnished where required for proper access.
- D. Approval: Access doors shall not be installed until location and style have been approved by the Architect.

2.05 Firestopping for Conduit, Busway, Wire and Cable:

- A. General: Provide a UL Systems Classified, intumescent material capable of expanding up to eight to ten times when exposed to temperatures beginning at 250°F for sealing all holes or voids created to extend electrical system conduit, raceways, busway, wire, cable and

other components through fire-rated floors and walls to prevent the spread of smoke, fire, toxic gas and water.

- B. Fire barrier products shall be used to create through-penetration firestop systems as required. All firestop systems shall be listed in the Underwriter's Laboratories Building Materials Directory, Through Penetration Firestop Systems (XHEZ).
- C. The products manufactured by 3M/Electrical Products Division, HILT 1, Dow Corning, or an approved equal are acceptable subject to Shop Drawing submittal approval.
- D. Install firestop materials according to the following UL Systems Classifications and manufacturer's recommendations.

2.06 Fire Rated Partitions:

- A. Coordinate locations of raceways in fire-rated partitions so not to affect the fire rating of the partition. Notify VPTC Management Partners, LLC in writing where additional construction is required to maintain the partition fire rating.
- B. Outlet boxes installed in fire-rated partitions (2 hour or less) shall not exceed 16 square inches, with a maximum of 100 square inches of wall opening per 100 square feet of wall area.
- C. The outlet boxes shall be located whereby no two outlet boxes are installed closer than 24" on center, and securely attached to the partition studs, with at least one partition stud separating the outlet boxes.
- D. If electrical conduits, boxes, and other components are installed prior to construction of a fire/smoke partition, it will be the responsibility of the dry-wall contractor to properly fire-safe the partition. If this Contractor penetrates an "existing" fire/smoke partition, this Contractor will be responsible for the proper fire-safing of the penetration.

2.07 Flamespread Properties of Materials:

- A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255 (1984), "Method of Test of Surface Burning Characteristics of Building Materials". The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke-developed rating of 50.

2.08 Penetration Flashing and Seals:

- A. Conduit sleeves, pitch pockets, and flashings compatible with the roofing and waterproofing installation shall be provided for all roof and wall penetrations and roof-mounted equipment and supports. Coordinate flashing details with the Architectural details and the roofing/waterproofing contractors.
- B. Conduits passing through walls where exposed to weather or below grade shall pass through waterstop sleeves (new construction) or core-drilled openings (existing construction). The space between the conduit and sleeve/opening shall be sealed using segmented annular seals to prevent the entry of water or foreign materials. Segmented annular seals shall be Thunderline Incorporated, Type LS Series, Style C insulating type link seals for temperatures up to 250°F, or an approved equal. Waterstop sleeves shall be

Thunderline Corporation Century-Line or equal non-corroding thermoplastic sleeves with a molded in water stop lip.

2.09 Electrical Penetrations in Mechanical Equipment:

- A. Electrical penetrations made in mechanical equipment are to be made in locations approved by the equipment manufacturer where knock outs are provided. Cutting holes for electrical penetrations through equipment, curbs, etc is not acceptable
- B. Electrical penetrations are to be made in the roof where the manufacturer does not provide a chase for the conduit to penetrate the equipment.

2.10 Cleaning and Painting of Electrical Work:

- A. Prime, protective and touch-up painting is included in the Work of this Division. Finish painting in equipment spaces, concealed locations, and other locations not exposed to the view of building occupants is included in the work of this Division. Finished painting in areas exposed to the view of building occupants is specified under Division 9.
- B. All equipment and materials furnished by the electrical subcontractor shall be delivered to the job with suitable factory protective finish.
- C. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory-applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by VPTC Management Partners, LLC and in a color selected by VPTC Management Partners, LLC. Where factory-applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory-fresh condition by competent refinishers using the spray process.
- D. All equipment not finished at the factory shall be given a prime coat and then finish painted with two coats of enamel in a color as directed by VPTC Management Partners, LLC. No nameplates on equipment shall be painted, and suitable protection shall be afforded such plates to prevent their being rendered illegible during the painting operations.
- E. All ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, under floor and above ceilings shall be painted with two coats of zinc chromate primer as the construction progresses to protect against deterioration.
- F. All junction and pull boxes and covers and terminal cabinets which are part of the raceway/wiring system for fire alarm wiring shall be painted red. A system designation

(FA) shall be stenciled on the box or cabinet cover in minimum one inch (1") high white letters.

2.11 Equipment Housekeeping Pads and Anchor Bolts:

- A. Concrete pads for equipment (Housekeeping Pads) will be furnished under this Division. Pads shall be provided in locations where floor mounted equipment is to be installed.
- B. Pads shall be nominal 3-1/2" high and shall extend a minimum of 3" beyond all equipment and supports while generally conforming to the shape of the equipment.
- C. Pads shall be minimum 2500 psi (28 day) concrete. Pad tops and sides shall be hard troweled smooth with a 3/4" bull nose on all external corners. Refer to Division 3 for additional requirements.
- D. Furnish galvanized anchor bolts with layout templates for installation in equipment pads. Bolts shall be of the size and quantity recommended by the manufacturer and where vibration isolators are used, they shall be anchor bolted to the equipment pad.

2.12 Concrete:

- A. All concrete used in light pole bases and ductbank encasement shall be 5 sack mix with 1/2" maximum aggregate and 3000 psi compressive strength when tested after 28 days in accordance with ASTM 039-44, "Standard Method of Test for Compressive Strength of Concrete". Refer to Division 3 for additional requirements.
- B. Add 8 pounds of L. Sonneborn Sons, Inc. "Sonobrite Red" or an approved equal dye per cubic yard of wet mix ductbank encasement concrete to form a uniform red color throughout the concrete. Dye may be added to concrete mix in the truck or as concrete is placed.
- C. Use forms except where the earth is firm enough to support the concrete. Above grade portions of pole bases shall be formed using Sonatube or an approved equal forming system.
- D. Keep concrete wet at least 48 hours after forms are removed to ensure proper curing.
- E. Light pole bases shall be reinforced. Reinforce duct banks where required by soil conditions or the application.
- F. Ductbank concrete shall be carefully spaded during the pouring to eliminate all voids under and between the ducts and to prevent honeycombing of the exterior surfaces. Power driven tampers or agitators shall not be used unless specifically designed for the application.
- G. Generally, each run of the ductbank shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in an angular plane, and reinforcing rod dowels shall be added as necessary to ensure a sound joint. Partial pours shall not terminate in horizontal or vertical planes.
- H. The concrete encasement covering the ductbank may be poured directly against the sides of the trenches if the cut is clean enough, and free of loose material. All loose dirt and extraneous material shall be removed from the trenches before and during the pouring of

the concrete to ensure sound envelopes. The trench bed shall be smooth and properly graded for the placement of the bottom row of spacers.

2.13 Wiring Device and Equipment Mounting Heights:

- A. Refer to architectural drawings to determine whether outlets occur in wainscot or cabinet spaces and coordinate mounting heights as required by architectural form. For example, mounting heights of outlets occurring in a tile or brick wall should be adjusted so that the outlet will occur entirely within a single course. However, all outlets in a given space shall be mounted at the same height.
- B. In general, unless noted otherwise on Architectural Drawings, mounting heights to device center line shall be as follows:
 - 1. Wall Switches 48" above finished floor.
 - 2. Receptacles 18" above finished floor.
 - 3. Receptacles 6" above countertops without backsplash and 4" above backsplash for countertops with backsplash, mounted with their long axis horizontal.
 - 4. Clock Outlets 7'-6" above finished floor.
 - 5. Panelboards 72" from finish floor to top of panelboard.
 - 6. Stairway Lighting Fixtures Wall mounted 7'-6" above finished floor or mid- landing.
 - 7. Fire Alarm Pull Stations 48" above finished floor. Coordinate with architectural graphics package for actual mounting heights.
 - 8. Fire Alarm Audio and Audio/Visual devices Wall-Mounted 6'8" above finish floor or 6" below ceiling, whichever is lower. Installation shall comply with ADA Accessibility Guidelines and local and state codes.
 - 9. Voice and Data Processing Outlets 18" above finished floor.
 - 10. Wall Telephone Outlets 54" above finished floor.
- C. All receptacles shall be mounted with their long axis vertical, unless noted otherwise.

2.14 Noise and Vibration:

- A. General: Warrant that the entire electrical system and its component items of equipment as installed shall operate without objectionable vibration or noise. Objectionable noise, vibration, or transmission thereof to the building shall be corrected.

2.15 Electrical Work Close-Out:

- A. General: Refer to the Division 1 for general close-out requirements. Maintain a daily log of operational data on electrical equipment and systems through the close-out period;

record hours of operation, assigned personnel, power consumption, and similar information; submit copy to VPTC Management Partners, LLC.

- B. Coordination with Mechanical Work: Coordinate close-out operations with close-out of mechanical systems, elevators, and other power-consuming equipment. Accurately record locations of primary (major) conduit which is underground or otherwise concealed.
- C. Support Services: Test run electrical equipment in coordination with test runs of mechanical systems. Clean and lubricate operational equipment. Instruct Owner's operating personnel thoroughly in the operation, sequencing, maintenance, and safety/emergency provisions of the electrical systems. Turn over the operations to Owner's personnel at the time(s) of substantial completion. Until the time of final acceptance of the total Work of the Contract, respond promptly with consultation and services to assist Owner's personnel with operation of electrical systems.
- D. Commissioning: Refer to Section 16995, Electrical Commissioning, for electrical commissioning requirements and report form samples.

2.16 Guarantee:

- A. General: Contractors shall guarantee all materials and equipment installed by them against defect in workmanship and materials for a period of 12 months after final acceptance of the work, and they shall repair or replace any materials or equipment developing such defects within that time, promptly on due notice given them by VPTC Management Partners, LLC and at no additional expenses to the Owner.
- B. Equipment: All equipment bearing a manufacturer's guarantee, such as electrical switchgear, emergency generator, and lighting services shall be construed to have an extended guarantee to the Owner by the manufacturer. Any such equipment that proves defective in materials or workmanship within the guarantee period is to be replaced by the Contractor in accordance with the manufacturer's guarantee, at no additional expense to the Owner.

END OF SECTION 16010

Section 16041 – Interior Finish Office Design Parameters

Part 1 General

1.01 Related Documents:

- A. The requirements of the General and Special Conditions, Bidding and Contract Requirements - Division 0 and Division 1 VPTC Management Partners, LLC Interior Finish Master Specification apply to all work under this Section.

1.02 Definition(s):

- A. Net Rentable Area-S.F (NRSF): Shall mean the result of subtracting from the gross area of the floor, the area of the major vertical penetrations on that same floor. No deductions shall be made for columns and projections necessary to the building. Spaces outside the exterior walls, such as balconies, terraces, or corridors, are excluded. The building net rentable area shall equal the sum of all net rentable areas from each floor.
- B. Major Vertical Penetrations: Shall mean stairs, elevators shafts, flues, pipe shafts, vertical ducts, and their enclosing walls. Atria and light wells above the finished floor are included in this definition. Not included, are vertical penetrations built for the private use of a tenant. Structural columns, openings for vertical electric cable or telephone distribution, and openings for plumbing lines are not considered major vertical penetrations.
- C. Gross Building Area-S.F.(GSF): Shall mean the total constructed area of the building, excluding parking areas and loading docks (or portions of the same) outside the building line.
- D. Common Area Building Zone: The common area building zone is defined as the areas common to all tenants. These areas include but are not limited to restrooms, janitors closets, electrical rooms, telecommunication closets, mechanical rooms, corridors, atrium and lobbies.
- E. Perimeter Building Zone: The perimeter building zone is defined as the area measured under the length of the perimeter of the building and 15 feet from the exterior column line.
- F. Interior Building Zone: The interior building zone is defined as the total net rentable square feet less the common area square feet and less the perimeter building zone square feet.

1.03 Descriptions of Work

- A. Work Included: The Work includes, but is not limited to, design and installation of the following systems, equipment, and services:
 - 1. Power Distribution:
 - a. The tenant power distribution equipment (feeders and distribution panels) shall be sized for loads described within the interior finish scope descriptions and per the requirements as described by the NEC. All square footage calculations used in determining load shall be based upon Net Rentable Square Feet (NRSF).
 - b. As a minimum requirement, tenant distribution system shall include 4 va per NRSF for 120/208 power, 2.5 va for tenant lighting and 6.0 va for tenant heating equipment.

The tenant designer shall confirm available distribution provided in space prior to completion of tenant finish electrical design.

- c. The tenant designer shall maximize use of all circuits provided in the Tenant construction. Dedicated circuits shall be installed at a minimum, unless otherwise required per NEC.
- d. Panelboards serving receptacles and small equipment on typical tenant floors shall have a minimum capacity of 42 single-pole circuit breakers.

2. [Emergency Power System:]

- a. Emergency power shall be supplied from an engine generator set complete with prime mover, generator, controls, starting equipment, NEMA 3R enclosure, (if installed outdoors) exhaust system, automatic transfer switches, and all necessary auxiliaries.
- b. Emergency power distribution shall consist of a distribution panel feeding automatic transfer switches and conduit and wire feeders to emergency and legally required standby loads.
- c. Loads served by the emergency power system are to only include loads classified by the NEC as emergency system loads and/or legally required standby systems load. These loads shall include, but may not be limited to exit, egress and emergency lighting in the building (allow a minimum of 0.1 VA per usable square foot of floor area), the fire alarm system, the stairwell pressurization fans, the fire pump, the jockey pump, elevator cab lighting, and elevators (one per bank at a time plus the dedicated fireman's elevator).
- d. Optional standby system loads (building loads that may be of critical nature to the business operations conducted within the facility but are not required by code to be provided with a backup source, or whose interruption does not threaten life safety or fire suppression or fire fighting efforts) are not to be placed on the emergency power system.

3. Fire Alarm System:

a. General Requirements:

- 1) The system shall be an analog addressable type system.
- 2) Fixed temperature/rate-of-rise detectors shall be provided in rooms and areas such as unenclosed garage elevator lobbies where a smoke detector is unsuitable due to the environment and in elevator machine rooms and elevator hoistways where separate signals are required for power shutdown features.
- 3) Additional fire alarm panels installed during the interior finish shall be tied into the main fire alarm panel as a specific addressable point.
- 4) Added supervisory switches installed during the interior finish on valves and flow switches for the sprinkler system shall be furnished and installed by the Sprinkler Contractor and wired by this Contractor.
- 5) Provide zoning as required by the local building code.
- 6) Refer to specification sections 16720 or 16721 for additional fire alarm requirements.

- 7) The fire alarm system addressable point capacity shall contain,
 - 8) A minimum of 15% spare addressable point capacity remaining in the panel at full occupancy.
 - 9) A minimum of 1 addressable point per 1000 net rentable square feet (NRSF) for all addressable systems installed.
- b. Voice System Requirements: Where required the system shall include the following voice features:
- 1) The system shall be a combination alarm and voice communication fire alarm system.
4. Lighting System:
- a. Preliminary lighting layouts and fixture specifications for both interior and exterior spaces shall be generated by the Contractor in accordance with the architectural documents.
 - b. Exterior lighting (accent lighting, parking lot lighting, walk way lights, etc) shall be controlled via time switches or BAS (when applicable) with local override and with photoelectric control (photoelectric control integrated into BAS when applicable). Provide interior lighting control via the BMS for lighting in lobbies, elevator lobbies, atriums, future common corridors, interior loading docks, etc.
 - 1) Where the facility is provided with a Building Automation System (BAS) per 15950, the BAS will provide the time switching function. This contractor shall provide and install lighting contactor(s) and land the low voltage wire to the contactor as provided by the mechanical contractor.
 - c. Provide energy saving lamps and electronic ballasts. The use of incandescent lighting is discouraged.
 - d. Lighting levels shall be in accordance with the Illuminating Engineering Society (I.E.S.) recommendations for the specific areas. The lighting level in all mechanical, electrical, and elevator machine rooms shall be 70 foot-candles. The parking lot lighting shall provide an average maintained ½ foot-candles on every on every paved or concrete surface or higher as required by local ordinances. Fixtures and lamp types shall be selected to comply with “dark sky” ordinances, if any, and to minimize spill light on adjacent properties.
 - e. Coordinate the selection of light sources with VPTC Management Partners, LLC and the architect to ensure the correct color rendering properties of the lamps and luminaires.
 - f. **Conference Rooms, Store Rooms, Utility Rooms, Restrooms, Janitors Closets, Electrical Closets, Mechanical Rooms** – The lighting control in these rooms shall utilize ceiling mounted dual technology motion sensors.
 - g. When required by local codes or other energy codes, lighting fixtures, lamps and ballasts shall be selected and installed to provide a cost effective means of achieving the energy conservation goals established by these codes.
 - 1) **(Optional for build to suite projects) Daylighting Controls** – The daylighting system shall include controls (photocells, relays, contactors) and fixtures necessary to reduce the lighting adjacent the perimeter windows and the first and

second rows of lighting from the windows. The perimeter zone controlled by daylighting is defined as 15 foot from the exterior walls in occupied office space.

- 2) **(Optional for build to suite projects) Open Office Area Lighting Control** – Open office area lighting will be controlled to provide the ability for all lighting in the open office areas as well in the corridors, not part of the life safety system, to be swept on and off at programmable times and holidays based on a 365 day calendar which will allow for individual weekend and holidays to be programmed. This shall also include override light switches (1) per quadrant (a total of (4)) to be installed near the central elevator lobby to enable a (2) hour occupant override of the the time clock system.
- 3) **(Optional) Individual Offices** – Each individual office shall have an occupancy sensor installed to control lighting.
5. **Grounding:** The electrical distribution system and all equipment shall be grounded in accordance with the NEC.
6. **Structural Openings:**
 - a. The Electrical Contractor shall cut or provide and locate all forms for holes through the roof for his equipment, and provide roof jackets or pitch pockets for conduit passing through the roof or shall coordinate with the Roofing Contractor such that the roofer installs the necessary sleeves and pitchpockets as directed by the Electrical Contractor. Reinforcement of all holes through roof, where required, shall be provided in a manner approved by the Structural Engineer.
 - b. The Electrical Contractor shall provide the Structural Engineer with locations, dimensions and weights of his equipment to be supported by the floor and roof structural systems immediately following the awarding of the Contract. The final locations of his equipment shall be subject to the approval of the Structural Engineer. The Electrical Contractor shall provide accessories necessary to hang his equipment from structure at locations and in a manner approved by the Structural Engineer.
 - c. All holes of area less than 150 square inches required through concrete floors, precast concrete, masonry, and similar items, shall be provided by the Electrical Contractor. All holes required through post-tensioned concrete floors and roof and all other holes that proper installation require to be of a larger area than 150 square inches will be provided by the Contractor for precast construction at locations determined by this Contractor. Any cutting and patching for holes required for proper installation where information on sizes and locations is not provided to VPTC Management Partners, LLC in sufficient time shall be the responsibility of the Electrical Contractor. All cutting and patching shall be subject to the direction and approval of VPTC Management Partners, LLC.
7. **[Security System:]**
 - a. Per tenant requirements.
8. **Telephone System:**
 - a. From telephone demark to tenant space.
 - b. Some cities provide conduit, other cities no conduit. Verify local requirements from demark to tenant space.

- c. Tenant responsible for providing all telephone cable. Tenant will provide plenum rated cable for all plenum return ceilings.
9. Interior Finish Typical Office Space Layout:
- a. Lighting – 2' x 4' deep cell parabolic 3-lamp light fixtures to achieve an average maintained 60 f.c. at 30" aff. Lamp color - 4100° K.
 - b. Switches – One single pole switch per enclosed room. Multiple, grouped, single pole switch(es) as required for the quantity of light fixtures in an open area.
 - c. Electric Power Devices:
 - 1) Enclosed office/Conference Room: Two standard duplex receptacles.
 - 2) Open Areas/Common Areas: Convenience outlets to have one standard duplex receptacle every 100 lf.
 - d. Tenant Cubicles: (pre-wired systems) – Average of one circuit for every two cubicles, grouped as required to connect to office furniture feed flexible conduit connection. Coordinate with tenant furniture system layout and requirements..
 - 1) Furniture power to be either floor mount, ceiling mount or wall mount per tenant specification and power requirements. Note: If nothing is specified, power to be fed through power poles and or wall mount boxes to a three circuit pre-wired system furniture.
 - e. Specialty Equipment: To be designed per tenant equipment power requirements. These are typically dedicated duplex receptacles. Example: Telephone systems, printers, copiers, fax, stamps, vending, hot water heater, exhaust fans, etc.
 - f. Voice/Data Outlet:
 - 1) A drywall opening with a metal plaster ring and pull string.
 - 2) One per enclosed room.
 - g. Tenant Cubicles Voice/Data: (pre-wired systems).
 - 1) One wall mount box for every (4) cubicles if positioned along perimeter.
 - 2) One power pole or floor box for every (4) cubicles if positioned in center of floor.
 - h. Life Safety Devices:
 - 1) Exit lights per local code.
 - 2) Emergency Lights and Night Lights per local code.
 - 3) Smoke detectors per code.
 - 4) Manual pull stations per code.
 - 5) Fire Alarm Audible: At egress pathway; (1) within 15 ft. of egress door and per local code. Installation shall comply with ADA Accessibility Guidelines and local and state codes.

- 6) Strobes: Within site of egress pathway; (1) in every conference room; (1) in every break room; (1) in restrooms; in open area (1) within 15 ft. of egress door and per local code. Installation shall comply with ADA Accessibility Guidelines and local and state codes.
 - i. The tenant's designer is responsible for providing locations of all electrical devices. It is the responsibility of the electrical contractor to circuit all devices per local code.

END OF SECTION 16041

Section 16110 – Electrical Raceways and Fittings

Part 1 General

1.01 Related Documents:

- A. A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide electrical raceway and fitting work as required and specified.
- B. Types: The types of electrical raceways and fittings required for the project include the following:
1. Rigid steel and intermediate metal conduit (IMC),
 2. PVC coated rigid steel conduit,
 3. Electrical metallic tubing (EMT),
 4. Flexible metal conduit,
 5. Liquid-tight flexible metal conduit, and
 6. Rigid nonmetallic conduit.
 7. Decorative surface mounted raceway.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
1. Rigid Steel and Intermediate Metal Conduit:
 - a. Allied Tube & Conduit Corporation,
 - b. Republic Steel Corporation,
 - c. Triangle PWC, Inc.,
 - d. Youngstown Sheet & Tube, or
 - e. Wheatland.
 2. EMT:
 - a. Allied Tube & Conduit Corporation,
 - b. ETP-Uni-Couple,
 - c. Republic Steel Corporation,
 - d. Triangle PWC, Inc.,

- e. Youngstown Sheet & Tube, or
 - f. Wheatland.
3. Flexible Metal and Liquid-tight Flexible Metal:
- a. AFC,
 - b. Anaconda Metal Hose,
 - c. Electri-Flex Company,
 - d. Flexi-Guard, Inc.,
 - e. Triangle PWC, Inc. or
 - f. Wheatland.
4. Rigid Nonmetallic and Electrical Nonmetallic Tubing (ENT):
- a. Carlon,
 - b. Cantex, or
 - c. Triangle PWC, Inc.
5. Raceway Fittings:
- a. Appleton Electric Company,
 - b. Cantex (PVC),
 - c. Carlon (PVC),
 - d. Crouse Hinds,
 - e. Efcor Division,
 - f. ETP-Uni-Couple,
 - g. O. Z. Gedney Company,
 - h. Racco, Inc.,
 - i. Republic Steel Corporation,
 - j. Steel City, or
 - k. Thomas and Betts.
6. Decorative Surface Mounted Raceways:
- a. Wiremold Company.
 - b. Thomas & Betts Corporation.
7. UL Label: All electrical raceways and fittings shall be UL-labeled.

Part 2 Products

2.01 Materials and Components:

- A. General: For each electrical raceway system, provide a complete assembly of conduit, tubing, or duct with fittings, including, but not necessarily limited to, connectors, nipples, couplings, expansion fittings, bushings, locknuts, other components, and accessories as needed to form a complete system of the type indicated.
- B. Rigid Steel and Intermediate Metal Conduit: Use rigid steel or intermediate metal conduit to run all electrical raceway systems where cast in concrete walls or floor slabs which have waterproof membranes and where cast in masonry walls. Use threaded type couplings and fittings. Split type couplings and fittings are not acceptable. Conduit smaller than 1/2" in diameter will not be permitted. EMT conduit may be used instead of rigid steel or intermediate metal conduit for feeder raceways, if the location is acceptable for use of EMT as described herein below.
- C. EMT: Use EMT for branch circuit electrical raceway systems where concealed in furred ceilings or walls, exposed inside where not exposed to physical damage, in built-up masonry unit walls not subject to moisture, and cast in concrete walls or floor slabs which do not have waterproof membranes. Use compression or set screw type couplings and fittings made-up tight for conduit sizes up to 2" in diameter and set screw type couplings and fittings made-up tight for conduit size 2" and greater. Use watertight couplings and fittings where required. Where cast in concrete and floor slabs, use concrete tight couplings and fittings and terminate conduit in a box cast in concrete, or with rigid steel conduit turnouts from concrete. Conduit smaller than 1/2" in diameter will not be permitted. At the Contractor's option, EMT using "uni-couple" type connectors may be used instead of tubing and individual connectors.
- D. Flexible Metal: Use flexible metal conduit and fittings for lighting fixture connections, motor connections, and for other electrical equipment connections where subject to movement and vibration. Use flexible metal conduit from junction boxes to lighting fixtures in such lengths as required, 6' maximum. Conduit smaller than 1/2" in diameter will not be permitted except that 3/8" flexible metallic conduit may be used for lighting fixture "pigtailed".
- E. Liquid-tight Flexible Metal: Use liquid-tight flexible metal conduit and fittings for motor connections and for other electrical equipment connections where subject to movement and vibration and when subject to one or more of the following conditions: exterior location; moist or humid atmosphere where condensation can be expected to accumulate; corrosive atmosphere; subject to water spray; subject to dripping oil, grease or water. Conduit smaller than 1/2" in diameter will not be permitted.
- F. Rigid Nonmetallic: Use rigid PVC Schedule 40 conduit and solvent type fittings for electrical raceway systems in cast in place concrete floors and walls, and below grade, with or without concrete encasement. Conduit may be Type EB for underground installation with concrete encasement. Where permitted by the local utility company and applicable codes, Type DB may be used for utility company primary services. Conduit system shall be UL-listed in accordance with Article 347 of the NEC. Conduit smaller than 1/2" in diameter will not be permitted.
- G. Electrical Nonmetallic Tubing (ENT): Use ENT conduit and fittings for branch circuits where concealed in walls and non-return air plenums as permitted in NEC Article 331 and the local authority having jurisdiction.
- H. Decorative Surface Mounted Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard coating. Single channel equal to Wiremold V3000 series. Dual channel equal to Wiremold V4000 series.

2.02 Metal Conduit, Tubing, and Fittings:

- A. General: Provide metal conduit, tubing, and fittings of the type, grade, size, and weight (wall thickness) as required for each service. Provide proper selection determined by Section 16110, "Electrical Raceways and Fittings", to fulfill the wiring requirements and complying with the NEC for electrical raceways.
- B. Metal Conduit:
 - 1. Rigid Steel and Intermediate Metal Conduit: ANSI C80.1, hot-dipped galvanized.
 - 2. Rigid Steel or Intermediate Metal Conduit Fittings: ANSI C80.4.
 - 3. EMT: ANSI C80.3, galvanized.
 - 4. EMT Fittings: ANSI C80.4, galvanized, and die-cast zinc-coated fittings.
- C. Flexible Metal Conduit:
 - 1. Type: Zinc-coated steel and aluminum.
 - 2. Flexible Metal Conduit Fittings: Zinc-coated steel and die-cast zinc-coated fittings.
 - 3. Liquid-tight Flexible Metal Conduit: Liquid-tight flexible metal conduit comprised of single strip, continuous, flexible, interlocked, double-wrapped steel, galvanized inside and outside; forming smooth internal wiring channel; with liquid-tight jacket of flexible PVC.
 - 4. Liquid-tight Flexible Metal Conduit Fittings: Liquid-tight; zinc-coated steel, die-cast zinc-plated, and malleable iron zinc plated.
- D. Nonmetallic Conduit Fittings:
 - 1. Rigid PVC Schedule 40 and Type EB Conduit: NEMA Standard TC-2.
 - 2. PVC Conduit Fittings: NEMA Standard TC-3.
- E. Conduit Tubing Accessories: Provide conduit and tubing accessories including straps, hangers and expansion joints as recommended by the conduit and tubing manufacturer and as specified in this section.

Part 3 Execution

3.01 Installation:

- A. General: Install electrical raceways and fittings in accordance with the manufacturer's written instructions, the applicable requirements of the NEC and in accordance with recognized industry practices to ensure that products serve the intended function. Complete electrical raceway installation before starting the installation of cables.
- B. Communications System Raceways: Install electrical raceways and fittings per the EIA/TIA (Electronic and Telecommunications Industry) Standards.

3.02 Interior Conduit System:

- A. General: Ground all metallic conduits in accordance with the requirements of the latest edition of the NEC.
- B. Install all conduit as a complete system without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in such a manner as to ensure a tight joint. Fasten the entire conduit system securely into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting. Install approved expansion fittings in all conduit runs exceeding 150' or when crossing building expansion joints.
- C. Ream all ends of conduit properly to remove rough edges. Whenever a rigid steel or IMC conduit enters a switchboard, panelboard, enclosure, or box, it shall be securely fastened by the use of a locknut inside and outside and an approved insulating grounding bushing shall be installed. Whenever an EMT conduit enters a switchboard, panelboard, enclosure, or box, it shall be securely fastened by use of an insulated throat connector or with a plastic bushing. Lay out and install all conduit systems as to avoid all other services or systems, the proximity of which may prove injurious to the conduit or the wires or conductors that the conduit confines.
- D. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical rooms and where otherwise shown or indicated. On exposed systems, run the conduit parallel or perpendicular to the structural features of the building and rigidly support with listed conduit supports or clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners insofar as practicable.
- E. All conduit shall be run without traps. Where traps or dips are unavoidable, a junction or pull box shall be placed at each low point.
- F. Support exposed raceway on galvanized channel using compatible galvanized fittings (bolts, beam clamps and similar items) and galvanized threaded rod pendants to secure raceway to channel and channel to structure. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt/nut and threaded rod. All raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on all conduit passing through walls and ceilings in finished areas.
- G. Support conduit concealed in ceiling cavities with No. 13 AWG galvanized iron wire pendants. Install conduit support in accordance with the manufacturer's written instructions, the applicable requirements of the NEC, and in accordance with applicable state and local codes. Branch circuit conduit 3/4" trade size and smaller may be suspended using "caddy clips" attached to the ceiling support system, in a manner acceptable to the ceiling manufacturer, and where permitted by code.
- H. Make all joints and connections to ensure mechanical strength and electrical continuity. All joints are to be cleaned, completely dry and primed prior to application of solvent cement. PVC conduit shall be joined, or have fittings attached, by using a fusing (solvent) compound complying with ASTM D-2564 for the application. Solvent Cement shall be equal to the following:
 - 1. For application in temperatures down to 40 degrees: United Elchem Industries Plasti-weld 404, medium body PVC solvent cement.

2. For application in temperatures down to 0 degrees: United Elchem Industries Uni-weld Polarweld all season PVC solvent cement.
3. No PVC solvent cement shall be applied below 0 degrees.
- I. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8" clear. Whenever possible, install horizontal raceway runs above water piping. All roof penetrations shall be made in adequate time to allow the Roofer to make proper flashings.
- J. Carefully review architectural, structural, mechanical, plumbing and electrical Drawings and place boxes and conduit to avoid conflicts with structural members or other general construction.
- K. All conduits passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet.
- L. Provide metallic conduit elbows when transitioning from below grade to above grade applications where the conduit is exposed and subject to damage.
 1. Metallic conduit installed below grade in contact with earth shall have its entire length painted with two coats of protective finish. Each coat shall consist of 5 mils of PPG "Coat Cat Epoxy Coating" applied in accordance with the manufacturer's recommendations.
 2. The entire length of metallic conduit, including fittings, shall be protected to a point 6" above finished grade (or concrete slab).
- M. Coordinate locations of raceways in fire rated partitions so as not to affect the fire rating of the partition. Notify VPTC Management Partners, LLC in writing where additional construction is required to maintain the partition fire rating.

3.03 Power Duct Bank Systems:

- A. Power duct banks for primary and secondary services shall be of individual conduit. Conduit shall be rigid PVC Schedule 40, Type DB, or Type EB encased in concrete. Rigid PVC Schedule 40 and Type DB shall be permitted for direct buried conduits where concrete encasement is not required. Concrete encasement shall be provided when required by the Power Company, when crossing beneath roadways, and elsewhere as required by the NEC or the authority having jurisdiction. The type of conduit used shall not be mixed in any one duct bank and shall be sized for the NEC or Power Company standards. Where required, the concrete encasement surrounding the duct bank shall be rectangular in cross section, having a minimum concrete thickness of 3". Conduit shall be separated by a minimum concrete thickness of 2", except that light and power conduit shall be separated from control and signal conduits by a minimum concrete thickness of 3".
- B. The power duct bank shall be routed underground and the top of the concrete envelope shall be not less than 24" below grade. Duct banks without encasement shall be not less than recommended in the appropriate NEC article to the top of the conduits.
- C. Changes in direction of duct bank runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5' and shall be separated by a minimum of 10'. Factory fabricated elbows with radius of curvature less than 5' are acceptable at end of runs.

- D. During construction, partially completed duct banks shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of the duct bank is completed, a testing mandrel shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until each conduit is clear of all particles of earth, sand, or gravel. Conduit plugs shall then be immediately installed.
- E. Power duct bank shall be installed per Power Company standards, where applicable.
- F. Concrete for duct banks shall be the responsibility of this Contractor. Refer to Section 16010, Paragraph 2.11.
- G. All manholes installed shall be identified on the cover to describe the system served (e.g., "ELECTRIC").
- H. All underground conduits installed for future use shall be rodded to ensure system integrity.
- I. All underground conduits installed under an interior slab shall be installed 12" below the bottom of the slab. This shall be the minimum depth of the installed conduit unless otherwise specified by the NEC.

3.04 Telephone Duct Bank Systems:

- A. Exterior telephone duct banks shall be of individual conduit direct buried without concrete encasement and conduit shall be rigid PVC Schedule 40, or Type DB if acceptable to the local telephone company. Interior duct banks shall be of individual conduit and conduit shall be EMT. The type of conduit used shall not be mixed in any one duct bank and shall not be smaller than 4" in diameter.
- B. Where the telephone duct bank is routed underground, the top of the duct bank shall be not less than 24" below grade.
- C. Changes in direction of telephone duct bank runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5' and shall be separated by a minimum of 10'. Factory fabricated elbows with less than a 5' radius of curvature are acceptable at end of runs. There shall be no more than two 90 degree bends in any run of telephone duct bank.
- D. During construction, partially completed duct banks shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of the duct bank is completed, a testing mandrel with diameter 1/4" smaller than the conduit shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until each conduit is clear of all particles of earth, sand, or gravel. Conduit plugs shall then be immediately installed.
- E. Sleeves for telephone duct bank passing through basement walls shall be rigid steel conduit and shall extend a minimum of 24" outside basement wall.
- F. Telephone duct bank shall be installed per Telephone Company standards.
- G. All manholes installed shall be identified on the cover to describe the system served (e.g., "ELECTRIC").
- H. All underground conduits installed for future use shall be rodded to ensure system integrity.

3.05 Telephone and Signal System Raceways:

- A. General: Conduit shall be installed in accordance with the previous specified requirements for conduit and tubing and with the additional requirements that 3/4" is the minimum size and no length of run shall exceed 50' for 3/4" trade sizes, and 100' for one inch or larger trade sizes, and shall not contain more than two 90 degree bends or the equivalent thereof. Pull or junction boxes shall be installed to comply with these requirements. Empty telephone and signal system raceways shall include a pull wire or cord, as described in Paragraph 3.06 herein below.

3.06 Surface Mounted Decorative Raceway:

- A. Install where indicated for power and/or telecommunications devices in laboratories, data centers, or similar locations required by the design. Install at height indicated, straight and level. Provide all necessary accessories and components from the system manufacturer as required for a complete and operational installation with devices as indicated. Feed raceway with conduits installed hidden in wall construction with (1) 3/4" conduit to the power channel and (1) 1-1/4" conduit to the telecommunications channel for each 10' section of raceway or fraction thereof.

3.07 Empty Conduit Raceway System:

- A. General: Empty conduit in which wire is to be installed by others shall have pull wires installed. The pull wire shall be No. 14 AWG zinc-coated steel, or plastic having not less than 200 pounds tensile strength. Not less than 12" of slack shall be left at each end of the pull wire.
- B. All empty conduits shall be sealed with a cap that can be removed for future use without cutting or damaging the installed conduit.

END OF SECTION 16110

Section 16120 – Cable, Wire, and Connectors

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide electrical cable, wire and connector work as shown, scheduled, indicated, and as specified.
- B. Types: The types of cable, wire, and connectors required for the project include the following:
1. 150 volt control and signal wire and cable
 2. 150 volt control and signal wire and cable connectors
 3. 600 volt building wire and cable
 4. 600 volt building wire and cable connectors
- C. Application: The applications for cable, wire, and connectors required on the project are as follows:
1. Power distribution circuitry
 2. Lighting branch circuitry
 3. Appliance, receptacle and equipment branch circuitry
 4. Motor branch circuitry
 5. Control wiring
 6. Fire alarm wiring

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
1. Cable and Wire:
 - a. Alcan
 - b. American Insulated Wire Corporation
 - c. Cerro Wire and Cable Company
 - d. Cyprus Wire and Cable Company
 - e. Electrical Cable Division, USS Corporation

- f. Essex International, Inc.
 - g. General Cable Corporation
 - h. ITT Royal Electric
 - i. Kaiser
 - j. Okonite Company
 - k. Southwire Company
 - l. Triangle PWC, Inc.
 - m. Viakon
2. 150 Volt Cable and Wire:
- a. Alpha
 - b. Belden
 - c. West Penn
3. Connectors:
- a. AMP, Inc.
 - b. Burndy Corporation
 - c. The General Electric Company
 - d. Ideal Industries, Inc.
 - e. ILSCO
 - f. Mac Products, Inc.
 - g. Minnesota Mining and Manufacturing Company
 - h. O. Z. Gedney Company
 - i. Thomas & Betts Company
4. MC Cable:
- a. AFC Cable Systems, Inc.

B. UL Label: All cable, wire, and connectors shall be UL-labeled.

Part 2 Products

2.01 600 Volt Building Cable, Wire And Connectors:

- A. General: Provide cable, wire, and connectors of manufacturer's standard materials, as indicated by his published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.

- B. Wire and Cable: Provide factory-fabricated wire and cable of the size, rating, material, and type as indicated for each use.
- C. Conductors: Provide soft or annealed copper wires meeting, before stranding, the requirements of ASTM B3, "Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes", latest edition.
 - 1. Conductors for power wiring sized No. 14 AWG through No. 10 AWG shall be solid or stranded. Stranded conductors in these sizes can only be used if properly terminated using crimp-on terminals or connected to terminals rated for use with stranded conductors.
 - 2. Conductors for control wiring sized No. 18 AWG through No. 10 AWG shall be stranded.
 - 3. Conductors sized No. 8 AWG and larger shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B8, "Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft".
- D. Insulation: Insulation shall meet or exceed the requirements of UL 83, "Standard for Thermoplastic Insulated Wires".
 - 1. Insulation for conductors sized No. 18 AWG through No. 10 AWG shall be UL Type TW, THW, or THHN/THWN.
 - 2. Insulation for conductors sized No. 8 AWG and larger shall be UL Type THW, THHN/THWN, or XHHW.
 - 3. All wiring inside lighting fixtures shall be temperature rated per the NEC.
 - 4. Branch circuit wiring within 3" of fluorescent ballasts shall be temperature rated for 90°C.
- E. Type "AC" and "MC" Cable Option: "At the Contractor's option, and subject to the approval of the local electrical inspection department, Type "AC" armor-clad ("BX") flexible cable may be used for all branch circuits in approved locations and Type "MC" metal-clad flexible cable may be used for all branch circuits and/or feeders in approved locations. "BX" cable shall consist of two, three or four code-sized insulated copper conductors and steel binder strip enclosed in a flexible metal armor. Type "MC" cable shall consist of two, three or four insulated copper conductors and a code-sized grounding conductor enclosed in an overall flexible metal jacket." "BX" and "MC" cable terminations shall be made using approved fittings. "Bundling of cables shall be limited in accordance with local inspection agency requirements and to comply with code-required temperature limitations."

2.02 150 Volt Control/Signal Cable, Wire, And Connectors:

- A. General: Except as otherwise indicated, provide cable, wire, and connectors of manufacturer's standard materials, as indicated by his published product information, designed, and constructed as instructed by the manufacturer, and as required for the installation.
- B. Wire and Cable: Provide factory-fabricated wire and cable of the size, rating, material, and type as indicated for each use.
- C. Conductors: Provide soft or annealed copper wires meeting, before stranding, the requirements of ASTM B3, "Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes", latest edition.

- D. Conductor Gauge: Provide conductor gauge as required for the application with a minimum of 24 AWG. Conductors shall be stranded.
- E. Insulation: Insulation shall meet or exceed the requirements of UL 83, "Standard for Thermoplastic Insulated Wires", and the requirements of NEC Article 725 for Class 2 wiring.
 - 1. Insulation shall be rated for a maximum working voltage of 150 volts.
 - 2. Insulation of cables used in environmental air spaces shall be UL-listed for use in air plenums.
- F. Connection: Provide factory-fabricated, metal connectors of the size, rating, material, type, and class required for the application.

Part 3 Execution

3.01 Installation:

- A. General: Install electrical cable, wire and connectors as shown, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.
- B. Coordination: Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. 600 Volt Building Wire and Cable:
 - 1. Pull all conductors together when more than one is being installed in a raceway. Whenever possible, pull all conductors into their respective conduits by hand. Use pulling compound or lubricant when necessary; compound shall not deteriorate conductor or insulation.
 - 2. Before any wire or cable is pulled into any conduit, thoroughly swab the conduit to remove all foreign material and to permit the wire to be pulled into a clean, dry conduit.
 - 3. Run all feeders their entire length in continuous section without joints or splices where feasible. If joints or splices are required, provide appropriately sized junction boxes.
 - 4. No wire smaller than No. 12 AWG will be permitted for any lighting or power circuit except that No. 14 AWG Type THHN wire may be used for lighting fixture "pigtails". No wire smaller than No. 18 AWG shall be utilized for any control circuit, unless shown otherwise.
 - 5. Branch circuit voltage drop shall not exceed 3% of rated branch voltage.
 - 6. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. NO SPLICING IS PERMITTED IN PANELBOARDS, SWITCHBOARDS, OR MOTOR CONTROL CENTERS. Make all taps and splices by the use of an approved type compression connector. Insulate all taps and splices equal to that of the adjoining wire. Make splices or taps only on such conductors as are a component part of a single circuit, properly protected by approved methods.
 - 7. Support all conductors in vertical raceways, as specified in Section 300-19 of the NEC.

8. Do not permit conductors entering or leaving a junction or pull box to deflect so as to cause pressure on the conductor insulation.
 9. Make joints in branch circuits only where such circuits divide. These shall consist of one through circuit to which shall be spliced the branch from the circuit.
 10. Make connections in conductors up to a maximum of three No. 8 AWG wires using twist-on pressure connectors of required size. Conductor combinations spliced with twist on pressure connectors shall be limited to manufacturer's approved combinations.
 11. Connections shall be made with silicone filled wire connectors where located in wet areas and at all exterior locations at or below grade.
 12. Make connections in conductors or combinations of conductors larger than described hereinabove using cable fittings of the type and size required for the specific duty.
 13. Splices in circuits serving motors 1HP and above shall not be made using twist on pressure connectors.
 14. After a splice is securely "made-up", insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
 15. Make all splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
 16. Make all grounding connections using ground clamps, connectors, or exothermic welds of a type suitable and UL-approved for duty involved.
- D. 150 Volt Control/Signal Cable and Wire:
1. Install all low voltage wiring in a suitable raceway except in areas with accessible (lay-in) ceilings where UL-listed plenum cable may be used. Where plenum cable is used, bundle all cables and secure to the structure using nylon ties. Do not run cable loose on top of suspended ceilings. Conceal conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.
 2. Number code or color code conductors appropriately for future identification and servicing of the system.
 3. Make all splices and connections in stranded conductors using UL-approved solderless crimp connectors.

2.02 Testing:

- A. Pre-Energization Check: Prior to energization, check cable and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- B. Feeder Insulation Resistance Test: Each main 600 volt feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination.
 1. Tests shall be made using a Biddle Megger Earth Tester or equivalent test instrument at a voltage of not less than 1000 VDC. Resistance shall be measured from conductor to

conductor and from conductor to ground. Insulation resistance shall not be less than the following:

- a. No. 12 wire - 1,000 Ohms
 - b. No. 10 through No. 8 wire -250 K Ohms
 - c. No. 6 through No. 2 wire - 100 K Ohms
 - d. No. 1 through No. 4/0 - 50 K Ohms
 - e. Larger than No. 4/0 25 K Ohms
2. Conductors, which do not meet or exceed the insulation resistance values listed above, shall be removed, replaced, and retested.
- C. Voltage and Current Values: The voltage and current in each main feeder conductor shall be measured and recorded after all connections have been made and the feeder is under load.
- D. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to VPTC Management Partners, LLC for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature and weather conditions.

END OF SECTION 16120

Section 16121 – Electrical Connections for Equipment

Part 1 Part 1 - General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: The extent of electrical connections for equipment is as indicated by the requirements of this Section and as specified elsewhere in these Specifications.
- B. Types: The types of electrical connections specified in this Section include, but are not necessarily limited to, the following connections:
 - 1. Motors
 - 2. Resistance heaters
 - 3. Motor starters
 - 4. Light fixtures
 - 5. Transformers
 - 6. Master units of communication, signal, alarm, and public address systems
 - 7. Line voltage temperature control equipment
 - 8. Elevators
- C. Work of Other Sections:
 - 1. Refer to Section 16945, "Miscellaneous Electrical Controls and Control Wiring", for miscellaneous electrical controls and control system wiring.
 - 2. Refer to other Divisions of these Specifications for specific individual equipment electrical requirements.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
 - 1. AMP, Inc.
 - 2. Burndy Corporation
 - 3. Cadweld
 - 4. General Electric Company
 - 5. Ideal Industries, Inc.

6. ILSCO
 7. Mac Products, Inc.
 8. Minnesota Mining and Manufacturing Company
 9. O. Z. Gedney Company
 10. Thomas & Betts Company
- B. UL Label: All products shall be UL-labeled to the maximum extent possible.

Part 2 Products

2.01 **Materials and Components:**

- A. General: For each electrical connection, provide a complete assembly of materials, including, but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices and terminations.
- B. Raceways: Refer to Sections 16110, "Electrical Raceways and Fittings, and 16130, "Electrical Boxes and Fittings".
- C. Cable, Wire, and Connectors: Refer to Section 16120, "Cable, Wire, and Connectors".
- D. Terminals: Provide electrical terminals as instructed by the terminal manufacturer for the intended application.

Part 3 Execution

3.01 **Installation of Electrical Connections:**

- A. General: Install electrical connections in accordance with applicable portions of the NECA'S "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, match conductors of the electrical connection for proper interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare cables and wires by properly cutting and stripping covering, jacket and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practicable and arrange routing to facilitate inspection, testing and maintenance. Utilize only factory provided or approved entry and exit points.

- F. Polyvinyl Chloride (PVC) Coated Conduit: Provide PVC-coated rigid steel conduit and fittings where required for highly corrosive atmospheres.
- G. Flexible Conduit: Provide flexible conduit, minimum 18" for connection of lighting fixtures, motors, and other electrical equipment connections, where subject to movement and vibration.
- H. Liquid-tight Conduit: Provide liquid-tight flexible conduit, minimum 18" for connection of motors and for other electrical equipment where subject to movement and vibration and also where subjected to one or more of the following conditions:
 - 1. Exterior location,
 - 2. Moist or humid atmosphere where condensate can be expected to accumulate,
 - 3. Corrosive atmosphere,
 - 4. Subjected to water spray, and
 - 5. Subjected to dripping oil, grease or water.
- I. Conduit Location: All horizontal runs of conduit (not strapped to walls) shall be above 8' feet high, with a vertical drop to equipment. Conduit blocking walk and service space will not be acceptable and will require relocation. Conduit on and adjacent to equipment shall be located to allow free access to all removable panels for equipment service.
- J. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. All conduits passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet.
- K. Coordination: Coordinate installation of electrical connections for equipment with equipment installation work.
- L. Identification: Refer to Section 16010, "Basic Electrical Requirements", for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by Vptc management Partners, LLC. Affix markers at each point of termination, as close as possible to each point of connection.
- M. Elevators: Coordinate power and control provisions for elevators with the provisions required for the elevators as furnished. Where the power and control requirements are less than or equal to those shown, then modifications to power and control provisions shown shall be made at no cost as a matter of job coordination. Where power and control requirements are in excess of those shown, notify Vptc management Partners, LLC in writing of the requirements.

END OF SECTION 16121

Section 16130 – Electrical Boxes and Fittings

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide electrical box and fitting work as required and as specified herein.
- B. Types: The types of electrical boxes and fittings required for the project include the following:
1. Outlet boxes
 2. Junction boxes
 3. Pull boxes
 4. Floor boxes
 5. Fire rated poke-thru boxes
 6. Conduit bodies
 7. Bushings
 8. Locknuts

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
1. Interior Outlet Boxes:
 - a. Appleton Electric Company
 - b. Arrow Conduit and Fittings Corporation
 - c. Bowers
 - d. National Electric Products Company
 - e. O. Z. Gedney Company
 - f. RACO
 - g. Star Sheet Metal
 - h. Steel City, Midland-Ross Corporation
 2. Weatherproof Outlet Boxes:

- a. Appleton Electric Company
 - b. Crouse-Hinds Company
 - c. Harvey Hubbell, Inc.
 - d. Pyle-National Company
 - e. Red Dot
3. Junction and Pull Boxes:
- a. Appleton Electric Company
 - b. Arrow-Hart, Inc.
 - c. General Electric Company
 - d. Hoffman Engineering Company
 - e. Keystone Columbia, Inc.
 - f. O. Z. Gedney Company
 - g. Square D Company
 - h. Unity.
4. Cabinets:
- a. General Electric Company
 - b. Square D Company
 - c. Westinghouse
5. Floor Boxes:
- a. Harvey Hubbell, Inc.
 - b. Steel City, Midland-Ross Corporation,
 - c. Raceway Components, Inc.
 - d. Walker Parkersburg Division of Textron, Inc.
6. Fire Rated Poke-thru Boxes:
- a. Harvey Hubbell, Inc.
 - b. Raceway Products
 - c. Square D Company
 - d. Steel City, Midland-Ross Corporation
 - e. Walker Parkersburg Division of Textron, Inc.
7. Conduit Bodies:

- a. Appleton Electric Company
 - b. Crouse-Hinds Company
 - c. Killark Electric Manufacturing Company
 - d. Pyle-National Company
8. Bushings, Knockout Closures and Locknuts:
- a. Allen-Stevens Conduit Fittings Corporation
 - b. Allied Metal Stamping, Inc.
 - c. Appleton Electric Company
 - d. Carr Company
 - e. Raco, Inc.
 - f. Steel City, Midland-Ross Corporation
 - g. Thomas and Betts Company, Inc.

B. UL Label: All electrical boxes and fittings shall be UL-labeled.

Part 2 Products

2.01 **Fabricated Materials:**

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. Provide "gang" boxes where devices are shown to be grouped.
1. Type for Various Locations:
 - a. Ceilings: 4" square, 1-1/2" deep.
 - b. Plaster Walls: 4" square, 1-1/2" deep, with raised plaster cover; set with face approximately 1/8" from finished surface. Furnish shallow boxes where necessary.
 - c. Dry Wall Construction Walls: Standard galvanized switch box, 1-1/2" deep.
 - d. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be properly coordinated for each specific installation.
 - e. Surface: Type FS or FD box with surface cover.
 - f. Special: Where above types are not suitable, furnish boxes to suit the use taking into account space available, appearance and Code requirements.
 2. Interior Outlet Box Accessories: Provide outlet box accessories as required for each installation, including proper covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for all boxes in plaster construction, fixture studs,

cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

- B. Weatherproof Outlet Boxes: Provide hot-dipped galvanized cast iron or die-cast metal weatherproof outlet wiring boxes, of the type, shape, and size, including depth of box, with threaded conduit ends, Lexan fiberglass reinforced cover plate with spring-hinged waterproof caps suitably configured for each application, including face plate gasket and corrosion resistant fasteners.
- C. Junction and Pull Boxes: Provide galvanized sheet steel junction and pull boxes, with screw-on covers, of the type, shape and size, to suit each respective location and installation.
1. Type for Various Locations:
 - a. 100 Cubic Inches in Volume or Smaller: Standard outlet boxes with stamped knockouts.
 - b. 150 Cubic Inches in Volume or Larger: Code gage steel with sides formed and welded, screw covers unless shown to have hinged doors. Hinged doors with locking device same as furnished on panelboards. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: Weatherproof galvanized steel, fiberglass, PVC, or fiberglass reinforced precast polymer concrete construction with proper gaskets and corrosion resistant fasteners.
- D. Cabinets: Provide cabinets of size and style noted on the Drawings.
1. Cabinet fronts shall be steel. Other sheet metal for boxes shall be galvanized steel. Details of construction and methods of assembly shall meet the requirements of the Underwriters' Laboratories, Inc.
 2. The panel doors of cabinets shall be provided with locks. Single panel doors of cabinets shall have a lock with ring pull. Single doors 48" or longer and pairs of doors shall have a lock with vertical bolt operation, 3-point locking. Locks shall be keyed alike. Two keys shall be supplied for each cabinet.
 3. Cabinets shall have concealed hinges.
 4. Flush-mounted trim shall be fastened to cabinet with adjustable trim clamps. Fasteners for cabinets in concealed areas shall be concealed.
 5. Each voice/data cabinet shall be equipped with 3/4" plywood backboard covering entire inside rear surface and painted matte white.
 6. Trims and doors shall have a suitable primer coat and a finish coat of the manufacturer's standard color.
- E. Floor Boxes: Provide fully adjustable floor boxes for installation in concrete floors as indicated. Boxes shall be adjustable both before and after the concrete pour.
1. Waterproof Membrane Floors - Flush Boxes: Concrete tight cast iron floor box with brass trim to suit device shown and floor finish.
 2. Non-waterproof Membrane Floors (Above Grade) - Flush Boxes: Concrete tight steel floor box with brass trim to suit device shown and floor finish.

3. PVC floor boxes are acceptable for floors with or without waterproof membranes. Protect boxes against damage during installation and concrete placement.
- F. Fire Rated Poke-thru Boxes: Fire rated, UL-listed poke-thru boxes for installation through concrete slabs. Boxes shall be suitable for the slab thickness of the building and shall have UL-listed abandon plates for use where boxes are removed. Provide poke-thru boxes to suit device(s) shown.
- G. Conduit Bodies: Provide galvanized cast metal conduit bodies, of the type, shape and size, to suit each respective location and installation, constructed with threaded conduit ends, removable cover and corrosion resistant screws.
- H. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of the type and size to suit each respective use and installation.

Part 3 Execution

3.01 Installation of Boxes and Fittings:

- A. Install electrical boxes and fittings in compliance with NEC requirements, or in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes and fittings serve the intended purposes.
- B. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes may be located.
- C. Coordinate with the Architectural Drawings and by actual determination on the site, the exact location of each outlet. The outlet locations shall be modified from those shown to accommodate changes in door swings or to clear other interferences that may arise from job construction details, as well as modification to center them within room spaces. These modifications shall be made with no change in contract price and shall be a matter of job coordination. Check these conditions throughout the entire job and notify VPTC Management Partners, LLC of discrepancies, as they may occur, to verify the modifications, if any, before proceeding with the installation of the work. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required to extend boxes to the finished surfaces of special furring or wall finishes.
- D. Unless otherwise noted or directed to the contrary at the time of installation, outlet boxes shall be placed at the following heights (center of box to finished floor level): wall switches, wall telephone outlets - 48"; thermostats - 48"; receptacles and telephone outlets - 18" mounted with long axis vertical; clock outlets - 90".
- E. On exposed conduit systems provide pull boxes, junction boxes, wiring troughs, and cabinets wherever necessary for proper installation of various electrical systems.
- F. Use "Garvin" style covers on surface mounted boxes that contain wiring device(s). The use of drywall rings with plastic or metal faceplates will not be allowed.
- G. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- H. Provide knockout closures to cap unused knockout holes where blanks have been removed.

- I. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- J. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- K. At locations where conduit drops from the ceiling to freestanding equipment, provide a unistrut member secured to the building structure at each end for support of conduit and any junction box(es).
- L. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork, or mechanical piping.
- M. Provide junction and pull boxes for feeders and branch circuits where shown and where required by the NEC, regardless of whether boxes are shown or not.
- N. Coordinate locations of boxes in fire rated partitions and slabs so as to not affect the fire rating of the partition or slab. Notify VPTC Management Partners, LLC in writing where modifications or additional construction are required to maintain the partition or slab fire rating.
- O. All junction boxes in accessible locations shall be marked with a permanent marker to identify the circuit(s) within the box.
- P. Junction boxes utilized for emergency circuits shall be identified with markers to indicate circuits.
- Q. Do not install boxes back-to-back in walls. Provide minimum 6" separation. Provide minimum 24" separation in acoustic-rated walls. If boxes are connected together, install flexible connection between the boxes and pack openings with UL approved sound deadening material.
- R. Gang boxes shall be installed and sized per NEC.
- S. Switch boxes shall not be used as junction boxes.
- T. Install boxes in walls without damaging wall insulation.
- U. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- V. In inaccessible ceiling areas, position outlets and junction boxes within 6" of recessed luminaire, to be accessible through luminaire ceiling opening.
- W. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes in acoustic ceiling areas from building structures, not from acoustic ceilings. Light fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.
- X. Set floor boxes level and flush with floor. Install non-rated floor boxes as detailed on the Architectural Drawings.
- Y. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

Z. Where outlet or switch boxes are not supported from studs or joists directly, they shall be supported by expandable clip type bar hangers, Appleton Catalog No. SX-18 or SX-26. In no case shall conduit be used to support switch or outlet boxes.

AA. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8" plaster covering back of box.

END OF SECTION 16130

Section 16140 – Wiring Devices

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide wiring device work as required and as specified herein. The extent of miscellaneous electrical controls and control wiring work is as indicated by the requirements of this Section and as specified elsewhere in these Specifications. Temperature control wiring shall be performed by Division 15 except where specifically noted.
- B. Types: The types of electrical wiring devices and miscellaneous electrical controls and control wiring required for the project include the following:
1. Wiring Devices:
 - a. Receptacles
 - b. Switches
 - c. Wall plates
 - d. Occupancy Sensors
 2. Miscellaneous Electrical Controls
 - a. Contactors
 - b. Relays
 - c. Photocells
 - d. Time Switches
 3. Miscellaneous Control Wiring: Control and alarm wiring, conduit and connections shall be provided by the Division responsible for monitoring the equipment or system, unless otherwise specified.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
1. Wiring Devices:
 - a. Bryant
 - b. Eagle
 - c. G.E.

- d. Hubbell, Inc.
 - e. Leviton Mfg. Co., Inc.
 - f. Lightolier, Inc.
 - g. Lutron, Inc.
 - h. Pass and Seymour, Inc.
 - i. Prescolite
 - j. Wiremold
2. Contactors and Relays:
- a. Allen-Bradley
 - b. Automatic Switch Company
 - c. Square D Company
 - d. General Electric
3. Photocells and Time Switches
- a. Paragon Electric Company
 - b. Intermatic Time Controls
 - c. Tork, Inc.
 - d. Precision Multiple Controls

B. UL Label: All wiring devices shall be UL-labeled.

Part 2 Products

2.01 **Fabricated Devices:**

- A. General: Provide factory-fabricated wiring devices in type and electrical rating for the service indicated. Coordinate color with VPTC Management Partners, LLC. Catalog numbers of particular wiring devices are specified to establish a basis of design only. Equivalent products by manufacturers specified above are acceptable.
- B. Receptacles: Comply with NEMA Standard WD1 and as follows:
- 1. General Duty: Provide simplex or duplex commercial grade type receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, with metal mounting straps, side-wired with screw type terminals, molded phenolic compound, NEMA configuration as indicated. Color to be selected by Architect/Owner/Tenant. The following part numbers are based on commercial grade devices:
 - a. 15 amp, 125 volt grounded simplex NEMA #5-15R: Pass & Seymour (P&S) #5251-I.

- b. 15 amp, 125 volt grounded duplex NEMA #5-15R: P&S #CR15-I.
 - c. 15 amp, 125 volt grounded duplex NEMA #5-15R, isolated ground (orange ace): P&S #IG6200.
 - d. 20 amp, 125 volt grounded simplex NEMA #5-20R: P&S #5351-I.
 - e. 20 amp, 125 volt grounded duplex NEMA #5-20R: P&S #CR20-I.
 - f. 20 amp, 125 volt grounded duplex NEMA #5-20R, isolated ground (orange face): P&S #IG6300.
 - g. 15 amp, 125 volt grounded duplex NEMA #5-15R, ground fault interrupter: P&S #1591-I.
 - h. 20 amp, 125 volt grounded duplex NEMA #5-20R, ground fault interrupter: P&S #2091-I.
2. Heavy-duty Simplex: Provide single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal-mounting straps, back wiring, black molded phenolic compound, NEMA configuration as indicated.
- a. 30 amp, 125 volt grounded single NEMA #5-30R: Hubbell #9308 with #9363 stainless steel plate.
 - b. 30 amp, 250 volt, grounded, 3-wire, 2-pole NEMA #6-30R: Hubbell #9330 with #9353 stainless steel cover plate or weatherproof cover plate, as required.
 - c. 20 amp, 125/250 volt, grounded, 4-wire, 3-pole NEMA #14-20R: Hubbell #8410 with #93091 stainless steel cover plate.
3. General Duty Clock Simplex: Provide single commercial grade type receptacles, 2-pole, 3-wire grounding, recessed to contain male plug and permit clock to cover outlet, with metal hook for supporting clock, molded phenolic compound, side and back-wired with screw type terminals, NEMA configuration as indicated. Color to be selected by Architect/Owner/Tenant.
- a. 15 amp, 125 volt, grounded single NEMA #5-15R: P&S #S3713-I.
- C. Switches: Comply with NEMA Standard WD1 and as follows:
1. Toggle: Provide commercial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, brown switch handle, side-wired terminals, horsepower rated. Use toggle switches as fractional horsepower motor disconnect switches and to control lighting. Color to be selected by Architect/Owner/Tenant.
 - a. Single-pole, 120/277 volt, 20 amp switch, key operated: P&S #20AC1-L.
 - b. Single-pole, 120/277 volt, 20 amp switch: P&S #CS120-I.
 - c. Single-pole, 120/277 volt, 20 amp switch, red pilot light: P&S #20AC1-RPL.
 - d. Three-way, 120/277 volt, 20 amp switch: P&S #CS320-I.
 - e. Two-pole, 120/277 volt, 20 amp switch, two pole: P&S #PS20AC2-I
 - f. Three-pole, 600 volt, 30 amp switch/controller: P&S #7803

- D. Wall Box Dimmers: Provide self-contained, wall box mounted, linear slide square law dimmers with a positive OFF position at the end of travel. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and with an input of 100 to 130 volts. Color to match other devices.
1. Single-pole, 120 volt, 1000 watt: Lutron #N-1000.
 2. Single-pole, 120 volt, 1500 watt: Lutron #N-1500.
 3. Single-pole, 120 volt, 2000 watt: Lutron #N-2000.
- E. Occupancy Sensors: Passive infrared (switch style); dual infrared/ultrasonic motion sensors. Coordinate mounting and coverage type with room size and sensor location.
1. Ceiling Mounted: Leviton #osc series with 120/277 volt, 20 amp #osp20 power pack.
 2. Wall Mounted: Leviton #osw series with 120/277 volt, 20 amp #osp20 power pack.
 3. Switch Location: 120/277 volt, PIR, 1800VA/4000VA: Leviton #ods15-id
- F. Lighting Contactors and Relays: Provide contactors and relays as required and specified herein. The number of poles, ampere ratings and pole arrangements shall be as required. All contactors and relays shall conform to the following:
1. Be rated for continuous duty at full-rated current in an unventilated enclosure. Eight-hour duty ratings will not be acceptable.
 2. Contacts shall be readily replaceable, self-aligning, silver or silver tungsten alloy.
 3. Control voltage shall be 120 volt, 60 Hz, unless otherwise specified.
 4. All auxiliary contacts shall be rated for not less than 10 amperes.
 5. Contactors rated for lighting and mixed loads shall have an interrupting capacity of 150% of their continuous duty rating.
 6. Be capable of successfully handling inrush currents at 20 times rating.
- Lighting contactors shall be powered open/powered closed mechanically held devices that WILL NOT rely on constant power to hold the device in either the open or closed position.
- G. Mechanically-held Devices: Mechanically-held devices shall conform to the following:
1. Be single solenoid operated,
 2. Be positive locking without the use of latches, hooks, or magnets,
 3. Control stations shall be momentary action, unless otherwise shown and make-but-not break coil current,
 4. Permit manual operation in either direction and provide visual indication of contact position.
 5. Control circuits shall be 3-wire with separate open and close circuits, unless otherwise required.
 6. Contactors rated at 225 amperes or less shall operate satisfactorily in any mounting position.

H. Magnetically-held Devices: Magnetically-held devices shall conform to the following:

1. AC operated units shall have laminated low loss electrical steel core pieces with machine ground pole faces and shading coils.
2. Units rated at 300 amperes and above shall have dc operating coils and include the necessary rectifier for the AC/DC operation.

Normally open contactors shall be spring-loaded open and magnetically closed.

2.02 Wiring Device Accessories:

A. Wall Plates: Provide switch, duplex outlet, and telephone wall plates, with single or multigang cutouts as indicated, complete with metal screws for securing plates to devices. Screw heads shall be colored to match finish of plate. Wall plates shall possess the following additional construction features:

1. Material and Finish:
 - a. Specification grade, smooth, plastic for general duty receptacles and switches. Color to be selected by Architect/Owner/Tenant.
 - b. Specification grade, smooth, Lexan, nylon, or Norryl for general duty receptacles for elevator lobbies, entrance lobbies, restrooms, and public areas. Color to be selected by Architect/Owner/Tenant.
 - c. Specification grade, Type 302, satin-finished stainless steel, 0.030 in. thick for heavy duty receptacles and general duty receptacles and switches for food service areas.
 - d. Specification grade, weatherproof, cover plate, Lexan fiberglass-reinforced, with gasket, for exterior and wet area receptacles.

2.03 Interior and Exterior Lighting Control:

A. Photocells: Provide self-contained, adjustable, weatherproof photoelectric controls designed for mounting on an outdoor junction box. Photoelectric control shall switch on at dusk and off at dawn and be adjustable in a range of 2 to 50 fc. This control shall be incorporated into the BAS (when used) as an input point.

1. Photoelectric control shall have 2000-watt contacts suitable for the voltage used and shall include an inherent 5-second delay in operation to prevent false switching.

B. Time Switches: Provide time switches with astronomic dial and contacts as required and 10-hour reserve power feature. Time switches shall be installed in a flush or surface-mounted NEMA 1 enclosure as required.

1. Where the facility is provided with a Building Automation System (BAS) per 15950, the BAS will provide the time switching function. This contractor shall provide and install lighting contactor and land the low voltage wire to the contactor as provided by the mechanical contractor.

C. Photocell By-pass: Provide a by-pass for the photocell in the exterior lighting circuit to enable the testing of the exterior lighting during daylight hours. This by-pass will enable the exterior lights to be energized without manually covering the photocell.

- D. Where required by code, interior lighting for spaces over 5,000 sq. ft. shall be provided with automatic shutoff per ASHRAE 90.1.
- E. Interior elevator lobby lighting, Atrium lighting, lobby lighting, tenant corridors, and loading docks shall be provided with lighting contactors connected into the BAS. Atriums will be provided with ambient light sensors connected to the BAS to control of lighting levels during daytime hours. This control will be plan specific and may include part or all of the lighting circuits.
- F. Parking decks shall be connected to a lighting contactor connected to the BAS. Photo cells or ambient light controls will be incorporated into the control scenario so that the outer bay of lighting at each elevation can be turned off based on ambient light levels. All circuiting shall be configured to allow for this switching scenario. Each level at each elevation (assuming exposure to ambient light) shall have its own circuit with light control.

2.04 Wiring and Raceways:

- A. Line Voltage Control Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors".
- B. Low-Voltage Control Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors", except that conductors shall consist of a multiconductor jacketed cable whenever possible.
- C. Raceways: Raceways for line voltage and low-voltage control wiring shall be as specified in Section 16110, "Electrical Raceways and Fittings", and Section 16130, "Electrical Boxes and Fittings".

Part 3 Execution

3.01 Installation of Wiring Devices:

- A. General: Install wiring devices in accordance with manufacturer's written instructions, applicable requirements of NEC, and in accordance with recognized industry practices to ensure that products serve intended function. Delay installation of devices until wall construction and wiring is completed.
- B. Box Condition: Install receptacles and switches only in electrical boxes which are clean, free from excess building materials, debris, and similar matter.
- C. Alignment: Install all wiring devices plumb and aligned in the plane of the wall, floor, or ceiling in which they are installed.
- D. Switches: Install switches at a height of 48" to switch centerline on the strike side of doors as hung and in a uniform position so that the same direction will open and close the circuit throughout the project. Where there is more than one switch in the same location, install switches in a multigang box with a single cover plate. Where two or more circuits of a 480/277 volt system are present in one box provide barriers between switches.
- E. Receptacles: Install receptacles at 18" to receptacle centerline above finished floor and horizontally at 6" to receptacle centerline above counter tops unless shown otherwise. Where back splash occur above counters, mount devices horizontally at 4" to receptacle centerline

above back splash. All devices shall be installed complete with cover plates. Use 20 ampere receptacle when only one receptacle is installed on a branch circuit. Provide GFI protected receptacles in all toilet rooms, exterior locations, elevator pits, at rooftop mechanical equipment, and at other locations as required by NEC, applicable state and local codes, and the local electrical inspection agency.

- F. Cover Plates: Install stainless steel cover plates on all heavy duty wiring devices and on all wiring device in kitchen areas. Install Lexan, nylon, or Noryl cover plates on all receptacles in elevator lobbies, entrance lobbies, restrooms, and public areas. Install weatherproof cover plates on all exterior and wet area receptacles. Install plastic cover plates on all other 15 and 20 amp wiring devices.
- G. Lighting Contactors: Install in a NEMA 1 enclosure at indoor locations and a NEMA 3R enclosure at exterior locations. Control of contactor by BAS, Timeclock and Photocell control if no BAS system exists.

3.02 Protection of Wall Plates and Receptacles:

- A. General: Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.03 Installation of Miscellaneous Electrical Controls:

- A. General: Install miscellaneous electrical control devices as shown, in accordance with applicable portions of the NECA's "Standard of Installation" and recognized industry practices to ensure that products serve the intended functions.
- B. Conductors: Connect electrical conductors to miscellaneous electrical control devices in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, match conductors of the electrical connection for proper interface between the electrical supply and the installed equipment.
- C. Contactors and Relays: Install contactors and relays mounted in panelboards or individual enclosures as shown and be complete, including all control wiring and devices.
- D. Photocells and Time Switches: Install lighting controls as shown. Photocell and time switch settings shall be as directed by VPTC Management Partners, LLC.
- E. Line and Low-voltage Control Wiring: Line and low-voltage control wiring shall be installed in a suitable raceway.
- F. Connections: Refer to Section 16121, "Electrical Connections for Equipment", for connections to equipment.

3.04 Testing:

- A. General: Prior to energization, check for continuity of circuits, for short circuits, and check grounding connections. After energization, check wiring devices to demonstrate proper operation and receptacles for correct polarization.

END OF SECTION 16140

Section 16440 – Safety and Disconnect Switches

Part 1 Part 1 - General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide safety and disconnect switch work as required and as specified herein.
- B. Types: The types of safety and disconnect switches required for the project includes the following:
 - 1. Equipment disconnects
 - 2. Motor-circuit disconnects

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
 - 1. General Electric Company
 - 2. Siemens Sentron
 - 3. Square D Company
 - 4. Cutler-Hammer
- B. NEMA Compliance: Comply with National Electrical Manufacturers' Association (NEMA) Standard KS1.
- C. UL-Approved: Safety and disconnect switches must have Underwriters' Laboratories approval and bear the UL label.

Part 2 Products

2.01 Material:

- A. General: Provide dead front, sheet steel-enclosed, surface mounted safety switches of the type and size indicated, general-duty type for use on circuits of up to 240 VAC maximum, heavy-duty type for circuits above 240 VAC. Fusible general-duty type safety switches are UL short circuit rated for use on circuits of up to 100,000 rms symmetrical amperes with proper rejection kit and Class R fuses. Fusible heavy-duty type safety and disconnect switches are UL short circuit rated for use on circuits of up to 200,000 rms symmetrical amperes with proper rejection kits and Class R fuses. Safety and disconnect switches shall be applied only within the above listed short circuit ratings.

B. Switch Mechanism:

1. Safety switches shall be quick-make quick-break type with permanently attached arc suppressors and constructed such that switch blades are visible in the "OFF" position with the door open. The operating handle shall be an integral part of the box, not of the cover. Switch shall have provision to padlock in the "OFF" position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the "ON" position or closing of the switch mechanism when the switch door is open.
2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. All current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper cable and front removable.
3. Provide electrical auxiliary interlock kit for interrupting control or auxiliary circuits to the equipment being served.

C. Fusing: Provide fusible safety and disconnect switches where required. Fuse clips shall be positive pressure rejection type fuse clips suitable for use with UL Class R fuses.

D. Neutral: Provide safety switches with number of switched poles as required. Where a neutral is present in the circuit, provide a solid neutral with the disconnect switch.

E. Enclosures:

1. All safety switches installed in indoor locations shall be NEMA 1 general purpose enclosures unless otherwise required.
2. Safety switches installed in exterior locations shall be NEMA 3R (water resistant) unless otherwise required.
3. Safety switches installed at cooling towers and in other wet areas, shall be NEMA 4 or NEMA 4X, unless otherwise required.

Part 3 Execution

3.01 Installation of Disconnect Switches:

- A. General: Install safety and disconnect switches in accordance with the manufacturer's written instructions, the applicable requirements of the NEC, the NECA'S "Standard of Installation", and recognized industry practices to ensure that products serve the intended function. Provide identification on each switch that indicates the load it disconnect and the service they are fed from.
- B. Location: Provide a disconnect switch at each motor. Install a disconnect switch used with motor-driven appliances, motors and controllers within sight of the controller position.
- C. Supports: Provide all safety and disconnect switches with galvanized angle or other suitable supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas.

- D. Coordination: Coordinate safety and disconnect switch installation work with electrical raceway and cable work as necessary for proper interface.

3.02 Testing:

- A. General: Prior to energization, check for continuity of circuits and for short circuits.

END OF SECTION 16440

Section 16450 – Electrical Grounding

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide electrical service and equipment grounding as required and as specified herein.
- B. Types: The types of electrical service and equipment grounding specified in this Section include, but are not necessarily limited to, grounding all equipment and devices shown and as required by the National Electrical Code (NEC), the local electrical inspection agency, and the local power company.

1.03 Quality Assurance:

- A. NEC Compliance: Comply with Article 250 of the NEC (NFPA 70) for grounding.
- B. Approval: All grounding shall be in accordance with the requirements of, and shall be subject to the approval of VPTC Management Partners, LLC and the local electrical inspection department.
- C. UL Label: All grounding products shall be UL-labeled.

Part 2 Products

2.01 Materials and Components:

- A. General: For each electrical grounding connection, provide a complete assembly of materials to construct a completely grounded electrical system.
- B. Ground Rods: Ground rods shall be 3/4" diameter and a minimum of 10' long with steel core and thick copper jacket. Ground rods shall be as manufactured by Copperweld.
- C. Raceways: Raceways for grounding conductors shall be as specified in Sections 16110, "Electrical Raceways and Fittings", and 16130, "Electrical Boxes and Fittings".
- D. Cable, Wire, and Connectors: Grounding cable, wire and connectors shall be as specified in Section 16120, "Cable, Wire, and Connectors".

Part 3 Execution

3.01 Installation of Electrical Grounding:

- A. General: Install grounding connections in accordance with applicable portions of the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.
- B. Grounding Electrode System: The main switchboard neutral and ground bus shall be connected to the incoming cold water piping system to the building on the street side of the building water meter. The main grounding conductor shall be sized as shown and shall be run in conduit, where required by code. The cold water pipe ground shall be supplemented as required by NEC, Article 250 H, and as required by the local inspection department. In addition, the lightning protection system ground rods specified in Section 16670, "Lightning Protection System", shall be interconnected with a bonding loop below the basement slab. This loop shall be bonded to the electric service ground and to the local power company transformer ground rods.
- C. Building Equipment Grounding System: The building equipment grounding system shall consist of the ground wire, where required by code, and electrically continuous metallic conduit system. Every item of equipment served by the electrical system shall be bonded to the building equipment ground. Portions of metallic piping and duct systems that are electrically isolated shall be bonded to the equipment grounding system with a flexible bonding jumper. The conduit shall be sized for all conductors contained within it per applicable sections of the NEC. Ground connections shall be in accordance with the National Electrical Code being used by this jurisdiction.
- D. Bonding: All metallic piping systems and building steel shall be effectively bonded to the electrical grounding system in accordance with Article 250 of the NEC. Install bonding jumpers to all piping systems and building steel.
- E. System Neutral: The system neutral shall be grounded to the grounding electrode system at the service entrance only, and shall be kept isolated from the building grounding system throughout the building. The neutral of separately derived systems shall be grounded at one point as specified hereinafter.
- F. Miscellaneous: Provide bonding and grounding wires run in conduit and sized per the NEC in accordance with the local electrical inspection department and the NEC. Metallic piping and duct systems that enter the building shall be grounded at the point of entry to the building, in accordance with the NEC.
- G. Continuity: Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be installed across conduit expansion fittings, all liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6' and all other non-electrically continuous raceway fittings.
- H. Main Conductors: All main grounding conductors shall be stranded copper conductors, sized as shown and run in a suitable raceway. All main grounding conductors shall be continuous without joints or splices over their entire length.
- I. Special Grounding: Provide special grounding systems where required.
- J. Separately Derived System Grounding: Bond the case and neutral of each transformer directly to the nearest available effectively grounded structural metal member of the structure, the nearest available effectively grounded metal water pipe or in accordance with the local electrical inspection department. Flexible conduit shall not be used as a ground path to a transformer.

- K. Verify generator grounding depending on application.
- L. Emergency Power System: Where the transfer switch does not interrupt the neutral, this is a non-separately derived system and shall not have its neutral grounded to the generator frame.
- M. Telephone Equipment Grounding: Provide a ground conductor from the telephone service equipment to the building grounding system as required by the local Telephone Company.
- N. Fluorescent Fixtures: Carefully and securely ground all fluorescent fixture bodies to the conduit grounding system.
- O. Receptacles: Ground all grounding type receptacles with a separate ground wire where required per 3.01/C above. Receptacles with ground straps shall not require ground wire unless otherwise required.
- P. Isolated Ground Receptacles: Ground each isolated ground receptacle with a separate insulated ground wire; this ground wire shall not be connected to the outlet box. Run the isolated grounding conductor to an isolated ground bus in the panelboard and then back to the "source". At that point, bond the isolated ground to the equipment ground, neutral, and grounding electrode system. Ground each isolated receptacle outlet box with a separate grounding conductor unless a metal raceway is to be used and effectively grounds the outlet box.
- Q. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire either around the flexible conduit, or contained within the flexible conduit.
- R. Fountains and Pools: All fountains and pools shall be properly grounded in accordance with Article 680 of the NEC.
- S. Rigid Nonmetallic Conduit Systems: Install a continuous grounding conductor in accordance with NEC.
- T. Bolted Connections: Connections requiring bolting shall be made up with Monel metal bolts, washers, and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal. No strap grounding clamps shall be used.
- U. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to service grounding electrode.
- V. Telecommunications Rooms: Provide a continuous ground bar along the entire length of the room's longest wall. Provide a #6 ground wire from the bus to the building ground at the main service switchboard. Connect each telecommunication's room ground bus together with a #6 ground wire.

3.02 Coordination:

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Connections: Use exothermic welds or other approved means for connecting bonding and grounding conductors to ground rods, to counterpoise, structural steel, piping systems, and elsewhere as required by the application. Provide all accessories required for a complete installation.

3.03 Testing:

- A. Ground Resistance Test: Perform a ground resistance test on the building grounding systems for comparison to future inspection and testing data by the Owner. Service ground resistance shall not exceed 5 ohms. Overall system resistance shall not exceed 15 ohms. Test shall be performed using a Biddle Megger or equivalent test instrument operated in accordance with the test instrument manufacturers operating/test procedure. Test readings shall be taken after 30 and 60 seconds of Megger operation at slip speed. The test shall not be performed immediately following wet weather conditions.
- B. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit two copies of certified test results for Owner's record and submit four copies of certified test results to VPTC Management Partners, LLC for review. Test reports shall include date and time of tests, relative humidity, test results, temperature, and weather conditions.

END OF SECTION 16450

Section 16460 - Transformers

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: Provide transformer work as required and as specified herein.
- B. Types: The types of transformers required for the project include dry type general purpose transformers.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
 - 1. General Electric Company
 - 2. Square D Company
 - 3. Cutler-Hammer
 - 4. Siemens
- B. Standards: Transformers shall be designed and tested in accordance with NEMA and ANSI C33.4 and C89.2 standards.
- C. UL Label: All transformers shall be UL-labeled.

Part 2 Products

2.01 Materials and Components:

- A. General: Provide transformer manufacturer's standard materials and components as indicated by his published product information, designed and constructed as recommended by the manufacturer and as required for a complete installation. Provide handles on all transformer removable access panels.

2.02 Dry-Type, General Purpose Transformers:

- A. General:
 - 1. Indoor transformers shall be dry type, 2-winding transformers, rated as shown, and shall have manufacturer's standard impedance.

2. Primary winding of 3-phase transformers shall be delta-connected. Secondary windings of 3-phase transformers shall be wye connected, with the common neutral brought out. Transformer primary and secondary voltages shall be as shown on the Drawings.
 3. Suppression transformers shall have the primary and secondary coils physically separated.
- B. Construction:
1. Transformer core shall be of a common core construction using cold rolled, oriented, high permeability silicon steel, formed as a coil. Windings shall be copper or electrical grade aluminum individual windings terminated with tin-plated or silver-plated copper bars or wire electrically welded to the ends of the windings, Neutral terminals for K Factor rated transformers shall be designed for 200 percent of the secondary phase conductor ampacity. Foil windings shall not be acceptable.
 2. Transformer coils shall be vacuum pressure impregnated (VPI) or dipped with non-hydroscopic, thermosetting varnish and shall have a final wrap of electrical insulating material designed to prevent injury to the magnet wire. Transformers having coils with magnet wire visible will not be acceptable. The core and coil shall be completely isolated from the enclosure by means of vibration absorbing mounts.
 3. All ventilating openings shall be of the baffled type. Ventilated dry-type transformers installed in sprinklered space shall have rain shields on all openings.
 4. The base of the transformer shall be constructed of heavy gauge steel. The transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished with baked enamel.
- C. Taps: Transformers 0.25 to 2 kVA shall have no taps. Transformers 3 to 9 kVA shall have a minimum of two 5% taps below normal. Single phase transformers 25 to 167 kVA and 500 kVA 3-phase transformers shall have a minimum of four 2-1/2% taps, two above and two below normal. Three phase transformers 15 to 300 kVA shall have a minimum of six 2-1/2% taps, two above and four below normal.
- D. Temperature Rating: Transformers shall utilize an insulation system which has been properly temperature classified and approved by UL. Transformers smaller than 2 kVA shall have a maximum winding temperature rise of 80°C with an insulation system temperature classification of 155°C. Transformers 2 through 9 kVA shall have a maximum winding temperature rise of 115°C with an insulation system temperature classification of 185°C. Transformers 15 kVA and above shall have a maximum winding temperature rise 115°C energy saving and K Factor rated design or 150°C (general purpose) with an insulation system temperature classification of 220°C. Energy saving temperature rise shall be obtained by increasing the transformer conductor size and shall not employ larger air ducts or cooling aids to lower the resistance temperature rise. The maximum top of case temperature shall not exceed 35°F (energy saving design) or 50°F (standard and K Factor rated designs) rise above ambient.
- E. Non-Linear Load Ratings: Transformers serving personal computers, HID lighting and other non-linear loads shall be K Factor rated to serve non-linear loads. Transformer primary and secondary temperature shall not exceed 220°C at any point in the coils while carrying the transformer full rated capacity of non-linear loads at the load K Factor shown on the drawings.
- F. Load Rating:

1. Transformers shall be capable of operating at 100% of nameplate rating continuously while in an ambient temperature not exceeding 40°C.
 2. Transformers 5 kVA and larger shall be capable of meeting the daily overload requirements of ANSI Standard C57.12.
- G. Vibration Isolation: Each transformer core and coil shall be mounted in the transformer enclosure on rubber vibration isolators. If vibration isolators limit the transmission of sound from the 120 Hz harmonic to 10% of its un-isolated level and are certified as such on the shop drawings, the vibration isolators under PART 3 - EXECUTION may be omitted.
- H. Grounding: The core and coils shall be visibly grounded to the frame of the transformer cubicle by means of a flexible grounding strap of adequate size.
- I. Sound Rating: The transformer shall have sound levels equal to or lower than those ratings established in the latest revision of NEMA ST-20. Sound ratings shall be measured per ANSI C89.91.
- J. Testing:
1. The manufacturer shall have thoroughly tested each transformer for proper operation before shipment.
 2. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied. Furnish proof-of-performance of these tests in the form of test data sheets upon request.
 - a. Sound levels,
 - b. Temperature rise tests,
 - c. Full-load core and winding losses,
 - d. Percent regulation with 80 and 100% power factor load,
 - e. Percent impedance,
 - f. Exciting current,
 - g. Insulation resistance, and
 - h. Efficiency at 1/4, 1/2, 3/4, and full load.
- K. Shield: Provide an electrostatic shield between the transformer primary and secondary to attenuate source side line interference for all transformers with a K factor greater than 1.0.

Part 3 Execution

3.01 **Installation of Transformers:**

- A. General: Install transformers in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the transformers comply with the requirements and serve the intended purposes. Comply with the requirements of NEMA and NEC standards and applicable portions of NECA's "Standard of Installation", for installation of transformers.

- B. Dry Type Transformer Mounting: Floor mount transformers on properly sized Amber/Booth Type RYD rubber-in-shear vibration isolators or trapeze-mount using properly sized Amber/Booth Type BRD rubber-in-shear hangers. If the requirements of Paragraph 2.02.G. above are met, the additional external isolators may be deleted. Transformer enclosures shall make no contact with wall surfaces.
- C. Conduit: All conduits directly connected to transformer enclosures shall be flexible steel conduit extending for a minimum of one foot from transformer enclosure as measured along the conduit centerline. Include a ground wire, size per the NEC, in each length of flexible conduit.
- D. Concrete Pads: Install transformers on a 3-1/2" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the transformer. Pads shall be minimum 2500 psi (28 Day) concrete. Pad tops and sides shall be hard troweled smooth with a 3/4" bull nose on all external corners. Transformer shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers where required by the manufacturer.

3.02 Testing:

- A. Winding Tests: Prior to energization, check transformer windings for continuity. During initial no-load energization, check current in each primary winding.
- B. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.
- C. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to VPTC Management Partners, LLC for review. Reports shall include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.
- D. Notification: Notify VPTC Management Partners, LLC in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION 16460

Section 16470 – Panelboards and Enclosures

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.
- B. Division 16 Section "Motor Starters" for motor control devices and protection requirements for panel mounted motor control units.

1.02 Description of Work:

- A. Work Included: Provide panelboard and enclosure work, including cabinets, as required and as specified herein.
- B. Types: The types of panelboards and enclosures required for the project include the following:
 - 1. Power distribution panelboards, and
 - 2. Lighting and appliance panelboards.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
 - 1. General Electric Company
 - 2. Siemens Sentron
 - 3. Square D Company
 - 4. Cutler-Hammer
- B. UL Standards: Panelboards and enclosures shall conform to all applicable UL standards and shall be UL-labeled.

Part 2 Products

2.01 Materials and Components:

- A. General: Lighting and appliance panelboards shall be dead front safety type equipped with molded case circuit breakers as shown and scheduled. Power distribution panelboards shall be dead front type equipped with fusible switches or circuit breakers as required. **"Load Center" construction is not acceptable.**
- B. Busing Assembly: Panelboard and power distribution panel board busing shall be silver-plated copper or tin-plated 55% conductivity aluminum, plated by the latest Alstan process. Bus structure and mains shall have ratings as required by the loads served. Such ratings

shall be established by heat rise tests in accordance with the applicable standards from UL, NEMA, and ANSI. Busing shall be derated if the ambient temperature of location where the panelboard is installed exceeds the ambient temperature listed in the standards. All bolted joint connections shall have at least two bolts per joint per phase. All bolted connections for aluminum bus having a yield strength of less than 20 KPSI shall have Belleville washers. Half lapped bus joint construction will not be acceptable. Furnish a bare uninsulated (insulated where required) ground bus inside each panelboard enclosure. All two-section panelboards shall be connected with copper cable, with an ampacity meeting or exceeding the main bus ampacity.

- C. Circuit Breakers: Circuit breakers shall be of the molded case, thermal magnetic type equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. All panelboards shall have bolt-in breakers. All 2 and 3-pole breakers shall have common trips.
1. Provide panel board circuit breakers with conventional interrupting capacity unless otherwise required by the application, but in no case less than the following symmetrical amperes RMS:
 - a. 120/208 volts - 10,000 AIC Interrupting capacity
 - b. 277/480 volts - 14,000 AIC Interrupting capacity
 2. Ground fault interrupter (GFI) circuit breakers, where required, shall be 5 ma ground fault trip and shall include a TEST button.
 3. Provide distribution panel circuit breakers with conventional interrupting capacity, high interrupting capacity or integral current limiters as required. Circuit breakers shall be conventional interrupting capacity unless otherwise required, but in no case less than the symmetrical amperes RMS listed in Item 1 above.
 4. All circuit breakers serving fluorescent lighting branch circuits shall have an SWD rating.
 5. All circuit breakers serving heating, air-conditioning, and refrigeration loads shall be HACR rated.
 6. All circuit breakers serving HID lighting branch circuits shall be approved for such loads by the circuit breaker manufacturer.
- D. Fusible Switches: Fusible switches shall be quick-make quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Cover shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position. This interlock shall be constructed so that it can be over-ridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the "OFF" position. Switches shall include positive pressure rejection type fuse clips for use with UL Class R fuses and be UL-labeled for 200,000 AIC.
- E. Spaces: Where space for future breakers or switches is provided, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches and panelboard busing shall be complete, including all required connectors.
- F. Integrated Equipment Rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to the interrupting rating of the weakest overcurrent device installed in the

panelboard. Such ratings shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.

- G. Panelboard Enclosures: Provide sheet steel enclosures, NEMA Type 1, minimum 16 gage thickness, with multiple knockouts, unless otherwise required. Provide doors with concealed hinges, spring-loaded door pulls, flush lock and key, all panelboard enclosures keyed alike, equipped with interior circuit directory frame, card and clear plastic covering for all lighting and appliance panelboards. Provide painted gray enamel finish over a rust inhibitor. Enclosure shall be for recessed or surface mounting as required by the application. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multisection panelboards shall have common cover and trim.

Part 3 Execution

3.01 Installation of Panelboards and Enclosures:

- A. General: Install panelboards and enclosures, including electrical connections, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.
- B. Coordination: Coordinate installation of panelboards and enclosures with cable and raceways installation work.
- C. Anchoring: Anchor enclosures firmly to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Concrete Pads: Install floor mounted distribution panelboards on a 3-1/2" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the panelboard. Pads shall be minimum 2500 psi (28 Day) concrete. Pad tops and sides shall be hard troweled smooth with a 3/4" bull nose on all external corners. Panelboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers where required by the manufacturer.
- E. Directory Card: Type the enclosure's circuit directory card upon completion of work. Spare circuit breakers shall be labeled as such on the panelboard directory.
- F. Fuses: Install fuses, of the ratings and class shown, in each power distribution and motor control panelboard.
- G. Nameplate: Install plastic laminate panelboard nameplate that includes panelboard name, voltage, and feeder panel/circuit.
- H. Circuit Arrangement: Branch circuit connections to 3-phase lighting and appliance panelboards shall be arranged such that when two or three circuits are run with a common neutral, each circuit shall be connected to a different phase unless otherwise shown. Branch circuits shall be connected to the circuit breakers in the lighting and appliance panelboard to provide the best possible phase balance.
- I. Non-Linear Load Rated Equipment: Panels and panelboards supplied from K-rated transformers shall be furnished with 200% rated neutral busing. Neutral conductors between the transformer and the panel or panelboard shall be selected with at least twice the ampacity of the phase conductors. Where feed-through lugs are provided, the neutral conductors

between the panelboards must be rated with twice the ampacity of the required phase conductors.

2.02 Testing:

A. General: Prior to energization, check for continuity of circuits and for short circuits.

END OF SECTION 16470

Section 16475 - Fuses

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: The extent of fuse work is as indicated by the requirements of this Section and as specified elsewhere in these Specifications.
- B. Types: The types of fuses required for the project include the following:
 - 1. 250 volt current-limiting fuses
 - 2. 600 volt current-limiting fuses.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
 - 1. Bussmann Manufacturing
 - 2. Littelfuse, Inc.
 - 3. Gould – Shawmut
 - 4. Commercial Enclosed Fuse Company
- B. Coordination: All fuses shall, to the maximum extent possible, be from the same manufacturer and in matched sets per load to facilitate positive selective coordination of protective devices. Fusing shall be selectively coordinated using size ratios for fuse types installed, as published by the fuse manufacturer.

Part 2 Products

2.01 Current Limiting Fuses - 600 Volts and Less:

- A. General: Provide 200,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings required and with a voltage rating equal to or greater than the voltage at the point of application.
- B. Types:
 - 1. Fuses in circuits supplying individual motors, groups of motors or loads including motors, 600 amperes or less, shall be UL Class RK1 dual-element, time-delay fuses.

2. Fuses in circuits supplying individual motors, groups of motors or loads including motors, 601 to 4000 amperes, shall be UL Class L time-delay fuses. Provide silver link construction.
 3. Fuses in circuits supplying other than motor loads, 600 amperes or less, shall be UL Class RK1 dual-element, time-delay fuses.
 4. Fuses in circuits supplying other than motor loads, 601 to 4000 amperes or less, shall be UL Class L time-delay fuses.
 5. Where the available short circuit currents and the manufacturer's data on circuit breaker series ratings with fuses dictate, fuses shall be UL Class J time-delay fuses, Bussmann Type JKS or equal.
- C. Lighting Fixture Protection: All HID ballasts shall be protected on the supply side with a Bussmann type GLR fuse in a Bussmann type HLR fuse holder.

2.02 Spare Fuses:

- A. General: Provide spare fuses in the amount of 10% of each type and size installed, but not less than three spares of a specific size and type. Deliver these spares to the Owner at the time of acceptance of the project. Fuses shall be neatly encased in a properly labeled steel enclosure with lock provision, to be wall mounted as directed in the main electrical room.

Part 3 Execution

3.01 Installation:

- A. General: Install fuses in fuse holders immediately prior to energization of the circuit in which the fuses are installed. Fuses shall be installed so that the electrical information is right-side up and visible. Fuses shall not be installed and shipped with equipment.
- B. Labels: Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch.

END OF SECTION 16475

Section 16482 – Motor Starters

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: The extent of motor starter work is as indicated by the requirements of this Section and as specified elsewhere in these Specifications. Except for motor starters provided integral with the driven equipment, all starters shall be furnished and installed by the Electrical Contractor.
- B. Types: The types of motor starters required for the project include the following:
1. Individual motor starters
 2. Combination motor starters
 3. Manual motor starters
 4. Starters integral to M.C.C. or motor starter panelboards
- C. Reduced Voltage Starters: All motors of 50 hp and larger shall be provided with either star/delta, closed transition, or auto transformer type reduced voltage motor starters. Motors smaller than 50 hp may utilize reduced voltage starters provided cost benefits can be proven.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following:
1. Allen-Bradley
 2. Cutler-Hammer
 3. General Electric Company
 4. Siemens Sentron
 5. Square D Company

Part 2 Products

2.01 Individual Motor Starters:

- A. General: Individual motor starters shall consist of an integrally mounted, magnetic, full-voltage, nonreversing (FVNR); auto-transformer or wye-delta type, closed transition (RVNR), or 2-speed, 2-winding (2S-2W) starter in a heavy-duty type, dead front, sheet steel enclosure and surface-mounted. Starters may also be mounted in motor control centers or motor starter

panelboards. Size and number of poles shall be as required by equipment served. All starters shall be constructed and tested in accordance with the latest NEMA standards.

- B. Contacts: Magnetic starter contacts shall be solid silver cadmium oxide alloy and shall not require any filing, dressing, or cleaning throughout the life of the starter.
- C. Operating Coils: Operating coils shall be 120 volts and shall be pressure molded and designed so that accidental exposure to excessive voltage up to 480 volts will not damage the coil. The starter design shall also be such that when a coil fails due to an overvoltage condition, the starter shall definitely open and shall not freeze in the closed position.
- D. Overload Relays: All starters shall have manual reset, trip-free overload relays in each phase conductor. Three-phase FVNR and RVNR starters shall have three overload relays. Single-phase FVNR starters shall have an overload relay in each ungrounded conductor. Two-speed, full-voltage magnetic starters shall have overload relays in all six control legs. Overload relays shall not be field-convertible from manual to automatic reset.
- E. Pilot Lights: Provide RUNNING pilot lights for all motor starters. Provide FAST and SLOW pilot lights for all 2-speed starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.
- F. Controls: Provide starters with HAND-OFF-AUTOMATIC switches, or START-STOP push buttons as required. Provide for FAST-SLOW speed selection from HVAC control system for all 2-speed starters. All 2-speed starters shall have deceleration relays between fast and slow speeds. Coordinate motor starter controls with the requirements of Division 15. Motor starter controls shall be mounted in the starter enclosure cover. Disabling any function of these switches for specific control reasons shall only be allowed if approved by VPTC Management Partners, LLC. If changes in this operation are made, the starter shall be clearly labeled with the new operating conditions.
- G. Control Power: A single-phase control power transformer shall be included integrally with each starter for 120 volt control power. The primary shall be connected to the line side of the motor starter; the secondary shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer. If a motor controller is supplied with main power from one source and control power from another source, both sources will be clearly identified and the controller shall have a placard installed alerting the need to de-energize multiple sources of power to make safe the device.
- H. Auxiliary Contacts: Each starter shall have a minimum of one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock" and control wiring. In addition, it shall be possible to field-install one or more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.
- I. Unit Wiring: Unit shall be completely prewired to terminals to eliminate any interior field wiring except for:
 - 1. Connection of power supply conductors to switch line side terminals,
 - 2. Motor leads to the starter load side terminals, and
 - 3. Control conductors to holding coil terminals.

- J. Power Monitor: Provide a Square D Type MPS, Taylor Phase Guard, Diversified Electronics, or Agastat Electronics phase failure/phase reversal relay for each 3-phase motor starter serving a motor of 5 hp or greater. Monitor relay shall drop out upon loss of any phase, undervoltage on any or all phases, or phase reversal from A-B-C sequence. Relay shall be adjustable for trip range and shall automatically reset upon correction of trouble.
- K. Enclosures: All motor starter enclosures shall be NEMA 1, general purpose enclosures, unless otherwise required.

2.02 Combination Motor Starters:

- A. General: Combination motor starters shall consist of an integrally mounted magnetic starter and a fusible disconnect switch in a heavy-duty type, dead front, sheet steel NEMA 1 enclosure, surface-mounted. Size and number of poles shall be as shown and required by equipment served. Combination motor starters shall be as specified for individual motor starters in Paragraph 2.01/A, except as modified herein.
- B. Disconnect Switch: Disconnect switch shall be as specified in Section 16440, "Disconnect Switches".
- C. Unit Wiring: Unit shall be completely prewired to terminals to eliminate any interior field wiring except for:
 - 1. Connection of power supply conductors to switch line side terminals,
 - 2. Motor leads to the starter load side terminals, and
 - 3. Control conductors to holding coil terminals.
- D. Enclosures: All combination motor starter enclosures shall be NEMA 1, general purpose enclosures, unless otherwise required.

2.03 Manual Motor Starters:

- A. General: Manual motor starters shall consist of an integral starter and overload protection in a common enclosure, surface-mounted. Size and number of poles shall be as required by equipment served. Furnish pilot light when motor is located remote from the starter. Provide auxiliary contacts, as required, of an adequate rating to operate accessory equipment.
- B. Manual Motor Starters:
 - 1. Manual motor starter with overload protection, one horsepower maximum, 115 or 230 volts; Square D Class 2510 FG-1-(1) Pole, FG-2-(2) Pole; Square D Class 2510 FG-1P-(1) Pole with pilot light, and FG-2P-(2) Pole with pilot light.
 - 2. Manual motor starter with overload protection, five horsepower maximum, 600 VAC; Square D Class 2510 MBG2-(3) Pole with pilot light.
 - 3. Manual motor starter with overload protection, ten horsepower maximum, 600 VAC; Square D Class 2510 MCG3-(3) Pole with pilot light.
- C. Enclosures: All manual motor starter enclosures shall be NEMA 1, general purpose enclosures, unless otherwise required.

- D. Switch: For self-protected motors where one pole toggle motor control switch is allowed, the switch shall be as specified for toggle switches in Section 16140, "Wiring Devices".

Part 3 Execution

3.01 Installation of Motor Starters:

- A. General: Install motor starters in accordance with the manufacturer's written instructions, the applicable requirements of the NEC and the NECA'S "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.
- B. Overloads: Install overload heaters in each motor starter. Heater ratings shall be based on actual motor nameplate full load amps.
- C. Coordination: Motor starters shall be provided to properly coordinate with motors as furnished by Division 15. Motor starter controls shall be provided to properly coordinate with controls specified in Division 15.
- D. Nameplates: Install plastic laminate nameplate at each controller that includes load name and voltage.
- E. Supports: Provide all individual and combination motor starters with galvanized angle or other suitable supports where mounting on wall or other rigid surface is impractical. Starters shall not be supported by conduit alone. Where motor starters are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas. Manual motor starters shall be installed plumb and aligned in the plane of the wall in which they are installed.
- F. All motor starters shall be located and installed such that they are readily accessible as defined in the National Electrical Code.

3.02 Testing:

- A. Pre-energization Check: Check motor starters for continuity of circuits and for short circuits.
- B. Post Hook-up Test: Subsequent to wire and cable hook-ups, energize motor starter and demonstrate satisfactory functioning.
- C. Motor Rotation: Verify that motor rotation is correct as connected. Where rotation must be changed, reconnect phase conductors to motor leads at motor junction box.

END OF SECTION 16482

Section 16501 – Lighting Fixtures and Lamps

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 16010, "Basic Electrical Requirements", govern this Section.

1.02 Description of Work:

- A. Work Included: The extent of lighting fixture work is as indicated by the requirements of this Section and as specified elsewhere in these Specifications.

- B. Types: The types of lighting fixtures required for the project include the following:

1. Fluorescent type fixtures.
 - a. Fluorescent Downlights: Downlights for general ambient illumination or accent lighting applications in lobbies, vestibules, and other common building shell areas shall be energy-efficient fluorescent type.
2. High-intensity-discharge (HID) type fixtures:
 - a. Metal halide type fixtures
3. Incandescent type fixtures.
 - a. The application of incandescent fixtures is discouraged. Acceptable applications are as follows:
 - 1) Elevator pit lights, rooftop mechanical equipment service lights, x-ray in use signage, aircraft warning lights, special purpose fixtures and applications available only in incandescent versions or requiring dimming from 100% to 0 (zero) illumination level.
 - 2) Other applications are to be approved by VPTC Management Partners, LLC prior installation.

- C. Applications: The applications of lighting fixtures required for the project include the following:

1. General lighting
2. Emergency lighting
3. Outdoor area lighting

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following for ballasts, lamps, and light fixtures:

1. Ballast Manufacturers:

- a. Advance Transformer Company
 - b. Lutron
 - c. Universal Manufacturing Company
 - d. Sylvania Osram
2. Lamps:
- a. General Electric
3. Emergency Light Fixture Manufacturers:
- a. Lithonia
 - b. Sure-Lites
 - c. Concealite
 - d. Dual-Lite
 - e. Emergilite
4. Light Fixtures (various brands from the following companies)
- a. Lithonia Lighting
 - b. Cooper Lighting
 - c. Hubbell Lighting
 - d. Thomas Lighting
- B. CBM Label: Provide fluorescent ballasts which comply with Certified Ballast Manufacturers' Association (CBM) standards and carry the CBM mark on the label.
- C. UL Standards: Lighting fixtures shall conform to all applicable UL standards and shall be UL-labeled.

Part 2 Products

2.01 **Materials and Components:**

- A. General: Provide lighting fixtures, of the size, type, and rating as selected by the Architect and confirmed by the Construction Manager; complete with, but not necessarily limited to, lamps, lamp holders, reflectors, ballasts, starters, and wiring. Provide for separate supports for HID fixtures.
- B. Fixture Types:
1. Fluorescent Fixtures: Provide fluorescent fixtures complete with lamps and ballasts.
 - a. Fluorescent fixture lenses, where required, shall be extruded virgin acrylic, prismatic type, nominal 0.125" thick.

- b. Parabolic fixture louvers shall be low iridescent aluminum, 3" deep, in an 18 cell (3x6) configuration (2'x4' fixture size).
- c. Fluorescent fixtures in continuous rows shall be supplied with all fixture couplings, chase nipples, and other accessories recommended by the manufacturer for continuous row installation.
- d. Lamps:
 - 1) Each fixture shall be factory-lamped with energy saving, low fluorescent lamps compatible with electronic ballasts.
 - 2) T-5 lamps can be utilized as an energy saving measure for fluorescent fixture applications where reviewed and approved by VPTC Management Partners, LLC.
 - 3) Contractor shall replace any lamps damaged during shipping or installation, with lamps of like manufacture, to those installed in the future.
- e. Ballasts:
 - 1) Energy Saving Electronic Ballasts - Indoor Fluorescent: Provide UL-listed, low noise, high power factor, rapid start, Class P, thermally protected, encased and potted solid state energy saving electronic ballasts for indoor lighting fixtures. Ballasts shall operate at a frequency between 20 and 35 kHz and shall produce no visible lamp flicker. Ballasts shall operate lamps on parallel circuits and shall deliver normal lamp life. Lamp failure shall not affect ballast life. Ballasts shall comply with all applicable FCC and NEMA standards concerning EMI and RFI emissions and shall meet applicable ANSI standards related to harmonic distortion and surge suppression. Provide ballasts with a maximum power input wattage of 60 watts when installed in a surface-mounted, 2-lamp, strip fixture with standard F32T8 lamps. Ballast power factor shall be 90% or greater and input current harmonic content shall not exceed 10%. Electronic ballasts shall be manufactured by Advance, Osram, Lutron, or Universal. Ballasts shall be mounted in fixtures so as to provide maximum sound attenuation.
 - 2) Ballasts - Fluorescent: Where energy saving electronic ballasts are inappropriate due to ambient temperatures or fixture style, provide low noise, high power factor, rapid start, Class "P", thermally protected, encased, and potted magnetic, energy saving ballasts. Use ballasts for indoor conditioned spaces with an "A" sound rating and a +50°F temperature rating. Use ballasts for exterior or indoor non-conditioned spaces with a "C" sound rating and a 0°F temperature rating. Fixtures in fire rated ceilings shall have high temperature ballasts if the fixture is enclosed in a fire rated enclosure.
- f. Body Construction:
 - 1) Minimum 22 ga. steel, and
 - 2) Maximum body depth of 6-1/2".
- g. Enclosure: Enclosure door hinging either side is preferred.
- h. Shipping Requirements:
 - 1) It shall be the Contractor's responsibility to coordinate with the Construction Manager and evaluate the shipping schedule for fixtures as required by the progress of the job.

- 2) The Owner will not accept payment responsibility for fixtures scheduled and delivered out of construction sequence at an earlier time than reasonably required by job progress.
 - 3) Fixtures shall be in first class condition after installation. The lens shall be cleaned, if required. Fixtures with rust or damaged doors or lens shall be replaced at no cost to the Owner.
2. Fluorescent Downlights:
- a. Provide downlights for general ambient illumination or accent lighting applications in lobbies, vestibules, and other common building shell areas shall be energy-efficient LED type, nominal 6" diameter, with recessed housings, clear specular anodized aluminum reflector, low audible noise, high power factor ballast conforming to specifications listed elsewhere in this Section and color temperature as required to match the predominant fluorescent lamp in adjacent areas.
3. HID Fixtures: Provide HID fixtures complete with lamps and ballasts.
- a. Protect HID lighting fixtures on the line side of the ballast with fuse and holder. Holder shall be mounted in a protected location convenient for changing fuses or be an in-line waterproof holder. Size and type of fuse shall be as recommended by ballast manufacturer.
 - b. Provide high power factor, constant wattage, autotransformer ballasts with a -20°F temperature rating. Use ballasts for lamps up to 250 watts with a "B" sound rating. Use ballasts for lamps 400 watts and larger with a "C" sound rating.
 - c. All fixtures used as unswitched night lights shall also contain a quartz restrike system. In addition to NL fixtures, provide (1) fixture equipped with a quartz restrike system for every 6 fixtures or fraction thereof installed in a space.
4. Exit Signs: The exit lighting fixtures shall be LED type, Sure-Lites UN-1-SRWLED, or equal, and shall meet the requirements of Federal, State and Local codes. Battery powered emergency exit signs shall employ sealed, maintenance-free, nickel cadmium batteries sized to illuminate the exit sign and any integral and/or remote lampheads for a period of not less than 1-1/2 hours, and shall include a solid state, electronic battery charger, transfer relay, LED status indicator and push-to-test feature.
5. Emergency Lights: Where the building is not provided with an emergency generator, provide battery powered emergency lighting units in quantities and locations meeting the requirements of Federal, State and Local Codes. Battery powered emergency lighting units shall employ sealed, maintenance-free, nickel cadmium batteries sized to illuminate the combination of integral and/or remote lampheads for a period of not less than 1-1/2 hours, and shall include a solid state, electronic battery charger, transfer relay, LED status indicator and push-to-test feature. Lampheads required to illuminate the egress route from the exit discharge to the public way shall be included and shall be weatherproof. Where emergency battery units are located in areas normally illuminated by high intensity discharge lamps or other sources that require time to achieve full brightness, measures shall be taken to insure that illumination of the means of egress is provided at all times. These measures may include:
- a. Quartz-restrike lamps in normally illuminated high intensity discharge fixtures.
 - b. Time-delay "off" of emergency battery units.

- c. Other means acceptable to the local code authority.
- C. Voltage: Ballasts for use on 120 volt systems shall be suitable and guaranteed for a voltage range of 100 volts to 130 volts. Ballasts for use on 277 volt systems shall be suitable and guaranteed for a voltage range of 225 volts to 290 volts.
- D. Lamps: Provide lamps of the wattage, type, color, and reflector lamps with type of beams required for the application. Provide extended service lamps that are inside frosted.

Part 3 Execution

3.01 **Installation:**

- A. General: Install lighting fixtures in accordance with the fixture manufacturer's written instructions and recognized industry practices to ensure that the fixtures comply with the requirements and serve the intended purposes. Fixtures shall exactly fit the type of ceiling system scheduled for the space.
- B. Standards: Comply with NEMA standards, applicable requirements of the NEC pertaining to installation of interior lighting fixtures and with applicable portions of the NECA'S "Standard of Installation".
- C. Attachment: Fasten fixtures securely to the structural support members of the building in accordance with local code requirements. Provide separate supports for all recessed ceiling-mounted lighting fixtures. Separate fixture supports can be deleted if the ceiling grid supports are sized to carry the load of the fixtures and if permitted by the authority having jurisdiction. Check to ensure that solid pendant fixtures are plumb.

3.02 **Testing:**

- A. General: Upon completion of installation of lighting fixtures and after building circuitry has been energized, apply electrical energy to demonstrate proper operation of lighting fixtures and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units and proceed with retesting.
- B. Lamps: Install all new incandescent lamps just prior to final inspection. Fluorescent and HID lamps may be utilized in the final finishing of the building. Replace gaseous discharge lamps that are defective, show discolorations or have exceeded more than 1/3 of their rated life, as per construction inspector's records, with new lamps for final inspection.
- C. Pre-inspection Tasks: Immediately before final inspection, thoroughly clean all fixtures inside and out, including plastics and glassware, adjust all trim to properly fit adjacent surfaces, replace broken or damaged parts and lamp, and test all fixtures for electrical and mechanical operation. Any fixtures or parts of fixtures, which have begun to show signs of rust or corrosion at the time of completion of the job, shall be removed and replaced with properly protected metal parts.

END OF SECTION 16501

Section 16720–Fire Alarm System (General)

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1, Section 16010, "Basic Electrical Requirements", and Section 16041, "Design Parameters", govern this Section.

1.02 Description of the Work:

- A. General: The extent of fire alarm system work is as shown and scheduled and includes, but is not limited to, providing a system with the following functions and operation:
1. Provide a complete modular, solid state, low voltage, double supervised, limited energy, analog addressable, phased sounding, closed circuit, fire alarm and voice communications system to be wired, tested, and left in first class operating condition.
 2. System shall include, but not be limited to, all control panels, power supplies, alarm initiating devices, audible alarm devices, auxiliary control relays, conduit, wire, fittings, and all accessories required for the system to perform as specified.
 3. System shall operate as a non-coded, continuous ringing system that will have addressable audible circuits.
 4. System shall be wired as a Class B system for signal initiating circuits and audible alarm circuits.
 5. The fire alarm system addressable point capacity shall contain,
 - a. A minimum of 15% spare addressable point capacity remaining in the panel at full occupancy.
 - b. A minimum of 1 addressable point per 1000 nrs for all addressable systems installed.
 - c. A minimum of 2 addressable points per 1000 nrs for systems requiring smoke detectors installed at each heat pump.
 6. Provide a fire alarm system that can be serviced by an owner appointed fire alarm service company.
 7. This Contractor shall coordinate requirements for duct-mounted smoke detectors with the Mechanical Contractor. All duct smoke detectors must be connected to this fire alarm system by this Contractor as part of the fire alarm system work.
 8. This Contractor shall be responsible for providing all wiring and interface devices necessary to control and shutdown HVAC equipment, elevators, and other items as described herein and as required by the authority having jurisdiction.
- B. System Operation:
1. Fire Alarm: Operating sequences shall be as follows:

- a. Activation of any automatic detector on a floor or elevator lobby or of a manual station or sprinkler flow switch, shall cause the zone of alarm to be identified by a supervised lamp, LED, or LCD and audible alarm at the Fire Alarm Control Panel and by a non-zoned lamp, LED, or LCD and audible alarm at the remote annunciator and shall initiate the following events without a time delay:
 - 1) Activate the audible alarm signal, a slow whoop, on the floor of alarm, the floor above, the floor below and the stairways.
 - 2) Activate the visual alarm signals on the floor of alarm, the floor above, and the floor below.
 - 3) Shut down or energize HVAC equipment as required by code for smoke control and exhaust.
 - 4) Activate the electric strike, unlocking, but not unlatching, all locked stairwell doors and the building emergency control center room door, if any.
 - 5) Activate a common alarm signal to a remote Central Station.
- b. Activation of an automatic detector in the elevator lobby shall initiate the following events without a time delay:
 - 1) Elevator doors at that lobby shall close and remain closed.
 - 2) Elevator cars serving that lobby shall return to a floor providing direct egress from the building (or to a transfer floor if the cars do not serve an egress floor). The elevator doors shall open to permit egress of passengers, close after predetermined time interval and the elevator shall shut down.
 - 3) In the event of a fire on the lowest terminus floor, the elevator cars serving that lobby shall stop on a floor above the floor of fire involvement.
 - 4) Banks of elevators not deactivated by automatic detectors shall remain in normal operation.
2. Valve Annunciation: Activation of a valve supervisory switch shall initiate the following events without a time delay:
 - a. Activation of a main sprinkler system valve supervisory switch shall initiate a supervisory signal on that sprinkler valve supervisory circuit and at the remote annunciator. No building alarm shall sound.
 - b. Activation of a floor sprinkler system valve supervisory switch shall initiate an alarm signal on that sprinkler valve supervisory zone and at the remote annunciator. No building alarm shall sound.
 - c. Activation of a cooling tower sprinkler system valve supervisory switch (wooden towers only) shall initiate an alarm signal on the sprinkler valve supervisory zone serving the area and at the remote annunciator. No building alarm shall sound.
 - d. Activation of a floor sprinkler system zone valve supervisory switch shall not prevent the events listed under System Operation to occur.
3. Fire Pump Annunciation: Activation of the fire pump in a running condition from the fire pump controller shall initiate an alarm signal on that fire pump supervisory zone and at the remote annunciator (if provided). Loss of power or other alarm signals from a fire pump

controller (or jockey pump controller) shall initiate a trouble signal on that fire pump supervisory zone. No building alarm shall sound.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following manufacturers:
 - 1. Gamewell/Alarmtronics,
 - 2. Notifier Company,
 - 3. Silent Knight
- B. National Fire Protection Association (NFPA): Comply with NFPA sections NFPA 72, 90A, 101, and additional sections where applicable.
- C. Compliance: The complete combination fire alarm system shall comply with all applicable state and local building and fire codes. Modifications required to provide compliance shall be made at no cost to the Owner. Where Contract Document requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern.
- D. UL-Listing: All fire alarm system components shall be UL-labeled and the entire system shall be UL-listed as a system.
- E. Sync: Assume that building is already in sync and upon testing on final of project building must test out in sync or it will be the contractor's responsibility to repair.

Part 2 Products

2.01 Materials and Components:

- A. General: Provide the required fire alarm system products in the sizes and capacities required, complying with the manufacturer's published product information, of standard materials and components, designed and constructed for the applications indicated.

2.02 Fire Alarm Control Panel:

- A. General: Provide a modular, solid state, dead front Fire Alarm Control Panel. Alarm initiating circuits shall meet the requirements of NFPA 72.
 - 1. The Fire Alarm Control Panel shall contain, audible trouble signals with silencing switches, system reset switch and system test switch. All alarm and signal circuits shall be double supervised to sound a trouble signal upon loss of either supervisory or operating power. Pilot lights or LED's shall be included to indicate that both incoming power supplies are energized.
 - 2. Alarm and trouble signal switches shall be included to silence audible signals. The act of acknowledging the alarm or trouble signal shall not remove the visual annunciation at the control panel nor shall such act inhibit the ability to resound the alarm in the building should another alarm be received. Acknowledging the alarm shall not override the control functions performed by the control panel.
- B. Features: Fire Alarm Control Panel features shall include, but not be limited to:

1. System reset switch,
 2. System ground detection indication,
 3. Fire Alarm Control Panel lamp TEST push-button,
 4. System trouble signal,
 5. System trouble lamp,
 6. System trouble signal silence switch,
 7. The panel shall be capable of supervising either normally open or normally closed alarm initiation devices by a pluggable solid-state circuit card.
 8. Supervision and alarm circuitry for one alarm signal circuit per floor, one alarm signal circuit for the penthouse, one alarm signal circuit for each elevator bank, one alarm signal circuit for each stairway, and strobe circuits where required by code.
 9. All alarm initiation, alarm signal and firefighters' communications zones shall incorporate Class B wiring. If a break occurs, the control panel shall indicate a trouble condition.
 10. Circuitry for alarm and monitoring of valve supervisory switch zones, including one address for each main sprinkler zone valve, one address for each sprinkler zone valve per floor, one address for each sprinkler zone valve for each cooling tower, one address for each fire pump, and two spare address..
 11. Circuitry and controls for unlocking all stairway doors simultaneously, where required.
 12. Supervised, regulated power supplies of sufficient size to power all system connected equipment, internal panel, logic, and alarm transmission functions.
 13. Logic circuitry to perform all functions as specified.
 14. Provisions for a common alarm signal to a remote Central Station.
- C. Cabinet: The Fire Alarm Control Panel shall be enclosed in a code gauge cabinet, factory-finished in baked enamel. The panel shall be flush-mounted and factory-harnessed to perform all functions as specified.

2.03 Manual Stations:

- A. General: Typical manual fire alarm stations shall be semiflush-mounted, non-coded, double action stations. Main lobby manual fire alarm stations shall be semiflush-mounted, non-coded, double action station with a door. Finish and style of main lobby manual stations shall be approved by VPTC Management Partners, LLC.

2.04 Smoke Detectors:

- A. General: Smoke detectors installed in finished ceiling areas shall be semiflush-mounted photoelectric type detectors. Smoke detectors installed in non-finished ceiling areas and in mechanical return air plenums shall be surface-mounted photoelectric type detectors. Detectors installed in plenums shall be UL-tested and listed for operation at the anticipated air velocities. Smoke detectors installed in building HVAC ventilation ductwork shall be photoelectric type air duct detectors. All detectors shall be protected by plastic wrapping until

all cleanup has been accomplished. All smoke detectors shall meet the requirements of UL 268. All smoke detectors are to have a non-sealed head that can be taken apart and cleaned.

B. Surface and Semiflush-Mounted Photoelectric Detectors: These detectors shall operate on the photoelectric principle, activated by the presence of combustion products. Detectors shall be listed by UL and approved by Factory Mutual (FM).

1. Detectors shall operate on the light scatter principle and shall be rate-compensated and set to detect smoke at a nominal 1.5% light obscuration per foot. The unit's detection chamber shall extend beyond the main housing into the area to be protected, to provide maximum smoke entry capability into the chamber from any direction. The detector light source shall be an LED. The detector shall operate on the multiple-cell concept and the LED intensity shall be controlled by a regulating photocell circuit matched to the smoke detection circuit. The detector shall lock-in on alarm and have a lock-in alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without generating smoke.
2. All smoke detectors are to be addressable.
3. A steel mounting plate shall be provided with provisions for attachment to a 4" square or octagonal electrical junction box. Connection to the system wiring shall be by means of a prewired, plug-in connector attached to the mounting plate. The detector shall plug directly into the connector and shall be held in place by a snap-lock feature incorporated in the design of the housing and mounting plate.
4. Do not mount detectors directly to HVAC units, air handlers or other equipment unless required by the application and approved by VPTC Management Partners, LLC.

C. Photoelectric Type Air Duct Detectors: These detectors shall operate on the photoelectric activated by the presence of combustion products. Detectors shall be listed by UL and approved by FM specifically for use in air handling systems. Duct detectors shall be furnished and installed by Division 15. Duct detectors shall be connected to the fire alarm system by this Contractor. Coordinate installation and wiring requirements, including interlock and shut-down interconnections, with the work of Division 15.

1. Detectors shall be designed to provide detection of invisible combustion products, fire, and smoke in HVAC system ducts in compliance with NFPA 90A. Detectors shall consist of a photoelectric type detector and an air sampling assembly. This assembly shall consist of a housing to accommodate sampling tubes that extend through the duct of the HVAC system. While the fan is operating, a continuous cross-sectional sampling of air from the duct shall flow through the detector, after which the sampled air shall be returned to the duct.
2. The unit shall utilize a plug-in detector head located in the air-sampling chamber. This detector head shall be similar to that specified for photoelectric or ionization detectors.
3. The sensitivity of the detector shall be independent of air velocity and remain uniform over a range of 500 to 3100' per minute. Each detector shall include a convenient means for checking the sensitivity under actual dynamic airflow conditions.

2.05 Heat Detectors:

A. General: Heat detectors shall be 135°F for food service areas and 200°F for emergency generator room and boiler room rate compensated/fixed temperature type detectors. Detector rate of rise elements shall be self-restoring after operation.

- B. Detectors in Elevator Machine Rooms: Heat detectors in elevator machine rooms and other sensitive areas protected by sprinklers shall have thermal elements with temperature rating at least 20°F below the rating of the sprinkler head.

2.06 Remote Annunciator:

- A. General: A liquid crystal display annunciator to show all alarms and troubles on two forty character displays, and give audible signal.

2.07 Flow Switches:

- A. General: Sprinkler system flow switches and dry pipe pressure switches shall be provided by Division 15 and connected to the fire alarm system by this Division.

2.08 Supervisory Switches and Contacts:

- A. Sprinkler Zone Valve Supervisory Switches: Supervisory switches shall be furnished and installed by Division 15 and connected to the Fire Alarm System by this Division.
- B. Fire Pump Alarm Indication: This indication shall be from dry contacts provided in the fire pump controller by Division 15 and connected to the fire alarm system by this Division.

2.09 Electric Door Locks:

- A. General: Electric door locks, where required, shall be provided by Division 8 and connected to the Fire Alarm System by this Division. Operating power for door locks shall be controlled from the Fire Alarm Control Panel.

2.10 Door Holders:

- A. General: Provide wall-mounted magnetic door holders where shown. Door holder operating power shall be provided from the Fire Alarm Control Panel. If door hold opens are part of the door hardware, power and interface relays shall be provided by the Electrical Contractor. Coordinate with all Divisions.

2.11 Control Relays: (Programmable)

- A. General: Auxiliary control relays shall be provided as required. All external connections shall be made with UL-approved terminal strips. Entire relay unit shall be housed in approved cabinet, keyed alike to the Fire Alarm Control Panel and finished in factory-applied enamel.

2.12 Notification Devices:

- A. Audible/Visual Combination Devices:
 - 1. Audible: Audible device shall be Wheelock EH Series solid state electronic alarm device, or approved equal. Electronic devices shall not contain any vibrating electromechanical solenoids or contacts for reliability and performance. Electromechanical devices shall not be considered as equal. Each unit shall provide a choice of eight different audible tones capable of be field selected. Preferred alarm signals shall be a slow whoop or fast warble tone productions a sound pressure of 91 dBA. Unit shall be semiflush mounted and molded of high-impact red thermoplastic.

2. Visual Device: The visual device lens shall be white with red lettering "FIRE" visible from a 180 degree field. The audible and visual device shall be mounted to a common panel. The visual signal shall flash at a rate of approximately three flashes per second and shall use a xenon lamp or other high intensity light source. The visual device shall operate in unison (synchronized) with all visual devices that are visible from any location. Visual devices shall operate from a supervised circuit and discontinue flashing upon silencing of alarm signals.

B. Audible Devices:

1. Audible: Audible device shall be Wheelock EH Series solid state electronic alarm device, or approved equal. Electronic devices shall not contain any vibrating electromechanical solenoids or contacts for reliability and performance. Electromechanical devices shall not be considered as equal. Each unit shall provide a choice of eight different audible tones capable of be field selected. Preferred alarm signals shall be a slow whoop or fast warble tone productions a sound pressure of 91 dBA. Unit shall be semiflush mounted and molded of high-impact red thermoplastic.

C. Visual Devices:

1. Visual Device: The visual device lens shall be white with red lettering "FIRE" visible from a 180 degree field. The visual device shall flash at a rate of approximately three flashes per second and shall use a xenon lamp or other high intensity light source. The visual device shall operate in unison (synchronized) with all visual devices that are visible from any location. Visual devices shall operate from a supervised circuit and discontinue flashing upon silencing of alarm signals.

2.13 Standby Power:

- A. General: Standby power shall be provided from a charger/battery module within the fire alarm control panel, in accordance with NFPA 72 sized to provide 24 hours of standby power followed by five minutes of full alarm. The primary power source to the Fire Alarm Control Panel shall be a 3-wire emergency power branch circuit.

2.14 Wiring and Raceways:

- A. Line Voltage Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors".
- B. Low-Voltage Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors", except that conductors shall consist of a multiconductor jacketed cable whenever possible.
- C. Raceways: Raceways for line voltage and low-voltage wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors", and Section 16130, "Electrical Boxes and Fittings".

2.15 Instructions and Manuals:

- A. Instruction Period: Upon completion of system installation, a representative of the fire alarm system manufacturer shall provide a period of instruction to representatives of the Owner in system use and maintenance.

- B. Manual: A manual describing the theory of operation of the complete systems and including internal diagrams of all installed equipment shall be submitted upon completion of system installation.

2.16 Spare Parts:

- A. General: Turn over all spare parts to the Owner.
1. Six spare system keys.
 2. 10% spare fuses for each type used; minimum of four fuses of each type.
 3. 10% spare lamps for each type used; minimum of four lamps of each type.
 4. System diagrams, schematics, parts lists and maintenance manuals.
 5. 3 spare smoke detectors for each type used in the project.
 6. 3 spare Notification Devices for each type used in the project.

Part 3 Execution

3.01 Installation:

- A. General: Install system and materials in accordance with manufacturer's instructions and roughing-in drawings and details on the Drawings. Install electrical work and use electrical products complying with the requirements of the applicable Division 16 Sections of these Specifications. Installation shall comply with the Americans with Disabilities Act, applicable NFPA standards, and applicable state and local codes. Mount manual stations at 4' above finished floor.
- B. Wiring: Install all wiring as required for the fire alarm system. Install all fire alarm system line voltage and low-voltage wiring in a suitable raceway. UL-listed plenum cable may be used for fire alarm low-voltage wiring in areas with accessible (lay-in tile) ceilings. Where plenum cable is used, bundle all cables and secure to the structure using nylon ties. All cable ties shall be plenum rated. Do not run cable loose on top of suspended ceilings. Conceal fire alarm system conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.
- C. Coding: Number code or color code conductors appropriately for future identification and servicing of the system.
- D. Checkout: Check wiring to ensure that wiring is in accordance with the system manufacturer's wiring diagrams and that the system is free of open circuits, short circuits, grounds and proper sync.

3.02 Testing and Demonstration:

- A. Testing: After completion of system installation, perform final tests and adjustments on the system by a factory trained representative. Submit four copies of certified test results to VPTC Management Partners, LLC for review.

- B. Demonstration: Perform demonstration of system operation for VPTC Management Partners, LLC and the authority having jurisdiction by the specially trained personnel described hereinbefore.

3.03 Coordination:

- A. Elevators: Coordination of fire alarm recall, fire alarm signal, provisions and connections with Division 14 shall be the responsibility of this Division.
- B. Fire Pump and Fire Sprinkler Systems: Coordination of fire pump and fire sprinkler system provisions and connections with Division 15 shall be the responsibility of this Division.
- C. Temperature Control System: Coordination of fire alarm system shutdown and start-up requirements with the temperature control system furnished by Division 15 shall be the responsibility of this Division.

3.04 Initial Verification Audit:

- A. The purpose of the initial verification audit is to confirm that a fire alarm system is 100% operational upon completion of the installation and complies with all specifications and requirements for that facility. It is intended that the audit be followed by a continuing program of inspection, testing, and maintenance.
- B. General Requirements: The initial verification audit shall be performed within 30 days after the fire alarm installation is completed. The audit shall be performed by qualified fire alarm system technician acceptable to the authority having jurisdiction. The audit, which is a comprehensive 100% inspection and test of all fire alarm system equipment, shall include the following:
1. A visual and functional test shall be conducted of all fire alarm control and auxiliary control equipment.
 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that all wiring is properly supervised as required.
 4. All indicators shall be tested to ensure proper function and operation.
 5. All control panel auxiliary functions such as door holder release, city connections, elevator capture, and fan control shall be functionally tested to verify proper operation.
 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A 5 minute general alarm stress test both under ac power and standby power shall be conducted to further ensure complete operation of the system.
 7. All annunciators shall be tested to ensure that each address communicates properly and the address location correctly defines that area of alarm.
 8. All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 9. Initiating Devices - Manual:

- a. Each manual fire alarm station shall be functionally tested for alarm operation.

10. Initiating Devices - Automatic:

- a. Each automatic initiating device shall be activated in accordance with manufacturers' instructions to ensure proper operation. Smoke detectors shall be tested by method approved by the manufacturer and jurisdiction code at each detector location.
- b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
- c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specification.

11. Alarm Signaling Devices:

- a. The overall sound level shall be surveyed by the inspecting officials and additional devices added if sound level is determined to be inadequate.
- b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
- c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
- d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.

C. Customer Training: A customer training session shall be conducted on fire alarm system operation. Training session shall include:

1. Conduct a functional training session on fire alarm control panel operation.
2. Instruct on peripheral device operation including what are normal indications and alarm indications on each type of device.
3. Present a fire alarm manual to the facility management which shall include emergency service phone numbers, complete listings and specification sheets on all fire alarm equipment supplied, as-built wiring diagrams, fire alarm testing and service log forms and fire alarm system operating instructions.

D. Reporting: Upon completion of the initial verification audit, a report shall be sent to the customer indicating that all fire alarm equipment has been tested and is in 100% operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100% audit shall be performed by a factory trained representative and the said individual shall possess a state license for fire alarm installation supervision where applicable. The final report shall be generated by the equipment manufacturer's headquarters to ensure integrity and uniformity of all audit procedure reporting. A detailed procedure of the 100% audit performance shall be submitted with the Fire Alarm System layout drawings and submittal data sheets. The report shall be provide by the Fire Alarm System supplier subject to approval by VPTC Management Partners, LLC of audit procedures. The final report of the audit findings shall be reviewed by both of the following:

1. VPTC Management Partners, LLC, and
2. Design Engineer or Design Engineer's authorized representative.

Section 16721 –Fire Alarm System (Voice Evacuation)

Part 1 General

1.01 Related Documents:

- A. The Conditions of the Contract and applicable requirements of Division 1, Section 16010, "Basic Electrical Requirements", and Section 16041, "Design Parameters", govern this Section.

1.02 Description of the Work:

- A. General: The extent of combination fire alarm system work is as shown and scheduled and includes, but is not limited to, providing a system with the following functions and operation:
1. Provide a complete modular, solid state, low voltage, double supervised, limited energy, analog addressable, phased sounding, closed circuit, fire alarm and voice communications system to be wired, tested, and left in first class operating condition.
 2. System shall include, but not be limited to, all control panels, power supplies, alarm initiating devices, audible alarm devices, auxiliary control relays, conduit, wire, fittings, and all accessories required for the system to perform as specified.
 3. System shall operate as a non-coded, continuous ringing system that will have addressable audible circuits.
 4. System shall be wired as a Class B system for signal initiating circuits, audible alarm and firefighters' communications circuits.
 5. The fire alarm system addressable point capacity shall contain,
 - a. A minimum of 15% spare addressable point capacity remaining in the panel at full occupancy.
 - b. A minimum of 1 addressable point per 1000 nrs for all addressable systems installed.
 - c. A minimum of 2 addressable points per 1000 nrs for systems requiring smoke detectors installed at each heat pump.
 6. Provide a fire alarm system that can be serviced by an owner appointed fire alarm service company.
 7. This Contractor shall coordinate requirements for duct-mounted smoke detectors with the Mechanical Contractor. All duct smoke detectors must be connected to this fire alarm system by this Contractor as part of the fire alarm system work.
 8. This Contractor shall be responsible for providing all wiring and interface devices necessary to control and shutdown HVAC equipment, elevators, and other items as described herein and as required by the authority having jurisdiction.
- B. System Operation:
1. Fire Alarm: Operating sequences shall be as follows:

- a. Activation of any automatic detector on a floor or elevator lobby or of a manual station or sprinkler flow switch, shall cause the zone of alarm to be identified by a supervised lamp, LED, or LCD and audible alarm at the Fire Alarm Control Panel and by a non-zoned lamp, LED, or LCD and audible alarm at the remote annunciator and shall initiate the following events without a time delay:
 - 1) Activate the audible alarm signal, a slow whoop, on the floor of alarm, the floor above, the floor below and the stairways.
 - 2) Activate the visual alarm signals on the floor of alarm, the floor above, and the floor below.
 - 3) Shut-down or energize HVAC equipment as required by code for smoke control and exhaust.
 - 4) Activate the electric strike, unlocking, but not unlatching, all locked stairwell doors and the building emergency control center room door.
 - 5) Activate a common alarm signal to a remote Central Station.
 - 6) Energize all stairwell pressurization fans.
 - 7) Activate the prerecorded message system.
 - b. Activation of an automatic detector in the elevator lobby shall initiate the following events without a time delay:
 - 1) Elevator doors at that lobby shall close and remain closed.
 - 2) Elevator cars serving that lobby shall return to a floor providing direct egress from the building (or to a transfer floor if the cars do not serve an egress floor). The elevator doors shall open to permit egress of passengers, close after predetermined time interval and the elevator shall shut down.
 - 3) In the event of a fire on the lowest terminus floor, the elevator cars serving that lobby shall stop on a floor above the floor of fire involvement.
 - 4) Banks of elevators not deactivated by automatic detectors shall remain in normal operation.
 - c. Activation of smoke detector at stair pressurization fan air intake shall cause the fan to shutdown, close intake damper and shall initiate the events listed in System Operation to occur.
2. Valve Annunciation: Activation of a valve supervisory switch shall initiate the following events without a time delay:
- a. Activation of a main sprinkler system valve supervisory switch shall initiate a supervisory signal on that sprinkler valve supervisory circuit and at the remote annunciator. No building alarm shall sound.
 - b. Activation of a floor sprinkler system valve supervisory switch shall initiate an alarm signal on that sprinkler valve supervisory zone and at the remote annunciator. No building alarm shall sound.

- c. Activation of a cooling tower sprinkler system valve supervisory switch (wooden towers only) shall initiate an alarm signal on the sprinkler valve supervisory zone serving the area and at the remote annunciator. No building alarm shall sound.
- d. Activation of a floor sprinkler system zone valve supervisory switch shall not prevent the events listed under System Operation to occur.
3. Fire Pump Annunciation: Activation of the fire pump in a running condition from the fire pump controller shall initiate an alarm signal on that fire pump supervisory zone and at the remote annunciator (if provided). Loss of power or other alarm signals from a fire pump controller (or jockey pump controller) shall initiate a trouble signal on that fire pump supervisory zone. No building alarm shall sound.
4. Voice Communication: The voice communications system shall be capable of channeling alarm tones, auxiliary tones or one-way voice communications to the following circuits or combination of circuits (Zones):
 - a. Each elevator bank shall be a separate circuit,
 - b. Each exit stairway shall be one circuit, and
 - c. Each floor shall be a separate circuit.
5. Firefighter Communications: The Firefighter Communications System shall provide zoned supervised 2-way communications from the Fire Alarm Control Panel to phone handsets located throughout the building.
6. Prerecorded Message System: The prerecorded message system shall be capable of channeling communications to the zones or combination of zones, as listed above.
7. Firefighters' Mechanical System Override Interface: The fire alarm system shutdown of air handling equipment shall not be overridden by either the HAND or AUTO position on the H-O-A selector switch at the air handling equipment starter. The fire alarm shutdown function shall only be overridden by an input from the Firefighters' Mechanical System Override Panel. The Firefighters' Override System shall be provided by this Division where required by the local authority having jurisdiction. Coordinate the installation of interface and interlock wiring with the Mechanical Contractor and the building temperature control system.

1.03 Quality Assurance:

- A. Manufacturers: Provide products produced by one of the following manufacturers:
 1. ADT,
 2. Gamewell/Alarmtronics,
 3. Notifier Company,
 4. Silent Knight.
- B. National Fire Protection Association (NFPA): Comply with NFPA sections NFPA 72, 90A, 101, and additional sections where applicable.
- C. Compliance: The complete combination fire alarm system shall comply with all applicable state and the local building and fire codes. Modifications required to provide compliance shall

be made at no cost to the Owner. Where Contract Document requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern.

- D. UL-Listing: All fire alarm system components shall be UL-labeled and the entire system shall be UL-listed as a system if required by local municipality.
- E. Sync: Assume that building is already in sync and upon testing on final of project building must test out in sync or it will be the contractor's responsibility to repair.

Part 2 Products

2.01 **Materials and Components:**

- A. General: Provide the required fire alarm system products in the sizes and capacities required, complying with the manufacturer's published product information, of standard materials and components, designed and constructed for the applications indicated.

2.02 **Fire Alarm Control Panel:**

- A. General: Provide a modular, solid state, dead front Fire Alarm Control Panel with voice communication and firefighters' communications features. Alarm initiating circuits shall meet the requirements of NFPA 72.
 - 1. The Fire Alarm Control Panel shall contain speaker select switches, audible trouble signals with silencing switches, system reset switch and system test switch. All alarm and signal circuits shall be double supervised to sound a trouble signal upon loss of either supervisory or operating power. Pilot lights or LED's shall be included to indicate that both incoming power supplies are energized.
 - 2. Alarm and trouble signal switches shall be included to silence audible signals. The act of acknowledging the alarm or trouble signal shall not remove the visual annunciation at the control panel nor shall such act inhibit the ability to resound the alarm in the building should another alarm be received. Acknowledging the alarm shall not override the control functions performed by the control panel.
- B. Features: Fire Alarm Control Panel features shall include, but not be limited to:
 - 1. System reset switch,
 - 2. System ground detection indication,
 - 3. Fire Alarm Control Panel lamp TEST push-button,
 - 4. System trouble signal,
 - 5. System trouble lamp,
 - 6. System trouble signal silence switch,
 - 7. The panel shall be capable of supervising either normally open or normally closed alarm initiation devices by a pluggable solid-state circuit card.

8. Supervision and alarm circuitry for one alarm speaker circuit per floor, one alarm speaker circuit for the penthouse, one alarm speaker circuit for each elevator bank, one alarm speaker circuit for each stairway, and strobe circuits where required by code.
 9. All alarm initiation, alarm signal and firefighters' communications zones shall incorporate Class B wiring. If a break occurs, the control panel shall indicate a trouble condition.
 10. Circuitry for alarm and monitoring of valve supervisory switch zones, including one address for each main sprinkler zone valve, one address for each sprinkler zone valve per floor, one address for each sprinkler zone valve for each cooling tower, one address for each fire pump, and two spare address..
 11. Circuitry and controls for unlocking all stairway doors simultaneously.
 12. Supervised, regulated power supplies of sufficient size to power all system connected equipment, internal panel, logic, and alarm transmission functions.
 13. Logic circuitry to perform all functions as specified.
 14. Provisions for a common alarm signal to a remote Central Station.
 15. A sufficient number of individually supervised dual amplifiers and preamplifiers constructed using computer-grade solid-state components throughout. Failure of either a primary or secondary amplifier or preamplifier shall immediately sound a trouble alarm and transfer function to the operable amplifier or preamplifier.
 16. Include tone generators for alarm signals (slow whoop).
 17. A hand held dynamic microphone behind a locked panel in the control panel. Microphone shall include a push-to-talk button and have speaker selects or all call.
 18. Include pre-recorded voice messages. The voice recorder shall include the ability to transmit the messages and number of messages as required by code.
 19. One supervised 2-way telephone communication system for firefighters' communication. Provide zoning as required by the local codes and fire department with the following minimums: one zone for the firefighters' telephone handset adjacent to the fire pump(s), one circuit per elevator bank, one circuit per stairway.
- C. Cabinet: The Fire Alarm Control Panel shall be enclosed in a code gauge cabinet, factory-finished in baked enamel. The panel shall be flush-mounted and factory-harnessed to perform all functions as specified.

2.03 Manual Stations:

- A. General: Typical manual fire alarm stations shall be semiflush-mounted, noncoded, double action stations. Main lobby manual fire alarm stations shall be semiflush-mounted, noncoded, double action station with a door. Finish and style of main lobby manual stations shall be approved by VPTC Management Partners, LLC.

2.04 Smoke Detectors:

- A. General: Smoke detectors installed in finished ceiling areas shall be semiflush-mounted photoelectric type detectors. Smoke detectors installed in nonfinished ceiling areas and in mechanical return air plenums shall be surface-mounted photoelectric type detectors. Detectors installed in plenums shall be UL-tested and listed for operation at the anticipated air

velocities. Smoke detectors installed in building HVAC ventilation ductwork shall be photoelectric type air duct detectors. All detectors shall be protected by plastic wrapping until all cleanup has been accomplished. All smoke detectors shall meet the requirements of UL 268. All smoke detectors are to have a non-sealed head that can be taken apart and cleaned.

B. Surface and Semiflush-Mounted Photoelectric Detectors: These detectors shall operate on the photoelectric principle, activated by the presence of combustion products. Detectors shall be listed by UL and approved by Factory Mutual (FM).

1. Detectors shall operate on the light scatter principle and shall be rate-compensated and set to detect smoke at a nominal 1.5% light obscuration per foot. The unit's detection chamber shall extend beyond the main housing into the area to be protected, to provide maximum smoke entry capability into the chamber from any direction. The detector light source shall be an LED. The detector shall operate on the multiple-cell concept and the LED intensity shall be controlled by a regulating photocell circuit matched to the smoke detection circuit. The detector shall lock-in on alarm and have a lock-in alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without generating smoke.
2. All smoke detectors are to be addressable.
3. A steel mounting plate shall be provided with provisions for attachment to a 4" square or octagonal electrical junction box. Connection to the system wiring shall be by means of a prewired, plug-in connector attached to the mounting plate. The detector shall plug directly into the connector and shall be held in place by a snap-lock feature incorporated in the design of the housing and mounting plate.
4. Do not mount detectors directly to HVAC units, air handlers or other equipment unless required by the application and approved by VPTC Management Partners, LLC.

C. Photoelectric Type Air Duct Detectors: These detectors shall operate on the photoelectric activated by the presence of combustion products. Detectors shall be listed by UL and approved by FM specifically for use in air handling systems. Duct detectors shall be furnished and installed by Division 15. Duct detectors shall be connected to the fire alarm system by this Contractor. Coordinate installation and wiring requirements, including interlock and shut-down interconnections, with the work of Division 15.

1. Detectors shall be designed to provide detection of invisible combustion products, fire, and smoke in HVAC system ducts in compliance with NFPA 90A. Detectors shall consist of a photoelectric type detector and an air sampling assembly. This assembly shall consist of a housing to accommodate sampling tubes that extend through the duct of the HVAC system. While the fan is operating, a continuous cross-sectional sampling of air from the duct shall flow through the detector, after which the sampled air shall be returned to the duct.
2. The unit shall utilize a plug-in detector head located in the air sampling chamber. This detector head shall be similar to that specified for photoelectric or ionization detectors.
3. The sensitivity of the detector shall be independent of air velocity and remain uniform over a range of 500 to 3100' per minute. Each detector shall include a convenient means for checking the sensitivity under actual dynamic airflow conditions.

2.05 Heat Detectors:

- A. General: Heat detectors shall be 135°F for food service areas and 200°F for emergency generator room and boiler room rate compensated/fixed temperature type detectors. Detector rate of rise elements shall be self-restoring after operation.
- B. Detectors in Elevator Machine Rooms: Heat detectors in elevator machine rooms and other sensitive areas protected by sprinklers shall have thermal elements with temperature rating at least 20°F below the rating of the sprinkler head.

2.06 Remote Annunciator:

- A. General: A liquid crystal display annunciator to show all alarms and troubles on two forty character displays, and give audible signal.

2.07 Flow Switches:

- A. General: Sprinkler system flow switches and dry pipe pressure switches shall be provided by Division 15 and connected to the fire alarm system by this Division.

2.08 Supervisory Switches and Contacts:

- A. Sprinkler Zone Valve Supervisory Switches: Supervisory switches shall be furnished and installed by Division 15 and connected to the Fire Alarm System by this Division.
- B. Fire Pump Alarm Indication: This indication shall be from dry contacts provided in the fire pump controller by Division 15 and connected to the fire alarm system by this Division.

2.09 Electric Door Locks:

- A. General: Electric door locks, where required, shall be provided by Division 8 and connected to the Fire Alarm System by this Division. Operating power for door locks shall be controlled from the Fire Alarm Control Panel.

2.10 Door Holders:

- A. General: Provide wall-mounted magnetic door holders where shown. Door holder operating power shall be provided from the Fire Alarm Control Panel. If door hold opens are part of the door hardware, power and interface relays shall be provided by the Electrical Contractor. Coordinate with all Divisions.

2.11 Elevator Interface:

- A. General: Elevator cab firefighters' telephone handsets and alarm speakers shall be installed by this Division in spaces provided under Division 14. All wiring, with the exception of traveling cables from the elevator cab to the elevator machine room, shall be furnished and installed by this Division. Traveling cables shall be furnished and installed by Division 14. This Division shall inform elevator supplier of quantity and size required. Voice telephones in elevator cabs shall be furnished and connected by the Elevator Contractor.

2.12 Control Relays: (Programmable)

- A. General: Auxiliary control relays shall be provided as required. All external connections shall be made with UL-approved terminal strips. Entire relay unit shall be housed in approved cabinet, keyed alike to the Fire Alarm Control Panel and finished in factory-applied enamel.

2.13 Communications Jacks:

- A. General: Provide communications jacks where shown. Coordinate elevator lobby firefighters' jacks with Architectural details.

2.14 Firefighters' Telephones:

- A. General: Furnish permanently installed stationary telephone handsets with 5' armored cords for use by the firefighters. Telephones shall be provided in a red flush-mounted enclosure with breakglass cover and keyed lock assembly. The handset shall be red in color. Enclosure shall be labeled "FOR FIRE DEPT. USE ONLY".

2.15 Notification Devices:

A. Audible/Visual Combination Devices:

1. Speaker Device: Speakers shall be rated per the most current UL #1480 testing procedure. The speaker assembly shall consist of a 4" fire retardant, moisture repellent treated cone speaker rear-mounted on a thermoplastic injection molded acoustic panel. The speaker shall be equipped with a matching transformer with multiple taps of 0.25, 0.5, 1.0, and 2.0 watts. All speakers shall be wired parallel for supervision.
2. Visual Device: The visual device lens shall be white with red lettering "FIRE" visible from a 180 degree field. The speaker and visual device shall be mounted to a common panel. The visual signal shall flash at a rate of approximately three flashes per second and shall use a xenon lamp or other high intensity light source. The visual device shall operate in unison (synchronized) with all visual devices that are visible from any location. Visual devices shall operate from a supervised circuit and discontinue flashing upon silencing of alarm signals.

B. Audible Devices:

1. Speakers: Speakers shall be rated per the most current UL #1480 testing procedure. The speaker assembly shall consist of a 4" fire retardant, moisture repellent treated cone speaker rear-mounted on a thermoplastic injection molded acoustic panel. The speaker shall be equipped with a matching transformer with multiple taps of 0.25, 0.5, 1.0, and 2.0 watts. All speakers shall be wired parallel for supervision.

C. Visual Devices:

1. Visual Device: The visual device lens shall be white with red lettering "FIRE" visible from a 180 degree field. The visual device shall flash at a rate of approximately three flashes per second and shall use a xenon lamp or other high intensity light source. The visual device shall operate in unison (synchronized) with all visual devices that are visible from any location. Visual devices shall operate from a supervised circuit and discontinue flashing upon silencing of alarm signals.

- D. Mounting: Notification Devices shall be flush wall-mounted adjacent to stairwell entrances. The mounting height shall comply with the Americans with Disabilities Act, NFPA, and applicable state and local codes. Alarm speakers in other finished ceiling areas shall be

flush-mounted in the ceiling. Alarm speakers in stairways and unfinished areas shall be semiflush-mounted in wall. Alarm speakers in stairways shall be surface-mounted. Visual signals shall be provided in toilet rooms and other areas as required to provide coverage specified by the ADA. Finish of all exposed alarm speakers and visual signals shall be selected by VPTC Management Partners, LLC.

2.16 Standby Power:

- A. General: Standby power shall be provided from a charger/battery module within the fire alarm control panel, in accordance with NFPA 72 sized to provide 24 hours of standby power followed by five minutes of full alarm. The primary power source to the Fire Alarm Control Panel shall be a 3-wire emergency power branch circuit.

2.17 Wiring and Raceways:

- A. Line Voltage Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors".
- B. Low-Voltage Wiring: This wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors", except that conductors shall consist of a multiconductor jacketed cable whenever possible.
- C. Raceways: Raceways for line voltage and low-voltage wiring shall be as specified in Section 16120, "Cable, Wire, and Connectors", and Section 16130, "Electrical Boxes and Fittings".

2.18 Instructions and Manuals:

- A. Instruction Period: Upon completion of system installation, a representative of the fire alarm system manufacturer shall provide a period of instruction to representatives of the Owner in system use and maintenance.
- B. Manual: A manual describing the theory of operation of the complete systems and including internal diagrams of all installed equipment shall be submitted upon completion of system installation.

2.19 Spare Parts:

- A. General: Turn-over all spare parts to the Owner.
 1. Six spare system keys.
 2. 10% spare fuses for each type used; minimum of four fuses of each type.
 3. 10% spare lamps for each type used; minimum of four lamps of each type.
 4. System diagrams, schematics, parts lists and maintenance manuals.
 5. 3-spare smoke detectors for each type used in the project.
 6. 3 spare Notification Devices for each type used in the project.

Part 3 Part 3 - Execution

3.01 3.01 Installation:

- A. General: Install system and materials in accordance with manufacturer's instructions and roughing-in drawings and details on the Drawings. Install electrical work and use electrical products complying with the requirements of the applicable Division 16 Sections of these Specifications. Installation shall comply with the Americans with Disabilities Act, applicable NFPA standards, and applicable state and local codes. Mount manual stations at 4' above finished floor.
- B. Wiring: Install all wiring as required for the combination fire alarm system. Install all fire alarm system line voltage and low-voltage wiring in a suitable raceway. UL-listed plenum cable may be used for fire alarm low-voltage wiring in areas with accessible (lay-in tile) ceilings. Where plenum cable is used, bundle all cables and secure to the structure using nylon ties. All cable ties shall be plenum rated. Do not run cable loose on top of suspended ceilings. Conceal fire alarm system conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.
- C. Coding: Number code or color code conductors appropriately for future identification and servicing of the system.
- D. Checkout: Check wiring to ensure that wiring is in accordance with the system manufacturer's wiring diagrams and that the system is free of open circuits, short circuits, grounds and sync.

3.02 Testing and Demonstration:

- A. Testing: After completion of system installation, perform final tests and adjustments on the system by a factory trained representative. Submit four copies of certified test results to VPTC Management Partners, LLC for review.
- B. Demonstration: Perform demonstration of system operation for VPTC Management Partners, LLC and the authority having jurisdiction by the specially trained personnel described hereinbefore.

3.03 Coordination:

- A. Elevators: Coordination of fire alarm recall, fire alarm speaker, firefighters' jack provisions and connections with Division 14 shall be the responsibility of this Division.
- B. Fire Pump and Fire Sprinkler Systems: Coordination of fire pump and fire sprinkler system provisions and connections with Division 15 shall be the responsibility of this Division.
- C. Temperature Control System: Coordination of fire alarm system shutdown and start-up requirements with the temperature control system furnished by Division 15 shall be the responsibility of this Division.

3.04 Initial Verification Audit:

- A. The purpose of the initial verification audit is to confirm that a fire alarm system is 100% operational upon completion of the installation and complies with all specifications and

requirements for that facility. It is intended that the audit be followed by a continuing program of inspection, testing, and maintenance.

- B. General Requirements: The initial verification audit shall be performed within 30 days after the fire alarm installation is completed. The audit shall be performed by qualified fire alarm system technician acceptable to the authority having jurisdiction. The audit, which is a comprehensive 100% inspection and test of all fire alarm system equipment, shall include the following:
1. A visual and functional test shall be conducted of all fire alarm control and auxiliary control equipment.
 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that all wiring is properly supervised as required.
 4. All indicators shall be tested to ensure proper function and operation.
 5. All control panel auxiliary functions such as door holder release, city connections, elevator capture, and fan control shall be functionally tested to verify proper operation.
 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A 5-minute general alarm stress test both under ac power and standby power shall be conducted to further ensure complete operation of the system.
 7. All annunciators shall be tested to ensure that each address communicates properly and the address location correctly defines that area of alarm.
 8. All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 9. Initiating Devices - Manual:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.
 10. Initiating Devices - Automatic:
 - a. Each automatic initiating device shall be activated in accordance with manufacturers' instructions to ensure proper operation. Smoke detectors shall be tested by method approved by the manufacturer and jurisdiction code at each detector location.
 - b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
 - c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specification.
 11. Alarm Signaling Devices:
 - a. The overall sound level shall be surveyed by the inspecting officials and additional devices added if sound level is determined to be inadequate.
 - b. Each alarm-signaling device shall be functionally tested for proper wiring supervision.

- c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
- C. Customer Training: A customer training session shall be conducted on fire alarm system operation. Training session shall include:
1. Conduct a functional training session on fire alarm control panel operation.
 2. Instruct on peripheral device operation including what are normal indications and alarm indications on each type of device.
 3. Present a fire alarm manual to the facility management which shall include emergency service phone numbers, complete listings and specification sheets on all fire alarm equipment supplied, as-built wiring diagrams, fire alarm testing and service log forms and fire alarm system operating instructions.
- D. Reporting: Upon completion of the initial verification audit, a report shall be sent to the customer indicating that all fire alarm equipment has been tested and is in 100% operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100% audit shall be performed by a factory trained representative and the said individual shall possess a state license for fire alarm installation supervision where applicable. The final report shall be generated by the equipment manufacturer's headquarters to ensure integrity and uniformity of all audit procedure reporting. A detailed procedure of the 100% audit performance shall be submitted with the Fire Alarm System layout drawings and submittal data sheets. The reported shall be provide by the Fire Alarm System supplier subject to approval by VPTC Management Partners, LLC of audit procedures. The final report of the audit findings shall be reviewed by both of the following:
1. VPTC Management Partners, LLC, and
 2. Design Engineer or Design Engineer's authorized representative.

END OF SECTION 16721