

SWITCHBOARDS - LOW VOLTAGE

PART 1 GENERAL

1.01 SCOPE

A. THE CONTRACTOR SHALL FURNISH AND INSTALL, WHERE INDICATED, A FREE-STANDING, DEAD-FRONT TYPE LOW VOLTAGE DISTRIBUTION SWITCHBOARD, UTILIZING GROUP MOUNTED CIRCUIT PROTECTIVE DEVICES AS SPECIFIED HEREIN, AND AS SHOWN ON THE CONTRACT DRAWINGS.

1.02 REFERENCES

A. THE LOW VOLTAGE DISTRIBUTION SWITCHBOARDS AND ALL COMPONENTS SHALL BE DESIGNED, MANUFACTURED AND TESTED IN ACCORDANCE WITH THE LATEST APPLICABLE FOLLOWING STANDARDS:

- 1. UL STANDARD 991 - SWITCHBOARDS
2. UL STANDARD 50 - ENCLOSURES FOR ELECTRICAL EQUIPMENT
3. NEMA PB-2 SWITCHBOARDS
4. UL STANDARD 489 - CIRCUIT BREAKERS
5. UL STANDARD 1449 - SURGE PROTECTIVE DEVICES
6. UL STANDARD 508 - INDUSTRIAL CONTROL EQUIPMENT

1.03 SUBMITTALS - FOR REVIEW/APPROVAL

A. THE FOLLOWING INFORMATION SHALL BE SUBMITTED TO THE ENGINEER:

- 1. FRONT VIEW AND PLAN VIEW OF THE ASSEMBLY
2. LAYOUT PLAN
3. TOP VIEW
4. SINGLE LINE DIAGRAMS
5. SCHEMATIC DIAGRAM
6. NAMEPLATE SCHEDULE
7. COMPONENT LIST
8. CONDUIT SPACE LOCATIONS WITHIN THE ASSEMBLY
9. ASSEMBLY RATINGS INCLUDING:
a. SHORT-CIRCUIT RATING
b. VOLTAGE
c. CONTINUOUS CURRENT RATING
10. MAJOR COMPONENT RATINGS INCLUDING:
a. VOLTAGE
b. CONTINUOUS CURRENT RATING
c. INTERRUPTING RATINGS
11. CABLE TERMINAL SIZES
12. PRODUCT DATA SHEETS

B. WHERE APPLICABLE, THE FOLLOWING ADDITIONAL INFORMATION SHALL BE SUBMITTED TO THE ENGINEER:

- 1. BUSWAY CONNECTION
2. CONNECTION DETAILS, COMPOSITE FRONT VIEW, AND PLAN VIEW OF CLOSE-COUPLED ASSEMBLIES
3. KEY INTERLOCK SCHEME DRAWING AND SEQUENCE OF OPERATIONS
4. AUTOMATIC TRANSFER SCHEME SEQUENCE OF OPERATION
5. MIMIC BUS SIZE AND COLOR

1.04 SUBMITTALS - FOR CONSTRUCTION

A. THE FOLLOWING INFORMATION SHALL BE SUBMITTED FOR RECORD PURPOSES:

- 1. FINAL AS-BUILT DRAWINGS AND INFORMATION FOR ITEMS LISTED IN PARAGRAPH 1.03, AND SHALL INCORPORATE ALL CHANGES MADE DURING THE MANUFACTURING PROCESS
2. WIRING DIAGRAMS
3. CERTIFIED PRODUCTION TEST REPORTS
4. INSTALLATION INFORMATION
5. SEISMIC CERTIFICATION WITH EQUIPMENT ANCHORAGE DETAILS AND CENTER OF GRAVITY AS SPECIFIED
6. COORDINATION DRAWINGS IF REQUIRED: FLOOR PLANS, DRAWN TO SCALE, SHOWING DIMENSIONED LAYOUT ON WHICH THE FOLLOWING ITEMS ARE SHOWN AND COORDINATED WITH EACH OTHER, USING INPUT FROM INSTALLERS OF THE ITEMS INVOLVED:
a. REQUIRED WORKING CLEARANCES AND REQUIRED AREA ABOVE AND AROUND SWITCHBOARD.
b. SHOW SWITCHBOARD LAYOUT AND RELATIONSHIPS BETWEEN ELECTRICAL COMPONENTS AND ADJACENT STRUCTURAL AND MECHANICAL ELEMENTS.

1.05 QUALIFICATIONS

A. THE MANUFACTURER OF THE ASSEMBLY SHALL BE THE MANUFACTURER OF THE MAJOR COMPONENTS WITHIN THE ASSEMBLY.

B. FOR THE EQUIPMENT SPECIFIED HEREIN, THE MANUFACTURER SHALL BE ISO 9001 OR 9002 CERTIFIED.

C. THE SWITCHBOARD MANUFACTURER SHALL HAVE THE ENVIRONMENT CERTIFICATION ISO 14001.

D. THE MANUFACTURER OF THIS EQUIPMENT SHALL HAVE PRODUCED SIMILAR ELECTRICAL EQUIPMENT FOR A MINIMUM PERIOD OF TWENTY (20) YEARS, WHEN REQUESTED BY THE ENGINEER, AN ACCEPTABLE LIST OF INSTALLATIONS WITH SIMILAR EQUIPMENT SHALL BE PROVIDED DEMONSTRATING COMPLIANCE WITH THIS REQUIREMENT.

E. WHERE NOTED IN THE CONTRACT DOCUMENTS PROVIDE SEISMIC QUALIFIED EQUIPMENT.

1.06 REGULATORY REQUIREMENTS

A. THE LOW-VOLTAGE SWITCHBOARD SHALL BE UL LABELED.

1.07 DELIVERY, STORAGE AND HANDLING

A. EQUIPMENT SHALL BE HANDLED AND STORED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. ONE (1) COPY OF THESE INSTRUCTIONS SHALL BE INCLUDED WITH THE EQUIPMENT AT TIME OF SHIPMENT.

1.08 OPERATION AND MAINTENANCE MANUALS

A. EQUIPMENT OPERATION AND MAINTENANCE MANUALS SHALL BE PROVIDED WITH EACH ASSEMBLY SHIPPED AND SHALL INCLUDE INSTRUCTION LEAFLETS, INSTRUCTION BULLETINS AND RENEWAL PARTS LISTS WHERE APPLICABLE, FOR THE COMPLETE ASSEMBLY AND EACH MAJOR COMPONENT.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. EATON
B. SCHNEIDER ELECTRIC
C. SIEMENS

THE LISTING OF SPECIFIC MANUFACTURERS ABOVE DOES NOT IMPLY ACCEPTANCE OF THEIR PRODUCTS THAT DO NOT MEET THE SPECIFIED RATINGS, FEATURES AND FUNCTIONS. MANUFACTURERS LISTED ABOVE ARE NOT RELIEVED FROM MEETING THESE SPECIFICATIONS IN THEIR ENTIRETY. PRODUCTS IN COMPLIANCE WITH THE SPECIFICATION AND MANUFACTURED BY OTHERS NOT NAMED WILL BE CONSIDERED ONLY IF PRE-APPROVED BY THE ENGINEER TEN (10) DAYS PRIOR TO BID DATE.

THE SWITCHBOARD SHALL BE EQUAL TO EATON TYPE POW-R-LINE XPRT UTILIZING THE COMPONENTS HEREIN SPECIFIED AND AS SHOWN ON THE DRAWINGS.

2.02 RATINGS

A. THE ASSEMBLY SHALL BE RATED TO WITHSTAND MECHANICAL FORCES EXERTED DURING SHORT-CIRCUIT CONDITIONS WHEN CONNECTED DIRECTLY TO A POWER SOURCE HAVING AVAILABLE FAULT CURRENT OF 65,000 AMPERES SYMMETRICAL AT RATED VOLTAGE OR AS SHOWN ON THE CONTRACT DOCUMENTS.

B. BUS VOLTAGE AND CURRENT RATING TO BE AS INDICATED ON THE CONTRACT DOCUMENTS.

2.03 CONSTRUCTION

A. SWITCHBOARD SHALL CONSIST OF THE REQUIRED NUMBER OF VERTICAL SECTIONS BOLTED TOGETHER TO FORM A RIGID ASSEMBLY. THE SIDES AND REAR SHALL BE COVERED WITH REMOVABLE BOLT-ON COVERS. ALL EDGES OF FRONT COVERS OR HINGED FRONT PANELS SHALL BE FORMED, PROVIDE ADEQUATE VENTILATION WITHIN THE ENCLOSURE.

B. ALL SECTIONS OF THE SWITCHBOARD SHALL BE FRONT AND REAR ALIGNED WITH DEPTH(S) SHOWN ON THE DRAWINGS.

C. THE ASSEMBLY SHALL BE PROVIDED WITH ADEQUATE LIFTING MEANS.

D. THE SWITCHBOARD SHALL BE SUITABLE FOR USE AS SERVICE ENTRANCE EQUIPMENT WHERE INDICATED ON CONTRACT DOCUMENTS AND BE LABELED IN ACCORDANCE WITH UL REQUIREMENTS.

2.04 BUS

A. ALL BUS BARS SHALL BE TIN-PLATED COPPER, MAIN HORIZONTAL BUS BARS SHALL BE MOUNTED WITH ALL THREE PHASES ARRANGED IN THE SAME VERTICAL PLANE. BUS SIZING SHALL BE BASED ON NEMA STANDARD TEMPERATURE RISE CRITERIA.

B. PROVIDE A FULL CAPACITY NEUTRAL BUS WHERE A NEUTRAL BUS IS INDICATED ON THE DRAWINGS.

C. A 1/4 X 2-INCH COPPER GROUND BUS (MINIMUM) SHALL BE FURNISHED FIRMLY SECURED TO EACH VERTICAL SECTION STRUCTURE AND SHALL EXTEND THE ENTIRE LENGTH OF THE SWITCHBOARD.

D. ALL HARDWARE USED ON CONDUCTORS SHALL BE HIGH-TENSILE STRENGTH AND ZINC-PLATED. ALL BUS JOINTS SHALL BE PROVIDED WITH CONICAL SPRING-TYPE WASHERS.

E. ALL BUSSING SHALL BE FULLY-RATED FOR THE ENTIRE LENGTH OF THE SWITCHBOARD LINEUP. TAPERED BUS IS NOT ACCEPTABLE.

2.05 WIRING/TERMINATIONS

A. SMALL WIRING, NECESSARY FUSE BLOCKS AND TERMINAL BLOCKS WITHIN THE SWITCHBOARD SHALL BE FURNISHED AS REQUIRED. CONTROL COMPONENTS MOUNTED WITHIN THE ASSEMBLY, SUCH AS FUSE BLOCKS, RELAYS, PUSHBUTTONS, SWITCHES, ETC., SHALL BE SUITABLY MARKED FOR IDENTIFICATION CORRESPONDING TO APPROPRIATE DESIGNATIONS ON MANUFACTURER'S WIRING DIAGRAMS.

B. MECHANICAL-TYPE TERMINALS SHALL BE PROVIDED FOR ALL LINE AND LOAD TERMINATIONS. TERMINALS SHALL BE SUITABLE FOR COPPER OR ALUMINUM CONDUCTORS RATED PER 75 DEGREES C FOR THE SIZE AS SHOWN ON THE DRAWINGS. 90 DEGREES C CONDUCTOR IS PERMISSIBLE BUT MUST BE SIZED IN ACCORDANCE WITH 75 DEGREES C RATED CONDUCTOR TABLES.

C. LUGS SHALL BE PROVIDED IN THE INCOMING LINE SECTION FOR CONNECTION OF THE MAIN GROUNDING CONDUCTOR. ADDITIONAL LUGS FOR CONNECTION OF OTHER GROUNDING CONDUCTORS SHALL BE PROVIDED AS INDICATED ON THE DRAWINGS.

D. ALL CONTROL WIRE SHALL BE TYPE SIS, BUNDLED AND SECURED WITH NYLON TIES. INSULATED LOCKING SPADE TERMINALS SHALL BE PROVIDED FOR ALL CONTROL CONNECTIONS, EXCEPT WHERE SADDLE TYPE TERMINALS ARE PROVIDED INTEGRAL TO A DEVICE. ALL CURRENT TRANSFORMER SECONDARY LEADS SHALL FIRST BE CONNECTED TO CONVENIENTLY ACCESSIBLE SHORT-CIRCUIT TERMINAL BLOCKS BEFORE CONNECTING TO ANY OTHER DEVICE. ALL GROUPS OF CONTROL WIRES LEAVING THE SWITCHBOARD SHALL BE PROVIDED WITH TERMINAL BLOCKS WITH SUITABLE NUMBERING STRIPS, PROVIDE WIRE MARKERS AT EACH END OF ALL CONTROL WIRING.

2.06 MAIN AND TIE PROTECTIVE DEVICES

A. INSULATED CASE MAIN AND TIE PROTECTIVE DEVICES

1. PROTECTIVE DEVICES SHALL BE FIXED MOUNTED OR DRAW-OUT INSULATED CASE LOW-VOLTAGE CIRCUIT BREAKERS. POWER DEFENSE RF OR APPROVED EQUAL. ALL BREAKERS SHALL BE UL LISTED FOR CONTINUOUS APPLICATION IN THEIR INTENDED ENCLOSURES FOR 100% OF THEIR CONTINUOUS AMPERE RATING.

2. MAIN AND TIE BREAKERS SHALL BE TRUE TWO-STEP STORED ENERGY DEVICES AND SHALL BE ELECTRONICALLY OPERATED UNLESS OTHERWISE INDICATED ON CONTRACT DOCUMENTS.

3. ALL MAIN AND TIE CIRCUIT BREAKERS SHALL HAVE A MINIMUM SYMMETRICAL INTERRUPTING CAPACITY OF 65,000 AMPERES. MAIN AND TIE CIRCUIT BREAKERS SHALL HAVE 3 CYCLE SHORT-TIME WITHSTAND RATINGS.

4. ALL MAIN AND TIE INSULATED CASE CIRCUIT BREAKERS SHALL BE UL489 LISTED.

5. ALL INSULATED CASE CIRCUIT BREAKERS SHALL HAVE A NAMEPLATE CLEARLY MARKING ANY ELECTRICAL ACCESSORIES THAT ARE MOUNTED IN THE BREAKER AT THE TIME OF SALE. THE ACCESSORY SHALL HAVE A LABEL THAT WILL INDICATE ITS FUNCTION AND VOLTAGE. ALL ACCESSORIES SHALL BE MODULAR, PLUG AND LOCK TYPE, AND UL LISTED FOR EASY FIELD INSTALLATION.

6. THE BREAKER CONTROL INTERFACE SHALL HAVE COLOR-CODED VISUAL INDICATORS TO INDICATE CONTACT OPEN OR CLOSED POSITIONS AS WELL AS MECHANISM CHARGED AND DISCHARGED POSITIONS. MANUAL CONTROL PUSHBUTTONS ON THE BREAKER FACE SHALL BE PROVIDED FOR OPENING AND CLOSING THE BREAKER. THE POWER CIRCUIT BREAKER SHALL HAVE A 'POSITIVE ON' FEATURE. THE BREAKER FLAG WILL READ 'CLOSED' IF THE CONTACTS ARE WELDED AND THE BREAKER IS ATTEMPTED TO BE TRIPPED OR OPENED.

7. EACH INSULATED CASE CIRCUIT BREAKER SHALL BE EQUIPPED WITH A TRUE RMS SENSING, SOLID-STATE TRIPPING SYSTEM CONSISTING OF AT LEAST THREE CURRENT SENSORS MICROPROCESSOR-BASED TRIP DEVICE AND TRIP ACTUATOR. THE TRIP UNIT SHALL USE MICROPROCESSOR-BASED TECHNOLOGY TO PROVIDE THE BASIC ADJUSTABLE TIME-CURRENT PROTECTION.

8. PROVIDE TRIP UNITS WITH INTEGRAL ARC FLASH REDUCTION MODE (ARMS) FOR 1200A FRAME AND ABOVE WITH NEC ARTICLE 240.87. THE USE OF ZSI TO SATISFY NEC 240.87 DOES NOT MEET THE INTENT OF THESE SPECIFICATIONS AND WILL NOT BE ACCEPTABLE AS A SUBSTITUTION.

9. SYSTEM COORDINATION SHALL BE PROVIDED BY ADJUSTING ROTARY SWITCHES FOR THE FOLLOWING MICROPROCESSOR-BASED TIME-CURRENT CURVE SHAPING ADJUSTMENTS:

- a. ADJUSTABLE LONG-DELAY PICK-UP SETTING WITH MINIMUM OF 10 SETTINGS
b. ADJUSTABLE LONG-DELAY TIME - 0.5 TO 24 SECONDS
c. ADJUSTABLE SHORT-DELAY PICK-UP SETTING - 1.5X TO MAX ALLOWABLE BY FRAME
d. ADJUSTABLE SHORT-DELAY TIME 0.0 SEC UP TO 0.5 SEC DEPENDING ON FRAME WITH SELECTABLE FLAT OR IZT CURVE SHAPING
e. ADJUSTABLE INSTANTANEOUS SETTING 2X TO MAX ALLOWABLE BY FRAME

f. WHERE INDICATED, ADJUSTABLE GROUND FAULT CURRENT PICKUP (0.2 - 1.0 X IN IN 0.10X INCREMENTS) AND TIME (0.1 - 1.0 SEC IN 0.10SEC INCREMENTS), WITH SELECTABLE FLAT OR FT CURVE SHAPING. PROVIDE SWITCH SELECTABLE OPTIONS FOR GF OFF, GF ALARM, OR GF TRIP.

2.07 FEEDER PROTECTIVE DEVICES

A. ALL FEEDER PROTECTIVE DEVICES SHALL BE EATON TYPE POWER DEFENSE OR APPROVED EQUAL MOLDED CASE CIRCUIT BREAKERS WITH INVERSE TIME TRIPPING CHARACTERISTICS.

B. CIRCUIT BREAKERS SHALL BE OPERATED BY A TOGGLE-TYPE HANDLE AND SHALL HAVE A QUICK-MAKE, QUICK-BREAK OVER-CENTER SWITCHING MECHANISM THAT IS MECHANICALLY TRIP-FREE. AUTOMATIC TRIPPING OF THE BREAKER SHALL BE CLEARLY INDICATED BY THE HANDLE POSITION. CONTACTS SHALL BE NON-WELDING SILVER ALLOY AND ARC EXTINCTION SHALL BE ACCOMPLISHED BY MEANS OF DE-ION ARC CHUTES. A PUSH-TO-TRIP BUTTON ON THE FRONT OF THE CIRCUIT BREAKER SHALL PROVIDE A LOCAL MANUAL MEANS TO EXERCISE THE TRIP MECHANISM.

C. CIRCUIT BREAKERS SHALL HAVE A MINIMUM SYMMETRICAL INTERRUPTING CAPACITY AS INDICATED ON THE CONTRACT DOCUMENTS.

D. CIRCUIT BREAKERS TO BE EITHER DRAW-OUT OR FIXED MOUNTED, AS INDICATED ON CONTRACT DOCUMENTS

E. CIRCUIT BREAKERS SHALL HAVE MICROPROCESSOR-BASED RMS SENSING TRIP UNITS AS SPECIFIED BELOW:

- 1. ALL MOLDED CASE CIRCUIT BREAKERS SHALL BE EQUIPPED WITH A TRUE RMS SENSING, SOLID-STATE TRIPPING SYSTEM CONSISTING OF AT LEAST THREE CURRENT SENSORS MICROPROCESSOR-BASED TRIP DEVICE AND TRIP ACTUATOR. THE TRIP UNIT SHALL USE MICROPROCESSOR-BASED TECHNOLOGY TO PROVIDE THE BASIC ADJUSTABLE TIME-CURRENT PROTECTION.
2. PROVIDE TRIP UNITS WITH INTEGRAL ARC FLASH REDUCTION MODE FOR 1200A FRAME AND ABOVE. THE USE OF ZONE SELECTIVE INTERLOCKING TO EMULATE THIS FEATURE DOES NOT MEET THE INTENT OF THESE SPECIFICATIONS AND WILL NOT BE ALLOWED.
3. SYSTEM COORDINATION SHALL BE PROVIDED BY ADJUSTING ROTARY SWITCHES FOR THE FOLLOWING MICROPROCESSOR-BASED TIME-CURRENT CURVE SHAPING ADJUSTMENTS:
a. ADJUSTABLE LONG-DELAY PICK-UP SETTING WITH MINIMUM OF 10 SETTINGS
b. ADJUSTABLE LONG-DELAY TIME - 0.5 TO 24 SECONDS
c. ADJUSTABLE SHORT-DELAY PICK-UP SETTING - 1.5X TO MAX ALLOWABLE BY FRAME
d. ADJUSTABLE SHORT-DELAY TIME 0.0 SEC UP TO 0.5 SEC DEPENDING ON FRAME WITH SELECTABLE FLAT OR IZT CURVE SHAPING
e. ADJUSTABLE INSTANTANEOUS SETTING 2X TO MAX ALLOWABLE BY FRAME

f. WHERE INDICATED, ADJUSTABLE GROUND FAULT CURRENT PICKUP (0.2 - 1.0 X IN IN 0.10X INCREMENTS) AND TIME (0.1 - 1.0 SEC IN 0.10SEC INCREMENTS), WITH SELECTABLE FLAT OR FT CURVE SHAPING. PROVIDE SWITCH SELECTABLE OPTIONS FOR GF OFF, GF ALARM, OR GF TRIP.

4. WHERE INDICATED PROVIDE 100% RATED UL LISTED CIRCUIT BREAKERS.

5. TRIP UNITS SHALL BE CAPABLE OF METERING PHASE, NEUTRAL, AND GROUND CURRENT WITH AN ACCURACY OF +/- 2.0% OF THE READING.

6. TRIP UNITS SHALL HAVE AN INTEGRAL, HIGH RESOLUTION LIQUID-CRYSTAL DISPLAY (LCD) CAPABLE OF DISPLAYING THE TRIP UNIT PROGRAMMING, STATUS, AND MONITORING INFORMATION INCLUDING BAR GRAPH DISPLAY.

7. TRIP UNITS SHALL INCLUDE EMBEDDED MODBUS RTU COMMUNICATION CAPABILITY. BREAKER STATUS AND ALL MONITORED PARAMETERS SHALL BE AVAILABLE.

8. TRIP UNITS SHALL COLLECT AND STORE PERTINENT INFORMATION TO THE TRIP UNIT AND CIRCUIT BREAKER HEALTH AND EVENT HISTORY. THE TRIP UNIT SHALL ALSO INCLUDE DIAGNOSTIC FEATURES TO ALLOW THE USER TO INVESTIGATE EVENTS AND DYNAMICALLY MONITOR THE HEALTH OF THE TRIP UNIT AND THE BREAKER.

a. NUMBER OF OPERATIONS (LOAD AND NO-LOAD)

b. NUMBER OF TRIPS (OVERLOAD TRIPS, SHORT CIRCUIT TRIPS)

c. RUN TIME

d. BREAKER AMBIENT TEMPERATURE.

e. BREAKER REMAINING LIFE - THE TRIP UNIT SHALL UTILIZE AN ALGORITHM THAT APPLIES A WEIGHTED VALUE TO MONITORED INFORMATION TO DETERMINE THE REMAINING LIFE OF THE BREAKER. THE REMAINING LIFE OF THE BREAKER SHALL BE DISPLAYED OR COMMUNICATED IN CALCULATED PERCENTAGE OF LIFE REMAINING.

f. ALL BREAKER HEALTH INFORMATION SHALL BE ACCESSIBLE VIA MICRO-USB PORT ON FRONT OF TRIP UNIT AND VIA EMBEDDED COMMUNICATIONS

9. TRIP UNIT SHALL PERFORM A WAVEFORM CAPTURE ON TRIP, ALARM, OR USER-INITIATED EVENTS.

a. ANY BREAKER TRIP EVENT SHALL CAPTURE A 10-CYCLE WAVEFORM. THE TRIP UNIT SHALL STORE THE MOST RECENT TRIP EVENT WAVEFORM.

b. ANY ALARM EVENT OR USER-INITIATED WAVEFORMS SHALL CAPTURE A 1-CYCLE WAVEFORM.

c. WAVEFORM EVENTS SHALL CAPTURE AND STORE ALL PHASE, NEUTRAL AND GROUND CURRENTS.

2.08 ACCESSORIES

A. PROVIDE SHUNT TRIPS, BELL ALARMS AND AUXILIARY SWITCHES AS SHOWN ON THE CONTRACT DRAWINGS.

2.09 MISCELLANEOUS DEVICES

A. KEY INTERLOCKS SHALL BE PROVIDED AS INDICATED ON THE DRAWINGS.

B. CONTROL POWER TRANSFORMERS WITH PRIMARY AND SECONDARY PROTECTION SHALL BE PROVIDED, AS INDICATED ON THE DRAWINGS, OR AS REQUIRED FOR PROPER OPERATION OF THE EQUIPMENT.

C. FOR OUTDOOR (NEMA 3R) INSTALLATIONS, EACH SECTION OF THE SWITCHBOARD SHALL BE PROVIDED WITH A THERMOSTATICALLY CONTROLLED SPACE HEATER. POWER FOR THE SPACE HEATERS SHALL BE OBTAINED FROM A SOURCE AS INDICATED ON THE DRAWINGS.

2.10 SURGE PROTECTIVE DEVICE

A. SPD SHALL COMPLY WITH ANS/UL 1449 4TH EDITION OR LATER LISTING BY UNDERWRITERS LABORATORIES (UL).

B. SERVICE ENTRANCE LOCATED SPD'S SHALL BE TESTED AND DEMONSTRATE SUITABILITY FOR APPLICATION WITHIN ANS/IEEE C62.41 CATEGORY C ENVIRONMENTS.

C. THE SPD SHALL BE OF THE SAME MANUFACTURER AS THE SWITCHBOARD.

D. THE SPD SHALL BE FACTORY INSTALLED INTEGRAL TO THE SWITCHBOARD BY THE ORIGINAL EQUIPMENT MANUFACTURER.

E. LOCATE THE SPD ON THE LOAD SIDE OF THE MAIN DISCONNECT DEVICE, AS CLOSE AS POSSIBLE TO THE PHASE CONDUCTORS AND THE GROUND/NEUTRAL BAR.

F. THE SPD SHALL BE CONNECTED THROUGH A DISCONNECT (30A CIRCUIT BREAKER). THE DISCONNECT SHALL BE LOCATED WITHIN IMMEDIATE PROXIMITY TO THE SPD.

G. ALL MONITORING AND DIAGNOSTIC FEATURES SHALL BE VISIBLE FROM THE FRONT OF THE EQUIPMENT.

H. MAINTENANCE FREE DESIGN - THE SPD SHALL BE MAINTENANCE FREE AND SHALL NOT REQUIRE ANY USER INTERVENTION THROUGHOUT ITS LIFE. SPD'S CONTAINING ITEMS SUCH AS REPLACEABLE SINGLE-MODE MODULES, REPLACEABLE FUSES, OR REPLACEABLE BATTERIES SHALL NOT BE ACCEPTED. SPD'S REQUIRING ANY MAINTENANCE OF ANY SORT SUCH AS PERIODIC TIGHTENING OF CONNECTIONS SHALL NOT BE ACCEPTED. SPD'S REQUIRING USER INTERVENTION TO TEST THE UNIT VIA A DIAGNOSTIC TEST KIT OR SIMILAR DEVICE SHALL NOT BE ACCEPTED.

I. BALANCED SUPPRESSION PLATFORM - THE SURGE CURRENT SHALL BE EQUALLY DISTRIBUTED TO ALL MOV COMPONENTS TO ENSURE EQUAL STRESSING AND MAXIMUM PERFORMANCE. THE SURGE SUPPRESSION PLATFORM MUST PROVIDE EQUAL IMPEDANCE PATHS TO EACH MATCHED MOV. DESIGNS INCORPORATING REPLACEABLE SPD MODULES SHALL NOT BE ACCEPTED.

J. ELECTRICAL NOISE FILTER - EACH TYPE 2 UNIT SHALL INCLUDE A HIGH-PERFORMANCE EMI/RFI NOISE REJECTION FILTER. NOISE ATTENUATION FOR ELECTRIC LINE NOISE SHALL BE UP TO 50 DB FROM 10 KHZ TO 100 MHZ USING THE MIL-STD-220A INSERTION LOSS TEST METHOD. PRODUCTS UNABLE TO MEET THIS SPECIFICATION SHALL NOT BE ACCEPTED.

K. TYPE 2 UNITS WITH FILTERING SHALL CONFORM TO UL 1283 5TH EDITION

L. TYPE 1 UNITS SHALL NOT CONTAIN FILTERING OR HAVE A UL 1283 5TH EDITION LISTING.

M. INTERNAL CONNECTIONS - NO PLUG-IN COMPONENT MODULES OR PRINTED CIRCUIT BOARDS SHALL BE USED AS SURGE CURRENT CONDUCTORS. ALL INTERNAL COMPONENTS SHALL BE SOLDERED, HARDWIRED WITH CONNECTIONS UTILIZING LOW IMPEDANCE CONDUCTORS.

N. MONITORING DIAGNOSTICS - EACH SPD SHALL PROVIDE THE FOLLOWING INTEGRAL MONITORING OPTIONS:

1. PROTECTION STATUS INDICATORS - EACH UNIT SHALL HAVE A GREEN / RED SOLID-STATE INDICATOR LIGHT THAT REPORTS THE STATUS OF THE PROTECTION ON EACH PHASE.

2. FOR WYE CONFIGURED UNITS, THE INDICATOR LIGHTS MUST REPORT THE STATUS OF ALL PROTECTION ELEMENTS AND CIRCUITRY IN THE L-N AND L-G MODES. WYE CONFIGURED UNITS SHALL ALSO CONTAIN AN ADDITIONAL GREEN / RED SOLID-STATE INDICATOR LIGHT THAT REPORTS THE STATUS OF THE PROTECTION ELEMENTS AND CIRCUITRY IN THE N-G MODE. SPD'S THAT INDICATE ONLY THE STATUS OF THE L-N AND L-G MODES SHALL NOT BE ACCEPTED.

3. FOR DELTA CONFIGURED UNITS, THE INDICATOR LIGHTS MUST REPORT THE STATUS OF ALL PROTECTION ELEMENTS AND CIRCUITRY IN THE L-G AND L-L MODES

4. THE ABSENCE OF A GREEN LIGHT AND THE PRESENCE OF A RED LIGHT SHALL INDICATE THAT DAMAGE HAS OCCURRED ON THE RESPECTIVE PHASE OR MODE. ALL PROTECTION STATUS INDICATORS MUST INDICATE THE ACTUAL STATUS OF THE PROTECTION ON EACH PHASE OR MODE. IF POWER IS REMOVED FROM ANY ONE PHASE, THE INDICATOR LIGHTS MUST CONTINUE TO INDICATE THE STATUS OF THE PROTECTION ON ALL OTHER PHASES AND PROTECTION MODES. DIAGNOSTICS PACKAGES THAT SIMPLY INDICATE WHETHER POWER IS PRESENT ON A PARTICULAR PHASE SHALL NOT BE ACCEPTED.

5. REMOTE STATUS MONITOR - THE SPD MUST INCLUDE FORM C DRY CONTACTS (ONE NO AND ONE NC) FOR REMOTE ANNUNCIATION OF ITS STATUS. BOTH THE NO AND NC CONTACTS SHALL CHANGE STATE UNDER ANY FAULT CONDITION.

6. AUDIBLE ALARM AND SILENCE BUTTON - THE SPD SHALL CONTAIN AN AUDIBLE ALARM THAT WILL BE ACTIVATED UNDER ANY FAULT CONDITION. THERE SHALL ALSO BE AN AUDIBLE ALARM SILENCE BUTTON USED TO SILENCE THE AUDIBLE ALARM AFTER IT HAS BEEN ACTIVATED.

O. ELECTRICAL REQUIREMENTS:

1. UNIT OPERATING VOLTAGE - REFER TO DRAWINGS FOR OPERATING VOLTAGE AND UNIT CONFIGURATION.

2. MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV) - THE MCOV SHALL NOT BE LESS THAN 115% OF THE NOMINAL SYSTEM OPERATING VOLTAGE.

3. THE SUPPRESSION SYSTEM SHALL INCORPORATE THERMALLY PROTECTED METAL-OXIDE VARISTORS (MOV'S) AS THE CORE SURGE SUPPRESSION COMPONENT FOR THE SERVICE ENTRANCE AND ALL OTHER DISTRIBUTION LEVELS. THE SYSTEM SHALL NOT UTILIZE SILICON AVALANCHE DIODES, SELENIUM CELLS, AIR GAPS, OR OTHER COMPONENTS THAT MAY CROWBAR THE SYSTEM VOLTAGE LEADING TO SYSTEM UPSHIFT OR CREATE ANY ENVIRONMENTAL HAZARDS. END OF LIFE MODE TO BE OPEN CIRCUIT. UNIT WITH END OF LIFE SHORT-CIRCUIT MODE ARE NOT ACCEPTABLE.

4. UNIT SHALL OPERATE WITHOUT THE NEED FOR AN EXTERNAL OVERCURRENT PROTECTION DEVICE (OCPD) AND BE LISTED BY UL AS SUCH. UNIT MUST NOT REQUIRE EXTERNAL OCPD OR REPLACEABLE INTERNAL OCPD FOR THE UL LISTING.

5. PROTECTION MODES - THE SPD MUST PROTECT ALL MODES OF THE ELECTRICAL SYSTEM BEING UTILIZED. THE REQUIRED PROTECTION MODES ARE INDICATED BY BULLETS IN THE FOLLOWING TABLE:

Table with 5 columns: CONFIGURATION, L-N, L-G, L-L, N-G. Rows include WYE, DELTA, SINGLE SPLIT PHASE, HIGH LEG DELTA.

6. NOMINAL DISCHARGE CURRENT (In) - ALL SPD'S APPLIED TO THE DISTRIBUTION SYSTEM SHALL HAVE A 20KA In RATING REGARDLESS OF THEIR SPD TYPE (INCLUDES TYPES 1 AND 2) OR OPERATING VOLTAGE. SPD'S HAVING AN In LESS THAN 20KA SHALL BE REJECTED.

7. ANS/UL 1449 4TH EDITION VOLTAGE PROTECTION RATING (VPR) - THE MAXIMUM ANS/UL 1449 4TH EDITION VPR FOR THE DEVICE SHALL NOT EXCEED THE FOLLOWING:

Table with 4 columns: MODES, 208Y/120, 480Y/277, 600Y/347. Rows include L-N, L-G, N-G and L-L.

2.11 DATA AGGREGATION PROCESSOR

A. PROVIDE A PROCESSOR AND HMI THAT IS TO BE FACTORY-INSTALLED WITHIN THE SWITCHBOARD THAT GENERATES A USER INTERFACE FOR VISUALIZING AND INTERACTING WITH THE TRIP UNITS AND METERS.

B. THE DASHBOARD SOFTWARE SHALL RUN ON A DEDICATED PROCESSOR INSTALLED IN THE SWITCHBOARD OR PANELBOARD. THE PROCESSOR WILL CONTROL ACCESS TO THE ELECTRONIC DEVICES CONNECTED TO IT. THE PROCESSOR SHALL BE THE POWER XPRT DASHBOARD LITE PROCESSOR OR APPROVED EQUAL. THERE SHALL BE A POWER XPRT DASHBOARD LITE PROCESSOR DEDICATED FOR EACH SWITCHBOARD OR PANELBOARD. EACH PROCESSOR SHALL OFFER MONITORING AND CONTROL FOR THE ASSEMBLY TO WHICH IT IS INTERFACED.

C. THE HMI USED WITH THE DASHBOARD SHALL BE EQUIVALENT TO 7" EATON PXDB-HMI-07.

1. THE HMI SHALL SUPPORT INTUITIVE MULTI-TOUCH FUNCTIONALITY PERMITTING USER TO PINCH, ZOOM, SCROLL AND SWIPE.

D. THE HMI SHALL BE MOUNTED IN A CONTROL COMPARTMENT AT A CONVENIENT VIEWING HEIGHT.

E. THE HMI SHALL BE MOUNTED IN AN ENCLOSURE MOUNTED ON THE WALL AND WIRED BY THE CONTRACTOR. THE ENCLOSURE SHALL INCLUDE A DISCONNECT AND POWER SUPPLY TO POWER THE HMI. THE ENCLOSURE SHALL BE LOCATED NEAR THE EQUIPMENT BUT OUTSIDE THE ARC FLASH BOUNDARY.

F. THE HMI SHALL USE ETHERNET CAT6 AS PHYSICAL MEDIA TO COMMUNICATE WITH THE POWER XPRT DASHBOARD PROCESSOR LOCATED IN THE ASSEMBLY EITHER DIRECTLY OR VIA AN ETHERNET SWITCH.

G. SECURITY

1. LOCAL VIEWING OF THE DASHBOARD ON THE HMI SHALL NOT REQUIRE A LOGIN. ALL OTHER ACCESS WILL REQUIRE A USERNAME AND PASSWORD SUBJECT TO CONFIGURABLE PASSWORD RULES.

2. THE DASHBOARD SHALL SUPPORT MULTIPLE SECURITY LEVELS THAT CAN BE ASSIGNED AS RULES TO SIMPLY CREATING USER ACCOUNTS. ROLE-BASED ACCESS CONTROL (RBAC) SHALL BE USED TO CREATE THE SET OF USERS AND ROLE-BASED PERMISSIONS. A COMPREHENSIVE SET OF PASSWORD MANAGEMENT FEATURES SHALL BE AVAILABLE TO ALLOW COMPLIANCE WITH SECURITY POLICIES IN EFFECT AT THE SITE.

3. CONTROL ACCESS POINTS SHALL BE STRICTLY CONTROLLED THROUGH PAIRING OF THE HMI, WITH THE PROCESSOR. ADDITIONAL SECURITY SHALL BE PROVIDED BY LIMITING ACCESS TO THE COMMUNICATION PORTS BY AUTHORIZED TRUSTED HOSTS' IP ADDRESSES

4. SSL ENCRYPTION SHALL BE AVAILABLE TO ENSURE THAT INFORMATION AND PASSWORDS EXCHANGED WITH THE DASHBOARD CANNOT BE INTERCEPTED ON THE LAN

5. THE DASHBOARD PROCESSOR SHALL BE CERTIFIED TO THE UL 2900-2-2 CYBERSECURITY STANDARD.

H. REMOTE ACCESS TO VIEW INFORMATION ON THE POWER XPRT DASHBOARD PROCESSOR SHALL BE AVAILABLE THROUGH A WEB INTERFACE. THE WEB INTERFACE SHALL BE ACCESSIBLE ON PERSONAL COMPUTERS, TABLETS OR PHONES.

I. USING THE ONBOARD SMTP SUPPORT, A USER SHALL HAVE THE ABILITY TO CUSTOMIZE AND DIRECT EMAIL TO NOTIFICATIONS UP TO 10 USERS IN THEIR ORGANIZATION. THESE SHALL BE SELECTABLE FROM ALARM NOTIFICATIONS, WAVEFORM NOTIFICATIONS, TREND LOG, ALARM LOG, AND DAILY EMAILS.

J. THE POWER XPRT DASHBOARD PROCESSOR SHALL SUPPORT THE FOLLOWING NETWORK PROTOCOLS FOR CONNECTION TO DCS, BMS OR SCADA SYSTEMS:

- 1. MODBUS TCP/IP: SUPPORTS DATA ACCESS FROM MODBUS TCP CLIENTS
2. BACNET/IP: SUPPORTS DATA ACCESS FROM BACNET CLIENTS

K. ARC FLASH

1. THE DASHBOARD SHALL DISPLAY ARC FLASH REDUCTION MAINTENANCE SYSTEM STATUS FROM THE BREAKER TRIP UNITS.

L. THE DASHBOARD SHALL HAVE FOLLOWING TABS:

- 1. DEVICES
2. ENERGY
3. TIMELINE
4. SETTINGS

M. TAPPING EACH DEVICE SHALL OPEN A NEW WINDOW ON THE HMI SCREEN SHOWING THE DETAILS AS FOLLOWS:

1. TRIP UNITS: MAINTENANCE MODE STATUS, TOTAL TRIP, LAST TRIP, DEVICE ALARM CONDITIONS, METERING TRENDS IF SUPPORTED BY THE DEVICE, SEQUENCE OF EVENTS AND CAUSE OF TRIP.

2. METERS: BASIC METERING INFORMATION INCLUDING BUT NOT LIMITED TO CURRENTS, VOLTAGES, FREQUENCY, POWER FACTOR, POWER, ENERGY, THD, HARMONICS, TRENDS, WAVEFORMS, ALARMS AND I/O STATUS.

N. UNDER THE TIMELINE TAB, TIME STAMPED ALARM OR FAULT CONDITIONS AS WELL AS USER OPERATIONS AND LOGIN INFORMATION SHALL BE DISPLAYED IDENTIFYING USER NAMES.

O. UNDER THE SETTINGS TAB WITH THE APPROPRIATE PASSWORD LEVEL, USERS WILL BE ABLE TO:

- 1. UPDATE SYSTEMS SETTINGS LIKE COLORS, DATE AND TIME AND SCREEN DEFAULTS
2. ADD AND MODIFY DEVICES
3. CONFIGURE ALARMS
4. MODIFY NETWORK SETTINGS
5. CONFIGURE USER ACCOUNTS AND PASSWORDS

P. ADDITIONAL PRODUCT FEATURES SHALL BE ABLE TO BE ADDED THROUGH FUTURE APPS THAT CAN DOWNLOADED AND INSTALLED ON THE POWER XPRT DASHBOARD LITE PROCESSOR.

Q. ARMS MODE OF ALL CONNECTED ARMS-CAPABLE CIRCUIT BREAKERS SHALL BE ENABLED AND DISABLED FROM THE DASHBOARD

R. DASHBOARD SHALL ALLOW THE OWNER TO READ AND MODIFY CIRCUIT BREAKER TRIP UNIT SETTINGS REMOTELY, AS WELL AS STORE AND LOAD SETPOINT FILES CREATED OFFLINE. THIS FUNCTIONALITY SHALL BE BOTH AVAILABLE BOTH AT THE DASHBOARD HMI AND OVER THE LOCAL AREA NETWORK VIA PASSWORD-PROTECTED WEB