

SECTION 01720

PROJECT RECORD DOCUMENTS

1.01 GENERAL: Related requirements specified elsewhere:

- A. General Conditions.
- B. Shop drawings, project data.

1.02 MAINTENANCE OF DOCUMENTS:

- A. Contractor shall maintain at the job site one copy of the project drawings and specifications, including all addenda, shop drawings and change orders, and shall make said documents available for inspection by the Owner.
- B. Maintain and submit to the Designer a set of the project drawings showing all changes made during the course of the work and any differences between the existing facilities encountered and that shown on the drawings. These drawings must be submitted before the final payment.

1.03 OPERATION AND MAINTENANCE MANUAL:

- A. Submit to the Designer 3 copies of an "Operation and Maintenance Manual" for all architectural specialties and mechanical and electrical equipment. The manual shall contain the following information in addition to shop drawings.
 - 1. Index of contents of manual and reference to use and location of item.
 - 2. Complete operation data and maintenance instructions.
 - 3. Parts lists and diagrams with component part numbers.
 - 4. Sequence of operation for all control systems.
 - 5. Wiring Diagrams.
 - 6. Names and addresses of local distributors.
 - 7. Warranty and bonds.
- B. Contractor shall perform all maintenance and retain all responsibility for required maintenance prior to submittal of the "Operation and Maintenance Manuals" to the Designer.

END OF SECTION

SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected site elements.
 - 2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Predemolition Conference: Conduct conference at **Project site**.

1.4 PROJECT CONDITIONS

- A. Owner will occupy portions of campgrounds immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. A selective number of circuit breakers and receptacles.
 - b. A selective number of pedestal assemblies.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
- B. Roadways: Repair any damage to roadways and/or campsite pads to original conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Owner.
- E. Survey of Existing Conditions: Record existing conditions by use of **preconstruction photographs**.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to the buildings.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be **recycled**, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.5 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 01732

SECTION 02221

TRENCHING AND BACKFILLING

PART I - GENERAL

1.01 Description

- A. This work includes excavation, trenching and backfilling for all electrical and related items.

1.02 Care of Existing Structures and Property

- A. All existing structures, utilities and property in the proximity of any excavation shall be supported and protected from damage by the Contractor during construction.
- B. When other utilities, such as sewer, gas, water, or other pipes or conduits cross the excavation, the Contractor shall support said pipes and conduits without damage to them and without interrupting service. The manner of support such pipes, etc. shall be subject to review by the Designer.
- C. All property shall be thoroughly cleaned of all surplus materials, earth and rubbish placed thereon by the Contractor.
- D. Any damage to structures, utilities and property resulting from the Contractor's work shall be promptly repaired by the Contractor. The quality of repair work shall meet the approval of the Designer.

1.03 Existing Underground Structures

- A. The Plans show the location of utilities based upon the best available information; however, the Designer does not accept any responsibility for the accuracy of this information nor does he guarantee that all utilities within the work area are shown.
- B. The Contractor shall notify the Designer, the Institution and the utility companies at least seventy-two (72) hours prior to the start of construction.
 - 1. The utility companies are to locate existing underground utilities and structures within the site limits.
 - 2. The Contractor, prior to the start of construction, shall verify the location of existing underground utilities and structures within the site limits. It is the responsibility of the Contractor to make all exploratory investigation necessary

to verify or locate the utility pipes, wires, structures and appurtenances of others. The Contractor shall notify the Designer of any conflicts between the location of existing underground utilities or structures. Any conflicts found shall be recorded by the Contractor as directed by the Designer.

Part II - Products

Not Used.

Part III - Execution

3.01 General Trenching

- A. Unless otherwise directed or permitted, not more than one hundred feet (100') of any trench shall be open at any time.
- B. During excavation, material satisfactory for backfilling shall be stockpiled at a safe distance from the banks of the trench to avoid overloading and to prevent cave-ins. Adequate drainage shall be provided by means of ditches, dikes, or other approved methods. Stockpiles shall be protected from contamination with unsatisfactory excavated material. If the Contractor fails to protect the stockpiles and the material becomes unsatisfactory, such material shall be removed and replaced with satisfactory on-site or imported material at no additional cost.
- C. Trench excavation may be accomplished either manually or with mechanical trenching equipment. The blades of road patrols or graders shall not be used to excavate the trenches. The depth of trenches shall be a minimum of 2'-0" to allow minimum cable depth of 2'-0". The bottoms of trenches shall be smooth and free from all aggregate larger than ½". Bracing and sheathing shall be provided as necessary. If the excavation is below the required level, the excess excavated area shall be refilled with suitable backfill. The accumulation of water shall be prevented by the use of pumps. When rocks or other granular material which might damage the cable are encountered, the excavation shall be at least 27 inches and backfilled with a 3-inch layer of sand or earth containing no particles that would be retained on a 1/4" sieve.
- D. All suitable materials removed from the trench shall be used in refilling cable and conduit trenches. Backfill for trenches shall be placed in layers not to exceed 6 inches, loose measurement. The first lay shall be sand or earth containing no particles that would be retained on a 1/4" sieve. The second layer shall contain no particles that would be retained on a 1" sieve. Subsequent layers shall contain no particles that would be retained on a 3" sieve. The second layer and each subsequent layer shall be compacted with pneumatic hand tamps to the satisfaction of the

Designer to prevent any future settlement of the backfilled area. Finish grading of earthwork shall be accomplished in a satisfactory manner. Materials authorized to be wasted shall be disposed of as approved.

- E. Dust conditions shall be kept to a minimum by the use of water. Salt or calcium chloride shall not be permitted.

3.03 Rock Excavation

- A. If encountered, the Contractor shall excavate rock as required for cable and conduit installation. He shall dispose of the excavated material, and shall furnish suitable materials for backfill in place of the excavated rock. The cost of excavation and backfill shall be included in the contract bid amount.
- B. Rock in trenches shall be excavated at a minimum of 6" below the cable depth of 2'-0", after it has been laid. Before the cable is laid, the trench shall be backfilled to the correct sub-grade with thoroughly compacted sand.

3.04 Removing Material

- A. The Contractor shall remove all surplus material, re-grade and leave the site clear, free and in good order all roadways and sidewalks affected by the construction of the work. He shall maintain the surface over the trenches in good condition promptly fill all depressions during the warranty period.
- B. Surplus or unsatisfactory excavated materials shall be properly disposed of off the site.
- C. Excavated rock shall be disposed of off the site.

3.05 Seeding

- A. Seed mixture shall be classified as Seed Mixture "RU" in accordance with INDOT section 621.05(a).
- B. Fertilizer shall be standard commercial fertilizer with an analysis of 12-12-12. Order in formula shall be 1) Total Nitrogen; 2) Available phosphoric acid; 3) Walter soluble potash.
- C. Mulch for seeding shall be reasonably free from primary noxious seeds.

D. Installation

1. All areas to be seeded and transition areas will be raked and leveled to a smooth and uniform grade matching original ground elevation. Loosen soil to a depth of one to two inches below finish grade.
2. Install mulched seeding at a rate of 150 pounds per acre.
3. Install seeding in areas inaccessible to mechanical equipment, and small areas with a hand operated cyclone seeder and cover by hand raking to a depth of 1/4 inch.
4. Water seeded areas with a fine spray to a minimum penetration of 1 inch.
5. Fertilizer shall be applied in accordance with INDOT Section 621.04.
6. Mulch shall be applied to seeded areas at a rate to give a uniform blanket covering of 1/4 inch thick.
7. The Contractor shall not destroy empty seed and fertilizer containers without permission of the Engineer, but shall retain them for inspection by the Engineer to verify quantities of the materials.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE:

- A. The Contractor shall furnish all supervision, labor, equipment, materials, tools and supplies to install electrical distribution panels, disconnect switches, pedestals and all U.G. conduit and conductors for a complete installation as shown on the Drawings and as specified herein. The work includes, but is not limited to the following:
1. All Demolition and removal of existing equipment.
 2. Trenching and backfilling for installation of new U.G. conductors.
 3. Concrete work as shown.
 4. Installation of electrical distribution panels, disconnect switches, power panel outlets and U.G. conduits and conductors.
 5. Installation of pads, bases and anchors; and all platforms and supporting stands for electrical equipment.
 6. Repair and return to original condition any existing facilities damaged in the process of completing this work.

Determine required location, arrangement and quantities of equipment and materials from Drawings.

The Drawings are generally diagrammatic and indicate the general design and arrangement of the proposed work. The Contractor shall familiarize himself with the Drawings and shall be responsible for the final locations of his particular equipment to suit field conditions encountered and to avoid interference's, without extra cost to the Owner. The Designer reserves the right to make minor changes in equipment location prior to roughing-in of the electrical work without any additional cost to the Owner.

1.02 GENERAL:

- A. The approximate location of existing utilities and other obstacles that might interfere with this work are shown on the Drawings. The locations are shown to the best of the Owner's knowledge and it shall be the contractor's responsibility to determine the exact locations and plan the work accordingly.
- B. Certain portions of the work hereinafter described might necessarily be done by the utility company furnishing the power of the property affected. Any costs, whatsoever, that might be charged by the Utility Company for their work and/or materials shall be paid by the Contractor and the cost(s) shall be included as a part of this contract.
- C. It is recommended that the successful low bidder notify the affected utility company that this work shall begin upon the bidder's receipt of the contract so that scheduling can be made accordingly.
- D. Some of the installation to be performed by the Contractor will require moving machinery and/or inventory out of the way to make room to work. The property personnel will be responsible for providing clearance.

1.03 CODES AND STANDARDS:

- A. All electrical work installed under this contract shall conform to current codes and standards listed here and all applicable requirements of Federal, State and Local Authorities having jurisdiction, including the latest OSHA requirements.
- B. All installations shall conform to all requirements of the following:
 - 1. Indiana Electrical Code - NFPA Electrical Code - NEC (latest edition in effect at time of awarding contracts). Certify in writing, after completion of all punch list items, that all systems and workmanship conform to the named edition of the National Electrical Code.
 - 2. Indiana Fire Prevention Code - International Fire Code - IFC
 - 3. Indiana State Construction Industry Safety Code.
 - 4. All Laws, Ordinances, Rules and Regulations in effect in/or by the State of Indiana and as required by Indiana Administrative Building Council and Local Authority having jurisdiction.
 - 5. Respective utility providing electric and communication service.
- C. Certain portions of the work as shown on the drawings and hereinafter specified shall exceed NEC minimum requirements however, all other work, materials and methods shall be no less than NEC minimums. Anything less than the NEC requirements and these specifications shall be rejected work.
- D. Standards:
 - 1. Underwriter's Laboratories, Inc. Labeling shall be provided where specified for specific items.
 - 2. All materials shall be manufactured and tested in accordance with latest editions of U.L., NEMA, ANSI, ASA, AIEE and IPCIA Standards.
 - 3. Owner's Requirements and Regulations, pertaining to safety, fire, conduct, parking, sanitary conditions, smoking, etc. shall be strictly adhered to by Contractor and his employees and sub-Contractors on the job.

1.04 WORKMANSHIP:

- A. All materials and equipment shall be installed in accordance with the manufacturer's recommendations, as approved by the Engineer to conform with the Contract Documents.
- B. The finished product shall be complete and functional. Where the term "Provide" is used in these Specifications, it shall mean to furnish, install and connect, unless otherwise stated.
- C. All work under this section shall be performed by or under the direction of a licensed electrician.

1.05 PRODUCT STORAGE:

- A. Conduit, fittings and boxes shall be stored on job site in such manner as to prevent damage and keep dirt and foreign matter from getting into product.
- B. Equipment, apparatus, accessories and instruments shall be stored on job site, in original cartons or otherwise protected, in such a manner as to prevent weather damage or breakage, with openings covered to keep out dirt and foreign matter.

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- C. Wire and cable shall be stored on job site; in factory cartons or on spools, protected in such a manner as to prevent weather, heat or mechanical damage.

1.06 SUBMITTALS:

- A. Submit shop drawings for all equipment specified in conformance with Section 01340. The submittal must include a written statement of exceptions and deviations from these specifications.
- B. Shop drawings shall include complete data including physical dimensions and other information required for installation, performance capabilities and limitations, equipment wiring diagrams complete with sequence of operation, and schedules indicating locations when more than one type of an item is to be used. All shop drawings must be certified as being correct for the proposed work.
- C. Shop drawings, brochures or catalog cuts showing more than one size or model shall be marked to indicate the size or model proposed for the particular application.
- D. Prior to submittal, shop drawings shall be coordinated with the work of all other trades.
- E. Shop drawings shall be identified as to the specific equipment for which the shop drawings relates. Identification shall be by reference to equipment designations as shown on the Drawings or by reference to the appropriate Article of the Specifications in which the equipment is specified.

1.07 INSTRUCTION MANUALS:

- A. Three sets of Instruction Manuals shall be furnished to the Designer prior to acceptance with each set to include the following:
 - 1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
 - 2. Schematic control, and wiring diagrams identifying the location and function of all system components and controls.
 - 3. Installation, operation, lubrication and maintenance instructions.
 - 4. Manufacturer's recommended spare parts list.
 - 5. Test data and performance curves where applicable.

1.08 WORK VERIFICATION AND FIELD MEASUREMENTS:

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. Location of all equipment and systems shall be coordinated to preclude interferences with other construction.

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- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Designer shall be notified and any changes approved before proceeding with the work.

1.09 RECORD DRAWINGS:

- A. A record shall be kept of all deviations in location or elevation of any underground or concealed installation from that shown on the Contract Drawings. Records shall consist of marked shop or Contract Drawings and shall be submitted to the Designer at any time upon request during or after completion of construction. No such deviations from the Contract Drawings or approved shop drawings shall be made without prior approval by the Designer.

1.10 ACCESSIBILITY:

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind. Access panels shall be provided when work is built in or concealed.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

- A. All materials shall be new unless use of an existing item is indicated on Drawings or permitted in writing by Designer, best grade of each representative type. All conductors, raceways, devices, etc. shall be, as a minimum, of service class and capacity suitable for location and load for which they will be used. All materials shall be of domestic manufacture and shall comply with Codes and Standards as described herein.
- B. Materials and equipment shall be furnished as specified in this Section and shall be in strict accordance with applicable ANSI, NBS, ASTM, NESC, NEMA, IEEE, IPCEA, UL, NEC, OSHA and NFPA standards. Manufacturer's products referred to in this Division shall establish minimum requirements for materials and equipment furnished for this installation.

PART 3 - EXECUTION

3.01 FASTENING TO BUILDING STRUCTURES:

- A. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to approval by the Designer at all times. Submit shop drawings or samples for approval before proceeding with the work.
- B. Cutting, burning, drilling, welding or the use of explosive driven fasteners on building structures shall require prior approval by the Designer for each type of application unless specifically shown on the Drawings.

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3.02 MISCELLANEOUS WORK:

- A. Excavation and backfilling for electrical work shall be the responsibility of the Electrical Contractor and shall meet the requirements of Section 02221: Site work.
- B. The Electrical Contractor shall provide all pads, bases and anchors required to complete the electrical work.
- C. The Electrical Contractor shall provide all platforms and supporting stands for electrical equipment required to complete his work.

3.03 SERVICE TIE CONNECTIONS:

- A. Contractor shall check and verify all voltage and phasing of service tie connections at switchboards.
- B. Phasing to be maintained shall be A.B.C. top to bottom, east to west and north to south in all cases.

3.04 ELECTRICAL CONNECTIONS TO EQUIPMENT:

- A. All equipment shall be wired complete in each detail, including all interlocks, safety switches, control devices, starters and disconnects.
- B. Drawings include equipment anticipated to be furnished; however, in case other makes, etc., are furnished than shown, the furnished equipment shall be wired completely as required at no additional cost to the Owner. Any additional shall be borne by the Contractor furnishing the equipment.
- C. All connections and wiring diagrams where shown on the Contract Documents are for bidding purposes only and the Electrical Contractor shall obtain final wiring diagrams from the Contractor furnishing the equipment. Diagrams as supplied shall be specifically for this Project.
- D. Conduits and wires where shown on the Contract Documents are for bidding purposes. Electrical Contractor shall verify all wire sizes, number of wires required, and supply the proper number to each piece of equipment before installation.

3.05 NAMEPLATES:

- A. All equipment shall have factory applied permanent nameplates indicating the manufacturer's name, model and serial numbers, voltage, current, phase and any other data necessary to conform with specified requirements.
- B. In addition to the factory applied nameplate, the Contractor shall furnish and install identification plates on the exterior of all panels. For Example: Panel A Identification plates shall be laminated phenolic engraving stock a minimum of 1/16 - inch thick, white background black letters. Letters shall be no smaller than 2 inches tall. Identification plates shall be attached with drive pins or rivets.

3.06 PAINTING AND FINISHING:

- A. All purchased equipment shall have a factory applied standard finish of the manufacturer's standard color unless otherwise specified.

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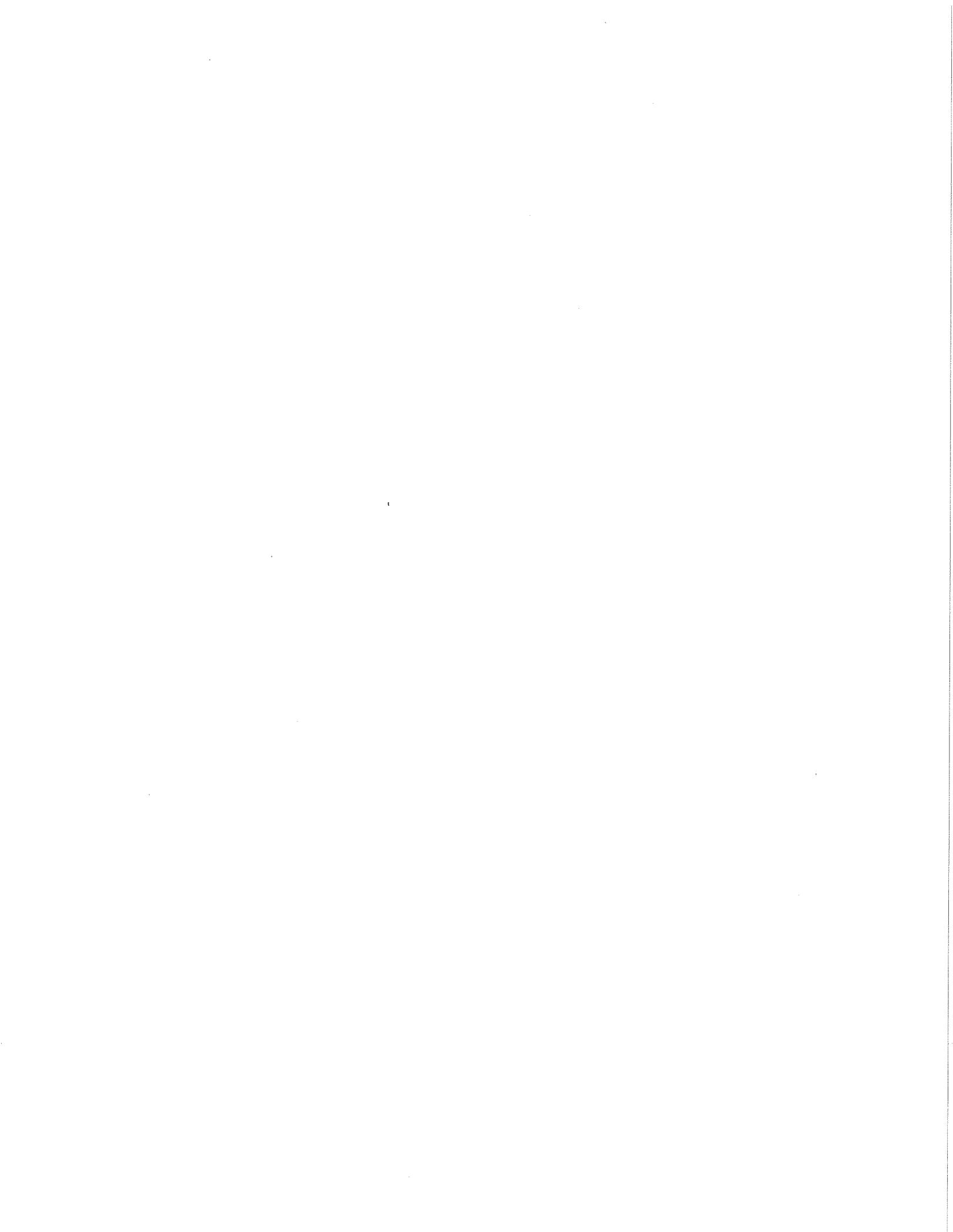
- B. Equipment which will be subject to abnormal conditions of high temperature, corrosive environment, etc., shall have finishes and/or protective coatings suitable for the service as noted on the Drawings and/or in the Specifications.
- C. Finishes which are marred during shipping, handling or installation shall be touched up to match the original finish. Finish shall be satisfactory to the Designer or the unit shall be completely repainted.
- D. Field fabricated bare iron or steel items required in installation of work under this Division shall have rough or shape edges removed, be thoroughly cleaned of dirt, rust, weld slag, grease or oil and be painted with one coat of Red Oxide primer and two coats of Exterior Enamel. Color shall be selected by the Designer.
- E. All exposed galvanized surfaces, supports, panels, conduits, etc. shall be thoroughly cleaned of dirt and oil and be given a vinyl wash primer, then one coat of zinc dust primer and one coat of exterior enamel. Color as selected by the Designer.

3.07 IDENTIFICATION:

- A. Underground-Type Plastic Line Markers: Manufacturers standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 3" wide x 4 mils thick. Provide red tape with black printing reading: CAUTION ELECTRIC LINE BURIED BELOW.
- B. Manufacturers:
 - 1. Seton Name Plate Corp.
 - 2. Allen Systems, Inc.
 - 3. Emed Co., Inc.
 - 4. Linetec, Inc.

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END OF SECTION



SECTION 16111

CONDUIT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required under this Section includes, but is not limited to, the provision, fabrication and installation of all conduit shown on the drawings and specified herein.
- B. This Section covers all conduit wire-way, junction boxes, outlet boxes and miscellaneous items to be used on the various portions of the contract. The Electrical Contractor shall meet the requirements of these Specifications wherever applicable.

1.02 CONTRACT REQUIREMENTS:

- A. All electrical work for all voltages shall be installed in a continuous conduit system unless specifically indicated otherwise on the Contract Documents.
- B. All conduits not used by this Contract shall have a #12 TW aluminum pull wire installed and securely tied off at each end for future pull wire.

1.03 SUBMITTALS:

Submit shop drawings and product data for the products of this Section in accordance with Section 01340.

PART 2 - PRODUCTS

2.01 RIGID GALVANIZED CONDUIT:

- A. The conduit shall be rigid heavy wall full weight mild steel and shall have uniform sherardized coating or hot dipped galvanized on the outside, and on the inside of the conduit including threads. The exterior surface shall be of standard weight and quality to afford maximum protection against corrosion.
- B. Elbows, bends and similar offsets shall be made of full weight materials and shall be treated, coated and threaded the same as conduit. All threads on conduit couplings and fittings shall be full depth and clean cut.

- C. All conduit shall be 3/4" trade size or larger and shall be one of the following makes:
National Electric Products Company, Youngstown Sheet and Tube Company;
Republic Steel; Allied, or approved equal.
- D. Couplings, unions and fittings: electrogalvanized steel, standard, threaded. Factory
manufactured 90° elbows shall be used for 1 1/4" trade size and larger. Fitting
Manufacturers: Appleton, T&B, Efcor, or approved equal.
- E. Expansion fittings: use O-Z Electrical Manufacturing Company Type EX with Type BJ
bonding jumper, or equal, for runs spanning expansion joints.
- F. Paint field cuts and repair damaged protective coating with red lead or zinc chromate.
- G. Corrosive atmospheres: use plastic jacketed conduit and fittings, Republic Steel
"Kekoran", Plastic Applicators "korkap," or equal. Repair damaged protective coating in
accordance with manufacturer's instructions.
- H. Direct buried: apply two coats of bituminous base paint after assembly of conduits and
fittings.

2.02 HWPVC CONDUIT:

- A. The conduit may be HWPVC (Schedule 80) as shown on the plans.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION:

- A. General: install in accordance with requirements of NEC and recognized standards of
good practice.
- B. Location: approximately as shown on Drawings, actual routing subject to approval.
- C. Embedded conduit:
 - 1. General: set before pouring of concrete begins. Route in as direct a line and with
as long bends as possible.
 - 2. Structural concrete slabs: minimum conduit size 1" except as directed.
- D. Joints: make with approved couplings and unions to provide electrically continuous and
moisture-tight system.

- E. Expansion joints: use expansions fitting and bonding jumpers wherever conduit spans building expansion joints.

- F. Drainage: avoid pockets in conduit runs as much as possible; provide suitable fittings at low spots in exposed conduit where pocket cannot be avoided. Weep holes not permitted.

- G. Bends: not more than equivalent of four 90° bends between pulling points.
 - No reduction in cross-sectional area.

 - No bend radius less than radius of standard elbow.

- H. Field cuts and threads:
 - 1. Cut ends of conduit with hand or power saw and ream to remove burrs and sharp edges. Do not use wheel cutter.
 - 2. Threads cut on job shall have same effective length, thread dimensions, and taper as factory cut threads.
 - 3. Carefully remove burrs from threads and paint conduit threads as specified.
 - 4. Apply coat of protective paint as specified to conduits where protective coating is damaged.

- I. Concealing: conceal conduits as shown on the Drawings.

- J. Exposed: run exposed conduits parallel with, or at right angles to, lines of buildings. Exposed conduit not permitted on exterior of building, unless otherwise shown on the Drawings or described herein.

- K. Conduit ends:
 - 1. Cap spare conduits.
 - 2. Open conduit ends terminating in panels or enclosures where exposed to entrance of foreign material: plug space around cables with commercial duct sealing compound.
 - 3. Cap conduit ends during construction to prevent entrance of foreign material

- L. Cleaning: clean and swab inside by mechanical means to remove all foreign materials and moisture before wires or cables are installed.

- M. Conduit connections at panels and boxes: double locknuts and insulating bushings.

3.02 UNDERGROUND CONDUIT INSTALLATION:

- A. Install all underground conduits on undisturbed or fully compacted earth.
- B. As completed conduit runs are installed, rod and draw through test mandrel. Plug conduit after testing to prevent entry of foreign material.
- C. Conduit shall be pushed beneath roadways. No open cutting of roadways will be accepted. Conduit shall extend the width of the road plus 5' -0" on each side.
- D. Bushings shall be installed on ends of conduits.

END OF SECTION

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SECTION 16120

WIRE AND CABLE 600 VOLT OR LESS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required under this Section includes, but is not limited to, furnishing and installing all power and control wire and cable shown on the drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

- A. Basic Electrical Requirements - Section 16010

1.03 SUBMITTALS:

- A. Submit shop drawings for all products to be used on this project.

PART 2 - PRODUCTS

2.01 CONDUCTORS:

- A. Material: Conductors shall be soft drawn Lake Copper. Conductivity of wire shall be not less than 98%.
- B. Stranding: Conductors shall be solid for No. 12 thru No. 10 AWG; Class B stranding for No. 8 AWG and larger. Stranded conductor shall be used where conductor is subject to flexing while in service.
- C. Minimum Sizes: Conductors shall be minimum No. 12 AWG for power and lighting wiring and minimum No. 14 AWG for control wiring; unless otherwise shown on the Drawings or specified herein.
- D. Standards: All conductors shall be no less than NEC requirements in regards to sizes, insulations and types. All conductors shall be copper material not greater than 2 years age; comply with the latest specifications of NFPA, and shall have U.L. label clearly affixed per U.L. standards. The use of salvaged conductors from other jobs is expressly prohibited.

E. IDENTIFICATION:

1. Identify grounded conductor: in accordance with NEC Article 200-6.
2. Multi-wire branch circuits and grounded conductor: Identify in accordance with NEC Article 210-5.

3. Other circuits:
 - a. Color code wire size No. 10 and smaller, as follows:

		<u>208/120V</u>	<u>480/277</u>
1.	Phase A	Black	Brown
2.	Phase B	Red	Orange
3.	Phase C	Blue	Yellow
4.	Neutral	White	White
5.	Ground	Green	Green

 - b. Cables larger than No. 6 shall have each phase labeled using Brady labels, or colored tape.

 - c. Tag each spare wire.

F. INSULATION:

1. Above ground, in conduit: 600-volt, NEC type THW, RHH, RHW, TWN, or THWN/THHN. Rated at 75°C for dry & wet locations.
 2. Below ground, in conduit: 600-volt, NEC type RHW.
 3. Direct burial shall be type USE, rated at 75°C for dry and wet locations.
 4. Insulation of connections:
 - a. Three layers 3/4" wide 3M Company "Scotch No. 33" "Scotch No. 88", or equal, electrical type, half lapped.
 - b. Use filler compound, "Scotchfil", or equal, at sharp edges to provide smooth surface before taping.
- G. Manufacturers: Anacoconda, Crescent, General Cable, General Electric, Hatfield, Okonite, Paronite, Rome Cable Company, Simplex, Triangle or equal. All conductors of a given type shall be a product of the same manufacturer, furnished in unbroken containers marked with date of production.

2.02 CABLE LUGS AND TAPS:

- A. For conductor sizes No. 8 or smaller: compression type. Thomas & Betts Stakon; Burndy Hydent; Buchanan Pressure; or equal.
- B. For conductors larger than No. 8: compression type. Thomas & Betts Lugit; Burndy Quiklug; Penn Union Ez; or equal.
- C. Underground splices and taps shall be insulated using pre-manufactured splicing kits similar to "Scotch cast" 85 Series as manufactured by the Electro Products Division/3M.

2.03 PULLING CABLES:

- 1. Steel Conduit: Nylon or steel.
- 2. PVC conduit: Nylon.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Run all wires of the same circuit in the same conduit.
- B. No wire shall be pulled until conduit installation is complete, clean and dry.
- C. Do not pull thermoplastic wire at temperatures lower than 33° F.
- D. Use pull-in compound (Wire-Lube, Y-Er-Ease, or equal) to facilitate pulling of wire. Grease or oils not permitted.
- E. Splice and connect wires only in readily accessible boxes. Number of splices must be held to an absolute minimum.
- F. Outdoor conduit runs shall be at least 24" below finished grade.
- G. Train and lace wiring inside equipment and panelboard with plastic wrap for a neat appearance.
- H. Make all spare wires in cabinets or panelboards of adequate length for connections. Terminate with insulating tape and tag.
- I. Underground direct burial wire and cable shall be installed in galvanized steel rigid conduit where entering buildings, rising up poles, or in other exposed locations and where crossing paved areas. Provide proper bushings on conduit.
- J. Bending radii: not less than permitted by IPCEA.

K. Supports in vertical runs: as prescribed by NEC.

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3.02 MARKING:

A. Main and feeder cables shall be tagged in all pull boxes, wireways and wiring gutters of the panels. Tags shall identify wire or cable number and/or equipment served as shown on the drawings. Tags shall be metal or of flame and resistive adhesive material.

3.03 WIRE CONNECTIONS AND DEVICES:

A. Thoroughly clean wires with oxidation inhibiting compound before installing lugs and connectors so that joint will carry full capacity of conductors without perceptible temperature rise. Use lugs or connectors of sufficient size to enclose all strands of the conductors.

3.04 PULLING CABLES:

A. Insert nylon pulling cables with carbon dioxide, composed air or vacuum. Use inert pulling compounds free of ingredients harmful to insulation. Use pulling grips. Do not use grease or oil.

3.05 INSULATION TESTS:

A. Test and record insulation resistance of all circuits. Megger readings must be taken before energizing a circuit. When the insulation resistance tests less than 5,000,000 ohm, the Contractor shall investigate causes and take remedial action to prevent damage to circuits. The megger test set shall have voltage rating as indicated below.

- | | | |
|----|--------------------------|----------------|
| 1. | 125 to 1000V insulation | 500V test set |
| 2. | 1001 to 7500V insulation | 1000V test set |
| 3. | Above 7500V insulation | 2500V test set |

B. All reports shall be certified and submitted to the Designer as shop drawings.

END OF SECTION

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SECTION 16145

POWER OUTLET PANELS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required under this Section includes, but is not limited to, furnishing and installing of all power outlet panels shown on the drawings and required herein.

1.02 SUBMITTALS:

- A. Submit shop drawings and maintenance data for all equipment specified in this Section.

PART 2 - PRODUCTS

2.01 POWER OUTLET PANEL:

- A. Power outlet panel shall be unit specifically designed and manufactured for recreational vehicle parks. Unit shall have all copper conductor interiors.
- B. Unit shall be of all metal construction and shall be pedestal mounted. Pedestal shall be constructed of not less than 14-gauge steel. Pedestal and panel shall be phosphate treated and finished with baked enamel. Unit shall be raintight when in use.
- C. Mains shall be rated at not less than 100 amps. Main lugs shall be provided for loop feed wiring and shall accept copper conductors from #6 to 250 KCMIL. Ground lugs shall accept #10 thru #2 copper conductors.
- D. Units shall be equipped with one 20 amp, 1 pole GFCI circuit breaker connected to one Duplex 20 amp receptacle NEMA 5-20R, one 30 amp, 1 pole circuit breaker connected to one single 30 amp receptacle NEMA 5-30R both 125 volt, 2 wire with grounding ANSI C73 13-1972 and, one 50 amp, 2 pole circuit breaker connected to one single 50 amp receptacle NEMA 14-50R 125/250 volt, 3 wire with grounding ANSI C73.12-1972. A 20 Amp GFCI receptacle is not an acceptable substitute for the GFCI circuit breaker required.
- E. The trip point for the GFCI circuit breaker shall be set at. Not less than 4 ma. nor more than 6 ma.
- F. Provide an auxiliary stabilizer foot for the pedestal.
- G. Panel door shall be equipped for padlock.
- H. All conductors inside unit shall be made from soft drawn lake copper.
- I. Type 2 unit shall be Square D Model PAK75PG-Cu; Midwest Electric Products, Inc. Model UO75GP6-Cu, Milbank Catalog No. HP-UPO4-75CGB-SP3, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Panels and pedestals shall be installed in complete accordance with manufacturer's installation instructions and as shown on the drawings.
- B. Perform operational testing in accordance with the specifications. Verify ground connection and polarity of all receptacles.
- C. Phase conductors supply power to the 120volt pedestal outlets shall be connected in alternating sequence from one pedestal to the next on each branch circuit. In other words for example; 120volt receptacles on circuit A-1, shall be wired as follows: Site 105 & 107 – Red wire, Sites 106,108 – black wire.
- D. Identify each campsite pedestal with the campsite number by installing an identification label on the front side of the front cover. Use 2" black lettering w/silver reflective vinyl background by Hillman or Ky-Ko. Protect the numbers by installing a ¼" Lexan 4"x7" clear U.V. resistant shield. Secure to lid using (4) pop rivets, one at each corner. Seal top of the shield using a clear RTV caulk.

END OF SECTION

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SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work required under this Section includes, but is not limited to, the furnishing and installing of all panelboards shown on the drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

- A. SECTION 16010 - Basic Electrical Requirements
- B. SECTION 16120 - Wire and Cables

PART 2 - PRODUCTS

2.01 CONSTRUCTION:

- A. Where indicated on the Drawings, provide a deadfront panelboard incorporating switching and protective devices of the number, rating and type noted herein or shown on the Drawings.
- B. Cabinet shall be NEMA 3R rated, for surface mounting, constructed of heavy gauge steel in accordance with UL standard 50 for cabinets.
- C. All panelboards shall be rated for the intended voltage and shall be in accordance with the Underwriter's Laboratories, Inc. A "Standard for Panelboard's " and Standard for Cabinets and Boxes and shall be so labeled where procedures exist.
- D. All panelboards shall comply with NEMA Standards for Panelboards and National Electric Code.
- E. All interiors shall be completely factory assembled with switching and protective devices, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated. Interiors shall be so designed that switching and protective devices can be replace without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

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- F. A nameplate shall be provided listing panel type and rating.
- G. Bus bars for the mains shall be of copper size in accordance with Underwriters Laboratories standards. Unless otherwise noted, full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of branch circuit devices.
- H. The short circuit rating of the assembled panelboard shall be in accordance with U.L. Inc. Standards and their test verification.
- I. All panelboards shall be fitted with an equipment ground bar.
- J. Boxes shall be made from unpainted galvanized code gauge steel having multiple knockouts except where noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4" on all sides.
- K. Hinged doors covering all switching device handles shall be included in all panel trims.
- L. Doors in panelboard trims shall conform to the following:
 - 1. In making switching device handles accessible, doors shall not uncover any live parts.
 - 2. Doors shall have flush-type cylinder lock and catch, except that doors over 48" in height shall have auxiliary fasteners at top and bottom of door in addition to flush-type cylinder lock and catch. Door hinges shall be concealed. All locks shall be keyed alike. A directory frame and card having a transparent cover shall be furnished on each door.
 - 3. The trims shall be fabricated from code gauge sheet steel.
- M. All exterior and interior steel surfaces of the panelboard trims shall be properly cleaned and finished with ANSI-61 paint over a rust-inhibiting phosphatized coating.
- N. New 1200 Amp panel shall be Square D "I-Line" style; Type "HCR-U", Catalog No. HCR548612U interior with Type 3R box Cat. No.HC4486, including 1200 amp main breaker with back-feed main lug kit, solid neutral assembly HCWM12SN, and equipment ground bar kit PK32DGTA. Branch breakers shall be Square D, "K" Frame Type KA.

2.02 PANELBOARD DIRECTORY:

- A. Provide each panel with a typewritten circuit directory filled in completely listing equipment served and campsite numbers.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Support panel cabinets independently with no weight bearing on conduits.
- B. Install panelboards so top breaker is not higher than 6'-0" above the floor or finish grade. All panels same height. Adjacent panel cabinets shall be same size and mounted in horizontal alignment.
- C. Protect panelboards and cabinets during construction to prevent damage and entry of dirt, paint, etc., Inspect and remove any debris, scrap wire, etc. from the cabinet interior before installing fronts.
- D. Distribute and arrange conductors neatly in the wiring gutters. Contractor shall maintain the largest practical bending radius of conductors.
- E. Connect ground electrode conductor to the equipment grounding terminal bar. Verify that the ground bar is securely bonded to the panelboard cabinet and that it is not connected to the neutral bar except at service equipment as permitted in the latest revision of NEC Article 250.

3.02 BALANCING ELECTRICAL LOAD:

Care shall be exercised in connecting various electrical loads to panelboards in order to arrive at a reasonable balance between loads on each phase at each panelboard. It shall be the responsibility of the Electrical Contractor to make tests and adjust loads at each panelboard to result in a reasonably balanced load condition, satisfactory to the Designer.

END OF SECTION

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SECTION 16311

DISTRIBUTION TRANSFORMER (PAD MOUNTED)

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required by this section includes but is not limited to the furnishing and installation of the pad mounted transformer.
- B. Transformer shall be pad mounted of low silhouette design.

PART 2 - PRODUCTS

2.01 RATINGS

- A. Frequency: 60 hz.
- B. KVA: 250 KVA
- C. Impedance: In accordance with ANSI Standards.
- D. Primary Voltage: 12740Y/7,200 volts Single Phase.
- E. Primary Basic Impulse Level: 95 kv.
- F. Secondary Voltage: 120/240 volts, (30KV Basic Impulse Level) single phase.
- G. Temperature Rise: 65°C above a 30° C average ambient with a maximum ambient not to exceed 40°C.
- H. Coolant: New insulating oil or high fire-point, non-propagating dielectric coolant. (Non-PCB).
- I. Primary and secondary winding shall be copper.

2.02 CONSTRUCTION

- A. The transformer shall comply with the latest applicable standards of the National Electrical Manufacturers Association (NEMA) and the American National Standards Institute (ANSI).
- B. The transformer shall be self-cooled, tamper resistant and weather protected for mounting on a pad. There shall be no exposed screws, bolts or other fastening devices which are externally removable.

- C. The transformer shall be of the sealed tank construction of sufficient strength to withstand a pressure of 7 psi. without permanent distortion. The cover shall be bolted on and the fastenings tamper resistant. The transformer shall remain effectively sealed for a top oil temperature range of 50°C to 106°C. When required, corrugate cooling panels or radiators shall be provided on the back and sides of the tanks. Lifting eyes and jacking pads shall be provided.
- D. A tap changing mechanism shall be provided for accurate voltage adjustment without opening the transformer tank. The tap changing mechanism shall be provided for accurate voltage adjustment without opening the transformer tank. The tap changing mechanism shall be externally operated and shall be for de-energized operation only.
- E. The high and low voltage compartments shall be located side-by-side separated by a steel barrier. When facing the transformer the low voltage compartment shall be on the right. Terminal compartments shall be full height, air filled with individual doors. The high voltage door shall not be accessible until the low voltage door has been opened. The low voltage door shall have a flip cover with provisions for a single padlock.

2.03 HIGH VOLTAGE TERMINATIONS AND EQUIPMENT

- A. The high voltage terminations and equipment shall be dead front and conform to ANSI C57.12.26 requirements. Provide one piece integrated bushings for use with elbow terminators and parking stands for mounting accessory equipment. Well shall be externally clamped.
- B. The terminations and equipment shall be four hole spade arranged for loop thru feed.

2.04 HIGH VOLTAGE PROTECTIVE EQUIPMENT

- A. Provide Bay-O-Net type oil immersed fuses.

2.05 LOW VOLTAGE TERMINATIONS AND EQUIPMENT

- A. The low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hole spacing arranged for vertical take-off. The low voltage neutral shall be an insulated bushing grounded to the transformer tank by a removable grounding strap.

2.06 ACCESSORIES

- A. Nameplate in low voltage compartment.
- B. ½-inch drain plug.

C. ½-inch filling plug.

D. Surge Arresters: Distribution class, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1. Transformers shall have **three arresters for loop-feed** circuits fully shielded for dead-front construction.

2.07 TEST

A. Routine tests shall be made on transformer as defined in “American National Standard Requirements, Terminology and Test Code for Distribution, Power and Regulating Transformers” and in “Parts Test Code” of NEMA Publication TR1-1962 or latest revisions thereof. Manufacturer shall certify transformer has passed all quality control and routine test.

B. Submit test data per Section 01340, Shop Drawings.

C. Inspection: Owner shall have the right to inspect at the factory, at any time during manufacture and assembly, all equipment and materials covered by these specifications and to be present during any tests made on the equipment.

2.08 MANUFACTURERS

A. Manufacturers acceptable contingent upon product’s compliance with the specifications.

1. RTE
2. ASEA Brown Boveri
3. Square D
4. Westinghouse
5. Solomon

PART 3 - EXECUTION

3.01 FOUNDATION

A. Contractor shall provide fiberglass ground sleeve as required for complete installation of transformer. Fiberglass ground sleeve shall be of heavy-duty reinforced fiberglass construction using fire-retardant resin with gel-coated exterior for superior weather ability.

B. Fiberglass ground sleeve shall come predrilled for transformer supplied.

C. Transformer shall be leveled and anchored to fiberglass ground sleeve.

D. Fiberglass ground sleeve shall be suitable to support weight of transformer without settlement. Ground sleeve shall be manufactured by Nordic or approved equal.

3.02 LIFTING, JACKING AND SLIDING

A. Transformers shall be lifted only by hooks furnished with and fastened permanently to the transformer shell.

- B. Transformer shall be jacked only by main support base.
- C. Sliding of transformer shall be only in direction of tank center axis front to back or side to side.
- D. Contractor shall not use any method that results in damaging impact to transformer. Care shall be taken to prevent damage to tank and core.

3.03 STARTUP

- A. Contractor shall provide manufacturer's Engineer for period of one week for startup service.
 - 1. All connection and methods of installation shall be thoroughly checked, approved and logged.
 - 2. All field test required to determine condition of transformer and readiness for service shall be performed.
 - 3. Engineer shall certify in writing that transformer is correctly installed and ready for service.

3.04 WARRANTY

- A. The Contractor shall warrant the equipment under this section free from defects in workmanship and materials for a period of one year from date transformer is first energized at site. Such warranty shall cover any defect or malfunction of transformer except those caused by vandalism, or acts of God.
- B. Such warranty shall include cost of removal from site and reinstallation after repairs, freight to and from repair facility up to ten percent (10%) of the cost of the transformer.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required under this Section includes, but is not limited to, furnishing and installing all materials and equipment required to ground, motors, motor starters, and conduit systems in accordance with NEC requirements and the drawings included herein.

1.02 SUBMITTALS:

- A. Submit product data for the products specified in this section.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

- A. Basic Electrical Requirements - Section 16010

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. Grounding electrodes shall be copperclad steel with a minimum diameter of 5/8" minimum length of 10'-0"; Blackburn Cat. No. W5810 or approved equal.
- B. Grounding electrode conductors shall be bare copper as required by the NEC. Minimum size shall be #3 for in-ground network, or as indicated on the Drawings.
- C. Ground rod clamps shall be heavy duty such as Blackburn Cat. No. GG58H or GG58, or approved equal.
- D. Ground rods shall have threaded ends to receive couplings, impact heads or drive points. Couplings, impact heads and drive points shall be provided as required.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All installations shall be made in strict accordance with NFPA-70, National Electrical Code, latest edition in effect except where more stringent requirements are specified herein.
- B. Each receptacle, light fixture, motor frame, equipment cabinet, etc. shall be provided with a bonded green-insulated ground wire connection to the associated rigid metal conduit system. Grounding clips furnished with wiring device mounting screws will not be considered as an adequate permanent ground method.
- C. All service entrance, panel feeder, motor control center feeder, transformer feeder conduits and other electrical equipment, shall be furnished with grounding bushings inside respective equipment cabinets. All grounding bushings within an enclosure shall be connected with a #8 AWG bare copper conductor and bonded to the equipment ground bus.
- D. At all locations where non-metallic conduits are installed, provide with the normal circuit or

feeder conductors a separate green-insulated grounding conductor sized in accordance with the National Electric Code.

- E. Flexible conduit shall not be permitted as a grounding conductor. Provide a separate green-insulated grounding conductor, size as required, from the solid metal conduit system to the item being grounded.
- F. Grounding connections shall be in accessible locations permitting future inspection, testing and maintenance and shall be made using threaded mechanical lugs or fittings.
- G. Use driving studs or other suitable means when driving ground rods to prevent damage to threaded ends of sectional rods. Head of ground rod to be minimum of 1'-0" below grade.
- H. No connections shall be covered before inspection by the Designer.

3.02 TESTING:

- A. The Contractor shall perform the following tests:
 - 1. D.C. resistance-to-earth measurement shall be made with all grounding electrode conductors temporarily jointed in the service entrance equipment enclosure before the conductors are connected to the equipment ground bus. Maximum D.C. resistance allowable shall be 5 ohms. The "three terminal" test method of measurement shall be used utilizing equipment and instructions by James G. Biddle Company, Associated Research or equal.
 - 2. D. C. Resistance tests shall be performed to measure resistance between grounding conductors systems and grounded (neutral) conductor systems. Measurements shall be taken between the ground and neutral pin contacts on standard 120 volt receptacles or between neutral conductors and equipment cabinets. Maximum D.C. resistance shall be 2 ohms. Standard digital ohmmeters having a scale graduated in tenths of an ohm shall be used. Perform tests at a minimum of three (3) branch circuit locations for each electrical panel installed.
 - 3. D. C. Resistance measurements between grounding conductor systems and grounded (neutral) conductor systems shall be taken between the ground and neutral pin contacts on standard 120 volt receptacles or performed with the bonding jumper between ground and neutral bus in the service entrance equipment removed. Standard meggar test equipment shall be used.
 - 4. All tests shall be performed before connection of the grounding system to its associated electrical equipment and after distribution and branch circuit wiring systems are installed, and before electrical systems are energized.
 - 5. Ground system test shall be performed and test reports shall be certified. Furnish Test Reports to the Designer as Shop Drawings.

END OF SECTION

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SECTION 16940

FIELD TESTS AND ADJUSTMENTS

PART 1 - GENERAL

- 1.01 All electric systems shall be tested by the Contractor prior to placing in service. Test reports shall be typewritten, listing equipment used, person or persons performing the tests, date tested, circuits tested, and results of tests.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

- 3.01 Insulation resistance tests, general:
- A. Perform insulation resistance tests on equipment and cables listed herein.
 - B. Test Equipment: furnished by Contractor, equal to "Megger" as manufactured by James G. Biddle Company.
 - C. Resistance measures: Line-to-ground.
 - D. Disconnect all solid state equipment before making cable tests. Contractor responsible for damage to any such equipment caused by cable tests.
- 3.02 Insulation resistance tests, cable: test all 600-volt class power, control, and lighting circuits at 500-volt rating of "Megger" for one-minute duration to assure compliance with NEC Section 110-20.
- A. Make tests after replacement of cable with terminations made but before connection to equipment.
 - B. Minimum acceptable values of insulation resistance shall be as recommended by cable manufacturer.
- 3.03 insulation resistance tests, equipment: minimum acceptable values of insulation resistance, in mehoHms, as shown in parentheses.
- A. Motors, 115-volt (1); test at 500-volt rating of "Megger".

- B. Lighting transformers (1); test at 500-volt rating of "Megger".
- 3.04 Voltage level test:
- A. When performed; after all equipment is installed, ready for operation.
 - B. Contractor shall measure voltage at 2 points in the system as directed.
 - C. Load conditions: no-load and full-load, insofar as practicable.
 - D. Test Report: required, as specified under paragraph 1.01.
- 3.05 Continuity Test: test all receptacle and control circuits to determine continuity of wiring and connections. Submit connections as required.
- 3.06 Phase relationship:
- A. Check connections to all equipment for proper phase relationship. Determine motor rotation. Correct connections as required.
 - B. Disconnect, prior to check, any device which could be damaged by application of voltage of reversed phase sequence.
 - C. Test report: written statement that this check has been made.
- 3.07 Correction of defects:
- A. If tests disclose any unsatisfactory workmanship, wiring or equipment furnished under this Contract, Contractor shall repair or replace, at his expense, such defects in an approved manner.
 - B. If any wiring or equipment is damaged by tests, Contractor shall repair or replace, at his expense, such wiring or equipment in an approved manner.

END OF SECTION