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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

19 FEB 2018

DEPARTMENT ORDER NO. 27 Series of 2018

SUBJECT: DPWH Standard Specification for Item 1726 – Electromechanical Equipment and Facilities for Pumping Stations

It has been the thrust of the Department to provide effective standard specifications in the implementation of various infrastructure projects. As such, there is a need to set a standard specification for the proper installation of electromechanical equipment and facilities for pumping stations. The attached **DPWH Standard Specification for Electromechanical Equipment and Facilities for Pumping Stations, Item 1726** is hereby prescribed for the guidance and compliance of all concerned.

This specification shall form part of the on-going revision of the DPWH Standard Specifications for Public Work Structures – Buildings, Ports and Harbors, Flood Control and Drainage Structure and Water Supply Systems, Volume III, 1995 Edition.

This Order shall take effect immediately.

MARK A. VILLAR
Secretary

14.1.2 FET/RGT

DPWH STANDARD SPECIFICATION FOR ITEM 1726 – ELECTROMECHANICAL EQUIPMENT AND FACILITIES FOR PUMPING STATIONS

1726.1 Description

This Item shall consist of furnishing and installing electromechanical equipment and facilities for pumping stations in accordance with the Plans and this Specification, or as directed by the Engineer.

1726.2 Definition

1726.2.1 Motor Control Center (MCC)

A motor control center (MCC) is a metal floor-mounted assembly in NEMA 3R, powder-coated or NEMA 4x of one (1) or more metal enclosed vertical sections typically having a horizontal common power bus and principally containing combination of motor-control units, over current protection and overloading devices. These units are mounted one above the other in the vertical sections. The sections normally incorporate vertical copper bus bars connected to the common power bus, thus extending the common power supply to the individual units. Power may be supplied to the individual units by copper bus bar connections, bolt or bolted connection or suitable wiring. The motor control center shall be installed to control all main pumps and pumping station facilities.

1726.2.2 Local Control Panel (LCPC)

An enclosed metal assembly in NEMA 3R, powder-coated or NEMA 4x of a systematic and standard arrangement of two (2) or more components such as motor, magnetic controllers, overload relays, fused disconnect switches, and circuit breakers and related control devices such as pushbutton stations, selector switches, timers, switches, control relays, and the like with associated wiring, terminal lugs, pilot lights, and similar components. The local control panel shall be installed for the control of auxiliary and facility equipment such as cranes, rakes and flood gates.

1726.3 Material Requirements

1726.3.1 Motor Control Center (MCC)

1726.3.1.1 General

The motor control center shall be completely enclosed by metal stud/powder-coated or stainless dead-front type with operating handles, push buttons, name plates, mounted on the front and all arranged to present a neat appearance. It shall consist of vertical sections divided into isolated compartments for the individual motor starters and other major equipment.

The motor control center (enclosure and equipment) shall meet the requirements of Codes and Standards such as UL 845 (Standard for Motor Control Centers) and Philippine Electrical Code (PEC), and recommendations of the manufacturer.

All MCC equipment shall be marked in accordance with the requirements of the PEC.

1726.3.1.2 Enclosure

The enclosure of the MCC shall surround the equipment to protect personnel from contact with live buses or connections and to protect equipment from external conditions. The selection of type of enclosure to be used shall be based on the location of the MCC. The type of metal enclosure to be used shall conform to the requirements of the PEC.

1726.3.1.3 Equipment and Appurtenances

A motor control center shall contain any of the combination of the following equipment such as:

1. Full-voltage reversing or non-reversing combination motor control units
2. Full-voltage multispeed combination motor-control units
3. Reduced-voltage part-winding, wye-delta or auto-transfer combination motor-control unit
4. Solid-state industrial controllers such as adjustable-speed drives, programmable controllers, protective relays
5. Lighting or distribution panelboards
6. Feeder-tap units
7. Incoming-line equipment, such as main lugs, fusible switch, isolation switch, or air circuit breaker
8. Control or lighting transformers
9. Special equipment assemblies
10. Over voltage and low voltage control unit device
11. Ground system component
12. Lightning Protection System

The foregoing equipment shall also contain such items as pushbuttons, selector switches, indicating lights, control transformers, control circuit fuses and auxiliary contacts incorporated as an integral part of the above units.

The specifications of all MCC equipment and appurtenances shall conform to the requirements of the UL 845, PEC, and recommendations of the manufacturer.

1726.3.1.4 Wires and Cables

All wires and cables for MCC equipment shall conform to the applicable requirements of Item 1101 – Wires, Cables and Wiring Devices.

Grounding cables shall be provided and the size shall be in accordance with the PEC when not shown on the Plans or Drawings.

1726.3.1.5 Raceways

Raceways shall conform to the applicable requirements of Item 1100 – Conduits, Boxes and Fittings.

1726.3.1.6 Panelboard

NEMA Enclosure, Manual Transfer Switch & Automatic Transfer Switch shall conform to the applicable requirements of Codes and Standards such as PEC, and recommendations of the manufacturer.

1726.3.2 Generator Set

A generator set shall be required to allow the pumping station to operate in case of a power failure. The generator set shall be sized to accommodate all loads at the pump station and shall be of type suitable for locations in which they are installed. The rating of generators shall be in kilovolt amperes, kilowatts, voltages, cycles and phase.

Each generator shall be provided with a nameplate giving the manufacturer's name, engine (Gas or Diesel, capacity & specs), the rated frequency, power factor, number of phases if of alternating current, the subtransient and transient impedances, the rating in kilovolt amperes & kilowatt, the normal volts and amperes corresponding to the rating, rated revolutions per minute, insulation system class and rated ambient temperature or rated temperature rise, time rating, separate elevated fuel tank and back-up heavy duty automatic battery charger.

1726.3.3 Local Control Panel Center (LCPC)

1726.3.3.1 General

The local control panel center (enclosure and devices) shall meet the requirements of Codes and Standards such as UL 508 (Industrial Control Equipment) and Philippine Electrical Code (PEC), and recommendations of the manufacturer.

All LCPC units shall be marked in accordance with the requirements of the PEC.

1726.3.3.2 Enclosure

The requirement for the enclosure of LCPC shall be the same with Section 1726.3.1.2.

1726.3.3.3 Devices and Appurtenances

The specifications of all devices and appurtenances such as controllers, push buttons, crane limit switches, auxiliary contacts and master switches shall conform to the applicable requirements of UL 508 and the PEC and with the recommendations of the manufacturer.

1726.3.3.4 Wires and Cables

All wires and cables for LCPC equipment shall conform to the applicable requirements of Item 1101 – Wires, Cables and Wiring Devices.

The size of the control panel conductors shall have an ampacity of not less than 125 percent of the full-load current rating of all resistance heating loads plus 125 percent of the full-load current rating of the highest rated motor plus the sum of the full-load current ratings of all

other connected motors and apparatus based on their duty cycle that may be in operation at the same time.

1726.3.3.5 Raceways

Raceways shall conform to the applicable requirements of Item 1100 – Conduits, Boxes and Fittings.

1726.4 Construction Requirements

1726.4.1 General

All equipment and enclosures of motor control units, generators and local control panel center shall be installed so that it complies with the standards and codes such as UL 845, UL 508, the PEC and the recommendations of the Manufacturer.

1726.4.2 Motor Control Center (MCC)

1726.4.2.1 Unit Mounting

Construction of enclosure for MCC shall be in accordance with UL 845.

Provision shall be made so that each combination of motor-control unit and feeder-tap unit may be readily removed as a unit for rearrangement, replacement or repair. Exceptions shall be permitted where the size or weight of the unit makes its removal impracticable.

Unit doors shall be hinged and attached either to the vertical section or to the unit. Where the door is mounted on the unit, removal of the unit shall not leave the bus so exposed that accidental contact with it is likely.

A vertical section shall be provided to support the vertical and horizontal buses, the units, the doors and covers.

A vertical section shall be self-supporting and properly bolted to the floor or otherwise secured. These sections shall be assembled into a group to which additional sections may be readily added.

1726.4.2.2 Interlocking of Doors

Access to each combination motor-control unit or feeder tap unit shall be provided by a single separate hinged door, interlocked with its associated disconnecting device so that the door cannot be opened without first opening the disconnecting device.

Where two (2) sets of circuit disconnecting means are mounted in a single compartment to form a dual feeder tap unit, each disconnecting device shall be interlocked with its associated door. Provision shall be made for locking the disconnecting device in the open position when the door is closed.

Where required by the particular application, a deactivating means (defeater) shall be provided to permit entry into the enclosure when the disconnecting device is closed.

1727.4.2.3 Copper Busbars and Conductors

Bus bars shall be protected from physical damage and be held firmly in place. Other than for required interconnections and control wiring, only those conductors that are intended for termination in a vertical section shall be located in that section.

Conductors shall be permitted to travel horizontally through vertical sections where such conductors are isolated from the bus bars by a barrier. The conductor cable/wire shall be color coded.

The phase arrangement on three (3) - phase horizontal common power and vertical buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front, combination of wye-delta connection is used for starting system with large motors. Other busbar arrangements shall be permitted in addition to the existing installations and shall be marked.

The minimum wire-bending space at the motor control center terminals and minimum gutter space shall be as required in the PEC.

Spacings between motor control center bus terminal and other bare metal parts shall be based on the approved specification, design and shop drawing of control center by the Professional Electrical Engineer and Mechanical Engineer.

Barriers shall be placed in all service-entrance motor control centers to isolate service bus bars and terminals from the remainder of the motor control center.

1726.4.2.4 Overcurrent Protection

The motor control center shall be provided with overcurrent protection in accordance with the PEC. The ampere rating or setting of the overcurrent protective device shall not exceed the rating of the common power bus. This protection shall be provided by (1) an overcurrent protective device located ahead of the motor control center or (2) a main overcurrent protective device located within the motor control center.

1726.4.3 Generators

The installation of generators shall meet the requirements of the PEC. The ampacity of the conductors from the generator terminals to the first distribution device(s) containing over-current protection shall be based on the nameplate current rating of the generator and approved designed capacity by the designer.

Where wires pass through an opening in an enclosure, conduit box, or barrier, a bushing/locknut shall be used to protect the conductors from the edges of an opening having sharp edges. The bushing shall have smooth, well-rounded surfaces where it may be in contact with the conductors. The bushing and locknut shall be made of a material not deleteriously affected by oils, grease, or other contaminants.

The generator should be grounded and shall not be exposed to accidental contact where accessible to unqualified persons.

Generators shall be equipped with disconnect(s) by means of which the generator and all protective devices and control apparatus are able to be disconnected entirely from the circuits supplied by the generator except where both of the following conditions apply:

1. The driving means for the generator can be readily shut down.
2. The generator is not arranged to operate in parallel with another generator or other source of voltage. Provide synchronized panel controller.

Generators shall be provided with overcurrent protection in accordance to the applicable requirements of the PEC.

1726.4.4 Local Control Panel Center (LCPC)

1726.4.4.1 Unit Mounting

Construction of enclosure for LCPC shall be in accordance with UL 508.

Industrial control panel enclosures shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices, unless adequate space for this purpose is provided.

1726.4.4.2 Busbars and Conductors

Busbars shall be protected from physical damage and be held firmly in place.

The phase arrangement on 3-phase horizontal common power and vertical buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front, combination of wye-delta connection is used for starting system with large motors of the industrial control panel. Other busbars arrangements shall be permitted for additions to existing installations and shall be marked.

The conductors shall not fill the wiring space at any cross section to more than 40 percent of the cross-sectional area of the space, and the conductors, splices, and taps shall not fill the wiring space at any cross section to more than 75 percent of the cross-sectional area of that space.

Wire bending space for the main supply terminals and for other terminals shall be in accordance with the requirements in the PEC.

Multisection control panels shall be bonded together with an equipment grounding conductor or an equivalent grounding bus, sized in accordance with the PEC. Equipment grounding conductors shall terminate on this grounding bus or to a grounding termination point provided in a single-section control panel.

1726.4.4.3 Overcurrent Protection

The control panel shall be provided with overcurrent protection in accordance with the PEC.

The rating or setting of the overcurrent protective device for the circuit supplying the control panel shall not be greater than the sum of the largest rating or setting of the branch-circuit

short-circuit and ground-fault protective device provided with the industrial control panel, plus 125 percent of the full-load current rating of all resistance heating loads, plus the sum of the full-load currents of all other motors and apparatus that could be in operation at the same time.

1726.5 Personnel Qualification

The installation of equipment and devices for motor control center, generators and local control panel center including wiring shall be done by a certified installer under the supervision of a duly registered Professional Electrical Engineer (PEE) and / or Mechanical Engineer.

The installer shall be certified and experienced in the proper installation of all equipment and devices and trained by a MCC/LCPC manufacturer.

1726.6 Testing

All mechanical and electrical equipment shall be tested to the satisfaction of the Engineer before any facility is put into operation. Test shall be made to determine whether the equipment has been properly assembled, aligned, adjusted and connected. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work. In addition to the mentioned testing conditions, the following field test requirements should be considered for electrical equipment, materials and components. The generator should be tested by no load and full load test at the plant from the time of delivery. Qualified personnel should operate the testing.

1. System test - Each panel board shall be tested with the power equipment connected, circuit breakers closed and all loads and fixtures permanently connected for their intended operation for a minimum of 24 hours continuous operation in the presence of the Engineer, at the expense of the Contractor. The entire installation shall be free from any ground fault and from any short circuit. In no case shall the insulation resistance be less than that allowed by PEC regulations for Electrical Equipment of Buildings and/or manufacturer's recommendations. Failures shall be corrected in a manner satisfactory to the Engineer.

2. Performance Test and Equipment Setting - It shall be the responsibility of the Contractor to test the entire electrical system for the proper equipment operation. Setting of all protective relays, pilot devices and auxiliary systems shall conform with the operating requirements of the installations. The Contractor shall turn-over the entire electrical installation in a satisfactory working condition.

3. Orientation to the qualified personnel for turn-over and submittal of book manual operation is a must.

1726.7 Method of Measurement

The work under this Item shall be measured by lump sum actually placed and installed motor control center, generators and local control panel center as indicated on the Plans.

1726.8 Basis of Payment

The accepted quantities, measured as prescribed in Section 1726.7, Method of Measurement shall be paid for at the contract unit price for Electromechanical for Pumping Station which price and payment shall be full compensation for furnishings and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1726 (1)	Motor Control Center (for main pumps and facilities)	Lump Sum
1726 (2)	Generator Set	Lump Sum
1726 (3)	Local Control Panel Center (for Auxiliary Equipment)	Lump Sum

References:

1. *Philippine Electrical Code*
2. *Underwriters Laboratory*
   UL 508 – Standard for Industrial Control Equipment
   UL 845 – Standard for Motor Control Centers
3. *National Electrical Manufacturers Association Publications*
   NEMA ICS 18 – Motor Control Centers
   NEMA ICS 1 - Industrial Control and Systems