

PART I – GENERAL

- The work specified in this section includes, but is not limited to, the electrical service, grounding, panel boards, disconnect switches, transformers, and other distribution equipment as specified.
- Installation of the miscellaneous electrical wiring required for all plumbing, A/C, and heating equipment, complete as shown on the mechanical and/or electrical drawings, and specified herein, including all labor, materials, equipment, accessories, services, and tests of all systems.
- Electrical contractor to offload, set, and install Villa Lighting prefabricated electrical wall equipment (This is a Required Vendor). Approximate weight of prefabricated wall unit is 2,000 pounds.
- All motor and motor driven equipment such as pumps, etc., will be furnished and set in place by the mechanical, refrigeration and plumbing contractors.
- Equipment indicated as N.I.C. (Not in Contract).

SUBMITTALS

- Unless otherwise noted, the contractor shall prepare all shop drawings, product literature, etc. only as required to properly coordinate and construct the project.
- Review of submittals by the Professional of Record is limited to specific shop drawings as called for in the Project Manual.
- Shop drawings for review by the Professional of Record are not required for this section.

PART II – PRODUCTS**GROUNDING**

- Provide main ground connections between all apparatus and conduits and the water and/or gas piping, as required by the latest approved edition of Article 250 of the NEC, and according to the requirements of the local utility company. Grounding conductors so routed as to permit as far as practicable, the shortest and most direct path to the grounding electrode system. Install all ground conductors in conduit and make connections readily accessible for inspection.
- Equipment grounding consists of connecting all noncurrent-carrying metal parts of the wiring system to a ground source. This includes the conduit or other steel raceway itself, boxes, and similar components, as well as the metal enclosures of panels and equipment.
- Ground source to be the ground terminal of the system grounding at the main service equipment.
- Branch circuit and distribution panelboards and switchboards shall be grounded as shown on Contract drawings.
- Motors shall be grounded by connecting a bare conductor from each motor frame to the grounding terminal on the rigid-to-flexible conduit

adapter. Ground conductor for motor equipment shall be at least 50 percent of the total copper per phase of the largest feeder to the equipment grounded. Minimum size ground conductor in conduit shall be No. 12 AWG. Minimum exposed ground conductor shall be No. 6 AWG.

- Connect all step-down transformers and switchgear to the main ground with copper ground wire.

SERVICE ENTRANCE SECTION

- Install the service entrance distribution panelboard as herein specified and shown on the Electrical Drawings. Panelboard shall be designed, built, and tested in accordance with the applicable portion of the latest editions to NEMA PB-2 and Underwriter's Laboratories No. UL-891.
- Provide embossed steel identification nameplates with 1/4" high letters for each circuit (screwed on cover of each switch), properly marked to indicate equipment served and circuit number. Nameplates shall be furnished and installed by equipment manufacturer for every switch or circuit breaker in the service entrance and distribution line-up.
- All equipment shall be rated to comply with NEMA standards for construction, capacity and quiet operation.
- All equipment compartments with hinged access doors shall be provided with friction catches to facilitate inspection and adjustment, live compartments secured with captive bolts.
- Provide "pulse type" equipment for the energy management system as described on the EM sheets.

METERING (EXTERIOR)

Provide in the metering section facilities for mounting power company furnished and installed CT's and PT's and metering per P.U.E.S.R. and utility company requirements.

DISTRIBUTION SECTION

- The distribution section (NEMA-3R construction where installed outside the building) shall consist of completely enclosed, self-supporting metal clad structures containing distribution circuit breakers, bus bars, supports, etc.
- Enclosed construction: The panelboard framework shall be fabricated on a die-formed steel base or base assembly consisting of the formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing, and component devices during shipment and installation. Top and bottom conduit areas are to be clearly shown and dimensioned on the shop drawings. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.

- Bus bars shall be high strength, 55% conductivity, pure aluminum and suitably plated. Unless otherwise indicated, bus bar bracing shall be 50,000 RMS amperes symmetrical. The panelboard bussing shall be plated and sufficient cross-sectional areas to continuously conduct rated full load current with a maximum temperature rise of 50°C, above an ambient temperature of 40°C. Provide equipment ground bus.
- The circuit breaker shall be suitable for use on the service as described and the sizes as shown on the associated drawings. The units shall be listed and approved by Underwriter's Laboratories for general service entrance use. The circuit breakers shall be group mounted in panel-type construction.

BRANCH CIRCUIT PANELBOARDS

- 120/208 volt, 3-phase, 4-wire Circuit Breaker Type: Install circuit breaker panelboard as indicated in the panelboard schedules, and where shown on the plans. Panelboards shall be of the dead-front safety type, equipped with thermal-magnetic molded case circuit breakers with frame and trip ratings as shown on the schedule. The unit shall be listed, approved by UL for service entrance use and labeled at each unit.
- All circuit breakers shall be bolt-on type, quick-break, quick-make, thermal-magnetic, trip indicating, have a common trip on all multipole breakers and shall be UL approved for switching duty. Tandem, twin duplex, or thin types are not acceptable. All breakers shall have large permanent individual circuit numbers affixed to each breaker in a uniform position. All breakers having a 225 amp frame and larger shall be equipped with adjustable trips.
- Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. All current-carrying parts of the bus assembly shall be plated. Mains rating shall be as shown in the panelboard schedule on the plans. Provide an equipment ground bus and an insulated, isolated ground bus. Bus bars shall be high strength 55% conductivity pure aluminum and suitably plated.
- Wiring Terminals: Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.
- The panelboard bus assembly shall be enclosed in a steel cabinet. Fronts shall include doors and have flush-brushed, stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Fronts shall not be removable with door in the locked position. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. The directory shall be typed to identify the load fed by each circuit.
- Provide one spare 3/4" conduit for each three unused poles and one spare 1" conduit in all flush mounted panelboards. Extend conduits from panelboard to an accessible point beyond the area of finished wall or ceiling construction.
- 277/480 Volt, 3-Phase, 4-Wire, Circuit Breaker Type: Install circuit breaker lighting panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be dead front safety type equipped with thermal magnetic molded case circuit breakers of frame and trip ratings as shown on the schedule. The units shall be listed, approved by UL and labeled at each unit.
- Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise test with maximum hot spot temperature on any connector or bus bar not to exceed 50° rise above ambient. Heat rise test shall be conducted in accordance with Underwriter's Laboratories Standard UL 57.
- Provide an equipment ground bus. Bus bars shall be high strength 55% conductivity pure aluminum and suitably plated. Bus bar shall be adequately braced and supported to withstand the mechanical forces exerted when connected directly to a power source having the indicated short circuit. Unless otherwise indicated, bus bar bracing shall be series rated 50,000-RMS amperes symmetrical.
- Circuit breakers shall be bolt-on circuit breakers equipped with individually insulated, braced, and protected connectors. Large permanent individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit). Provisions for additional breakers shall be such that no additional connectors will be required to add breakers.
- Each panelboard, as a complete unit, shall have a rating equal to or greater than the integrated equipment rating shown on the panelboard schedule on the plans. Such rating shall be established by test with the circuit breakers mounted on the panelboard.
- Doors shall be fastened to trim with concealed hinges and provided with flush type combination latch and lock with three keys each (all keyed alike).
- Panelboards, with circuit breakers installed, to be provided by Required Vendor, Villa Lighting. See "Bidding Requirements" Section 5 for approved vendor.

BRANCH CIRCUITS

- A general layout of branch circuit wiring and routing is indicated. Generally, receptacles and appliances are on separate circuits from lighting.

- No. 14 wires will be permitted only on control circuits of relays, contractors, starters, etc. No. 12 wire will be a minimum size for any lighting, motor or general branch circuits unless specifically noted otherwise.
- In general, conductor sizes for major branch circuits such as large motor and equipment branch circuits are noted. Where conductor sizes for circuits are not noted, produce branch circuits with conductors sized as follows:
 - Conductor for individual motor branch circuits shall have ampere capacity of not less than 125% of the running current of the motor.
 - Conductors for multiple motor branch circuits: Have ampere capacity of not less than 125% of the running current of the largest motor plus 100% of the running current for each additional motor connected to the circuit.
 - Conductor sizes for lighting, receptacles, and small motor branch circuits, with less than 20 ampere connected load, are not shown. Conductors for such circuits are sized as follows:
- Conductor size for branch circuits (120/208V) 75 feet in length from branch circuit panel to center of load, not smaller than No. 12, up to 150 feet not smaller than No. 10, up to 200 feet not smaller than No. 8. Conductor size for branch circuits (277/480V) not smaller than No.12, up to 300 feet not smaller than No. 10, 400 feet not smaller than No. 8.
- Where specific conductor sizes required by the drawings and specifications are larger than Code requires, the largest sizes are installed.

DISCONNECT SWITCHES AND PROTECTIVE DEVICES

- Disconnecting devices, when not included, with electrically-operated equipment furnished under other sections of the specifications, shall be furnished and installed under this section.
- Safety disconnect switches shall be quick-make, quick-break, heavy-duty, horsepower rated, with voltage rating as required by the system and current rating as scheduled or as required by the motor manufacturer. All switches shall be furnished with a defeatable cover interlock. All disconnect switches shall be fusible except where otherwise noted.
- All fused switches shall accept only Class "R" type current-limiting fuses and reject all other class and type.
- Disconnect switches for fractional horsepower (1/4 or less), 120 volt, single-phase motors shall be Fusetron box cover units with a toggle switch, pilot light and a fustat dual-element fuse of a size nearest to ampere rating of motor.
- Disconnect switches for 1/3 and 1/2 horse power 120 volt motors and fractional horsepower motors (3/4 or less) single phase motors may

be a manual motor starter with pilot light. Provide thermal overload protection when not integral with motor.

- Disconnect switches for fractional horsepower motors and for equipment of similar capacity shall be a heavy duty industrial type fused disconnect, with solid neutral where required.
- Disconnects installed indoors to have NEMA 1R enclosures. Disconnects installed outdoors or in outdoor locations to have NEMA 3R enclosures.

FUSES (WHERE OCCUR)

- All fuses shall be non-renewable type R, current limiting, 250 or 600 volt, with interrupting rating of 200,000 amperes RMS, as manufactured by Bussman Division of McGraw Edison Company with current rating and type as scheduled.
- Fuses protecting distribution and branch circuit panels shall be Buss RK-1 low-peak dual element type or as noted on Drawings.
- Fuses protecting motor branch circuits shall be Buss Fusetron dual-element type, sized for motor nameplate data per manufacturer's recommendation. All other fuses shall be typed as noted on the contract drawings. Fuses furnished by contractor and approved by Professional of Record different from those specified shall be coordinated with each other and with circuit breakers which they are protecting. The contractor shall provide a written statement certifying that coordination verification has been performed. Provide a fuse in each fuseholder and a label inside each switch cover indicating specific type of fuse required for replacement in all fused switches including panels. S.E.S. distribution switchboards, and disconnects.
- Provide three spare fuses for each type and current rating used on this project. Fuses shall be mounted in fuse clips in a panel with a hinged, lockable door and installed in the mechanical rooms(s) as directed. Mount fuses by current rating in a manner to make sizes evident and fuses readily available. Cabinets shall be as manufactured by Bussman, a Division of McGraw Edison. Provide only where fuses are required on site.

STARTERS

- Furnish and install starters and control devices shown and required by code.
- Starters (manual and magnetic) shall be Square-D. Furnish complete with green light pilot lights to indicate equipment energized, auxiliary contacts as required, push buttons, hand-off-on-switches, etc., control devices and overload relays in each line to motors except neutral, all as required to complete installation.
- Control devices (push button stations, hand-off-auto, on-off, limit switches, etc.) Square-D.

SECTION 16400: SERVICE AND DISTRIBUTION

DRY TYPE TRANSFORMER

- Transformers shall have KVA ratings, primary and secondary voltages, phases, and electrical characteristics as scheduled on drawings.
- All transformers, 30 KVA and larger, shall incorporate a UL class 220°C insulation system in accordance with National Electrical Manufacturer's Association ST-20 and the latest revision. The electrical insulation shall have been examined and listed by Underwriter's Laboratories, Inc.
- The temperature rise shall not exceed 115° above a 24-hour 40°C ambient when loaded at the nameplate KVA. The 115°C rise transformers shall be capable of providing a 30% continuous overload without exceeding a 150°C rise.
- All coils shall be of the continuous wire wound construction and shall be vacuum impregnated with non-hydroscopic, thermosetting varnish, each layer having end fillers or tie downs to provide maximum mechanical strength. Tap terminations to be brazed to magnet wire. Primary and secondary magnet wire brazed directly to bus stubs or lugs firmly mounted. Windings continuous from start to finish. No

splicing acceptable. Materials incorporated must have a minimum of one year of proven field usage. Accelerated laboratory test are not acceptable.

- Tap arrangements shall either meet or exceed the requirements of NEMA ST-20. Those requirements are 2, 2-1/2 % full capacity taps below the normal primary voltage.
- Sound levels shall not exceed the following limits; 10 to 50 KVA - 45 D.B.; 51 to 150 KVA - 50 D.B.; 151 to 300 KVA - 55 D.B.; 301 to 500 KVA - 60 D.B.
- Dry-type transformers are provided by Required Vendor Villa Lighting. See "Bidding Requirements" Section 5 for approved vendor.

PART III – EXECUTION

All equipment shall be installed in accordance with manufacturer's recommendations and applicable codes as specified elsewhere.

END OF SECTION