



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Chilled Water Infrastructure Expansion Bernard Chiller Plant

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UNC Bldg. No. XXX

Prepurchased Electrical Equipment Manning Substation Medium Voltage Switchgear Bid Set

Submitted by:



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SECTION 26 1319

MEDIUM-VOLTAGE VACUUM INTERRUPTER SWITCHGEAR

PART 1 GENERAL

1.1 OWNER PRE-PURCHASED EQUIPMENT

- A. This equipment will be pre-purchased by the Owner and assigned to the successful Contractor after award expediting delivery and installation.
- B. Owner will make available shop drawings of Owner pre-purchased equipment for review. Contractor shall review shop drawings to ascertain that Contractor has included necessary labor and materials to install equipment and complete system it serves.
- C. Contractor shall be responsible for arranging/coordinating delivery of equipment and all other activities as if the Contractor purchased the equipment directly. This includes directing the delivery truck to the jobsite, coordinating the date and time of delivery, receipt/unloading of the equipment at the jobsite.
- D. Contractor shall install equipment and all auxiliaries as though Contractor had purchased equipment. This shall include, but not be limited to; rigging and setting equipment in place, making connections, starting, testing and installing equipment in accordance with manufacturer's recommendations, and maintaining equipment until such time as project is accepted by Owner. Perform all work and provide materials and connections for Owner furnished equipment in accordance with drawings and scope of work under all related specifications.
- E. After completion of equipment installation, assemble equipment shop drawings, operating/maintenance instructions and part lists into the Contractor's project operation/maintenance manuals.
- F. The following summarizes the general responsibilities of the electrical equipment supplier:
 - 1. Provide shop drawings and submittal data.
 - 2. Manufacture and delivery of equipment including coordination of exact delivery date and supervision of rigging, unloading and setting.
 - 3. Lead equipment check-out, testing and start-up process.
 - 4. Provide Owner training.
 - 5. Provide O&M documentation.

1.2 SCHEDULE

A. Schedule:

1. The following schedule is anticipated relative to the pre-purchased equipment delivery, installation and activation. This is a preliminary schedule and exact dates are to be coordinated with the Owner and Contractor.

- a. Equipment Delivery: December 2026
- b. Installation, Start-Up & Commissioning: January – March 2027

- ### B. Manufacturer shall be able to produce, test and deliver the equipment (FOB) to a location dictated by the Contractor per the schedule described above.

1.3 DESCRIPTION

- ### A. The switchgear lineup shall be free-standing, dead-front type, metal-clad medium-voltage distribution switchgear. The switchgear shall be Arc-Resistant Type 2B per ANSI/IEEE C37.20.7. The lineup shall contain the necessary number of monitoring, control modules and distribution modules (sections), including optional accessories. The switchgear shall be a NEMA rated cabinet construction, for indoor applications.
- ### B. Arc Resistant Type 2B definition: Arc-resistant accessibility is designated for equipment where isolation is required for the instrument compartment and arcing does not cause holes in the freely accessible front, sides, and rear of the enclosure or in the walls isolating the low-voltage control or instrument compartment(s). Smoke ingress in the compartment under evaluation is acceptable. Partial or total distortion of internal compartment walls, without signs of burning from a direct arc strike (i.e., a hole) or openings in the walls (i.e., torn seams) are acceptable. The application of suffix “B” to accessibility type 2 requirements additionally qualifies the equipment for installation of instrument and control devices on the door or cover of the compartment tested without retesting the switchgear for the condition where the door or cover is present with devices mounted on it.
1. Relay and meter Owner preferred brand alternate: SEL.
 - a. Acceptable alternate manufacturers: Schneider Electric, ABB
 2. Refer to the drawings for schematics on relay and communications system architecture for the switchgear system(s).
 3. This section is for new 15kV switchgear “BUS A” and “BUS B”.
 4. The switchgears shall have monitoring and control integrated into the existing UNC SCADA system cabinet located in the building. Provide all work to connect to that Owner furnished head-end equipment and provide support to the Owner for programming and start-up.
 5. Horizontal bussing shall be capable of extension at both ends in the future for added feeder circuit breaker sections for “BUS B”.
- ### C. Provide associated VDC battery system per Section 26 1319.1.

- D. Provide programming of all relays and meter mounted within switchgear. Program devices to coordinate with instrumentation and I/O. Designer shall provide protective function settings and output logic for close permissive and trip signals to Switchgear manufacturer for inclusion in programming of relays. Upon acceptance of relay file configuration and testing, relay files shall be further augmented by relay manufacturer, contracted separately by Owner, to program relays for use in automation and integration into the campus SCADA.
- E. This equipment shall be fully commissioned per the requirements in the North Carolina State Construction Office 2020 Electrical Guidelines and Policies Section 260800 and per ANSI/NETA ECS-2015. The Owner will contract directly with the commissioning agent separate from the General Contractor. Equipment supplier shall provide commissioning assistance during shop drawing submittal reviews, equipment inspections, equipment start-up and commissioning. Equipment supplier shall assist with coordinating the scheduling of commissioning activities as directed by the commissioning agent.

1.4 REFERENCE STANDARDS

- A. ANSI/IEEE C37.20.2
- B. ANSI/IEEE C37.20.7
- C. NEMA C37.57
- D. ANSI/IEEE C62.11
- E. NEMA SG5
- F. NEMA SG6

1.5 BID SUBMITTALS

- A. Submit all equipment procurement documents, including shop drawings and technical specifications to the State Construction Office for review and approval, in addition to the engineer of record.
- B. Cover letter with compliance table listing each specification section and indicating compliance "C", deviation for alternate "D", or exception with explanation "E". Any deviation or exception shall be accompanied with detailed explanation of how design intent is being upheld.
- C. Complete Bill of Materials
- D. Product Data: for switchgear, major components, relay/meter components, and options/accessories indicated:
- E. General Shop Drawings:
 - 1. For switchgear specified in this Section:
 - a. One Line Diagrams for both power and instrumentation & controls.
 - b. General Arrangement:

- 1) Indicate front, plan, and side views of switchgear; overall dimensions and components list; shipping splits and weights.
 - 2) Front elevation indicating location of devices and instruments.
 - 3) Sections through switchgear showing space available for conduits.
 - c. Conduit entrance locations and requirements
 - d. Configuration, size and number of bus bars for each phase and current rating of buses
 - e. Ground bus
 - f. Short circuit and withstand ratings of switchgear and overcurrent protective devices
 - g. Instrument details
 - h. Arc Flash ducting system
- F. System Mechanical Drawings:
1. Dimensional plans and elevations, with front view, side views and other pertinent elevation views.
 2. Conduit entrance locations and dimensions within all assemblies for both bottom and top entrance.
 3. Door details.
 4. Circuit breaker ratings.
 5. Weight of equipment.
 6. Assembly ratings including:
 - a. Short circuit rating
 - b. Voltage
 - c. Continuous current
 7. Cable terminal sizes.
 8. Base plan showing dimensions of base with anchoring provisions.

1.6 FABRICATION SUBMITTALS

- A. All information from the Bid Submittal per Section 1.4 to include any updates to the development of any of the information.
- B. Product Data: for switchgear, components and accessories indicated:
1. Include data on features and components and complete description; submit catalog cut sheets with selected features highlighted.
 2. Complete wiring diagrams.
- C. General Shop Drawings:
1. For switchgear specified in this Section:
 - a. General Arrangement:
 - 1) Indicate front, plan, and side views of switchgear; overall dimensions and components list; shipping splits and weights.
 - 2) Front elevation indicating location of devices and instruments.
 - 3) Sections through switchgear showing space available for conduits.

- b. Conduit entrance locations and requirements
 - c. Nameplate legends
 - d. Configuration, size and number of bus bars for each phase and current rating of buses
 - e. Ground bus
 - f. Short circuit and withstand ratings of switchgear and overcurrent protective devices
 - g. Instrument details; enclosure types and details
 - h. Wiring diagrams: power, signal and control wiring
 - i. Mimic-bus diagram; samples: representative portion of mimic bus with specified finish, for color selection.
- D. System Mechanical Drawings:
 - 1. Dimensional plans and elevations, with front view, side views and other pertinent elevation views.
 - 2. Conduit entrance locations and dimensions within all assemblies for both bottom and top entrance.
 - 3. Door details.
 - 4. Circuit breaker ratings.
 - 5. Weight of equipment.
 - 6. Assembly ratings including:
 - a. Short circuit rating
 - b. Voltage
 - c. Continuous current
 - 7. Cable terminal sizes.
 - 8. Base plan showing dimensions of base with anchoring provisions.
- E. System Electrical Drawings:
 - 1. Typical AC Three-Line Schematic diagrams with all components cross referenced.
 - 2. Typical DC Schematic diagrams with all components cross referenced.
 - 3. Typical equipment interconnect drawings showing terminal points and external device function.
 - 4. Metering/monitoring and LV wiring scheme.
- F. Manufacturer's Installation Instructions:
- G. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- H. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
- I. Closeout Submittals:
 - 1. Project Record Documents:

- a. Record actual locations, configurations, and ratings of switchgear and major components on single-line diagrams and plan layouts. Provide exact circuit breaker models and associated trip units.
- 2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.7 QUALITY ASSURANCE

- A. Obtain switchgear from one source and by single manufacturer.
- B. Regulatory Requirements:
 - 1. Comply with NFPA 70 for components and installation.
 - 2. Furnish products listed and classified by a third party agency amongst those acceptable to the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment.
- C. Factory Witness Test
 - 1. Provide separately priced quote for factory witness test to include four representatives from the Owner, two representatives from Designer (six persons total). The quote shall include all costs for travel, lodging, meals, etc. for the duration of the trip. The testing time and date(s) shall be scheduled at least 21 days prior the test. Provide test script plan for the factory witness test for approval at least 14 days prior to the test. The test script plan shall include all required testing per this specification in addition to standard manufacturer testing.
 - 2. The factory test (regardless if separately priced quote for witness test is accepted) shall include the following:
 - a. Inspection and comprehensive check of all circuit breakers, fuses, protective relays, instrument transformers, metering, etc.
 - b. Testing of switchgear and its components per NETA.
 - c. Testing of all metering/monitoring and local LCD display.
 - d. Testing of all local alarms.
 - 1) Additional test procedures as directed by the Designer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, fumes, water, corrosive substances, construction debris, and traffic. Provide temporary heaters in switchgear as required to prevent condensation.

- B. Deliver switchgear in 48" maximum width shipping splits that can be moved in delivery path, individually wrapped for protection, and mounted on shipping skids. Mark crates, boxes, and cartons clearly to identify equipment. Show crate, box, or carton identification number on shipping invoices.
- C. Handle switchgear in accordance with applicable portions of ANSI/NECA 400. Use factory-installed lifting provisions. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.

1.9 WARRANTY

- A. Manufacturer shall provide 2 year warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of final acceptance.
- B. Switchgear manufacturer shall have an established network of factory owned and operated service centers within the continental US capable of servicing the specified equipment.
- C. The manufacturer's personnel shall be factory trained and certified in the maintenance and repair of the specified equipment.
- D. After-warranty service contracts shall be available to the Owner by the manufacturer to provide periodic maintenance and/or repair of the specified equipment

1.10 MAINTENANCE

- A. Extra Materials: Furnish extra materials described below that match product installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10% of amount installed for each size and type, minimum of two of each size and type.
 - 2. Control-Power Fuses: Equal to 10% of amount installed for each size and type, minimum of two of each size and type.
 - 3. Indicating Lights: Furnish six of each type required. Equal to 10% of amount installed for each size and type, but no fewer than two of each size and type.
 - 4. Manual racking mechanism for drawout breakers.
 - 5. Breaker test cubicle.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Powell – PowlVac-AR
- B. Acceptable Alternates: ABB SafeGear, Point 8 Power

2.2 RATINGS

- A. Nominal System Voltage: 12470V 3-phase, 3 wire, grounded, 60 Hz.

- B. Rated maximum Voltage: 15 kV
- C. Basic Impulse Level: 95 kV.
- D. Main Bus Ampacity: as shown on the drawings, continuous.
- E. Short Circuit Current Rating: 25 kA, rms sym
- F. Vacuum Circuit Breaker:
 - 1. At Rated Maximum kV - Closing and Latching Capability: 67 kA Crest
 - 2. Three Second Rating: 25 kA
 - 3. Rated Interrupting Time: 3 cycles
- G. Bus shall be silver plated copper.
- H. Bus shall have epoxy flame-retardant and track-resistant insulation
- I. Provide a copper ground bus.

2.3 CONSTRUCTION

- A. Switchgear Arc-Resistant Assembly – Basic Type 2B Construction:
 - 1. Metal-clad construction using welded, industrial riveted.
 - 2. Self-supporting, mounted on concrete housekeeping pad.
 - 3. Front Compartment Doors:
 - a. Each compartment housing a high voltage device shall be provided with steel hinged doors.
 - b. Door shall be provided with means to padlock
 - c. Door shall be provided with a viewing window in view of circuit breaker position.
 - d. Door shall withstand arc fault.
 - e. Door shall be provided with handle to operate all required latching.
 - f. Door shall be provided with safety interlocks to prevent racking breaker into a compartment with door in open position and to prevent opening of door unless breaker is in the disconnected position. There shall be manual interlock override for maintenance purposes. Interlock shall be automatically reset when door is in closed position.
 - g. The breaker shall be able to be disconnected and racked out with the door in the closed position.
 - 4. Rear Compartment Doors:
 - a. Door shall be steel hinged type with means for padlocking.
 - b. Door shall withstand arc fault.
 - c. Door shall be provided with handle to operate all required latching.
 - 5. Plenum:
 - a. Provide plenum to direct arc fault pressure wave, gases, etc out the top over the entire length of the assembly.
 - b. Plenum shall be constructed of heavy gauge steel.

6. Provide mimic bus. Continuously integrated mimic bus factory applied to front of switchgear. Arrange in single-line diagram format showing bussing, connections and devices, using symbols and letter designations consistent with final mimic-bus diagram. Use black color plastic strips, fastened flat against panel face with corrosion-resistant screws and rivets. Coordinate mimic-bus segments with devices in switchgear sections to which they are applied. Produce concise visual presentation of principal switchgear components and connections.
7. The assembly (including the bussing) shall be capable of future extension from either end for additional cabinets installed to maintain the integrity of the arc-resistant construction.
8. Any cooling or ventilation openings or vents shall conform to arc-resistant construction such that contact will not create a hazard to persons of the integrity of the system.

B. Contacts:

1. Provide silver-plated copper stationary primary contacts.
 - a. Provide minimum two spare NO/NC contacts.
2. Provide automatic steel shutter cover stationary primary contacts when breaker is in disconnected position or out of cell.
 - a. Provide minimum two spare NO/NC contacts.

C. Provide rails to withdraw 15kV circuit breaker.

2.4 BUS

A. Bus Phase:

1. Silver-plated Copper
2. Amperage as shown on the drawings.
3. Have epoxy flame-retardant and track-resistant insulation
4. Have provisions for future extension

B. Bus joints to be plated, bolted, and insulated with easily installed boots.

C. Bus supports to be flame-retardant, track-resistant, glass polyester for 15kV class.

D. A copper ground bus, to which the entire metallic enclosure is solidly connected, shall extend through the length of the switchgear. The ground bus shall be accessible in the cable compartment and shall have connection points in each switchgear section.

2.5 WIRING TERMINATIONS

- A. Control wiring 600 volt, UL 1015 or SIS. Use solderless compression screw type connectors for terminating all wires. Current transformer circuit terminations shall be ring tongue compression type. Other circuits shall be ring tongue compression type where feasible, otherwise they shall be spade type applied with the proper tooling.
- B. Label control wiring with wire markers.

- C. Control wires shall be numbered every six (6) inches and visible next to the terminals. Low level signal circuits shall be provided with shielded wire to minimize electromagnetic interference. Shielded wire grounded at one point.
- D. Current transformer circuits are connected through shorting terminal blocks.
- E. Control wiring routed in enclosed raceway through high-voltage compartments, and isolated per arc-resistant Type 2B requirements.
- F. Voltage transformer primary wiring shall be 15kV insulated.
- G. Provide small wiring, terminal blocks, and fuse blocks within vertical section.
- H. Provide minimum of 10% spare terminal connections.
- I. Incoming/Outgoing Medium Voltage Cabling:
 - 1. A termination bus shall be provided from the circuit breaker or switchgear primary disconnects to a location that allows cable connections to other equipment. Bus connections to cables shall be rigid.
 - 2. Termination bus arrangement shall allow at least 36 inches for primary cable terminations and stress cones. Reserve sufficient space for Class 1 type stress cones. The self-cooled rating of the termination bus shall be in accordance with ANSI C37.20.2, Table 4 at 45 deg C.
 - 3. Provide wire termination system such that no additional cable bracing, tying or lashing is required to maintain short circuit withstand rating of assembly.
 - 4. Equip each cubicle section that contains lugs for incoming and/or outgoing feeders with horizontal cable supports.
 - 5. The equipment shall be arranged for bottom entrance.
 - 6. Provide cable lug boots.
 - 7. Provide compression lugs of size to match cable size and quantity indicated on drawings. This shall be coordinated during the shop drawing review process.

2.6 CIRCUIT BREAKERS

- A. Circuit Breakers
 - 1. Horizontal draw out type.
 - 2. Electrically operated
 - a. Provide 125VDC close and capacitor trip control voltages. Note that controls circuit shall be derived from external battery plant.
 - 3. Operate by a motor-charged stored energy spring mechanism.
 - a. Charge spring mechanism normally by universal electric motor and by hand mechanism in emergency situations.
 - b. Provide primary disconnecting contacts of silver-plated copper.
 - 4. Contain 3 vacuum interrupters separately mounted.
 - a. Mount vacuum interrupter on glass polyester supports for 15kV class.
 - b. Provide a contact wear gap indicator for vacuum interrupters.
 - 1) Indicator shall not require tools to indicate available contact life.

- 2) Indicator to be visible when breaker is removed from its compartment.
 - 3) Current transfer from vacuum interrupter moving stem to breaker main conductor to non-sliding design.
- c. Breaker front panel to be removable when breaker is withdrawn.
- 5. Control switch and red and green indicating lights to indicate breaker contact position.
- 6. Be secured in housing between and in the operating and test positions.
- B. Provide silver-plated secondary contacts that automatically engage in breaker operating position.
 - a. Provide minimum two spare NO/NC contacts.
- C. Provide interlocks to:
 - 1. Prevent closing of breaker between operating and test positions
 - 2. Trip breakers upon insertion or removal from housing
 - 3. Discharge stored energy mechanisms upon insertion or removal from the housing
- D. Refer to drawings for design intent of breaker control schematics and interaction with protective relays and auxiliary devices.

2.7 SURGE ARRESTERS

- A. Provide 3 surge arrestors at each location depicted on the drawings.
- B. Distribution Class
- C. Surge arresters to be rated at 15 kV nominal, 12.7kV maximum continuous operating voltage (MCOV).

2.8 PROTECTIVE RELAYS

- A. Provide quantity, type and rating of protection relays as indicated on drawings.
- B. Basis of design devices listed below. Refer to Section 1.3.B.1.a for acceptable alternate manufacturers.
- C. Three-Phase Protective Relays - Applicable to Relays identified as Mains, Ties and Feeders on the drawings:
 - 1. Preferred Brand Alternate: Manufacturer: SEL-351S, Model Number: 0351S7X3D3J54X1 (351S#B6RL)
 - 2. Indoor Open/Close Push Buttons
 - 3. True RMS sensing of each phase and ground
 - 4. Solid-state microprocessor-based multi-functional type
 - 5. ANSI 25 Synchronism Check
 - 6. ANSI 50/51 Instantaneous over-current and Time over-current
 - 7. ANSI 50/51G Residual Ground Instantaneous over-current and Time over-current

8. ANSI 27 Under voltage
9. ANSI 32 Power Element
10. ANSI 59 Overvoltage
11. ANSI 81 Over/Under Frequency
12. Built-in alphanumeric display:
 - a. Individual phase currents
 - b. Ground current
 - c. Cause of trip
 - d. Magnitude and phase of current causing trip
 - e. Peak current demand for each phase and ground since last reset
13. Metering Capabilities:
 - a. Current: IA, IB, IC, IG, IN
 - b. Voltage: VA, VB, VC, VN, VAB, VBC, VCA
 - c. Power: kW, kVAR, kVA
 - d. Energy: MWh, MVARh, MVAh
 - e. Power Factor
 - f. Frequency
14. Input Contacts wired internally by Switchgear Manufacturer
 - a. 52A – Breaker Closed
 - b. 52B – Breaker Open
 - c. 52H – Breaker Withdrawn
 - d. Trip Coil Monitor
 - e. 86 Trip Coil Monitor (Mains and Ties Only)
 - f. 86 Trip Status (Mains and Ties Only)
 - g. Non-used inputs wired to terminal block
15. Output Contacts wired internally by Switchgear Manufacturer
 - a. Breaker Close
 - b. Breaker Open
 - c. Breaker Protective Function Trip
 - d. 86 Trip (Mains and Ties Only)
 - e. Close Circuit Permissive (Mains and Ties Only)
 - f. Remaining outputs wired to terminal block
16. Communication Capability:
 - a. One (1) Front EIA-232 Serial Port
 - b. One (1) Front USB Port
 - c. Two (2) Rear EIA-232 Serial Ports
 - d. Two (2) Rear 10/100 Base-T Ethernet Ports
 - e. One (1) Rear Fiber-Optic MM ST Serial Port
17. Time Synchronization Capability:
 - a. Accept demodulated IRIG-B via rear BNC input

- D. Bus Differential Relay
 - 1. Preferred Brand Alternate: Manufacturer: SEL-587Z, Model Number: 0587Z0X625322XX
 - 2. LCD Display
 - 3. Provide separate set of current transformers at each breaker for high impedance bus differential system
 - 4. Communication Capability:
 - a. One (1) Front EIA-232 Serial Port
 - b. One (1) Rear EIA-485 Port with C675 Pinout Module
 - 5. Time Synchronization Capability:
 - a. Accept demodulated IRIG-B via pins of EIA-485 Port
- E. Intertie Relay
 - 1. Preferred Brand Alternate: Manufacturer: SEL-700GT+, Model Number: 0700GT1A1A0X75850620 (700G#M7K5)
 - 2. Eight (8) Programmable Push Buttons
 - 3. LCD Display
 - 4. True RMS sensing of each phase and ground
 - 5. Solid-state microprocessor-based multi-functional type
 - 6. ANSI 25 Synchronism Check
 - 7. ANSI 50/51 Instantaneous over-current and Time over-current
 - 8. ANSI 50/51G Residual Ground Instantaneous over-current and Time over-current
 - 9. ANSI 27 Under voltage
 - 10. ANSI 32 Power Element
 - 11. ANSI 59 Overvoltage
 - 12. ANSI 81 Over/Under Frequency
 - 13. ANSI 87 Differential
 - 14. Built-in alphanumeric display:
 - a. Individual phase currents
 - b. Ground current
 - c. Cause of trip
 - d. Magnitude and phase of current causing trip
 - e. Peak current demand for each phase and ground since last reset
 - 15. Metering Capabilities:
 - a. Current: IAX, IBX, ICX, IAY, IBY, ICY, IG, IN
 - b. Voltage: VAX, VBX, VCX, VAY, VBY, VCY, VN
 - c. Power: kW, kVAR, kVA
 - d. Energy: MWh, MVARh, MVAh
 - e. Power Factor
 - f. Frequency
 - 16. Input Contacts wired internally by Switchgear Manufacturer

- a. 52A – Breaker Closed
 - b. 52B – Breaker Open
 - c. 52H – Breaker Withdrawn
 - d. 86 Trip Coil Monitor
 - e. 86 Trip Status
 - f. Upstream Duke Energy Breaker Status wired from terminal block
 - g. Non-used inputs wired to terminal block
17. Output Contacts wired internally by Switchgear Manufacturer
- a. Breaker Open
 - b. Breaker Protective Function Trip
 - c. 86 Trip
 - d. Close Circuit Permissive
 - e. Remaining outputs wired to terminal block
18. Communication Capability:
- a. One (1) Front EIA-232 Serial Port
 - b. One (1) Rear EIA-232 Serial Port
 - c. Two (2) Rear 10/100 Base-T Ethernet Ports
 - d. One (1) Rear Fiber-Optic MM ST Serial Port
19. Time Synchronization Capability:
- a. Accept demodulated IRIG-B via DB-9 Male Connector to Serial Port

F. Generator Relay

- 1. Preferred Brand Alternate: Manufacturer: SEL-700G+, Model Number: 0700G11A1A0X76850620 (700G#FKM8)
- 2. Eight (8) Programmable Push Buttons
- 3. LCD Display
- 4. True RMS sensing of each phase and ground
- 5. Solid-state microprocessor-based multi-functional type
- 6. ANSI 25 Synchronism Check
- 7. ANSI 50/51 Instantaneous over-current and Time over-current
- 8. ANSI 50/51G Residual Ground Instantaneous over-current and Time over-current
- 9. ANSI 27 Under voltage
- 10. ANSI 32 Power Element
- 11. ANSI 59 Overvoltage
- 12. ANSI 81 Over/Under Frequency
- 13. ANSI 87 Differential
- 14. Built-in alphanumeric display:
 - a. Individual phase currents
 - b. Ground current
 - c. Cause of trip

- d. Magnitude and phase of current causing trip
- e. Peak current demand for each phase and ground since last reset
- 15. Metering Capabilities:
 - a. Current: IA, IB, IC, IG, IN
 - b. Voltage: VA, VB, VC, VN, VAB, VBC, VCA, V Sync
 - c. Power: kW, kVAR, kVA
 - d. Energy: MWh, MVARh, MVAh
 - e. Power Factor
 - f. Frequency
- 16. Input Contacts wired internally by Switchgear Manufacturer
 - a. 52A – Breaker Closed
 - b. 52B – Breaker Open
 - c. 52H – Breaker Withdrawn
 - d. 86 Trip Coil Monitor
 - e. 86 Trip Status
 - f. Non-used inputs wired to terminal block
- 17. Output Contacts wired internally by Switchgear Manufacturer
 - a. Breaker Open
 - b. Breaker Protective Function Trip
 - c. 86 Trip
 - d. Close Circuit Permissive
 - e. Remaining outputs wired to terminal block
- 18. Communication Capability:
 - a. One (1) Front EIA-232 Serial Port
 - b. One (1) Rear EIA-232 Serial Port
 - c. Two (2) Rear 10/100 Base-T Ethernet Ports
 - d. One (1) Rear Fiber-Optic MM ST Serial Port
- 19. Time Synchronization Capability:
 - a. Accept demodulated IRIG-B via DB-9 Male Connector to Serial Port

2.9 AUXILIARY DEVICES

- A. Current Transformers (CTs):
 - 1. Furnish current transformers as indicated on the drawings and as needed for an operational system per the design intent.
 - 2. CTs shall be installed such that they can be removed from the front of the switchgear without exposure to power bussing or cable terminations.
 - 3. CTs shall have secondary termination on a shorting terminal block.
 - 4. CTs shall be fully rated for associated voltage class and suitable for connected burden.
 - 5. Minimum rating factor of CT shall be 1.25 at 30 deg C ambient.

- B. Voltage Transformers (PTs) and Control Power Transformers (CPTs):
 - 1. Furnish voltage and control power transformers as indicated on the drawings and as needed for an operational system per the design intent.
 - 2. PTs/CPTs shall be installed in drawout assembly easily disconnected from power bussing.
 - 3. PTs shall have voltage rating comparable to metering equipment with appropriate burden equal to twice the initial load.
 - 4. PTs shall have BIL to match the switchgear rating.
 - 5. PTs/CPTs shall have a lineside current limiting fuse. PTs shall have secondary fuse and CPTs shall have secondary circuit breaker.
 - a. Ampacity rating of overcurrent protective devices shall be determined by switchgear manufacturer.
 - 6. Shutters shall isolate primary bus stabs when drawers are withdrawn
- C. Furnish test switch/block to facilitate testing of relay without interrupting service and for prohibiting trip out relay as indicated on drawings. Provide type per tag identified on drawings as follows with black cover and screw terminals:
 - 1. Test Switch Designation TS1, TS3, TS5 or TS7, as indicated on drawings:
 - a. Two (2) Potential and Eight (8) Current Switches.
 - b. Basis of Design: ABB FT-1 10 POLE SWITCH MODEL # 849A513G01
 - 2. Test Switch Designation TS2 or TS4, as indicated on drawings:
 - a. Ten (10) Potential Switches
 - b. Basis of Design: ABB FT-1 10 POLE SWITCH MODEL # 9676A94G01
 - 3. Provide nameplate designated function of each switch position per test switch.
- D. Provide Breaker Control Switch per breaker.
 - 1. Device 01 (on drawings), manually operated, spring return to center device
 - 2. Minimum 1 deck
 - 3. Refer to drawings for additional internal wiring requirements.
- E. Provide separate Lockout Relay located at face of switchgear as indicated on drawings.
 - 1. Device 86 (on drawings), latching relay, manual reset.
 - 2. Quantity of decks as required to meet drawing intent and provide minimum two (2) spare NO and two (2) spare NC contacts.
 - 3. Refer to drawings for additional internal wiring requirements.
- F. Provide IRIG-B coaxial distribution and BNC T connectors to relays and meter as indicated on drawings. No more than ten (10) devices shall be arranged for connection to a single IRIG-B output.
 - 1. IRIG-B output shall be from GPS clock provided by others.
- G. Furnish one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments.
- H. Furnish one DC power breaker test station.

- I. Furnish one electric racking device. A portable, remote racking device to allow racking of a circuit breaker from distances of 10 to 20 feet.
- J. Generator Cubicle Auxiliary Devices:
 - 1. Voltmeter, scale as required with four position selector switch, for reading phase to phase voltage
 - 2. Frequency meter, for generator units, dial type, 55 to 65 hertz scale
 - 3. Ammeter, scale as required, with four position selector switch, for reading phase current
 - 4. Wattmeter, range shall be coordinated during submittal review
 - 5. Varmeter, range shall be coordinated during submittal review
 - 6. Synchroscope

2.10 OWNERS METERS

- A. Metering requirements – Refer to the drawings.
- B. Basis of design devices listed below. Refer to Section 1.3.B.1.a for acceptable alternate manufacturers.
- C. Meters shall be:
 - 1. Preferred Brand Alternate: Manufacturer: SEL-735, Model Number: 0735LX20944EXXXXXX16201CX (735#0401)
 - 2. Microprocessor based.
 - 3. Digital readout
 - 4. 3-phase for connection to 4-wire systems.
 - 5. Meter shall display direct readout metered or calculated values of:
 - a. Volts (V)
 - b. Amps (A)
 - c. Apparent Power (VA)
 - d. Power Factor (PF)
 - e. Reactive Power (VAR)
 - f. Amps demand (Ad)
 - g. Real Power Demand (kWd)
 - h. Frequency (Hz)
 - i. Real Power Usage (kWhr)
 - 6. PQM meters shall incorporate the following additional features:
 - a. Total Harmonic Distortion, Amps (THD)
 - b. Total Harmonic Distortion, Volts (THD)
 - c. Waveform Capture
 - d. Trending and forecasting
 - e. Alarm Summary
 - f. Voltage Flicker metering
 - g. Sag/swell metering

- h. Provided with 10-pole test switch (nickel plated with cover), with 4 handles tied to voltage and 6 handles tied to current. Test switches shall comply with ANSI C12.9.
 - i. Provide data outlet adjacent to the meter in switchgear for meter connection to the building network.
- 7. Input Contacts wired internally by Switchgear Manufacturer
 - a. 52A – Breaker Closed
 - b. 52B – Breaker Open
- 8. Communication Capability:
 - a. One (1) Front EIA-232 Serial Port
 - b. One (1) Front USB Port
 - c. One (1) Rear EIA-232 Serial Port
 - d. One (1) Rear EIA-485 Serial Port
 - e. One (1) Rear 10/100 Base-T Ethernet Port
- 9. Time Synchronization Capability:
 - a. Accept demodulated IRIG-B via 2-pin Phoenix connector.

2.11 NAMEPLATE

- A. Nameplates
 - 1. Engraved with 3/16" high black lettering on laminated plastic white background
 - 2. Secured to switchgear enclosure with screws
- B. Switchgear assembly:
 - 1. Provide nameplate indicating:
 - a. Manufacturer's name and drawing number
 - 1) Voltage ratings (kV nominal; kV maximum design; kV BIL)
 - 2) Main bus continuous rating (A)
 - 3) Short circuit ratings (amperes, rms symmetrical and MVA 3-phase symmetrical at rated nominal voltage)
 - 4) Monetary and fault-closing ratings (amperes, rms asymmetrical)
 - b. Each bay shall bear nameplate indicating:
 - 1) Ratings of interrupter switch (amperes continuous and interrupting)
 - 2) Maximum rating of power fuse in amperes
 - 3) Catalog number of fuse units or refill units
 - c. Mark control components for identification corresponding to designation on manufacturer's drawings.

PART 3 - EXECUTION - BY EQUIPMENT MANUFACTURER

3.1 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service

1. Engage a factory-authorized service representative to inspect and adjust field assembled components and equipment installation, including connections.
 2. Provide startup services for switchgear to provide a fully operational system. Startup services shall include but not be limited to:
 - a. Inspection and comprehensive check of all circuit breakers, fuses, protective relays, instrument transformers, metering, etc.
 - b. Verify functionality of internal and external control wiring associated with equipment.
 3. Prior to energization, factory representative shall visually inspect switchgear installation to ensure that all switches, motor operators and breaker chargers are operable, all breaker compartments rack-in/out and bus connections are complete.
 4. Switch operators shall be tested once after energization.
 5. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Provide copy of manufacturer's representative's certification
- C. Inspect equipment for physical damage, proper alignment, connections, anchorage, and grounding.

3.2 SOFTWARE INSTALLATION

- A. Switchgear Manufacturer shall upload program files for each protective relay and meter within the switchgear.
- B. Upload or modification of each file in the field shall follow the following procedure:
1. Download the currently installed file and save a copy labeled with the name of the relay and a suffix indicating "AS FOUND ON" with date.
 2. Upload the modified file in the field.
 3. Download the modified file and save a copy labeled with the name of the relay and a suffix indicating "AS LEFT ON" with date.
 4. Use software to perform a comparison of the "AS FOUND" and "AS LEFT" file.
 5. Alert engineer/owner to any differences discovered from the comparison that are not known changes.
- C. Upon acceptance of program file configuration and testing, program files shall be further augmented by relay manufacturer, contracted separately by Owner, to program relays for use in automation and integration into the campus SCADA.

3.3 TRAINING

- A. Provide services of factory-trained representative to instruct Owner on maintenance and operation for two (2) sessions, with each session a period of 4 hours.

PART 4 - EXECUTION - BY INSTALLING CONTRACTOR

4.1 COORDINATION

- A. Coordinate installation of housekeeping concrete pad based on actual equipment supplied
- B. Coordinate with miscellaneous trades for equipment foreign to the electrical installation to be outside of dedicated electrical space.
- C. Verify with manufacturer that “touch-up” paint kit is available for repainting.

4.2 EXAMINATION

- A. Examine areas and surface to receive switchboards for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that space indicated for switchgear mounting meets code-required working clearances.
- C. Notify Architect/Engineer of any discrepancies prior to submittal of product data and shop drawings.

4.3 INSTALLATION

- A. Install equipment per manufacturer's recommendations and as indicated.
- B. Install vendor standard labels for each switchgear, every instrument, overcurrent protective device and disconnect device. Attach nameplate to exterior of each switchgear using small corrosion-resistant metal screws and rivets. Do not use contact adhesive.
- C. Install switchgears in dedicated electrical space per NFPA 70, and as indicated on drawings.
- D. Tighten electrical connectors and terminal according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Install control/communication wiring between Switchgear and SCADA racks.

4.4 CONNECTIONS

- A. Ground switchgear according to Section 26 0526 – Grounding and Bonding for Electrical Systems.
- B. Connect power and control wiring according to Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables.

4.5 FIELD QUALITY CONTROL

- A. Inspect switchgear for physical damage, proper alignment, connections, anchorage, seismic restraints and grounding.
- B. Test continuity of each circuit.

- C. Test switchgear per requirements in Sections 26 0812 – Power Distribution Acceptance Tests and 26 0813 – Power Distribution Acceptance Test Tables.
- D. Interpret test results in writing and submit to Engineer.
- E. Test switch operators once after energizing.

4.6 REPAINTING

- A. Remove paint splatters and other marks from surface of equipment.
- B. Touch-up chips, scratches or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

4.7 SITE ACCEPTANCE TESTING

- A. Provide assistance to test sequence of operations of automation system.

4.8 CLEANING

- A. Clean switchgear during construction phase, prior to initial testing and energization of unit, and prior to final punch-list.
- B. Cleaning procedures as follows:
 - 1. Vacuum surfaces of enclosure and low voltage equipment.
 - 2. Blow out components with dry compressed air.
 - 3. Use small paintbrush to dust small, hard to reach crevices.

END OF SECTION

SECTION 26 1319.1

DC BATTERY SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide a complete DC Battery System, including battery rack, spill containment, battery chargers and fused disconnect.
- B. DC Battery system shall be provided by the switchgear manufacturer. Refer to specification 26 1319 Medium-Voltage Vacuum Interrupter Switchgear.

1.2 SUBMITTALS

- A. Submit all equipment procurement documents, including shop drawings and technical specifications, to the State Construction Office for review and approval, in addition to the engineer of record.
- B. Compliance Package: Submit document package confirming specifications and design intent have been met. Note that the compliance package shall include information for the switchgear system as well as all components of the battery and controls system. Compliance package shall include, but shall not be limited to, the following:
 - 1. Cover letter with compliance table listing each specification section and indicating compliance "C", deviation for alternate "D", or exception with explanation "E". Any deviation or exception shall be accompanied with detailed explanation of how design intent is being upheld.
 - 2. Complete bill of materials
 - 3. Engineering drawings for each component on the bill of materials. Drawings shall indicate physical dimensions of equipment.
 - 4. Battery System sizing calculations to align with project specific switchgear components, relays, control equipment, etc. based on parameters defined in this specification and drawings.
 - 5. Battery Charger sizing calculations to align with battery system sizing calculations based on parameters defined in this specification and drawings.
 - 6. Single line diagram including actual configurations of components.
 - 7. Product catalog sheets or equipment brochures.
 - 8. Product guide specifications.
- C. Product Data: Submit product data showing all material proposed for the system. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
 - 1. As bid system bill of materials.
 - 2. Product catalog sheets or equipment brochures.
- D. Manufacturer's Installation Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Recommended spare parts lists.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with NFPA 70 for components and installation.
2. Furnish products listed and classified by a third party agency amongst those acceptable to the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, fumes, water, corrosive substances, construction debris, and traffic.
- B. Use factory-installed lifting provisions. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.5 WARRANTY

- A. Manufacturer shall provide standard two year warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of final acceptance.

PART 2 - PRODUCTS

2.1 125VDC BATTERY

- A. Acceptable Manufacturers: C&D, East Penn, EnerSys, Exide, approved equal by switchgear supplier.
- B. Battery shall be Valve Regulated Lead Acid type.
 1. Battery system shall be sized based on the following criteria per the project specific vacuum breakers, relay, and auxiliary power requirements of each switchgear and associated control equipment.
 - a. Ambient Temperature = 77 deg F
 - b. End of Life Cell Voltage = 1.75V
 - c. Aging Compensation Factor = 1.25
 - d. Design Factor = 1.1
 - e. 20-year design life
 - f. Individual battery jar weight shall not exceed 225 lbs.
 - g. Battery shall be sized based on the following momentary loads, continuous loads and load profile. Note that the Electrical SCADA equipment and future switchgear lineup are estimated. Final determination of the Electrical SCADA equipment shall be determined by relay manufacturer/Owner prior to approval of battery system shop drawings.
 - 1). Note that total trip is based on the largest bus differential zone (most breakers tripping simultaneously).

Momentary Loads			
Description	QTY	AMPS	TOT
Trip Coil	18	0.7	12.6
Close Coil	3	1.8	5.4
Charging Motor	1	15	15
Total Trip			12.6
Total Close			5.4
Total Charging			15
Total Continuous Load (Includes Future Loads)			
Description	QTY	AMPS	TOT
SWGR Relay & Meter Equipment - Bus A			
Main Relay + Digital Inputs	1	0.21	0.2
Tie Relay + Digital Inputs	1	0.21	0.2
Feeder Relay + Digital Inputs	16	0.21	3.4
Bus Differential Relay + Digital Inputs	1	0.05	0.1
METER	1	0.12	0.1
LED Pilot Lights	54	0.01	0.6
SWGR Relay & Meter Equipment - Bus B			
Main Relay + Digital Inputs	1	0.21	0.2
Tie Relay + Digital Inputs	1	0.21	0.2
Feeder Relay + Digital Inputs	6	0.21	1.3
Bus Differential Relay + Digital Inputs	1	0.05	0.1
METER	1	0.12	0.1
LED Pilot Lights	24	0.01	0.3
SWGR Relay & Meter Equipment - Bus C (Existing)			
Main Relay + Digital Inputs	0	0.21	0.0
Tie Relay + Digital Inputs	2	0.21	0.4
Feeder Relay + Digital Inputs	16	0.21	3.4
Bus Differential Relay + Digital Inputs	1	0.05	0.1
METER	1	0.12	0.1
LED Pilot Lights	54	0.01	0.6
SWGR Relay & Meter Equipment - Future 6 Section Lineup			
Main Relay + Digital Inputs	1	0.21	0.2
Tie Relay + Digital Inputs	2	0.21	0.4
Feeder Relay + Digital Inputs	6	0.21	1.3
Bus Differential Relay + Digital Inputs	1	0.05	0.1
METER	2	0.12	0.2
LED Pilot Lights	27	0.01	0.3
Electrical SCADA Equipment - Estimated			
GPS Clock	1	0.75	0.8
Ethernet Switch	6	0.79	4.7
PLC	2	3.71	7.4
HMI/PC	2	3.71	7.4
I/O Interface	3	0.42	1.3
Misc Buffer	1	1.00	1.0
Total Continuous			36.39
Sizing Parameters			
Step Description	Step	Duration	AMPS
Total Continuous	1	4 hr	36.39
Total Continuous + Total Trip	2	1 min	48.99
Total Continuous + Total Charge	3	1 min	51.39

2. Battery rack shall be arranged to not exceed 4'-0" L x 2'-0" D. Height shall be as necessary for quantity of jars:
 - a. Seismic Zone 1 rated.
 - b. Provide front safety shield extending the full height of the battery rack.
3. Provide spill containment with minimum 4" High Steel Barrier with liner and neutralization and absorption pillows listed and classified by a third party agency amongst those acceptable to the NCBCC (North Carolina Building Code Council to Label Electrical & Mechanical Equipment.

2.2 125VDC BATTERY CHARGER

- A. Provide two (2) battery chargers arranged for parallel operation for redundancy.
- B. Acceptable Manufacturers: SAFT, Hindle or Approved Equal by switchgear supplier.
- C. Input: 208, 3 phase AC Voltage
- D. Output: 125V DC
- E. Microprocessor controlled with SCR based rectification.
- F. AC Input and DC Output Circuit Breakers
- G. Size Battery Charger based on calculated amp-hours removed from battery system per the following:
 1. Minimum Charger Size = (Amp-Hour Removed x Recharge Factor) / Recharge Time + Total Continuous Load
 2. Recharge Factor = 1.1
 3. Recharge Time = 8 Hours
- H. Provide battery eliminator option.
- I. Provide modbus communication card via ethernet for the following parameters at a minimum:
 1. AC Input Failure
 2. Summary Alarm
 3. DC Output Voltage
 4. DC Output Current
- J. NEMA 1 Enclosure
- K. Maximum Dimensions: 3'-0" L x 2'-0" D

2.3 DC FUSED DISCONNECT

1. Acceptable Manufacturer: ABB/GE, Eaton, Square D
2. NEMA AB 1, UL 98.
3. 125VDC.
4. Ampere Rating: As Determined by Switchgear Manufacturer
5. Load interrupter enclosed knife switch, heavy-duty type.
6. Non-fusible type as indicated.

7. Switch Interiors:
 - a. Switch blades that are visible in "OFF" position when switch door is open.
 - b. Plated current carrying parts.
8. Switch Mechanism:
 - a. Quick-make, quick-break, with visible blades and externally operable handle
 - b. Lockable only in "OFF" position and accept three industrial type, heavy-duty padlocks
 - c. Dual cover interlock to prevent unauthorized opening of switch door when handle is in "ON" position, and to prevent closing of switch mechanism with door open.
 - d. Defeater mechanism to bypass interlock.
 - e. Operating handle integral part of enclosure.
 - f. Handle to physically indicate "ON" and "OFF" position.

PART 3 - EXECUTION – BY EQUIPMENT MANUFACTURER

3.1 MANUFACTURER'S FIELD SERVICE

- A. Factory-authorized service representative shall inspect and adjust field assembled components and equipment installation, including connections, prior to energization.
- B. Provide startup services to provide a fully operational system. Startup services shall include but not be limited to:
 1. Verify all functional operations.
 2. Verify communications with the SCADA.
- C. Provide copy of manufacturer's representative's certification.

3.2 ADJUSTING

- A. Set field-adjustable circuit breakers trip settings, to values indicated by Designer.

3.3 FIELD QUALITY CONTROL

- A. Inspect equipment for physical damage, proper alignment, connections, anchorage and grounding.

3.4 ACCEPTANCE TESTING

- A. Testing by Equipment Supplier. Equipment Supplier shall provide factory standard start-up/check out services.

PART 4 - EXECUTION - BY INSTALLING CONTRACTOR

4.1 EXAMINATION

- A. Visually inspect to confirm that items and accessories are in accordance with specifications and drawings.
- B. Verify field measurements are as shown on shop drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

4.2 INSTALLATION

- A. Install equipment per manufacturer's recommendations and as indicated.
- B. Coordinate final locations of equipment with Owner and review final locations with Owner/Engineer prior to setting equipment.
- C. Protect equipment during installation to prevent twisting or deformations, exposure to potentially damaging environments, and work of other trades. Maintain protection until completion of construction.

4.3 CONNECTIONS

- A. Ground equipment as indicated on drawings and per Manufacturer's recommendations.
- B. Connect power and control wiring.

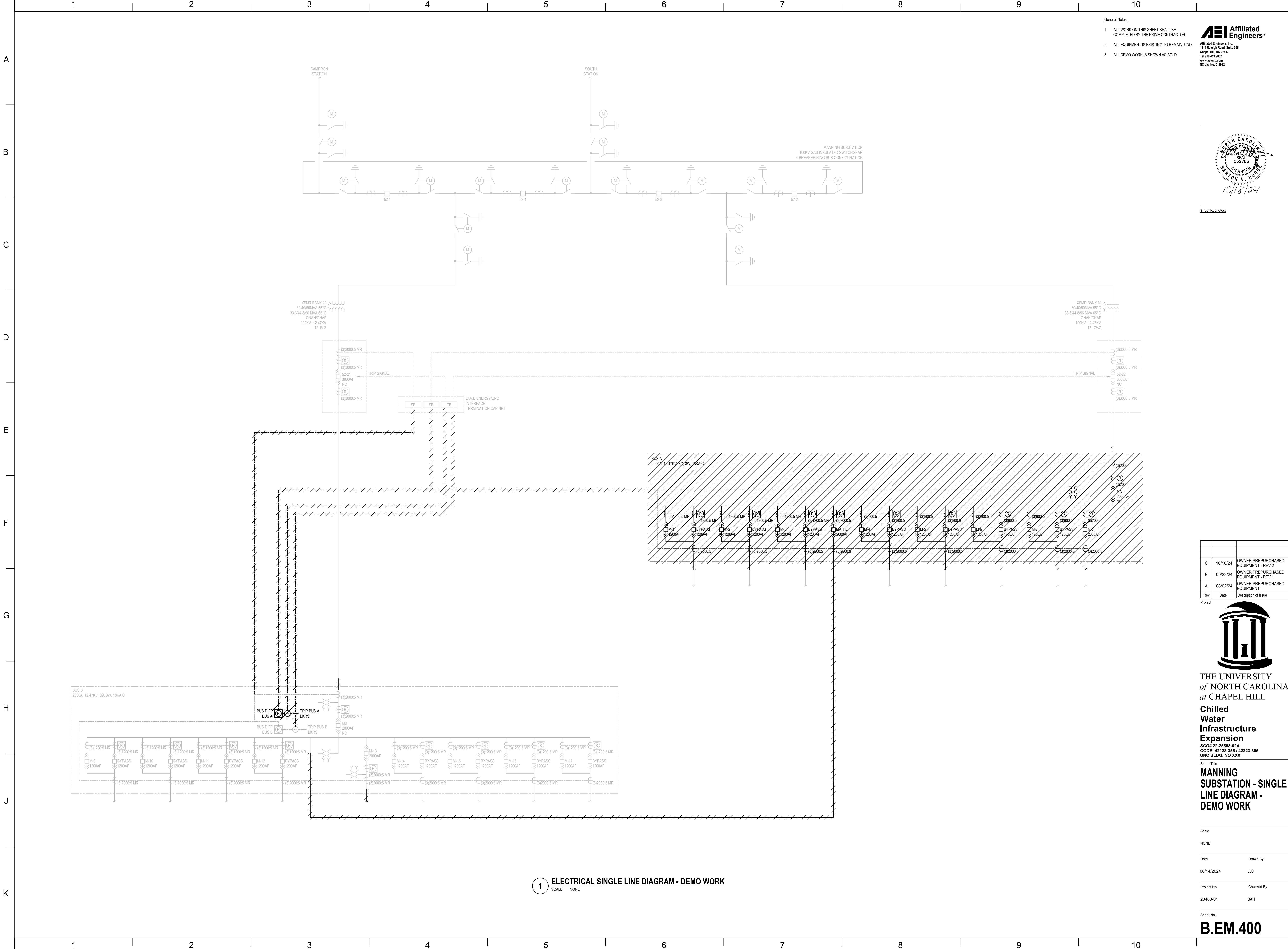
4.4 REPAINTING

- A. Remove paint splatters and other marks from surface of equipment.
- B. Touch-up chips, scratches or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

4.5 CLEANING

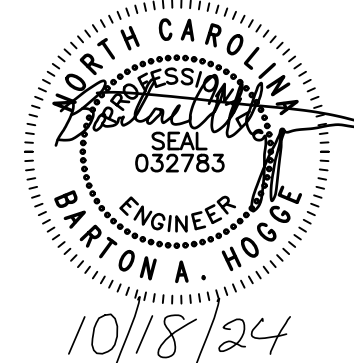
- A. Clean equipment during construction phase, prior to initial testing and energization of unit, and prior to final punch-list.
- B. Cleaning procedures as follows:
 - 1. Vacuum surfaces of enclosure and low voltage equipment.
 - 2. Blow out components with dry compressed air.
 - 3. Use small paintbrush to dust small, hard to reach crevices.

END OF SECTION



- General Notes:
- ALL WORK ON THIS SHEET SHALL BE COMPLETED BY THE PRIME CONTRACTOR.
 - ALL EQUIPMENT IS EXISTING TO REMAIN, UNO.
 - ALL DEMO WORK IS SHOWN AS BOLD.

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Sheet Keynotes:

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
B	09/23/24	OWNER PREPURCHASED EQUIPMENT - REV 1
A	08/02/24	OWNER PREPURCHASED EQUIPMENT

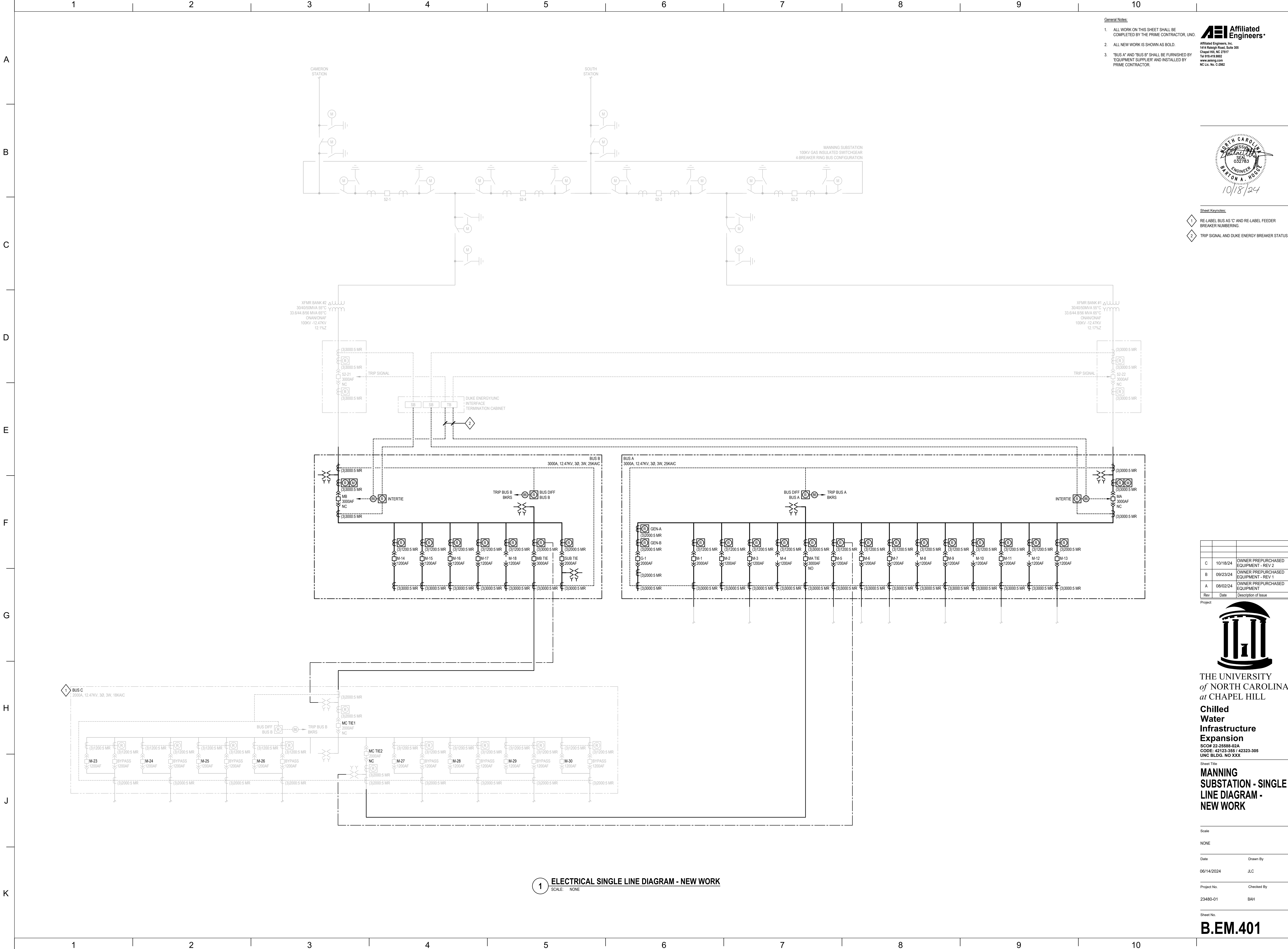

**THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL**
**Chilled
Water
Infrastructure
Expansion**
SC0# 22-25688-02A
CODE: 42123-355 / 42323-305
UNC BLDG. NO XXX

Sheet Title
**MANNING
SUBSTATION - SINGLE
LINE DIAGRAM -
DEMO WORK**

Scale	Drawn By
NONE	JLC
Date	Checked By
06/14/2024	BAH
Project No.	
23480-01	
Sheet No.	

B.EM.400

1 ELECTRICAL SINGLE LINE DIAGRAM - DEMO WORK
SCALE: NONE



- General Notes:**
- ALL WORK ON THIS SHEET SHALL BE COMPLETED BY THE PRIME CONTRACTOR, UNO.
 - ALL NEW WORK IS SHOWN AS BOLD.
 - *BUS A* AND *BUS B* SHALL BE FURNISHED BY EQUIPMENT SUPPLIER AND INSTALLED BY PRIME CONTRACTOR.

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- Sheet Keynotes:**
- RE-LABEL BUS AS 'C' AND RE-LABEL FEEDER BREAKER NUMBERING.
 - TRIP SIGNAL AND DUKE ENERGY BREAKER STATUS

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
B	09/23/24	OWNER PREPURCHASED EQUIPMENT - REV 1
A	08/02/24	OWNER PREPURCHASED EQUIPMENT

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Chilled Water Infrastructure Expansion

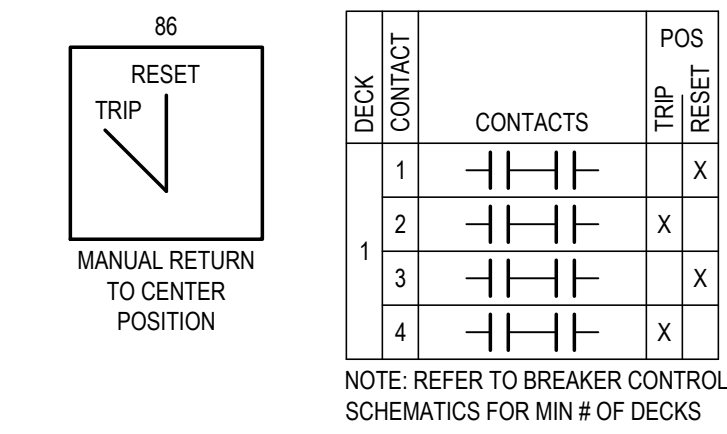
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CODE: 42123-355 / 42323-305
UNC BLDG. NO XXX

Sheet Title
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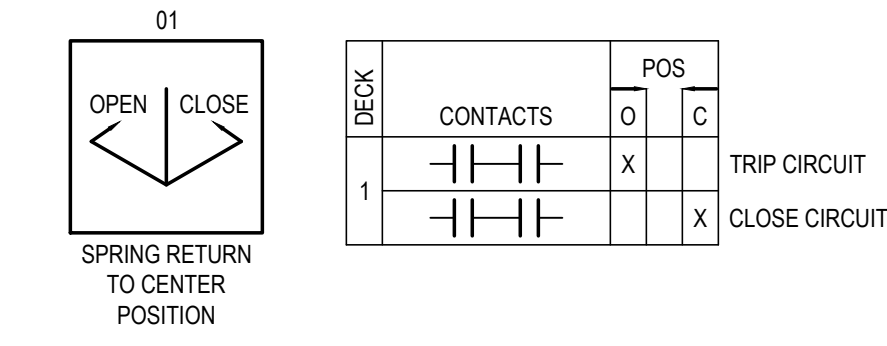
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Project No.	23480-01
Checked By	BAH

Sheet No.
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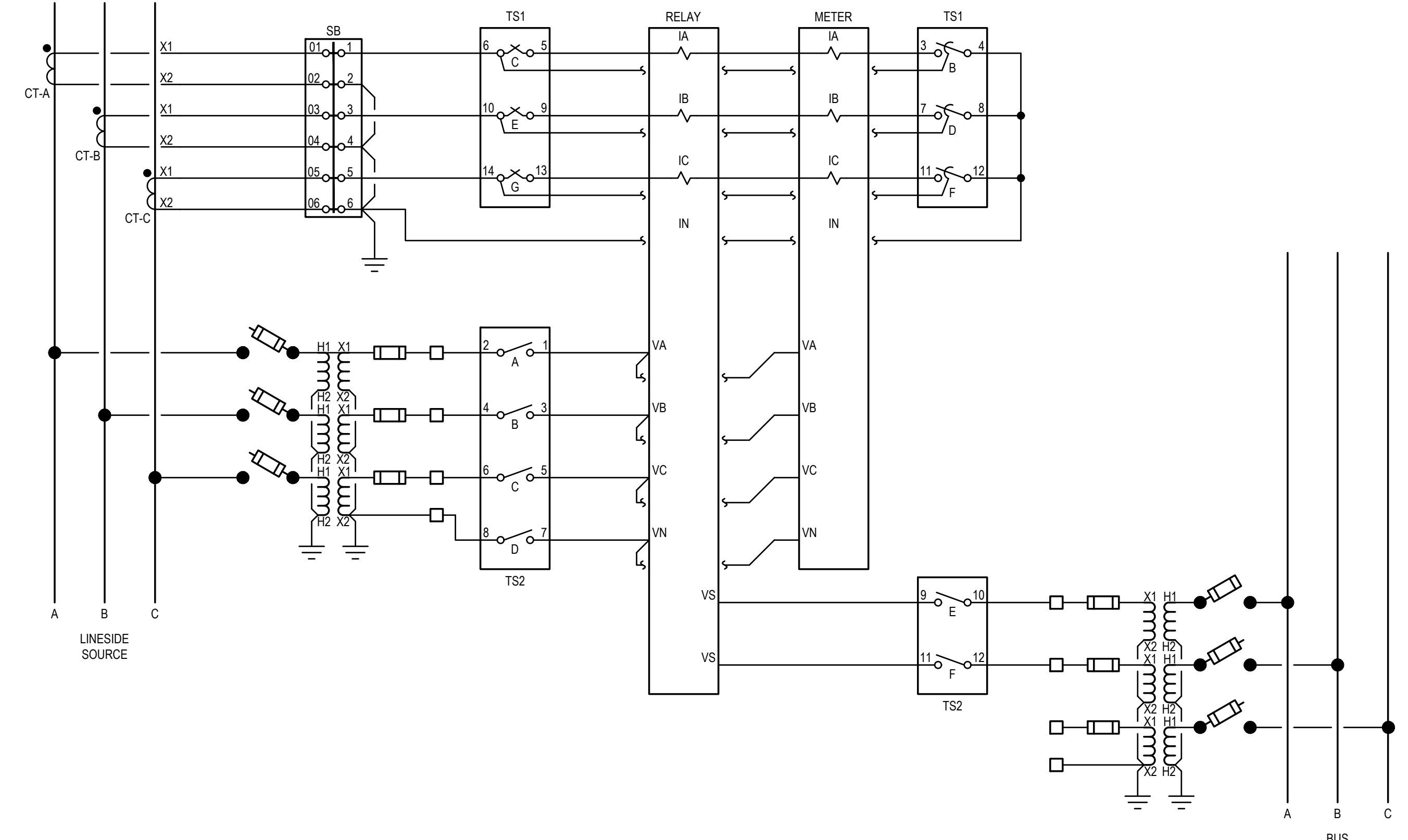
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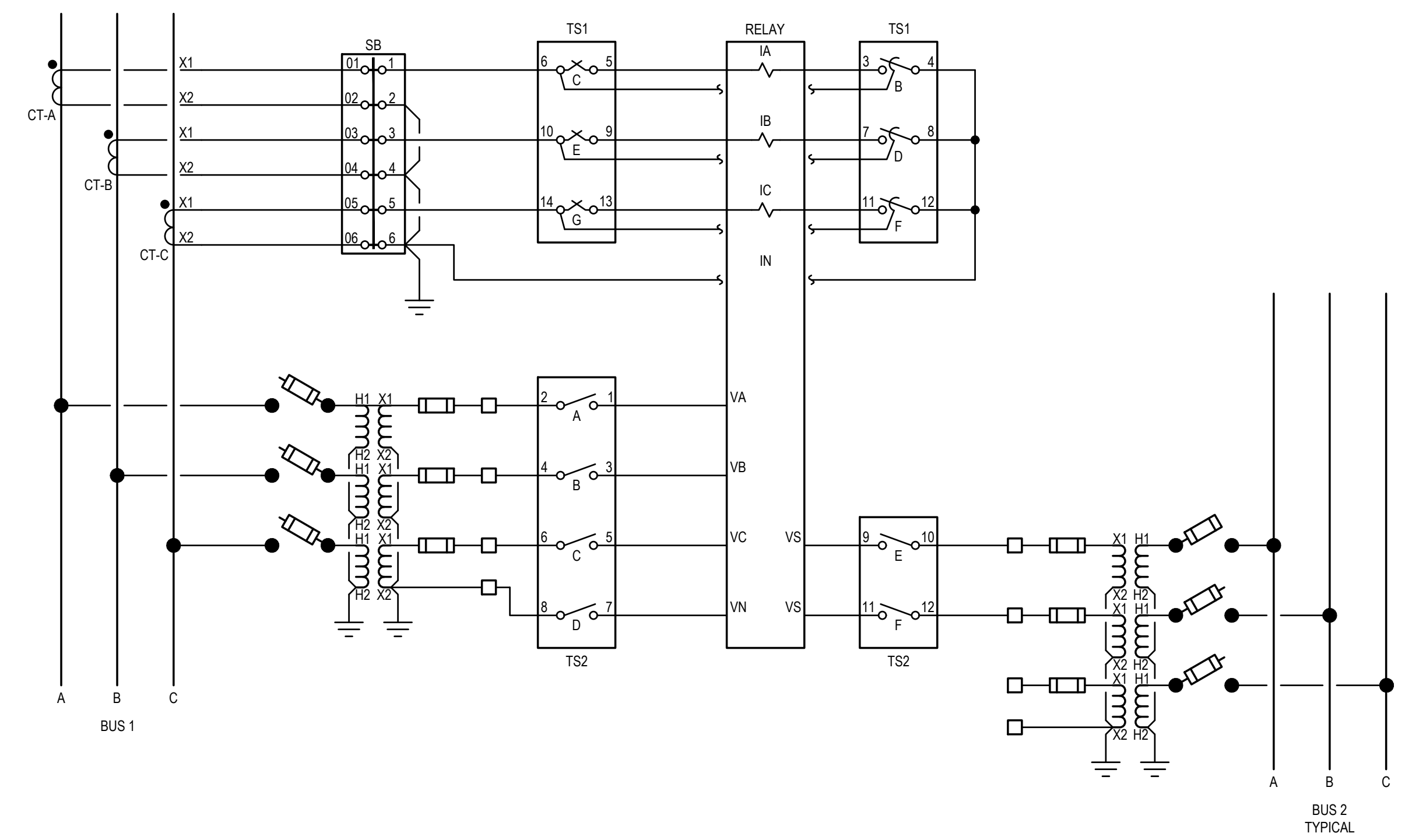
6 86 LOCKOUT RELAY DETAIL
SCALE: NOT TO SCALE



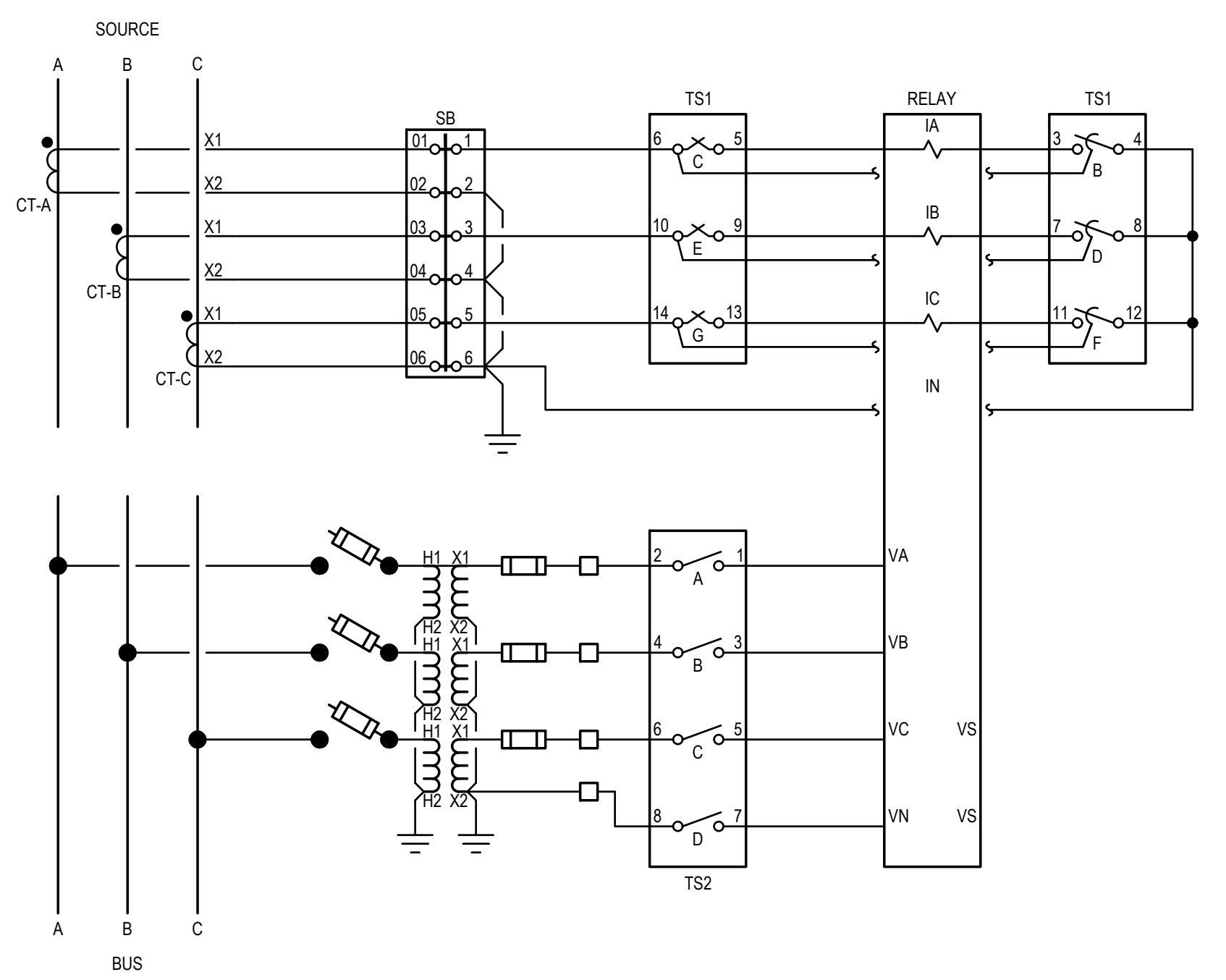
7 01 BREAKER CONTROL SWITCH DETAIL
SCALE: NOT TO SCALE



1 MAIN BREAKER CT/PT RELAY & METER TYPICAL DETAIL
SCALE: NOT TO SCALE



2 TIE BREAKER CT/PT RELAY TYPICAL DETAIL
SCALE: NOT TO SCALE



3 FEEDER BREAKER CT/PT FEEDER RELAY TYPICAL DETAIL
SCALE: NOT TO SCALE

SWITCHGEAR ELEVATION ABBREVIATIONS & LEGEND

A	AMBER COLOR PILOT LIGHT	TS#	TEST SWITCH
B	BLUE COLOR PILOT LIGHT	VARM	KILOVOLT METER
G	GREEN COLOR PILOT LIGHT	VM	AC VOLT METER
R	RED COLOR PILOT LIGHT	VMS	VOLT METER SELECTOR SWITCH
W	WHITE COLOR PILOT LIGHT	VS	VOLTAGE SYNC SOURCE
		VT	VOLTAGE TRANSFORMER
		WM	MEGAWATT METER
AH	ALARM HORN	A/H	UTILITY RETURN AUTO / HOLD SELECTOR SWITCH
AM	AMMETER	AM	AUTO / MANUAL SELECTOR SWITCH
AMS	AMMETER SELECTOR SWITCH	C/O	CLOSED / OPEN TRANSITION
AR	ALARM RESET PUSHBUTTON	RL	REMOTE / LOCAL CONTROL, SELECTOR SWITCH
AS	AUTO STANDBY MODE	RET	INITIATE RETURN TO UTILITY
CPM	CHILLER PLANT MODE	SYS	SYSTEM MODE SELECTOR SWITCH (AS-CPM-PU)
FM	FREQUENCY METER		
LT	LAMP TEST PUSHBUTTON	01	BREAKER CONTROL SWITCH
MOC	MECHANISM-OPERATED CONTACT	02	GENERATOR MODE SELECTOR SWITCH (RUN-OFF-AUTO)
MTR	POWER METER	03	SYNCHROSCOPE SELECTOR SWITCH
PU	PARALLEL WITH UTILITY MODE	86	LOCKOUT RELAY
RTD	GENERATOR REMOTE TEMPERATURE ALARM	86B	BUS DIFFERENTIAL LOCKOUT RELAY
RTM	RIDE THRU MODULE	86BF	BREAKER FAILURE LOCKOUT RELAY
SP	ALARM SILENCE PUSHBUTTON		
SS	SYNCHROSCOPE		
TOC	TRUCK-OPERATED CONTACT		

LEGEND:

MAIN RELAY	MULTI-FUNCTION MAIN PROTECTION RELAY	==	NORMALLY OPEN CONTACT
TIE RELAY	MULTI-FUNCTION TIE PROTECTION RELAY	≠	NORMALLY CLOSED CONTACT
XFMR RELAY	MULTI-FUNCTION TRANSFORMER PROTECTION RELAY	⊗	EMERGENCY STOP BUTTON
FDR RELAY	MULTI-FUNCTION FEEDER PROTECTION RELAY	⊙	SYNC AND CLOSE PUSH BUTTON
PLC	PROGRAMMABLE LOGIC CONTROLLER	↔↔↔↔	WYE-WYE POTENTIAL TRANSFORMERS
MTR	POWER METER	↔↔↔↔	OPEN DELTA POTENTIAL TRANSFORMERS
SB	SHORTING TERMINAL BLOCK	⊥	CURRENT TRANSFORMER, DOT INDICATES POLARITY
TS1	TEST SWITCH TYPE 1, REFER TO SPECIFICATIONS	⏏	MEDIUM VOLTAGE BREAKER
TS2	TEST SWITCH TYPE 2, REFER TO SPECIFICATIONS	⏏	LOW VOLTAGE BREAKER
TS3	TEST SWITCH TYPE 3, REFER TO SPECIFICATIONS	⏏	LOW VOLTAGE FUSE
86	LOCKOUT RELAY	⏏	EQUIPMENT GROUND CONNECTION
83	CONTROL POWER TRANSFER RELAY SCHEME	⏏	DIODE
01	BREAKER CONTROL SWITCH	⏏	MULTI-FUNCTION RELAY OUTPUT
43	LOCAL/REMOTE SWITCH	⏏	MULTI-FUNCTION RELAY INPUT
CR	CONTROL RELAY	⏏	SURGE ARRESTER
#	ANSI PROTECTIVE FUNCTION		
AMS	ARC FLASH MAINTENANCE MODE SWITCH		

ANSI PROTECTIVE FUNCTIONS

25	=	SYNC CHECK	52	=	CIRCUIT BREAKER
28Q	=	LIQUID THERMAL RELAY	59	=	OVERVOLTAGE
27	=	UNDERVOLTAGE	63PRD	=	PRESSURE RELIEF DEVICE
32	=	REVERSE POWER	63VAC	=	VACUUM GAUGE
43	=	BREAKER CONTROL SWITCH	63TX	=	SUDDEN PRESSURE RELAY
47	=	PHASE SEQUENCE	71	=	LIQUID LEVEL RELAY
49W	=	WINDING THERMAL RELAY	81U	=	UNDER-FREQUENCY
50	=	INSTANTANEOUS OVERCURRENT	81O	=	OVER-FREQUENCY
50N	=	NEUTRAL INSTANTANEOUS OVERCURRENT	83	=	CONTROL POWER AUTO-TRANSFER
50G	=	GROUND INSTANTANEOUS OVERCURRENT	86	=	LOCKOUT RELAY
51	=	TIME OVERCURRENT	87	=	DIFFERENTIAL
51N	=	NEUTRAL TIME OVERCURRENT			
51G	=	GROUND TIME OVERCURRENT			

COMMUNICATIONS ARCHITECTURE LEGEND

---	SINGLE MODE FIBER	MIN 12 STRAND
---	SINGLE MODE FIBER BY OWNER	OR EXISTING
---	MULTI-MODE FIBER	MIN 12 STRAND CABLE
---	ETHERNET	CATEGORY 6A
---	FUTURE ETHERNET	
.....	SERIAL	RS-485 CABLE
---	COAXIAL	LMR-400 TNC TO TNC, SEL-C691 OR APPROVED EQUAL
SP	COAXIAL SURGE PROTECTOR	SEL-915900139 OR APPROVED EQUAL
---	HARDWIRE	MIN 1-#14 AWG (OR QTY AS INDICATED)
---	EXISTING HARDWIRE	
---	FUTURE HARDWIRE	
---	IRIG-B TIME SYNC	RG68 COAXIAL CABLE
---	IRIG-B T CONNECTOR	BNC T CONNECTOR (FEMALE-FEMALE-FEMALE) AND BNC MALE TO BNC MALE OR DB-9 MALE CONNECTOR AT EACH DEVICE TERMINATION AS NECESSARY
---	IRIG-B RESISTOR	BNC 50 OHM TERMINATING RESISTOR (BASIS OF DESIGN SEL-240-1800)
---	SERIAL TERMINATION	SERIAL MALE TERMINATION FOR ETHERNET CABLE
DB9	DB-9 PINOUT TERMINATION	EIA-485 ADAPTER FOR IRIG-B AND EIA-485 CONNECTIONS (BASIS OF DESIGN SEL-C675)

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Professional Engineer
SEAL
05/18/83
BYRON A. VOGL
10/18/24

Sheet Keynotes:

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
B	09/23/24	OWNER PREPURCHASED EQUIPMENT - REV 1
A	08/02/24	OWNER PREPURCHASED EQUIPMENT

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Chilled Water Infrastructure Expansion

SC0# 22-25588-02A
CODE: 42123-355 / 42323-305
UNC BLDG. NO XXX

SWGR ELEVATION & DETAILED SINGLE LINE DIAGRAM SYMBOLS, ABBREVIATIONS, & DETAILS

Scale	NONE
Date	06/14/2024
Drawn By	JLC
Project No.	23480-01
Checked By	BAH

Sheet No.
B.EM.600

1 2 3 4 5 6 7 8 9 10

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B

C

D

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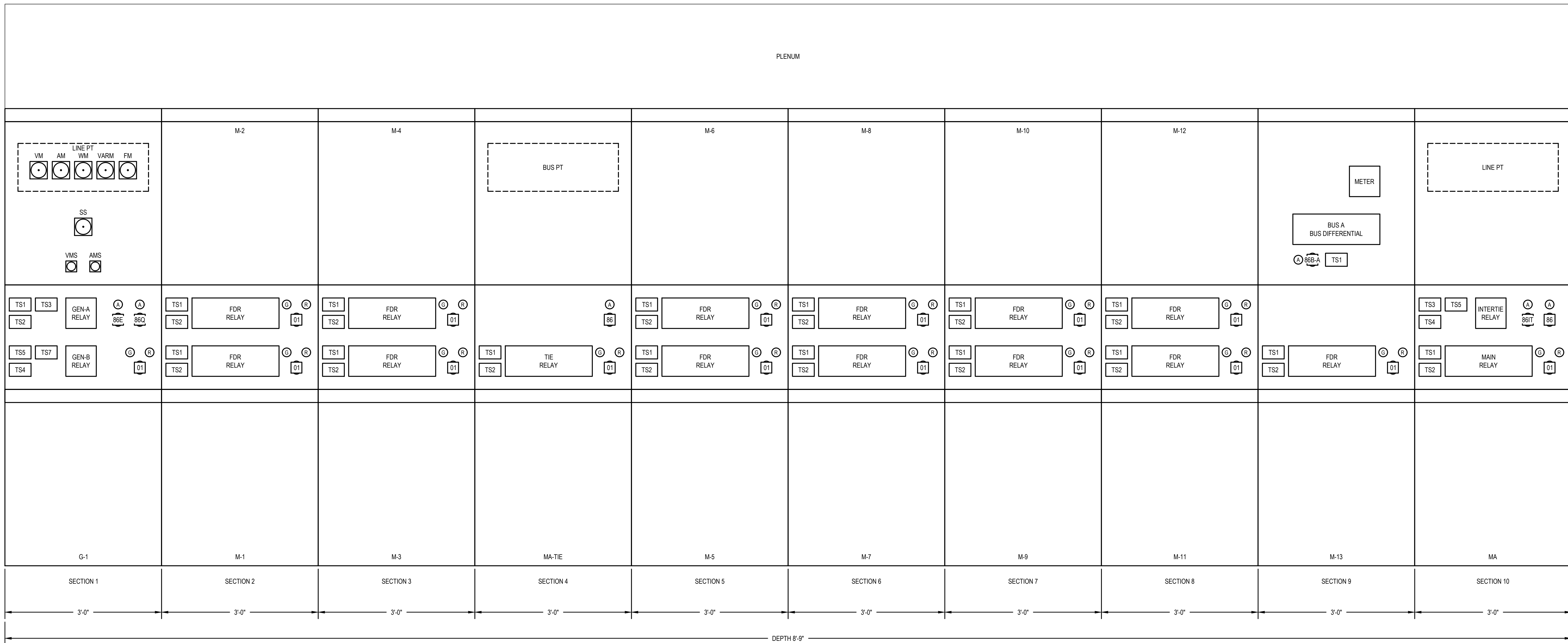
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G

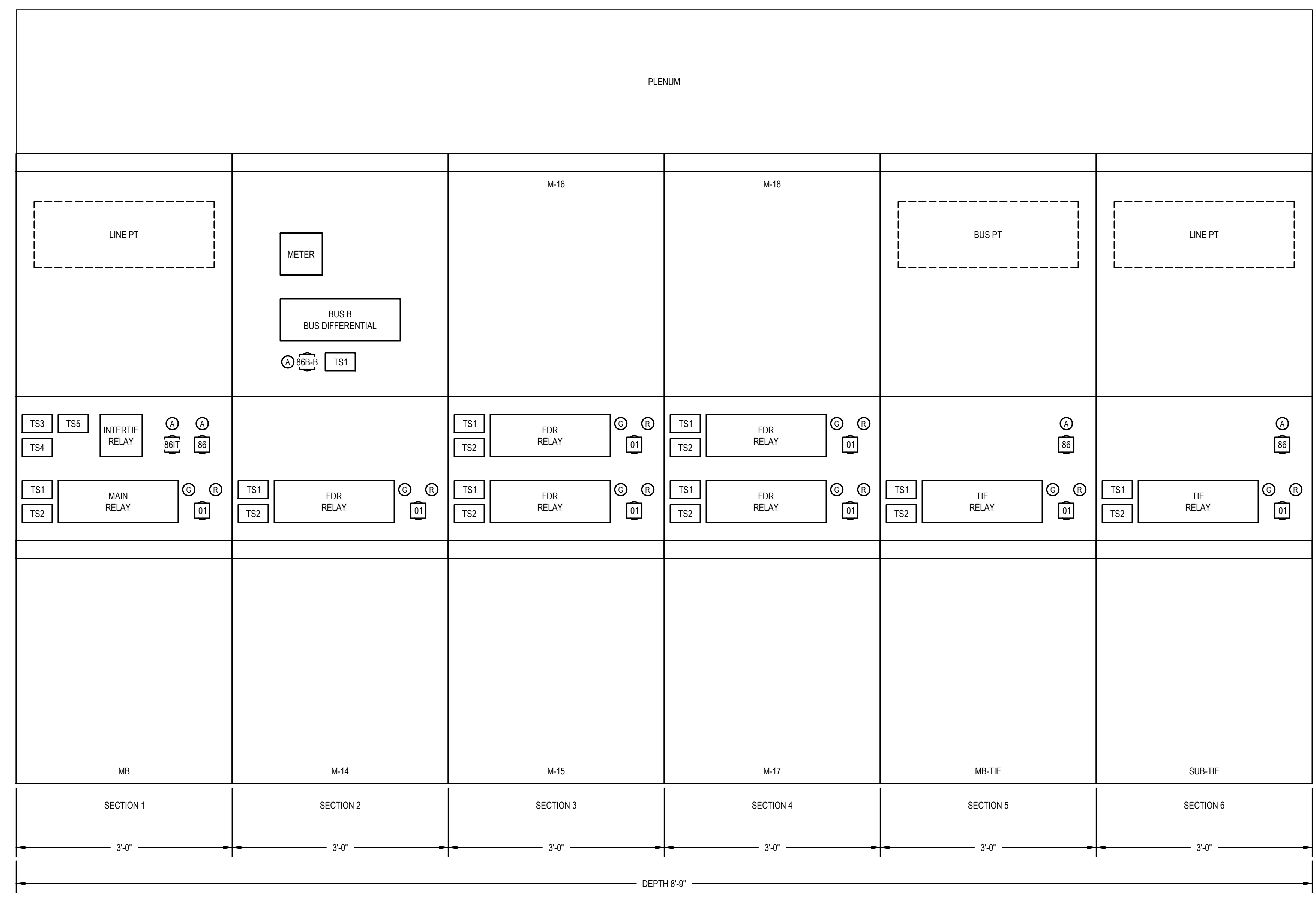
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K



1 ELECTRICAL EQUIPMENT ELEVATION - BUS A
SCALE: NONE



2 ELECTRICAL EQUIPMENT ELEVATION - BUS B
SCALE: NONE



Sheet Keynotes:

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
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Water
Infrastructure
Expansion**
SC0# 22-25688-02A
CODE: 42123-355 / 42323-305
UNC BLDG. NO XXX

Sheet Title
**MANNING SUBSTATION
ELECTRICAL
EQUIPMENT
ELEVATION
BUS A & BUS B**

Scale
NONE
Date
06/14/2024
Project No.
23480-01
Drawn By
JLC
Checked By
BAH

Sheet No.
B.EM.601

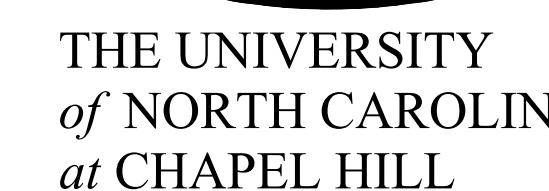
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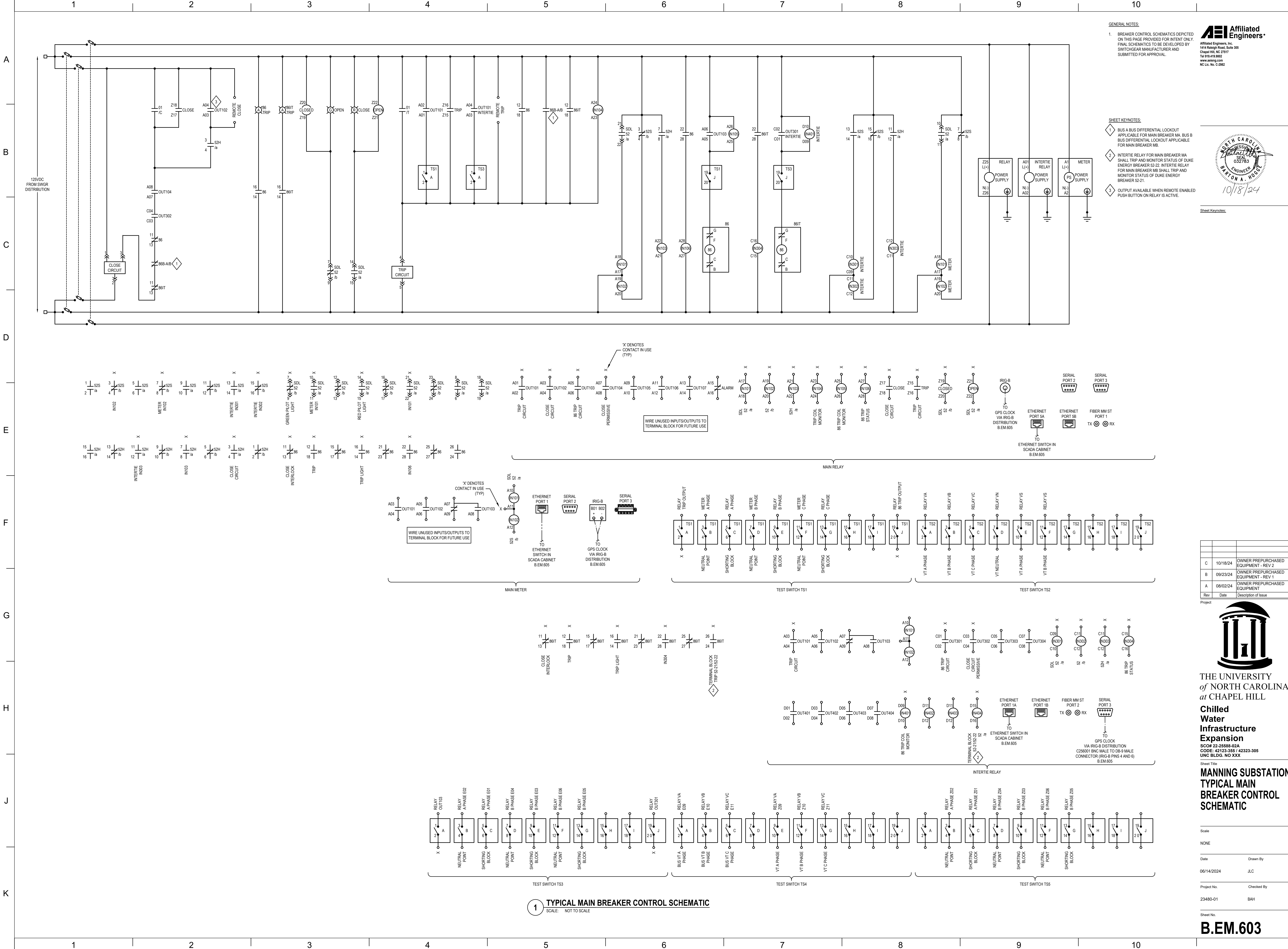
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SCALE: NONE



2 DETAILED SINGLE LINE DIAGRAM - BUS B
SCALE: NONE



SCO# 22-25588-02A
CODE: 42123-355 / 42323-355
UNC BLDG. NO XXX



GENERAL NOTES:
1. BREAKER CONTROL SCHEMATICS DEPICTED ON THIS PAGE PROVIDED FOR INTENT ONLY. FINAL SCHEMATICS TO BE DEVELOPED BY SWITCHGEAR MANUFACTURER AND SUBMITTED FOR APPROVAL.

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SHEET KEYNOTES:
1. BUS A BUS DIFFERENTIAL LOCKOUT APPLICABLE FOR MAIN BREAKER MA. BUS B BUS DIFFERENTIAL LOCKOUT APPLICABLE FOR MAIN BREAKER MB.
2. INTERTIE RELAY FOR MAIN BREAKER MA SHALL TRIP AND MONITOR STATUS OF DUKE ENERGY BREAKER 52-22. INTERTIE RELAY FOR MAIN BREAKER MB SHALL TRIP AND MONITOR STATUS OF DUKE ENERGY BREAKER 52-21.
3. OUTPUT AVAILABLE WHEN REMOTE ENABLED PUSH BUTTON ON RELAY IS ACTIVE.

Sheet Keynotes:

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
B	09/23/24	OWNER PREPURCHASED EQUIPMENT - REV 1
A	08/02/24	OWNER PREPURCHASED EQUIPMENT



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SCOW 22-25588-02A
CODE: 42123-355 / 42323-305
UNC BLDG. NO XXX

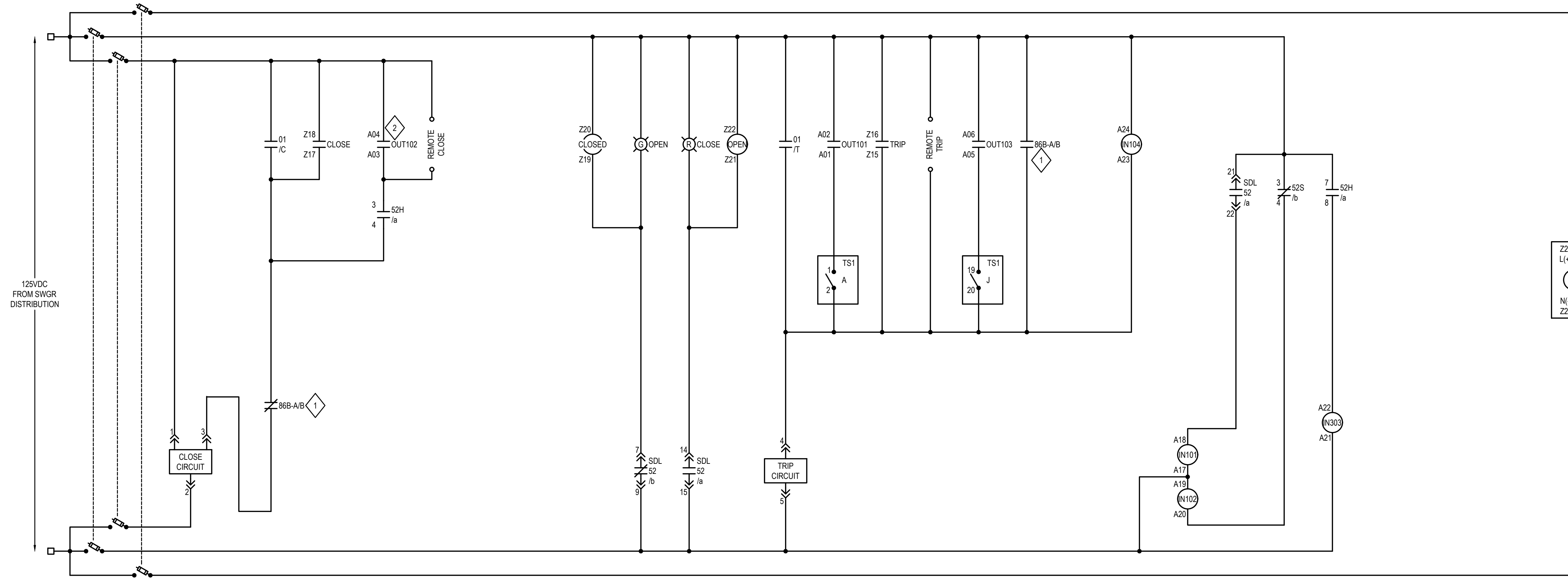
Sheet Title
MANNING SUBSTATION TYPICAL MAIN BREAKER CONTROL SCHEMATIC

Scale
NONE
Date
06/14/2024
Drawn By
JLC
Project No.
23480-01
Checked By
BAH

Sheet No.
B.EM.603

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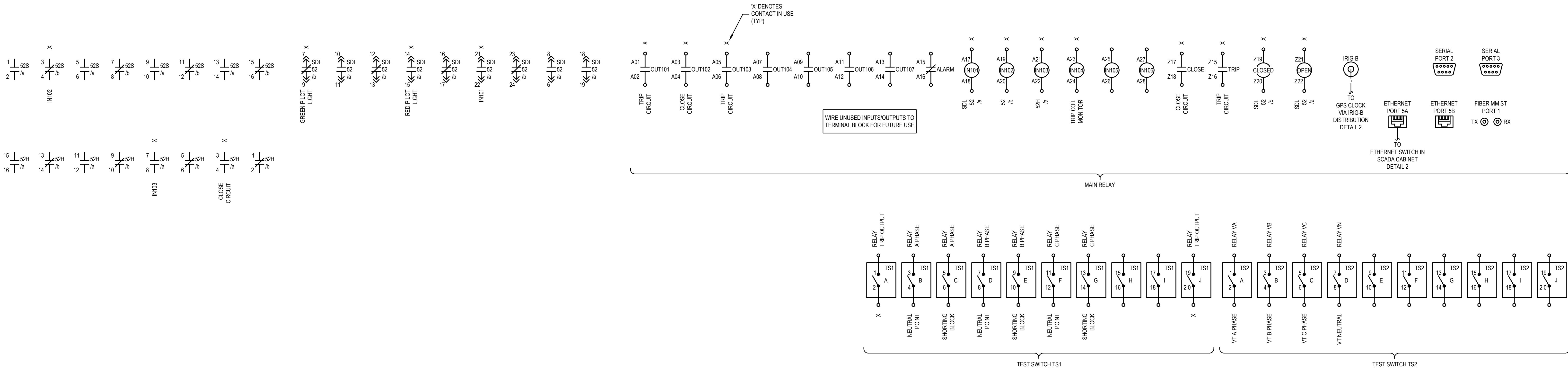
GENERAL NOTES:
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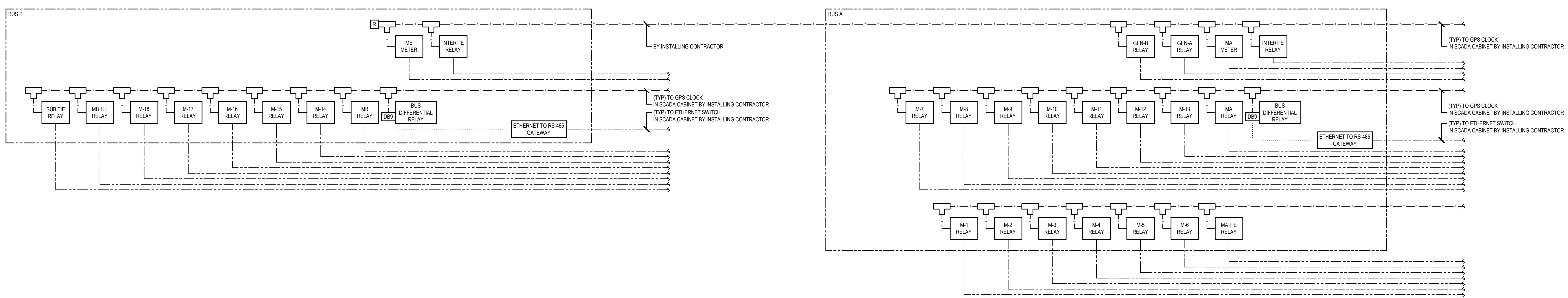
SHEET KEYNOTES:
1. BUS A BUS DIFFERENTIAL LOCKOUT APPLICABLE FOR BUS A BREAKERS. BUS B BUS DIFFERENTIAL LOCKOUT APPLICABLE FOR BUS B BREAKERS.
2. OUTPUT AVAILABLE WHEN REMOTE ENABLED PUSH BUTTON ON RELAY IS ACTIVE.

Professional Engineer
10/18/24

Sheet Keynotes:



1 TYPICAL FEEDER BREAKER CONTROL SCHEMATIC
SCALE: NOT TO SCALE



NOTE: ALL TIME SYNCHRONIZATION CABLEING AND COMPONENTS INTERNAL TO SWITCHGEAR SHALL BE PROVIDED BY SWITCHGEAR MANUFACTURER.

2 COMMUNICATIONS SINGLE LINE DIAGRAM
SCALE: NONE

Rev	Date	Description of Issue
C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
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A	08/02/24	OWNER PREPURCHASED EQUIPMENT

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UNC BLDG. NO XXX

Sheet Title

MANNING SUBSTATION TYPICAL FEEDER BREAKER CONTROL SCHEMATIC & COMM DETAILS

Scale
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Date
06/14/2024

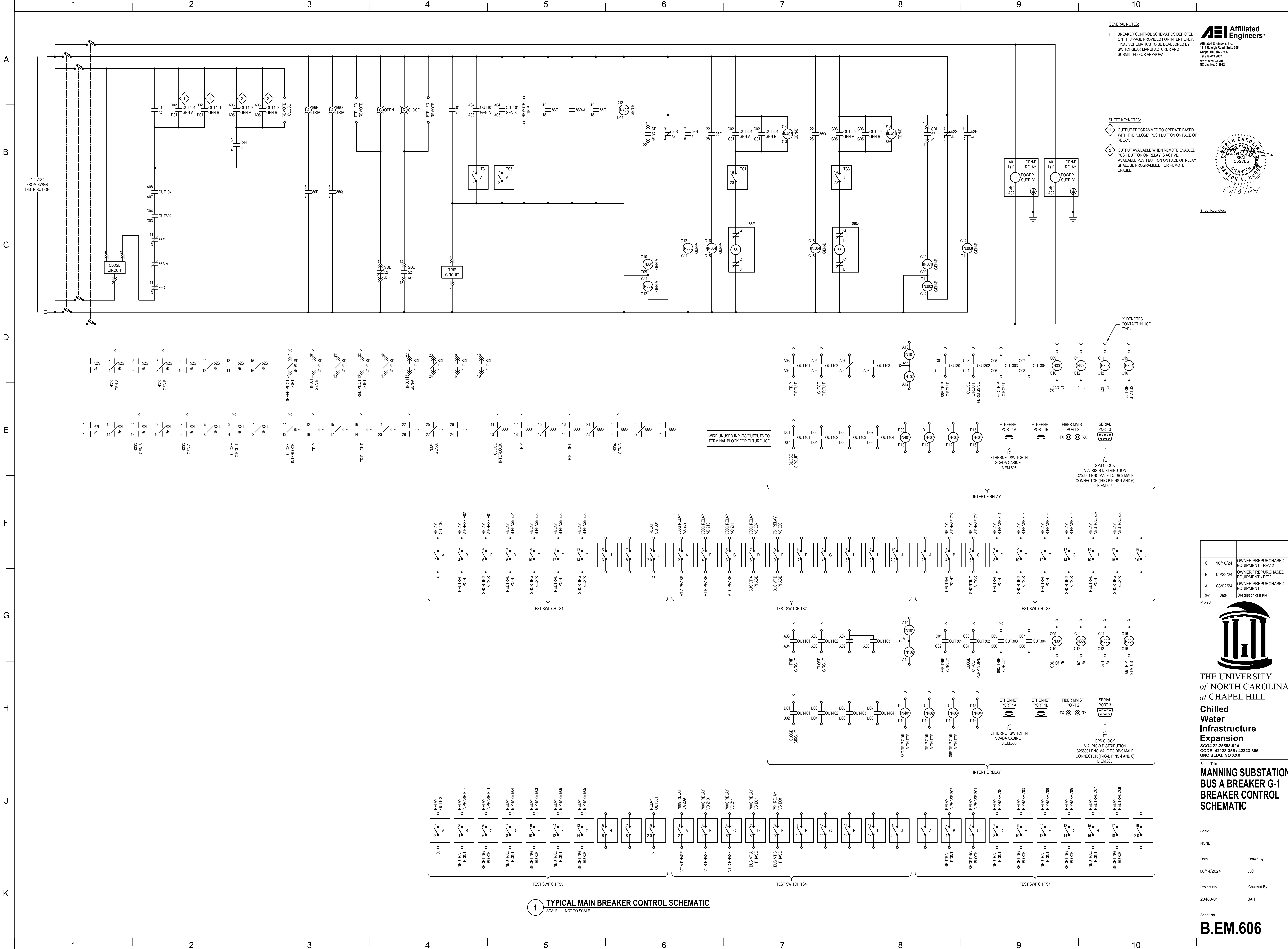
Drawn By
JLC

Project No.
23480-01

Checked By
BAH

Sheet No.

B.EM.605



GENERAL NOTES:
1. BREAKER CONTROL SCHEMATICS DEPICTED ON THIS PAGE PROVIDED FOR INTENT ONLY. FINAL SCHEMATICS TO BE DEVELOPED BY SWITCHGEAR MANUFACTURER AND SUBMITTED FOR APPROVAL.

SHEET KEYNOTES:
1. OUTPUT PROGRAMMED TO OPERATE BASED WITH THE "CLOSE" PUSH BUTTON ON FACE OF RELAY.
2. OUTPUT AVAILABLE WHEN REMOTE ENABLED PUSH BUTTON ON RELAY IS ACTIVE. AVAILABLE PUSH BUTTON ON FACE OF RELAY SHALL BE PROGRAMMED FOR REMOTE ENABLE.

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Professional Engineer
BRYAN A. VOGL
05/28/83
10/18/24

Sheet Keynotes:

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C	10/18/24	OWNER PREPURCHASED EQUIPMENT - REV 2
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SC0# 22-25568-02A
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Sheet Title
MANNING SUBSTATION BUS A BREAKER G-1 BREAKER CONTROL SCHEMATIC

Scale	NONE
Date	06/14/2024
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Checked By	BAH

Sheet No.
B.EM.606