

SECTION 33 72 33 16 – RELAY SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Section 13 34 23.23 - Fabricated Substation Control Enclosures
- B. Section 23 75 00 – Substation Enclosure HVAC Equipment
- C. Section 26 51 23 - Substation Interior Lighting and Receptacles
- D. Section 26 36 00 – Power Switching and Control Devices
- E. Section 33 72 33 36 – Cable Tray and Wireway for Utility Substations
- F. Section 33 72 33 33 – Raceway and Boxes for Utility Substations
- G. Section 33 72 43 11 - Substation Wire, Cable and Accessories
- H. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.02 DESCRIPTION:

- A. The Supplier shall partially design and fully manufacture, test, and deliver one (1) lot of instruments and devices, the quantity and types of protective relays, meters, switches, and accessories as shown on the Contract Documents (Bills of Material, Specifications, Data Sheets, Lists, and Contract Drawings) as defined herein.
- B. The Bill of Material included herein lists major items of equipment or devices required to meet the basic intent of the Specifications; furnish all other accessory devices and equipment to provide a complete and workable system when installed by the Owner. Devices have been grouped by functional systems to aid the understanding of the list. Duplicated devices may be indicated such as lockout relays. Mark numbers with "99" as a quantity are not estimated by the Engineer but are the responsibility of the Supplier.
- C. See Data Sheets for engineering drawing coordination required.

1.03 REFERENCE STANDARDS:

- A. Applicable Codes and Standards: Design, fabricate, assemble, and test equipment so as to conform with all applicable codes and standards including, but not limited to, the following:
 - 1. American National Standards Institute (ANSI):
 - a. C39.1 - Requirements for Electrical Analog Indicating Instruments.
 - 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. C2 - National Electrical Safety Code.
 - b. C37.2 - Electrical Power System Device Function Numbers.
 - c. C37.20.1 - Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.
 - d. C37.20.2 - Metal-Clad and Station-Type Cubicle Switchgear.
 - e. C37.20.3 - Metal-Enclosed Interrupter Switchgear.
 - f. C37.21 - Control Switchboards.
 - g. C37.90 - Relays and Relay Systems Associated with Electric Power Apparatus.
 - h. C37.90.1 - Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
 - i. C37.90.2 - Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - j. C37.91 - Guide for Protective Relay Applications to Power Transformers.
 - k. C37.93 - Guide for Power System Protective Relay Applications of Audio Tones over Telephone Channels.
 - l. C37.95 - Guide for Protective Relaying of Utility-Consumer Interconnections.

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- m. C37.96 - Guide for AC Motor Protection.
 - n. C37.97 - Guide for Protective Relay Applications to Power System Buses.
 - o. C37.98 - Seismic Testing of Relays.
 - p. C37.99 - Guide for the Protection of Shunt Capacitor Banks.
 - q. C37.100 - Definitions for Power Switchgear.
 - r. C37.101 - Guide for Generator Ground Protection.
 - s. C37.102 - Guide for AC Generator Protection.
 - t. C37.103 - Guide for Differential and Polarizing Relay Circuit Testing.
 - u. C37.105 - Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations.
 - v. C37.106 - Guide for Abnormal Frequency Protection for Power Generating Plants.
 - w. C37.108 - Guide for the Protection of Network Transformers.
 - x. C37.109 - Guide for the Protection of Shunt Reactors.
 - y. C57.13 - Requirements for Instrument Transformers.
 - z. C57.13.1 - Guide for Field Testing of Relaying Current Transformers.
 - aa. C57.13.2 - Conformance Test Procedures for Instrument Transformers.
 - bb. C57.13.3 - Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
3. National Fire Protection Association (NFPA):
- a. 70 - National Electrical Code.

1.04 QUALITY ASSURANCE:

- A. Acceptable Relay Switchboard Manufacturers: See Data Sheets.
- B. Factory Tests:
 - 1. Notify Engineer prior to factory tests as indicated in the Data Sheets.
 - 2. Conduct all tests standard with the Manufacturer and as specified.
 - 3. After factory assembly and wiring of equipment, conduct functional tests to prove correct wiring and operation of equipment.
 - a. Input 3-phase AC signal voltage at external terminal blocks where potential transformer connections will be made. Verify with a voltmeter and phase angle meter that the correct voltage is present at all points indicated.
 - b. Input 3-phase AC signal current at external terminal blocks where current transformer connections will be made. Verify with an ammeter, current test plug, and phase angle motor, where possible, that the correct current is present at all points indicated. Currents through devices not provided with current test jacks may be verified with a clamp-on ammeter.
 - c. Supply switchboards with required AC and DC power.
 - d. Connect latching type relays, with electric operate and reset coils, to external terminal blocks to simulate power circuit breakers. Connect DC power at external terminal blocks for circuit breaker trip and close control power.
 - e. Operate each control switch and selector switch in all positions to verify that all control circuits operate as shown on the DC schematic diagrams.
 - f. Verify proper operation of protective relays, lockout relays, auxiliary tripping relays, circuit breaker trip circuits, etc., by manually operating each relay to close its contacts or, if necessary, by jumpering the appropriate output terminals of each relay.
 - g. Verify that all blocking contacts in circuit breaker close circuits perform as indicated on the DC schematic diagrams.

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- h. Simulate remote contacts and switches by jumpers at the appropriate external terminal blocks to verify proper circuit operation.
 - i. Visually verify that all indicating lights operate properly.
 - j. With AC signal voltage and current applied to the switchboard, verify operation of all transducers connected to these circuits. Verify that transducer-driven devices operate properly and that they are correctly calibrated. Verify transducer outputs wired to external terminal blocks by connecting a meter to the external terminals.
 - k. Verify that all annunciator points operate correctly by jumpering or operating alarm initiating device or jumpering external terminals for remote alarm inputs.
- 4. Set passwords, communication baud rates, and logic jumpers on microprocessor relays and communication equipment as required by the Engineer. Confirm the correct operation by implementing the communication link.
- 5. Set and calibrate relays with settings if indicated on the Data Sheets. Confirm the correct operation by implementing the communication link.
- 6. If the functional testing indicates a schematic design error, the Supplier and the Engineer will determine the proper correction and the Supplier shall modify the equipment as necessary to incorporate the correction and retest to verify proper operation.
- 7. Submit the following in triplicate at the time of delivery:
 - a. Certified test report.
 - b. Certified statement that all equipment furnished complies with this Specification.

1.05 COMPLIANCE SUBMITTALS:

- A. Submit as specified including:
 - 1. Drawings as required by this Contract indicated in the Data Sheets.
 - 2. Instruction books and service manuals including:
 - a. Descriptive bulletins.
 - b. Instruction leaflets.
 - c. Device arrangement and dimension drawings.
 - d. Device outline and drilling plan.
 - e. Internal schematic and connection diagrams.
 - f. Protective device coordination curves.
 - g. Renewal parts data.
 - h. Bills of material.

PART 2 - PRODUCTS

2.01 MECHANICAL CONSTRUCTION:

- A. Fabrication and Assembly:
 - 1. Each switchboard section shall be interconnected with framing members so as to form a rigid self-supporting structure. Sections shall be bolted together to form switchboard lineups as indicated. Each switchboard lineup shall be provided with end trims and top sheets to form a completely enclosed and structurally sound unit.
 - 2. Panels shall be fabricated from members and sheets as indicated on Drawings and/or Data Sheets.
 - 3. Construct with no bolt heads or fastenings visible from the exterior.
 - 4. Construct with 1/4-inch outside radius corners.
 - 5. Provide interior side sheets for mounting auxiliary equipment and terminal blocks as required.

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6. Overall dimensions of switchboards are indicated. Modifications will be permitted only by approval of the Engineer.
 7. Make provisions for anchoring to the floor.
 8. Make provisions for extension of switchboards by addition of sections on side(s) as indicated.
 9. Construct units such that they join flush with existing units as indicated and maintain a general appearance of uniformity.
 10. Hinged subpanels may be used inside panels for mounting fuses, circuit breakers, disconnect switches, auxiliary transformers, diodes, resistors, etc. Relays subject to accidental operation due to subpanel motion shall not be mounted on such subpanels. Subpanel latches shall be of a rotating type. Use of subpanels requires approval by the Engineer.
- B. Finish:
1. Clean and treat surfaces before application of finish.
 2. Provide a high-quality, corrosion-resistant, multi-coat paint finish on all steel surfaces, interior and exterior.
 3. The exterior and interior finish paint color shall be as indicated.
- C. Arrangement:
1. Arrange switchboard assembly and equipment as indicated.
 2. Any modification in arrangement from that indicated or as provided by the Supplier shall be subject to approval by the Engineer.
 3. Component equipment on boards shall be arranged, wired, and connected in a neat and orderly manner, allowing access to all devices for operation and maintenance.
 4. All component equipment specified for installation in switchboards shall be factory installed unless specified to be field installed.
 5. Provide cutouts, drilling, and blank cover plates for future equipment as indicated.
- 2.02 ELECTRICAL CONSTRUCTION:
- A. Internal Control Wiring:
1. Completely install all switchboard internal wiring at the factory.
 2. Make all connections at equipment studs or terminal blocks. Terminate all CT leads on short-circuiting type terminal blocks. Install all internal wiring with no splices.
 3. Terminate all points requiring external wiring connections at numbered points on terminal blocks conveniently grouped to receive external (field) cables. The arrangement of external cable terminations will be by means indicated on Data Sheets.
 4. Each terminal block will be identified as indicated. Individual terminals will be identified numerically from bottom to top starting with the number "1" on each block. On schematic and three-line diagrams, terminal designations shall be prefixed with the unit number, i.e., 2B5 would indicate the fifth terminal from the top of block "B" in Unit No. 2.
 5. Use extra flexible hinge wire in areas subject to flexing, such as where hinged brackets or swing racks are used.
 6. Connect to agree with schematics and wiring diagrams.
 7. Install internal wiring in horizontal and vertical wiring troughs or channels with removable covers for easy accessibility. Tied cable bundles are not acceptable.
 8. Provide all wiring necessary for all equipment specified for installation on the switchboards.
 9. Use compression connectors as indicated on Data Sheet.
 10. Label all wires.

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11. Terminate no more than two wires at any one connection point.
 12. Wire all unused relay and auxiliary switch contacts to terminal block points.
 13. Furnish spare terminal block points in each unit as indicated.
 14. Wiring between sections shall be accomplished as indicated.
- B. Terminal Blocks:
1. Provide heavy-duty terminal blocks as indicated.
 2. Mount terminal blocks in one or more vertical rows on back or sides of the board, or on interior divider panels, brackets, or wireways, with means for supporting external control cables.
 3. Location of terminal blocks shall be subject to approval by the Engineer.
 4. The internal copper ground bus shall be as specified or indicated.
 5. Furnish internal lighting, convenience outlets, switches, auxiliary devices, and power supply busses as indicated on the Data Sheets.

2.03 EQUIPMENT:

- A. General: Furnish the types and quantities of equipment as indicated and specified, including software, covers, mounting, and accessories. Those items indicated as estimated quantities and/or partial descriptions shall be determined by the Supplier based upon the overall Contract Documents. The Supplier shall furnish equipment and materials which can meet the specified ratings and performance at the ambient conditions specified.

PART 3 - APPENDIX

3.01 APPENDIX:

- A. The following Appendix is a part hereto.
1. Data sheets
 2. Panel elevation
 3. Panel BOM
 4. AC/DC Schematic

END OF SECTION 33 72 33 16