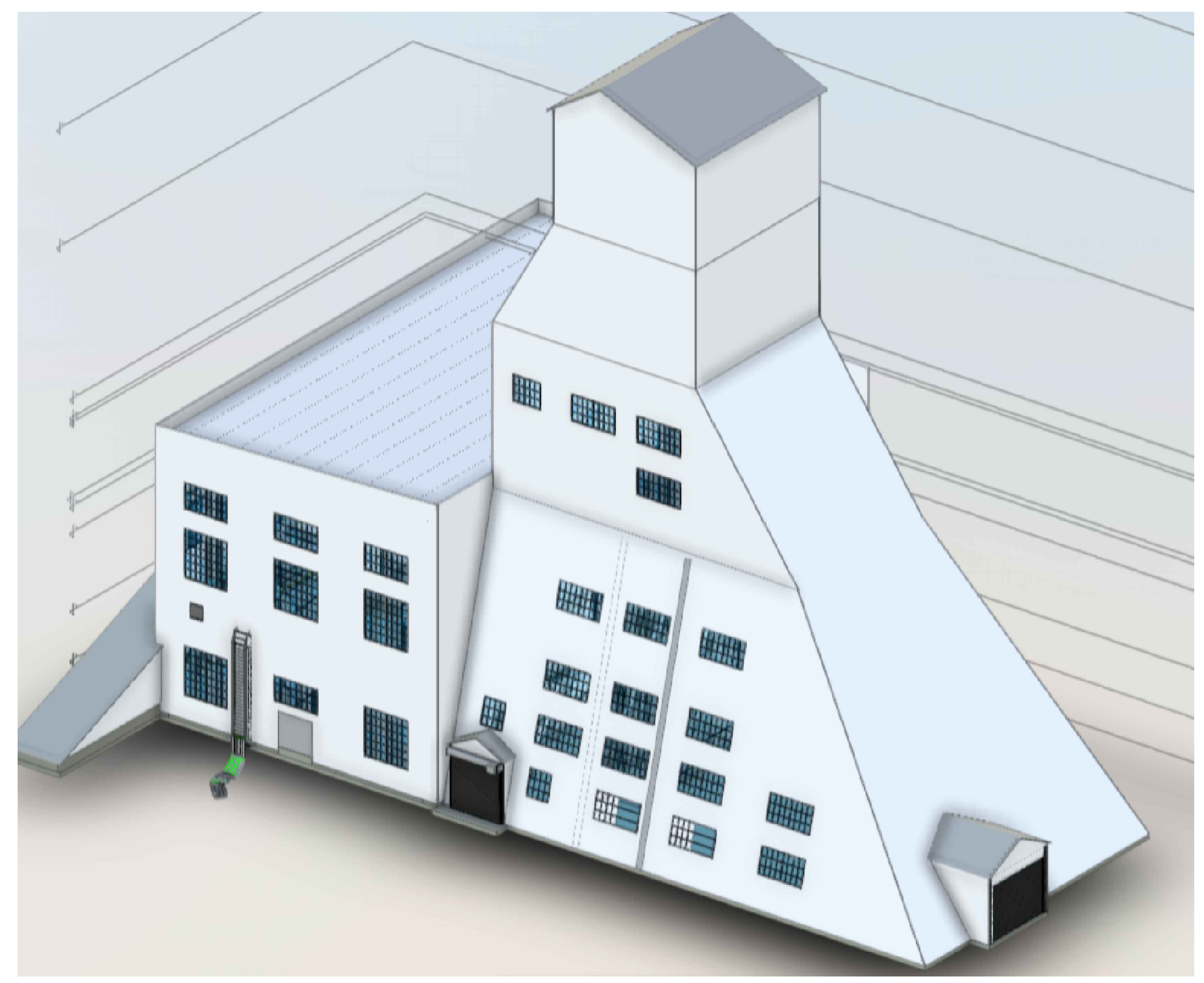
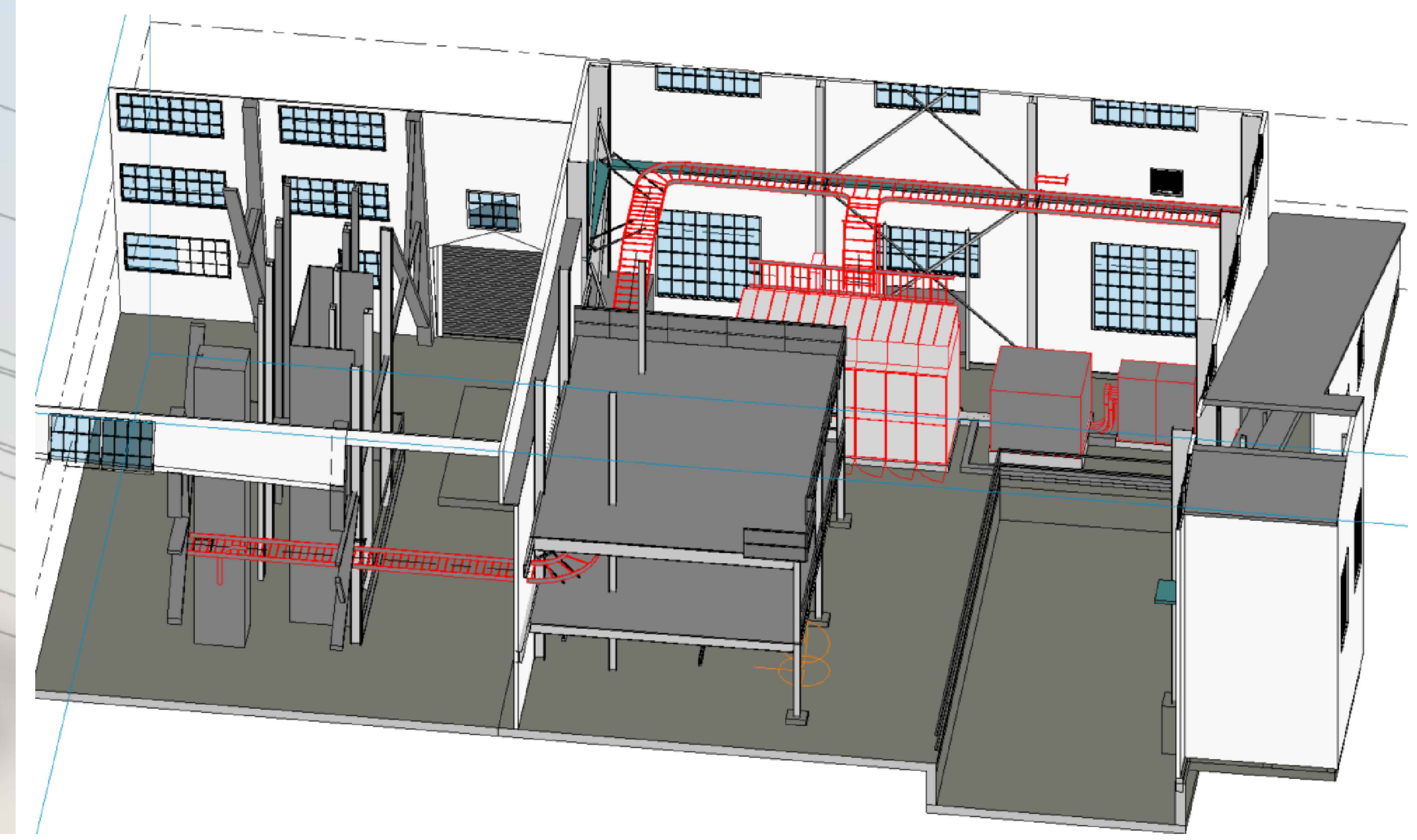
| DRAWING INDEX | | |
|---|---|---|
| SR.NO. | DRAWING NUMBER | DRAWING TITLE |
| 1 | 24768-E-000 | DRAWING INDEX |
| 2 | 24768-E-001 | LEGENDS AND SYMBOLS |
| 3 | 24768-E-002 | ABBREVIATIONS AND GENERAL NOTES |
| 4 | 24768-E-003 | STANDARD DETAILS - I |
| 5 | 24768-E-004 | STANDARD DETAILS - II |
| 6 | 24768-E-005 | STANDARD DETAILS - III |
| 7 | 24768-E-011 | OVERALL SINGLE LINE DIAGRAM |
| 8 | 24768-E-012 | SINGLE LINE DIAGRAM 12.47kV SWGR EQ-YSS04-01 SHEET 1 OF 2 |
| 9 | 24768-E-013 | SINGLE LINE DIAGRAM 12.47kV SWGR EQ-YSS04-01 SHEET 2 OF 2 |
| 10 | 24768-E-014 | SWITCHBOARD EQ-YSS04-02 SCHEDULE |
| 11 | 24768-ED100 | GENERAL ARRANGEMENT ELECTRICAL DEMOLITION PLAN |
| 12 | 24768-ED101 | GENERAL ARRANGEMENT ELECTRICAL DEMOLITION PLAN WWTP AREA |
| 13 | 24768-E-100 | GENERAL ARRANGEMENT ELECTRICAL SITE PLAN |
| 14 | 24768-E-101 | GENERAL ARRANGEMENT ELECTRICAL SITE PLAN WWTP AREA |
| 15 | 24768-E-102 | GENERAL ARRANGEMENT EAST SWITCHYARD AND FOUNDRY BUILDING AREA ELECTRICAL PLAN |
| 16 | 24768-E-103 | GENERAL ARRANGEMENT HEADFRAME, E&O AND ADMIN BUILDING AREA ELECTRICAL PLAN |
| 17 | 24768-E-104 | GENERAL ARRANGEMENT HOIST BUILDING AREA ELECTRICAL PLAN |
| 18 | 24768-E-105 | GENERAL ARRANGEMENT HEADFRAME/CRUSHER BUILDING ELECTRICAL PLAN |
| 19 | 24768-E-106 | GENERAL ARRANGEMENT HEADFRAME/CRUSHER BUILDING SECTIONS |
| 20 | 24768-E-107 | GENERAL ARRANGEMENT EXISTING DUCT BANK DETAIL |
| 21 | 24768-E-108 | GENERAL ARRANGEMENT FOUNDRY BUILDING AND WWTP TRANSFORMER DETAIL |
| 22 | 24768-E-500 | CONTROL SCHEMATIC MV TRANSFORMER FEEDER BREAKER TYPICAL - SHEET 1 OF 2 |
| 23 | 24768-E-501 | CONTROL SCHEMATIC MV TRANSFORMER FEEDER BREAKER TYPICAL - SHEET 2 OF 2 |
| 24 | 24768-E-502 | CONTROL SCHEMATIC MV VFD NO DISCONNECT FDR BREAKER TYPICAL - SHEET 1 OF 2 |
| 25 | 24768-E-503 | CONTROL SCHEMATIC MV VFD NO DISCONNECT FDR BREAKER TYPICAL - SHEET 2 OF 2 |
| 26 | 24768-E-504 | CONTROL SCHEMATIC MV VFD W/DISCONNECT FDR BREAKER TYPICAL - SHEET 1 OF 2 |
| 27 | 24768-E-505 | CONTROL SCHEMATIC MV VFD W/DISCONNECT FDR BREAKER TYPICAL - SHEET 2 OF 2 |
| 28 | 24768-E-506 | CONTROL SCHEMATICS MAIN BREAKER 2A SHEET 1 OF 3 |
| 29 | 24768-E-507 | CONTROL SCHEMATICS MAIN BREAKER 2A SHEET 2 OF 3 |
| 30 | 24768-E-508 | CONTROL SCHEMATICS MAIN BREAKER 2A SHEET 3 OF 3 |

OVERALL SITE





HEADFRAME/CRUSHER BUILDING

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH
KRPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec


3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com




Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-000.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
DRAWING INDEX

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-000
Revision 1

## SINGLE LINE DIAGRAM SYMBOLOGY

52 MEDIUM VOLTAGE DRAWOUT BREAKER

LOC 20 100 THERMAL MAGNETIC CIRCUIT BREAKER
X = LOCATION
TRIP (AMPS)
FRAME (AMPS)

LOC 7 MCP MCP CIRCUIT BREAKER
X = LOCATION
CONTINUOUS AMPS
TRIP SETTING BASED ON MOTOR HORSEPOWER

400 800 LOW VOLTAGE DRAWOUT CIRCUIT BREAKER
(L-S-I-G)
L LONG TIME
S SHORT TIME
I INSTANTANEOUS
G GROUND FAULT

X 40 MCP COMBINATION NEMA RATED STARTER WITH MCP DISCONNECT AND CONTROL POWER TRANSFORMER
ROMAN NUMERAL = NEMA SIZE
X = LOCATION
* = STARTER TYPE
(BLANK) FULL VOLTAGE NON-REVERSING
FVR FULL VOLTAGE REVERSING
2S2W TWO SPEED TWO WINDING
2S1W TWO SPEED ONE WINDING

X VFD VARIABLE FREQUENCY DRIVE
X = AMPERE RATING

X RVSS REDUCED VOLTAGE SOLID STATE STARTER
X = AMPERE RATING

X Y PACKAGED EQUIPMENT
X = EQUIPMENT SIZE
Y = TYPE (KW, KVA, OR HP AS INDICATED)

K KEY INTERLOCK

GENERATOR
RATINGS AS INDICATED

TRANSFER SWITCH (MANUAL OR AUTOMATIC)
RATINGS AS INDICATED

AS AMMETER SWITCH

VS VOLTMETER SWITCH

X METERING DEVICE
X = METER TYPE
WHM WATT HOUR METER
WM WATT METER
AM AMMETER
VM VOLTMETER
PFM POWER FACTOR METER

480/120 (3) POTENTIAL TRANSFORMER
RATIO AND NUMBER OF PT'S AS INDICATED

100/5 (3) CURRENT TRANSFORMER
RATIO AND NUMBER OF CT'S AS INDICATED

GROUND FAULT CURRENT TRANSFORMER
RATIO AS INDICATED

5A FUSE
SIZE AS INDICATED

X MOTOR
X = HORSEPOWER
* = FULL LOAD AMPS

DELTA-WYE TRANSFORMER WITH SECONDARY KVA SIZE AND VOLTAGE RATIO AS INDICATED

X AMPS
Y SECONDS
51G DELTA-WYE TRANSFORMER WITH RESISTANCE GROUNDED SECONDARY AND GROUND FAULT RELAYING
X - GROUNDING RESISTOR AMPS
Y - GROUNDING RESISTOR SECONDS

FUSED CONTROL POWER TRANSFORMER

MOV ELECTRICAL MOTOR OPERATED VALVE, WITH INTEGRAL REVERSING STARTER

30A DISCONNECT SWITCH
SIZE AS INDICATED

30A 30A FUSED DISCONNECT SWITCH
SIZE AS INDICATED

CAPACITOR

SPD SURGE PROTECTIVE DEVICE

SSM SOLID STATE METERING DEVICE

SSMP SOLID STATE MOTOR PROTECTIVE DEVICE

LIGHTNING ARRESTOR AND SURGE CAPACITOR

* (#) ANSI RELAY DEVICE
(#) = QUANTITY
* = ANSI DEVICE

| | |
|---|---|
| 25 | SYNCHRONISM CHECK RELAY |
| 27 | UNDERVOLTAGE |
| 27/47 | UNDERVOLTAGE, PHASE SEQUENCE, UNBALANCED VOLTAGE |
| 32 | DIRECTIONAL POWER RELAY |
| 41 | FIELD CONTACTOR |
| 43 | SELECTOR SWITCH |
| 40 | LOSS OF FIELD |
| 46 | CURRANT UNBALANCE |
| 49 | HIGH OIL TEMPERATURE |
| 50G | GROUND INSTANTANEOUS OVER CURRENT |
| 50/51 | INSTANTANEOUS AND TIME OVERCURRENT |
| 50/51N | INSTANTANEOUS AND TIME RESIDUALLY CONNECTED GROUND OVERCURRENT |
| 51G | GROUND FAULT |
| 51U | VOLTAGE RESTRAINED |
| 59 | OVER VOLTAGE |
| 60 | VOLTAGE BALANCE |
| 62 | TIME DELAY |
| 63 | SUDDEN PRESSURE |
| 67 | AC DIRECTIONAL CURRENT RELAY |
| 71L | LOW OIL LEVEL |
| 81 | FREQUENCY RELAY |
| 83 | CONTROL POWER TRANSFORMER |
| 86 | LOCKOUT |
| 87 | DIFFERENTIAL PROTECTION |
| 87G | GENERATOR DIFFERENTIAL |
| 87M | MOTOR DIFFERENTIAL |
| 87N | GROUND DIFFERENTIAL |
| 87TL | TRANSFORMER DIFFERENTIAL |
| 81O/U | OVER AND UNDER FREQUENCY |
| 81O/U | OVER AND UNDER FREQUENCY |
| AFD | ARC FLASH DETECTION |

## SCHEMATIC DIAGRAM SYMBOLOGY

SINGLE POLE TOGGLE SWITCH

START NORMALLY OPEN PUSHBUTTON

STOP NORMALLY CLOSED PUSHBUTTON

X PILOT LIGHT
X = LENS COLOR
R RED
G GREEN
A AMBER
W WHITE

GROUND CONNECTION

CROSSING OF CONDUCTORS - NOT CONNECTED

CROSSING OF CONDUCTORS - CONNECTED

FO FIBER OPTIC

E ETHERNET

X CONTROL RELAY OR COIL
X = DEVICE
C - CLOSING COIL
CR - CONTROL RELAY
M - MOTOR STARTER
PC - PHOTOCELL
TC - TRIPPING COIL
TD - TIME DELAY RELAY (TIMING RANGE AS INDICATED)

NORMALLY OPEN CONTACT

NORMALLY CLOSED CONTACT

SHUNT TERMINAL BLOCK IN EQUIPMENT FOR VENDOR USE

SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

TERMINAL BLOCK IN EQUIPMENT FOR VENDOR CONNECTIONS

TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

## PLAN SYMBOLOGY

### GROUNDING SYMBOLOGY

GROUND ROD AND GROUND WELL

GROUND ROD (3/4" X 10'-0")

GROUND CONNECTION - BOLTED TYPE

GROUND CONNECTION - EXOTHERMIC TYPE

BARE COPPER GROUND TO GROUND WIRE IN SLAB, OR UNDERGROUND GROUND GRID, SIZE AS NOTED

EARTH GROUNDING

### CONDUIT AND RACEWAY SYMBOLOGY

EXPOSED OR CONCEALED CONDUIT

CONDUIT RUN (UNDERGROUND OR IN CONCRETE)

CONDUIT RUN (CHANGE IN ELEVATION)

CONDUIT TURNING UP

CONDUIT TURNING DOWN

CONDUITS GROUPED TOGETHER BUT SHOWN AS A SINGLE LINE FOR CLARITY

CONDUIT FROM FLOOR ABOVE TO FLOOR BELOW

CONDUIT CAPPED, OR SEALED

HOMERUN TO EQUIPMENT INDICATED (3/4 " CONDUIT, 3/C #10 W/NEC GND UNLESS INDICATED OTHERWISE)

X RACEWAY BOX
X = BOX TYPE
MH MANHOLE
HH HANDHOLE
PB PULLBOX

J JUNCTION BOX OR FITTING

X X FENCE LINE

G G GROUND CONDUCTOR IN DB

DUCT BANK/DIRECT BURIED CONDUIT

LIGHTNING PROTECTION GROUNDING CONDUCTOR

LIGHTNING PROTECTION AIR TERMINAL

### MISCELLANEOUS ELECTRICAL SYMBOLOGY

POWER PANEL

DISCONNECT SWITCH

M MOTOR

DEMOLITION

BLACK COLOR INDICATES NEW WORK

GREY COLOR INDICATES EXISTING WORK

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\GENERAL SHEETS\24768-E-001.DWG
12/12/2025 9:31 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH KIRPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-001.dwg

| Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|
| SPM | VIC | SAD | 25.11.07 |

Title
LEGENDS AND SYMBOLS

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-001
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 9:28:05 AM By: smohite

# ELECTRICAL ABBREVIATIONS

| | |
|---|---|
| A | AMPERE, AUTOMATIC |
| AC | ALTERNATING CURRENT |
| AF | CIRCUIT BREAKER FRAME SIZE |
| AFD | ARC FLASH DETECTION |
| AIP | ABANDONED IN PLACE |
| AM | AMMETER |
| ANN | ANNUNCIATOR |
| AS | ADJUSTABLE SPEED |
| AT | AMPERE TRIP |
| ATS | AUTOMATIC TRANSFER SWITCH |
| AUTO | AUTOMATIC |
| AWG | AMERICAN WIRE GAUGE |
| ANOX | ANOXIC BUILDING |
| ADMN | ADMINISTRATION BUILDING |
| BATT | BATTERY |
| BC | BARE COPPER, BLOCK CLOSE |
| BKR | BREAKER |
| C | CONDUIT, CLOSED |
| CAP | CAPACITOR |
| CB | CIRCUIT BREAKER |
| CKT | CIRCUIT |
| CLF | CURRENT LIMITING FUSE |
| COM | COMMON |
| COMM | COMMUNICATIONS |
| COMP | COMPARTMENT |
| CP | CONTROL PANEL |
| CPT | CONTROL POWER TRANSFORMER |
| CR | CONTROL RELAY, CARD READER |
| CT | CURRENT TRANSFORMER |
| CONT | CONTROL |
| DCS | DISTRIBUTED CONTROL SYSTEM |
| DISC | DISCONNECT |
| DISTR | DISTRIBUTION |
| DPDT | DOUBLE POLE DOUBLE THROW |
| DPST | DOUBLE POLE SINGLE THROW |
| DIA | DIAMETER |
| E | EMER. |
| EMT | ELECTRICAL METALLIC TUBING |
| EMH | ELECTRICAL MANHOLE |
| ENCL | ENCLOSURE |
| ETM | ELAPSED TIME METER |
| F | FREQUENCY, FUSE, FIXED |
| FDR | FEEDER |
| FLA | FULL LOAD AMPS |
| FLUOR | FLUORESCENT |
| FM | FREQUENCY METER |
| FO | FIBER OPTIC |
| FVR | FULL VOLTAGE REVERSING |
| FVNR | FULL VOLTAGE NON-REVERSING |
| FD | FEED |
| GEN | GENERATOR |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| GND | GROUND |
| H | HAND/HEIGHT |
| HD | HEAT DETECTOR/HEADWORKS BUILDING |
| HH | HAND HOLE |
| HID | HIGH INTENSITY DISCHARGE |
| HOA | HAND-OFF-AUTOMATIC |
| HPS | HIGH PRESSURE SODIUM |
| HS | HAND SWITCH |
| HZ | HERTZ |
| IMC | INTERMEDIATE METALLIC CONDUIT |
| INCAND | INCANDESCENT |
| IND | INDICATION |
| INST | INSTANTANEOUS |
| I/O | INPUT/OUTPUT |
| Isc | SHORT CIRCUIT CURRENT, AMPS |
| ISO | ISOLATION |
| J, JB | JUNCTION BOX |
| KA | KILO AMPERES |
| KAIC | KILO AMP INTERRUPTING CURRENT |
| KCMIL | KILO CIRCULAR MILS |
| KVA | KILOVOLT AMPERE |
| L | LOCAL/LENGTH |
| LCP | LOCAL CONTROL PANEL |
| LCS | LOCAL CONTROL STATION |
| LOC | LOCAL |
| LOR | LOCAL-OFF-REMOTE |
| LOS | LOCKOUT STOP PUSHBUTTON |
| LP | LIGHTING PANEL |
| LRA | LOCKED ROTOR AMPS |
| LS | LEVEL SWITCH |
| LTG | LIGHTING |
| LTS | LIGHTS |
| M | MOTOR CONTACTOR COIL |
| mA | MILLIAMPERE |
| MCP | MOTOR CIRCUIT PROTECTOR |
| MLO | MAIN LUGS ONLY |
| MOV | MOTOR OPERATED VALVE |
| MS | MANUAL MOTOR STARTER |
| MTS | MANUAL TRANSFER SWITCH |
| NEUT | NEUTRAL |
| NP | NAMEPLATE |
| O | OPEN, OFF |
| OL | OVERLOAD |
| PA | PUBLIC ADDRESS |
| PB | PUSHBUTTON, PULLBOX |
| PC | PHOTOCELL |
| PCM | PROCESS CONTROL MODULE |
| PF | POWER FACTOR |
| PFM | POWER FACTOR METER |
| PH | PHASE |
| PL | PILOT LIGHT |
| PNLBD | PANELBOARD |
| PP | POWER PANELBOARD |
| POS | POSITION |
| POT | POTENTIOMETER |
| PRI | PRIMARY |
| PT | POTENTIAL TRANSFORMER |
| PTZ | PAN-TILT-ZOOM |
| PWR | POWER |
| PQR | POWER QUALITY METER |
| R | REMOTE |
| RECPT | RECEPTACLE |
| RGS | RIGID GALVANIZED STEEL |
| RMS | ROOT MEAN SQUARE |
| RTU | REMOTE TERMINAL UNIT |
| RVSS | REDUCED VOLTAGE SOLID STATE |
| RTRC | REINFORCED THERMOSETTING RESIN CONDUIT |
| SEL SW | SELECTOR SWITCH |
| SEQ | SEQUENCE |
| SHLD | SHIELDED |
| SIG | SIGNAL |
| SP | SPARE |
| SP HTR | SPACE HEATER |
| SPDT | SINGLE POLE DOUBLE THROW |
| SPST | SINGLE POLE SINGLE THROW |
| SSM | SOLID STATE METER |
| SSMP | SOLID STATE MOTOR PROTECTOR |
| ST, SH | SHUNT TRIP |
| STR | STARTER |
| SSTU | SOLID STATE TRIP UNIT |
| SW | SWITCH |
| SWBD | SWITCHBOARD |
| SWGR | SWITCHGEAR |
| SCH | SCHEDULE |
| TACH | TACHOMETER |
| TB | TERMINAL BOX |
| TERM | TERMINAL |
| TM | REPEAT CYCLE TIMER |
| TD | TIME DELAY RELAY |
| TS | TEMPERATURE SWITCH, TEST SWITCH |
| TYP | TYPICAL |
| UNO | UNLESS NOTED OTHERWISE |
| UPS | UNINTERRUPTIBLE POWER SUPPLY |
| V | VOLTAGE, VOLTS |
| VA | VOLT AMPERE |
| VAR | VOLT AMPERE REACTIVE |
| VFD | VARIABLE FREQUENCY DRIVE |
| VM | VOLTMETER |
| VP | VAPOR PROOF |
| VCP | VENDOR CONTROL PANEL |
| W | WATTS, WIRE/WIDTH |
| WM | WATT METER |
| WP | WEATHERPROOF |
| XFMR | TRANSFORMER |
| XMTR | TRANSMITTER |
| XP | EXPLOSION PROOF |

# GENERAL ELECTRICAL NOTES

1. ALL RACEWAYS AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, INDUSTRY STANDARD PRACTICE AND MANUFACTURER'S INSTRUCTIONS.
2. THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION OF TERMINAL BOXES AND CONDUIT ENTRANCES OF ALL EQUIPMENT AGAINST APPROVED SHOP DRAWINGS BEFORE STUBBING UP CONDUITS.
3. REFER TO SPECIFICATION SECTION 26 05 33 FOR REQUIREMENTS RELATED TO FLEXIBLE CONDUIT INSTALLATION.
4. CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT OR STRUCTURAL CONDITIONS. EXPOSED CONDUIT SHALL BE INSTALLED PARALLEL OR PERPENDICULAR TO BEAMS AND WALLS. REFER TO SPECIFICATION SECTION 26 05 33.
5. ANY DEVIATION TO THE DESIGN SHALL BE NOTIFIED TO THE SDSTA IN WRITING AND THE SDSTA SHALL APPROVE THE PROPOSED CHANGES BEFORE FIELD MODIFICATION.
6. IN THE EVENT OF INTERFERENCE BETWEEN ELECTRICAL EQUIPMENT SHOWN ON THE DRAWINGS AND OTHER EQUIPMENT, THE CONTRACTOR SHALL NOTIFY THE SDSTA IN WRITING AND THE SDSTA SHALL APPROVE PROPOSED CHANGES BEFORE THEY ARE MADE.
7. ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON THE INTERIOR OF EXTERIOR WALLS ABOVE GRADE OR IN OTHER LOCATIONS CONSIDERED DAMP OR WET SHALL BE MOUNTED SO AS TO MAINTAIN A 1/4 INCH (MINIMUM) AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
8. LOCATION OF PULLBOXES ARE APPROXIMATE. THE CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH MECHANICAL PIPING AND SHALL BE 12 INCHES (MINIMUM) AWAY FROM MECHANICAL PIPING FLOW LINES.
9. ONLY MAJOR PULLBOXES ARE SHOWN. THE CONTRACTOR SHALL PROVIDE ADDITIONAL PULLBOXES WHERE REQUIRED TO MAKE A WORKABLE INSTALLATION.
10. ALL CONDUIT RUNS CROSSING EXPANSION JOINTS SHALL HAVE EXPANSION OR EXPANSION AND DEFLECTION TYPE FITTINGS.
11. ALL PANELBOARDS SHALL BE MOUNTED SO THAT THE DISTANCE FROM THE CENTERLINE OF THE TOP CIRCUIT BREAKER OPERATING HANDLE IN THE UPPERMOST POSITION TO THE FINISHED FLOOR SHALL NOT EXCEED 6'-7".
12. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE SDSTA MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.
13. CONNECTIONS BETWEEN RIGID CONDUIT AND MOTOR TERMINAL BOXES OR SIMILAR EQUIPMENT SUBJECT TO VIBRATION SHALL BE FLEXIBLE LIQUID-TIGHT CONDUIT.
14. ALL FREE STANDING PANELS SHALL BE SET ON CONCRETE HOUSEKEEPING PADS WITH LEVELING CHANNELS EMBEDDED IN THE PAD.
15. CONCRETE MIX USED FOR ELECTRICAL EQUIPMENTS PAD AND FOR DUCT BANKS SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 4,500 PSI.
16. EXCAVATION FOR DUCT BANKS / DIRECT BURIED CONDUITS SHALL BE PER INDUSTRY PRACTICE FOR EXCAVATION AROUND UNDERGROUND ELECTRICAL UTILITY.
17. ALL CONDUIT CONNECTIONS TO ALL MOTORS, VIBRATING EQUIPMENT, BELT DRIVEN EQUIPMENT, PRESSURE AND LEVEL SWITCHES, THERMOCOUPLES, ETC., TO BE MADE WITH FLEXIBLE CONDUIT.

# CONDUIT DUCTBANK NOTES

1. DUCT BANKS SHALL MEET THE REQUIREMENT AS SPECIFIED IN NEC ARTICLE 300.5.
2. ALL DUCT BANKS CONNECTING TO VAULT SHALL SLOPE 3" PER 100 FEET TOWARDS THE VAULT.
3. CONTRACTOR TO BRING CONDUITS 8" ABOVE GRADE AND CAP USING RIGID GALVANIZED STEEL (RGS) CONDUIT. EXCEPT WHERE THERE IS CHEMICAL CONTAINMENT IN THOSE AREAS THE CONTRACTOR TO BRING CONDUIT 8" ABOVE THE CONTAINMENT WALLS/SURFACE AND CAP USING PVC COATED RIGID GALVANIZED STEEL (RGS) CONDUIT OR SCHEDULE 40 PVC.
4. CONDUITS IN DUCT BANK SHALL BE SCHEDULE 40 PVC.
5. CONTRACTOR TO APPLY SILICONE SEALANT TO CONDUIT BEFORE INSTALLING IT INTO VAULT CONDUIT SLEEVE (TYP. ALL CONDUITS ENTERING VAULT) OR PVC GLUE THAT PROVIDES WATER TIGHT ADHESION LIKE CARLON QUICK-SET CEMENT OR APPROVED EQUAL.
6. ALL DUCT BANKS SHALL BE A MINIMUM OF 24" BELOW GRADE. DUCT BANKS MAY BE DEEPER THAN 24".
7. A POLYPROPYLENE FILM, LAMINATED, ALUMINUM FOIL CORE, WARNING TAPE "CAUTION BURIED HIGH VOLTAGE LINE BELOW" SHALL BE INSTALLED.
8. FOR DUCT BANK USE OF HELIX CONCRETE MIX OR EQUIVALENT WITH MINIMUM COMPRESSIVE STRENGTH OF 4,500 PSI IS ACCEPTABLE.
9. EACH DUCT BANK SHALL HAVE A #4/0 GROUND CABLE ON TOP OF THE DUCT BANK. THIS CABLE SHALL TERMINATE AT THE VAULT GROUND ROD OR PLANT GROUND GRID.
10. ALL CONDUITS ARE SHOWN DIAGRAMMATICALLY, EXCEPT WHERE LOCATED BY DIMENSIONS, THE EXACT LOCATION SHALL BE DETERMINED BY THE CONTRACTOR. THE CONTRACTOR SHALL ALSO DETERMINE THE METHOD OF SUPPORT IN THE ABSENCE OF SPECIFICATIONS AND SDSTA'S INSTRUCTIONS. CONSTRUCTION SHALL PROVIDE ADDITIONAL PULL BOXES OR FITTINGS AS REQUIRED. CONDUIT RUNS BETWEEN BOXES OR PULL POINTS SHALL NOT CONTAIN MORE THAN 360° TOTAL BENDS.
11. ALL CONDUIT ENDS SHALL BE CLOSED DURING CONSTRUCTION. ENDS OF SPARE CONDUITS SHALL BE PLUGGED OR CAPPED.
12. ALL FIELD BENDS REQUIRED IN PVC CONDUIT SHALL BE UNIFORM LONG RADIUS SWEEPS, BENT ON A SUITABLE POWER BENDER OR WITH OTHER SUITABLE BENDING TOOLS. THE RADIUS OF ANY CONDUIT BENDS, MEASURED FROM THE CENTER OF THE BEND TO THE NEAREST EXTERNAL SURFACE OF THE CONDUIT SHALL, IF POSSIBLE, BE NOT LESS THAT THE BENDING RADIUS LISTED FOR THE PARTICULAR CONDUIT SIZE IN THE FOLLOWING TABLE:

BENDING RADIUS SCHEDULE - METALLIC OR PVC CONDUIT

| SIZE OF CONDUIT (NOMINAL DIA. INCHES) | MIN. BEND RADIUS (INCHES) |
|---|---|
| 2 | 24 |
| 4 | 36 |
| 5 | 48 |
| 6 | 60 |

# CABLE TRAY NOTES

1. ALL GROUNDING SHALL BE INSTALLED IN ACCORDANCE WITH ALL NATIONAL, STATE & LOCAL CODES.
2. THE GROUNDING SYSTEM IS SHOWN DIAGRAMMATICALLY. EXACT LOCATION OF CABLE AND CONNECTIONS SHALL BE DETERMINED BY THE CONTRACTOR UNLESS OTHERWISE NOTED.
3. CONDUCTORS SHALL BE #4/0 SOFT DRAWN, BARE STRANDED COPPER GROUND WIRES UNLESS OTHERWISE NOTED.
4. CONTRACTOR TO EXTEND GROUND CONDUCTOR TO EQUIPMENT FOUNDATION AND COIL AN ADDITIONAL 20'. CABLE TO BE PROTECTED FROM DAMAGE DURING CONSTRUCTION.
5. ALL ASSEMBLY HARDWARE, HANGERS ETC. SHALL BE B-LINE SERIES OR APPROVED EQUAL 2, 3, 4, AND 5 ALUMINUM.
6. MEDIUM/LOW VOLTAGE POWER, CONTROL AND INSTRUMENT TRAYS SHALL BE THE WIDTH AS SPECIFIED ON THE DRAWING WITH 6" SIDE RAILS. TRAY WIDTHS SHALL NOT DECREASED WITHOUT THE APPROVAL OF THE SDSTA.
7. CABLE TRAY SHALL BE SUPPORTED AT INTERVALS RECOMMENDED BY THE MANUFACTURER OR AS SPECIFIED IN THIS PROJECT'S SPECIFICATIONS.
8. ALL DIMENSIONS, ELEVATIONS AND ROUTING LOCATIONS SHOWN ON THE DRAWINGS REFLECT INTENDED DESIGN. INSTALLER SHALL VERIFY ALL DIMENSIONS, ELEVATIONS AND ROUTING LOCATIONS IN THE FIELD PRIOR TO INSTALLATION.
9. ALL ELEVATIONS SHOWN ARE TO BOTTOM OF TRAY.
10. INSTALLER SHALL COORDINATE CABLE TRAY INSTALLATIONS WITH OTHER TRADES TO AVOID CONFLICTS OF SPACE.
11. ALL CABLE EXITING CABLE TRAY SHALL BE FIELD RUN IN CONDUIT TO THEIR FINAL DESTINATION.
12. ALL CONDUIT INSTALLED OUTDOORS SHALL BE RGS.
13. ALL VERTICAL RUNS SHALL BE SUPPORTED EVERY 30 VERTICAL FEET WITH USE OF KELLEM GRIPS, PER APPLICABLE NEC STANDARDS.
14. CONTINUOUS GROUNDING OF THE CABLE TRAY SYSTEM SHALL BE MAINTAINED BY INSTALLING #4/0 BARE CONDUCTOR FOR ENTIRE LENGTH OF THE CABLE TRAY.
15. CABLE TRAY BLIND ENDS SHALL BE INSTALLED WHERE CABLE TRAY ENDS UNLESS OTHERWISE SHOWN ON THE DRAWINGS.
16. CABLE TRAY COVERS SHALL BE INSTALLED ON ALL HORIZONTAL, TOP MOST, TRAY INSTALLATIONS. ADDITIONALLY, VERTICAL TRAY SHALL BE COVERED TO AN ELEVATION OF 6'-0" WHERE ACCESSIBLE BY PERSONNEL.
17. CABLE TRAY LENGTHS PROVIDED REPRESENT TOTAL CALCULATED LENGTH OF STRAIGHT TRAY, AND DOES NOT ACCOUNT FOR THE NUMBER OF TRAY .
18. ALL CABLE TRAYS SUPPORTS SHALL INCORPORATE UNISTRUT AS A BEARING SURFACE FOR THE TRAY.
19. CABLE SHALL BE SECURED TO CABLE TRAYS USING UV RESISTANT BLACK NYLON TY-RAPS. ON HORIZONTAL RUNS, CABLES SHALL BE SECURED AT INTERVALS NOT TO EXCEED 5 FEET. ON VERTICAL RUNS, AT INTERVALS NOT TO EXCEED 3 FEET, AND ON INVERTED RUNS, AT EVERY SECOND RUNG.

# DIRECT BURIED CONDUIT NOTES

1. STANTEC ENGINEERS CANNOT CONFIRM MANY ASPECTS OF CONSTRUCTION INSTALLATION AND RELIES ON THE CONTRACTOR'S JOBSITE VERIFICATION, PROJECT RESEARCH, AND SAFETY PRACTICES TO ENSURE THE APPROPRIATE TIE-IN IS PERFORMED, CONTRACTOR SHALL USE ALL INDUSTRY STANDARD SAFETY PRECAUTIONS AND PRACTICES. INCLUDING SDSTA APPROVED JOB SAFETY PLAN, TO VERIFY LINE TIE-IN SUITABLE PRIOR TO COMMENCING CONSTRUCTION.
2. DIRECT BURIED CONDUIT SHALL MEET THE REQUIREMENT AS SPECIFIED IN NEC ARTICLE 300.5
3. CONTRACTOR SHALL FIELD VERIFY ALL LOCATION AND DIMENSIONS BEFORE COMMENCING WORK.
4. ALL WORK SHALL COMPLY WITH PROJECT SPECIFICATION. NEW FACILITIES AND MODIFICATION OF EXISTING FACILITIES SHALL MEET THE SAFETY REQUIREMENTS.
5. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITIONS OF THE STATE OF SOUTH DAKOTA ADMINISTRATION CODE, OSHA REGULATIONS & NATIONAL ELECTRICAL CODE.
6. ALL CONDUITS CONNECTING TO VAULT SHALL SLOPE 3" PER 100 FEET TOWARDS THE VAULT.
7. MINIMUM CONDUIT BURIAL DEPTH SHALL BE 24" BELOW GRADE FOR NEW CONDUIT. CONDUIT BURIAL MAY BE DEEPER THAN 24".
8. ALL CONDUITS SHALL HAVE A GROUND WIRE PULLED IN TO PROVIDE A GROUND FAULT RETURN PATH.
9. CONTRACTOR TO PLUG ALL UNUSED OPENINGS AND/OR SPARE CONDUITS.
10. FOR INSTALLATION, A CABLE MINIMUM BENDING RADIUS AS RECOMMENDED BY MANUFACTURER RECOMMENDATIONS MUST BE MAINTAINED.
11. CONTRACTOR TO BRING CONDUITS 8" ABOVE GRADE AND CAP USING RIGID GALVANIZED STEEL (RGS) CONDUIT. EXCEPT WHERE THERE IS CHEMICAL CONTAINMENT IN THOSE AREAS THE CONTRACTOR TO BRING CONDUIT 8" ABOVE THE CONTAINMENT WALLS/SURFACE AND CAP USING PVC COATED RIGID GALVANIZED STEEL (RGS) CONDUIT OR SCHEDULE 40 PVC.
12. DRAWINGS INDICATES DIAGRAMMATICALLY DESIRED LOCATIONS OF ELECTRICAL EQUIPMENT AND CONTROL DEVICES, ARRANGEMENT OF SYSTEM CONDUIT/CABLE ROUTING TO BE FOLLOWED AS CLOSELY AS POSSIBLE. PROPER JUDGEMENT MUST BE EXERCISED IN EXECUTION OF WORK TO SECURE THE BEST POSSIBLE INSTALLATION OF ALL DEVICES, EQUIPMENT, AND SYSTEM CONDUIT/CABLE ROUTING. METHOD OF CONDUIT/CABLE ROUTING SHALL BE CAREFULLY EXAMINED, PREPARED AND APPROVED BY THE SDSTA PRIOR TO INSTALLATION
13. ALL FIELD BENDS REQUIRED IN PVC CONDUIT SHALL BE UNIFORM LONG RADIUS SWEEPS, BENT ON A SUITABLE POWER BENDER OR WITH OTHER SUITABLE BENDING TOOLS. THE RADIUS OF ANY CONDUIT BENDS, MEASURED FROM THE CENTER OF THE BEND TO THE NEAREST EXTERNAL SURFACE OF THE CONDUIT SHALL, IF POSSIBLE, BE NOT LESS THAT THE BENDING RADIUS LISTED FOR THE PARTICULAR CONDUIT SIZE IN THE FOLLOWING TABLE:

BENDING RADIUS SCHEDULE - METALLIC OR PVC CONDUIT

| SIZE OF CONDUIT (NOMINAL DIA. INCHES) | MIN. BEND RADIUS (INCHES) |
|---|---|
| 2 | 24 |
| 4 | 36 |
| 5 | 48 |
| 6 | 60 |

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec
3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

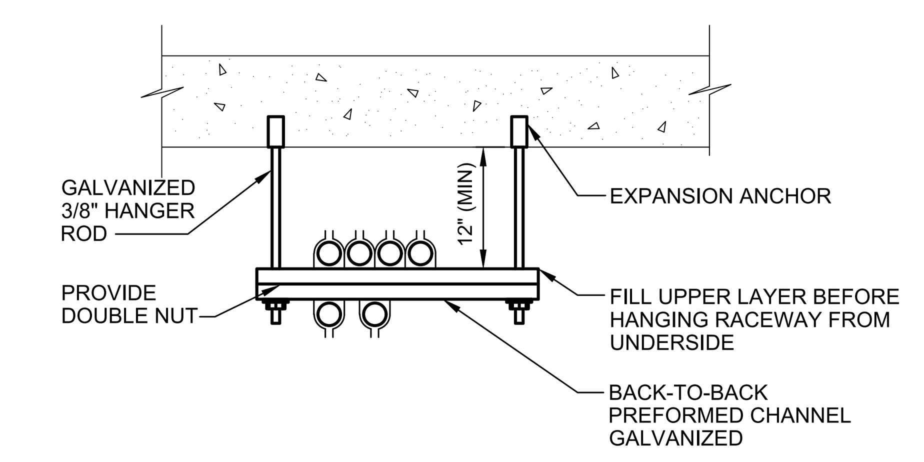
SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

| File Name: 24768-E-002.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

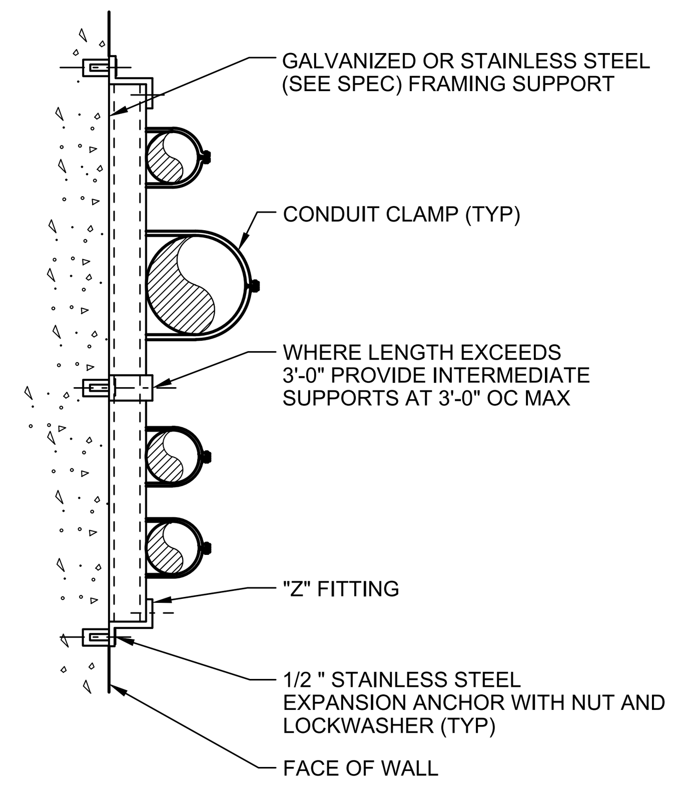
Title
ABBREVIATIONS AND GENERAL NOTES

Project No. 182924768
Scale NO SCALE

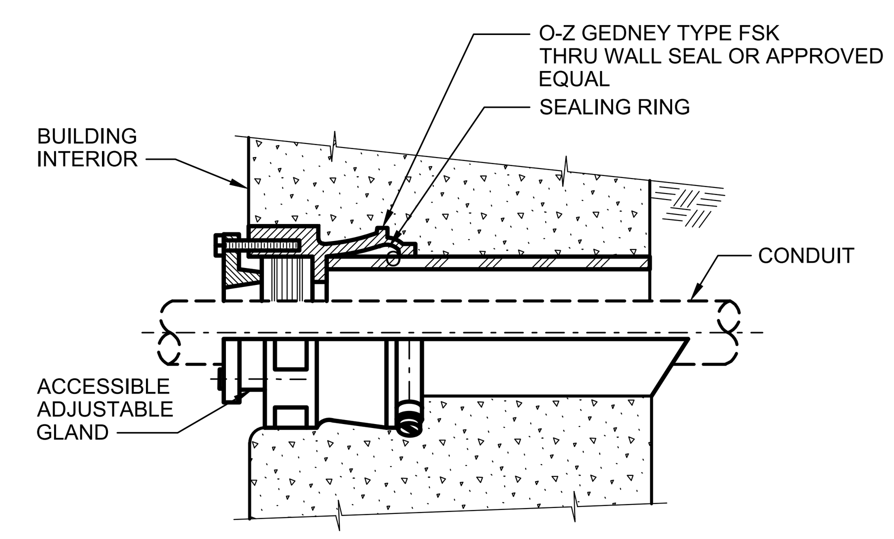
Drawing No. 24768-E-002
Revision 1




E-207 **CONDUIT/CABLE TRAPEZE**
REV 010119

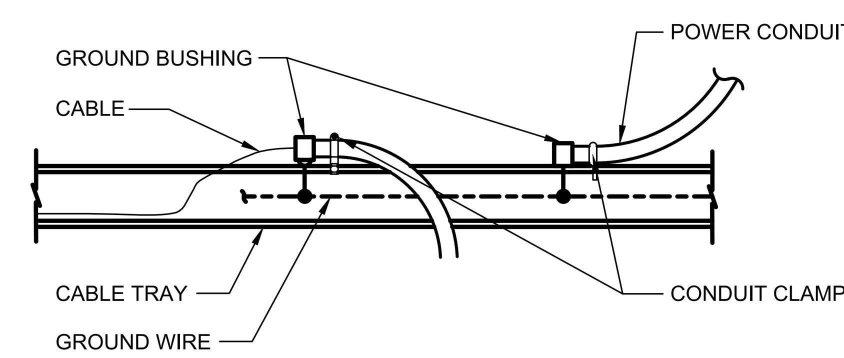



E-212 **CONDUIT SUPPORT**
FLUSH MOUNT
REV 010119



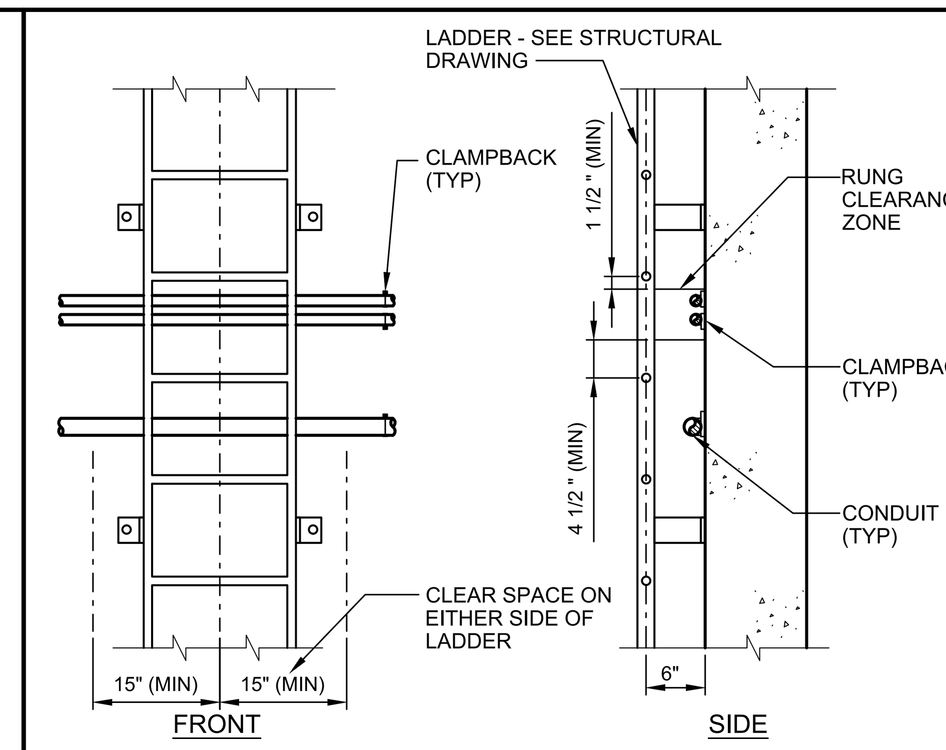

NOTE:
USE WATERTIGHT CONDUIT SEAL WHERE CONDUIT PENTRATIONS OF EXTERIOR WALLS ARE BELOW GRADE.

E-213 **WATERTIGHT CONDUIT SEAL**
BELOW GRADE EXTERIOR WALLS
REV 010119



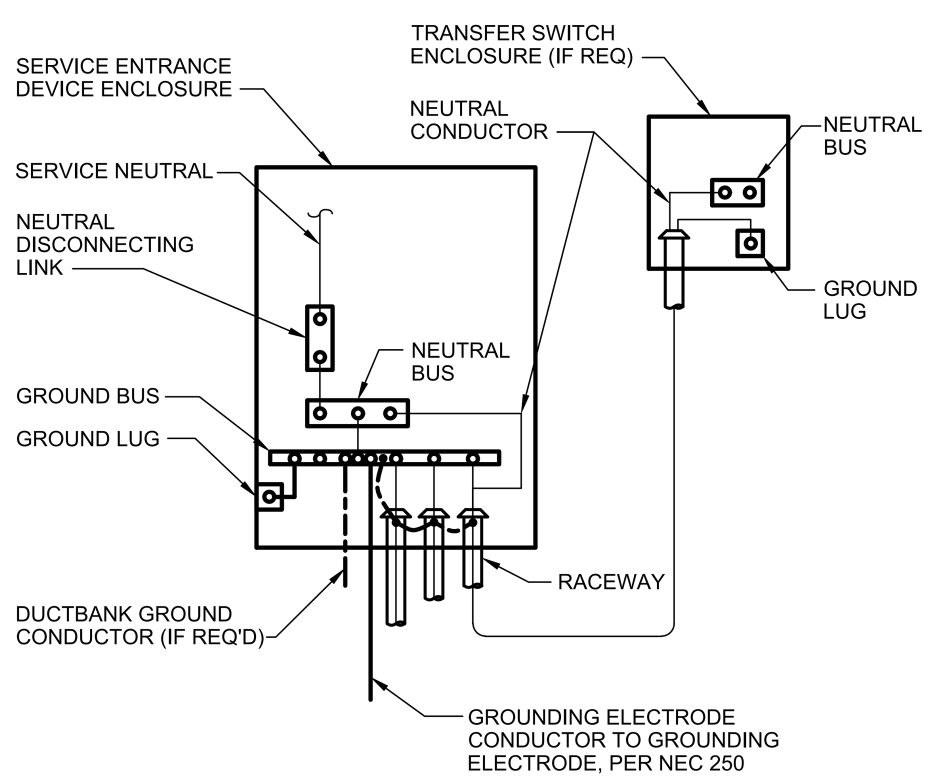

NOTE:
1. IN LIEU OF GROUNDING BUSHING, USE THE B-LINE 9G-1158 CONDUIT TO CABLE TRAY ADAPTER OR APPROVED EQUAL.
2. ROUTE CONDUIT SO IT CONNECTS HORIZONTALLY TO THE LOWER FLANGE OF THE CABLE TRAY.

E-215 **CABLE TRAY EXIT AND ENTRY**
REV 010119

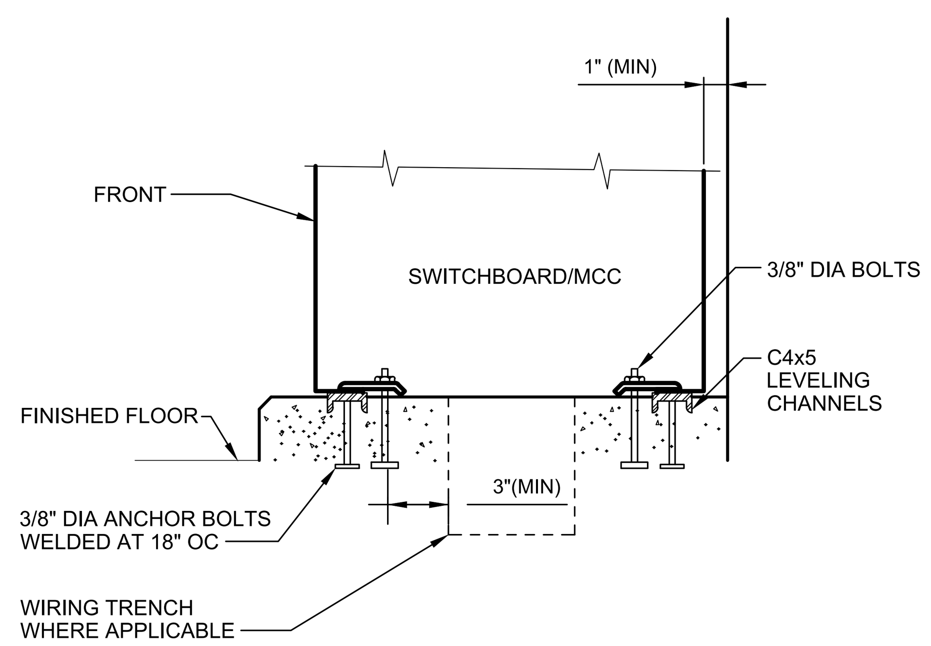



NOTE:
1/2 " CLAMPBACK - DAMP OR BELOW GRADE
1/4 " CLAMPBACK - DRY AND ABOVE GRADE

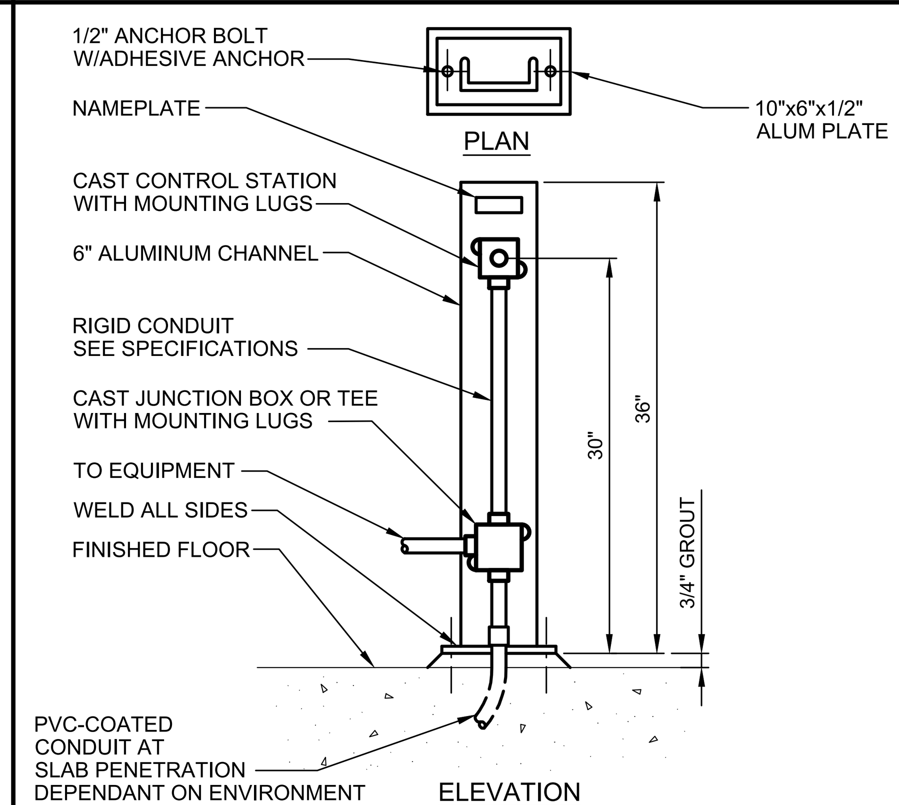
E-220 **MINIMUM LADDER CLEARANCES**
REV 010119



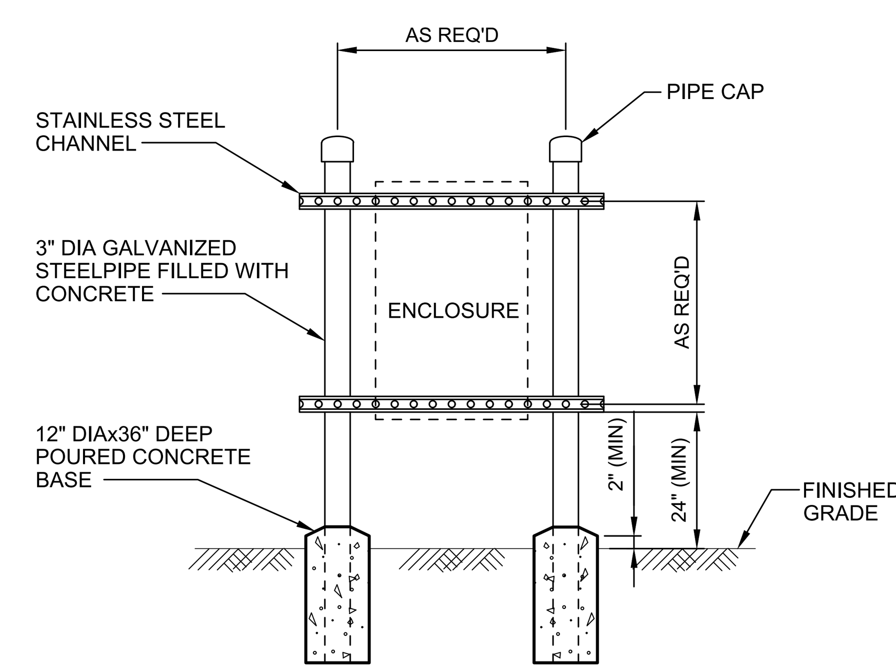

E-300 **SERVICE GROUNDING**
NON-SEPARATELY DERIVED SOURCE
REV 010119




E-400 **SWITCHBOARD/MCC MOUNTING**
REV 010119

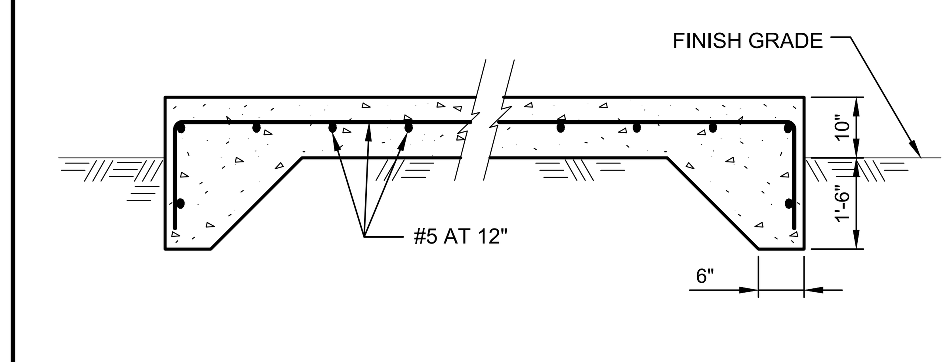



E-406 **PEDESTAL MOUNTED CONTROL STATION**
REV 010119



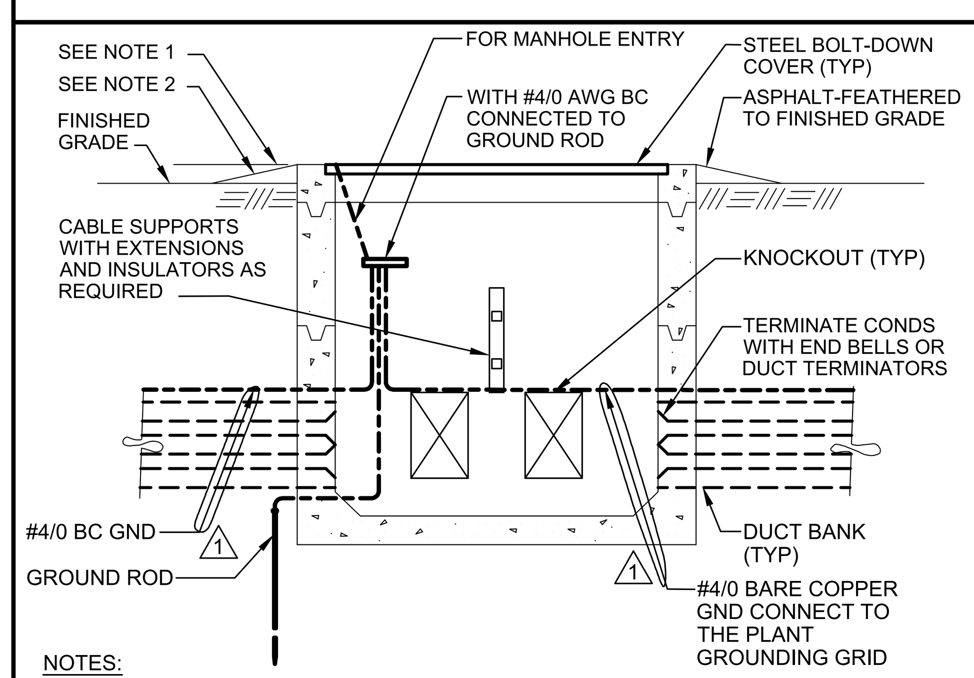

NOTE:
1. ONLY TO BE USED WHERE SPECIALLY CALLED OUT.

E-420 **ENCLOSURE MOUNTING STAND**
REV 010119



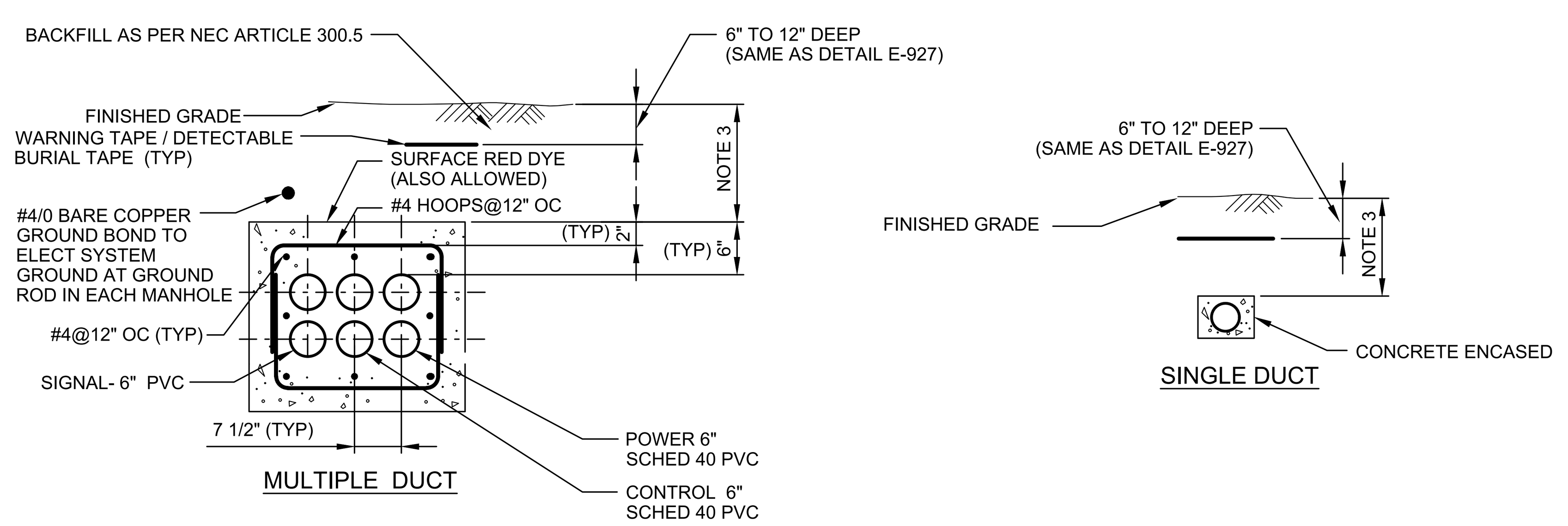

NOTES:
1. OVERALL PAD DIMENSIONS SHALL BE DETERMINED FROM ELECTRICAL DRAWING AND ADJUSTED AS REQ'D TO SUIT EQUIPMENT FURNISHED.
2. EQUIPMENT PAD WHERE HEIGHT MAY DIFFER ARE SHOWN ON DRAWING.
3. DETAIL WILL ONLY BE USED WHERE SPECIALLY CALLED OUT ON ELECTRICAL EQUIPMENT DRAWINGS

E-617 **ELECTRICAL EQUIPMENT PAD**
REV 010119



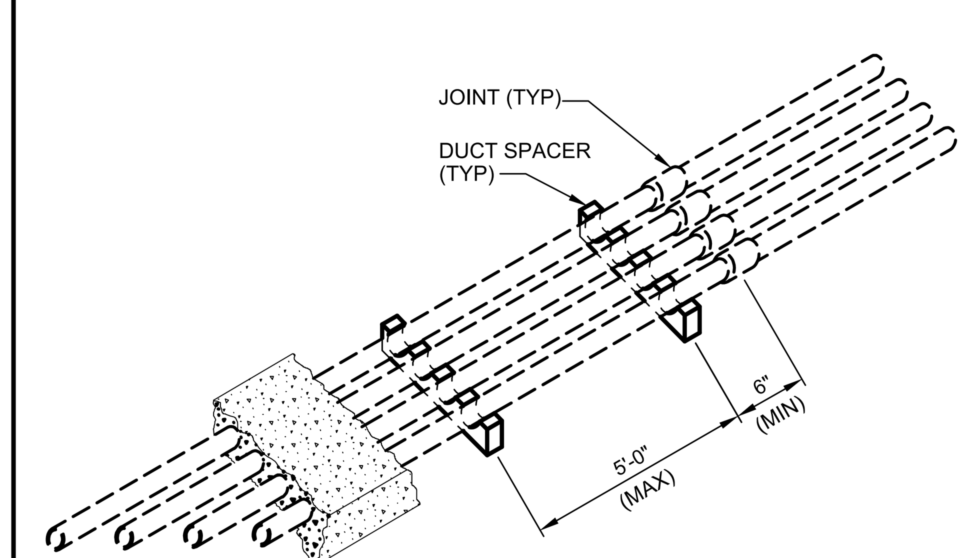

NOTES:
1. AT PAVED AREAS.
2. UNPAVED AREAS.
3. EMH INSTALLATION TO BE WATERTIGHT AFTER CONDUITS HAVE BEEN INSTALLED BY USING DUCT SEALING.

E-901 **TYPICAL MANHOLE/ PULLBOX (EMH)**

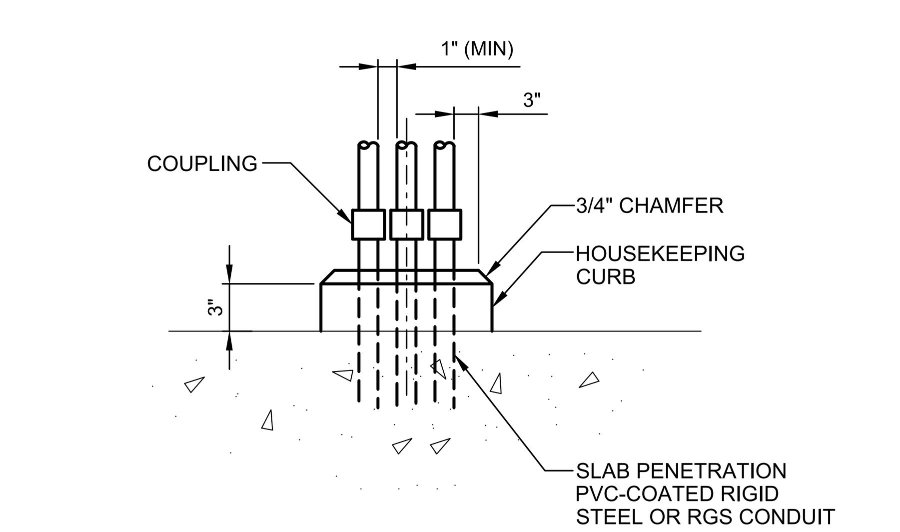



NOTES:
1. HELIX CONCRETE CAN BE USED IN LIEU OF REBAR.
2. FOR CONDUIT SIZE SEE DUCT BANK SECTION.
3. DEPTH AS REQUIRED OR 24" MINIMUM COVER.

E-902 **TYPICAL DUCTBANK**




E-903 **TYPICAL DUCTBANK/BURIED**
JOINT/SUPPORT SPACING




NOTE:
HOUSEKEEPING CURB REQUIRED AT ALL LOCATIONS FOR SINGLE AND MULTIPLE RISERS.

E-904 **CONCRETE HOUSEKEEPING CURB**
NON-HAZARDOUS LOCATIONS

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\GENERAL SHEETS\24768-E-003.DWG
12/12/2025 9:42 AM

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec
3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

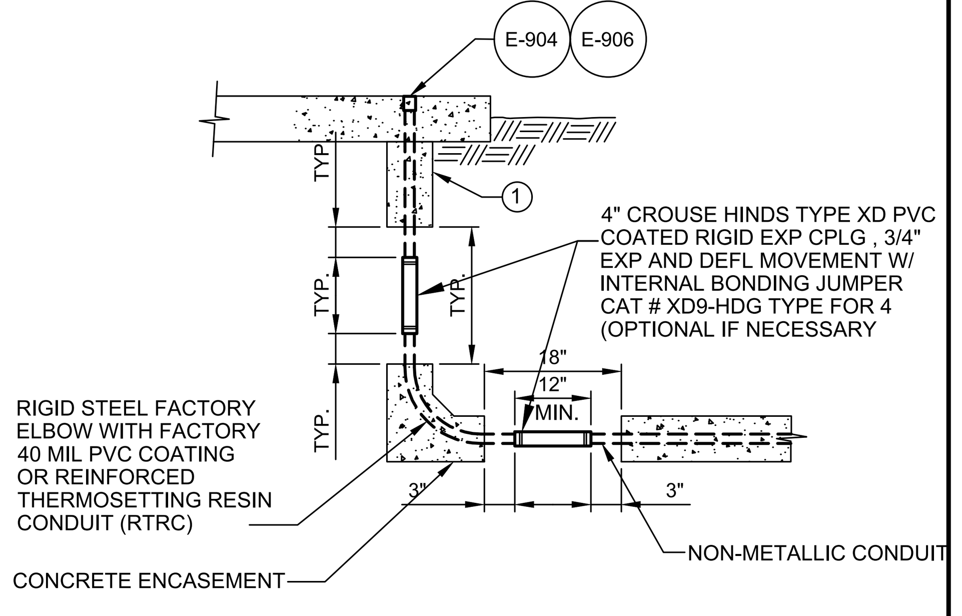
File Name: 24768-E-003.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title
STANDARD DETAILS - I

Project No. 182924768 | Scale NO SCALE

Drawing No. 24768-E-003 | Revision 1

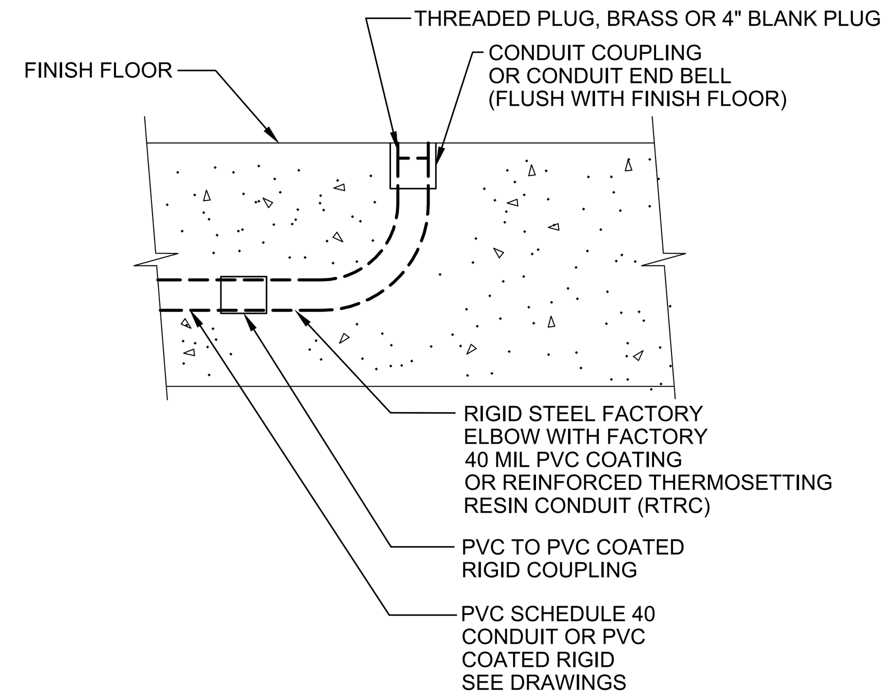
ORIGINAL SHEET - ARCH D
Dwg Updated: 12/12/2025 9:41:57 AM By: smohite



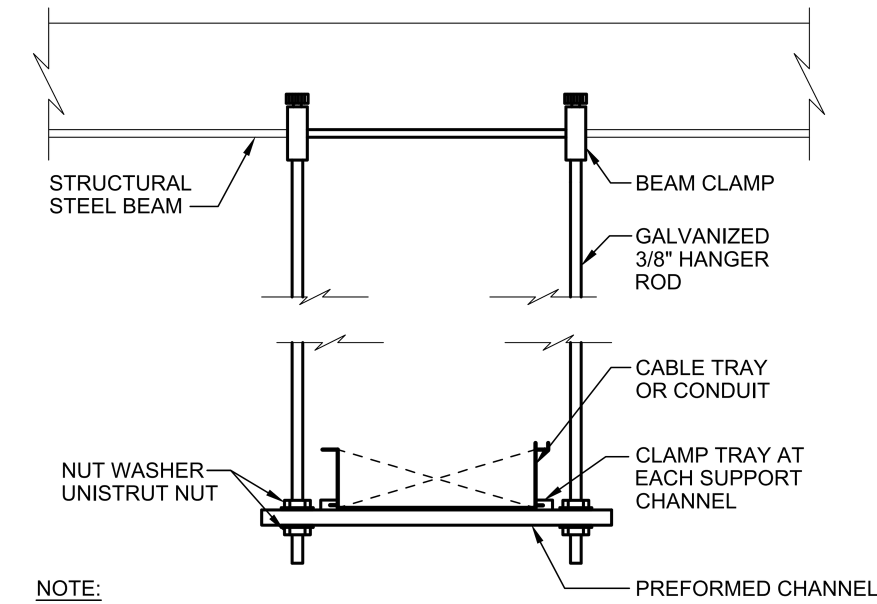

NOTES:

1. WHERE PILE PENETRATION ARE NOT AVAILABLE CONCRETE STUB UP SHALL BE FABRICATED

E-905 RISER FROM NON-METALLIC DUCT



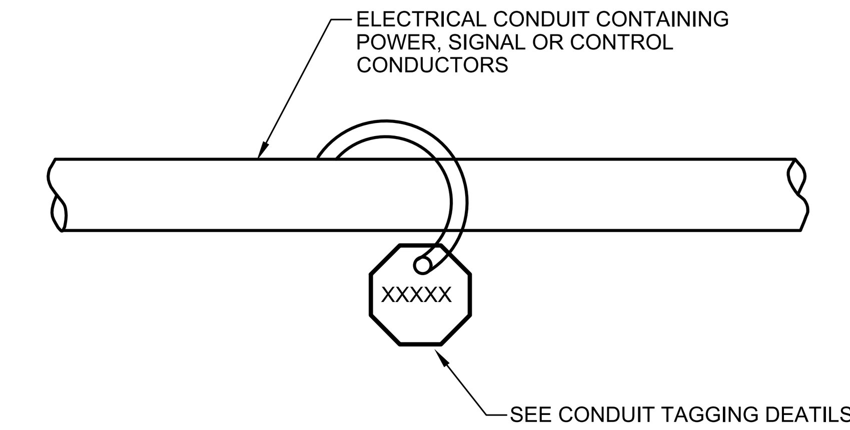

E-906 CONDUIT TERMINATION FOR FUTURE EQUIPMENT




NOTE:

1. SPACING OF TRAY SUPPORTS SHALL BE NO MORE THAN MANUFACTURERS RECOMMENDATIONS OR AS SUBMITTED AND APPROVED BY SDSTA.

E-907 TRAY OR CONDUIT HANGER




CONDUIT NUMBERS ARE LISTED ON THE CONDUIT / CABLE SCHEDULE AND CONDUIT PLAN DRAWINGS.

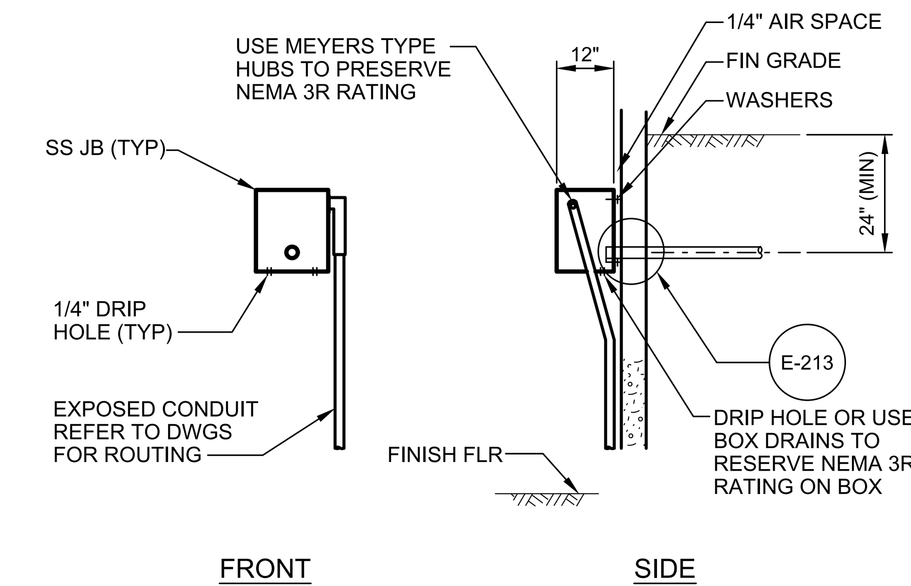
NOTE:

1. CONDUIT TAGS SHALL BE AFFIXED TO CONDUITS:

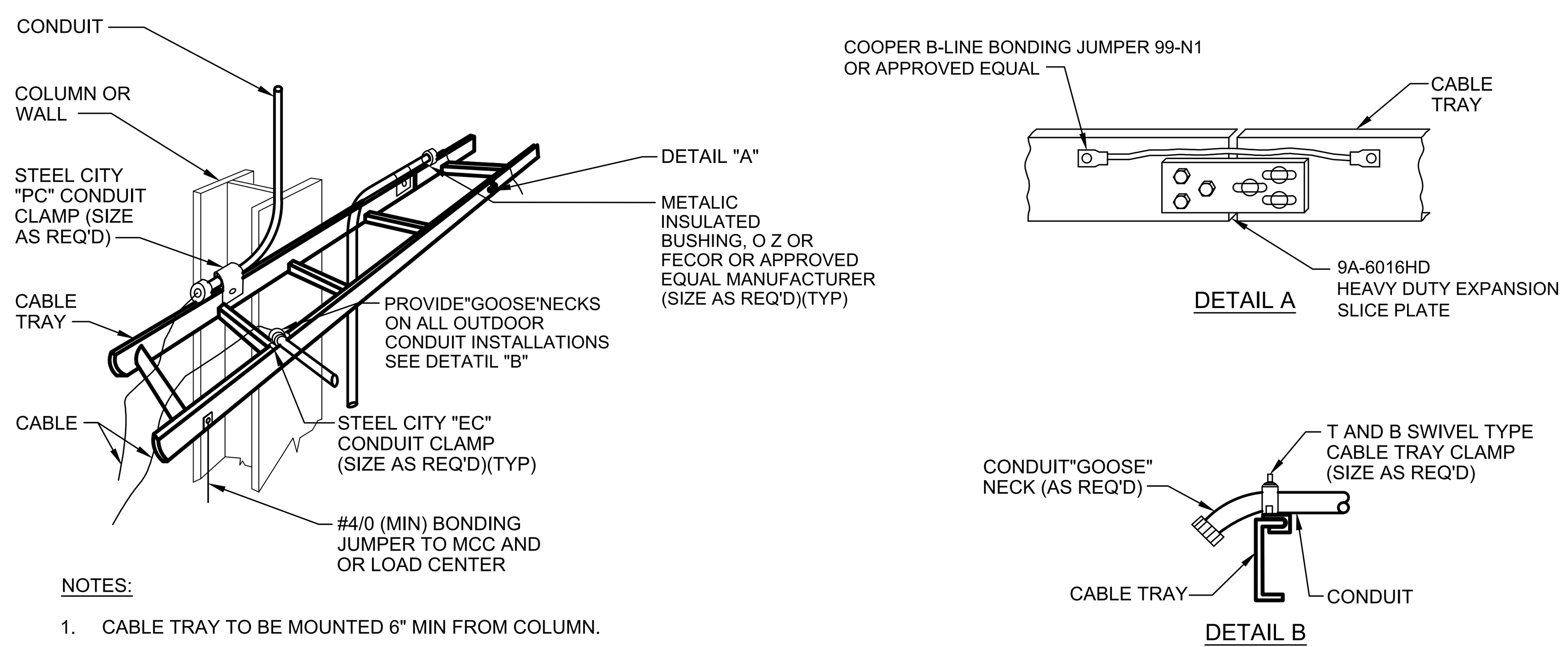
A. AFTER ALL WORKING DRAWINGS ARE APPROVED AND ALL FIELD MODIFICATIONS HAVE BEEN MADE.

B. BEFORE FINAL ACCEPTANCE TESTING HAS STARED.

E-908 UNDERGROUND CONDUIT IDENTIFICATION TAG



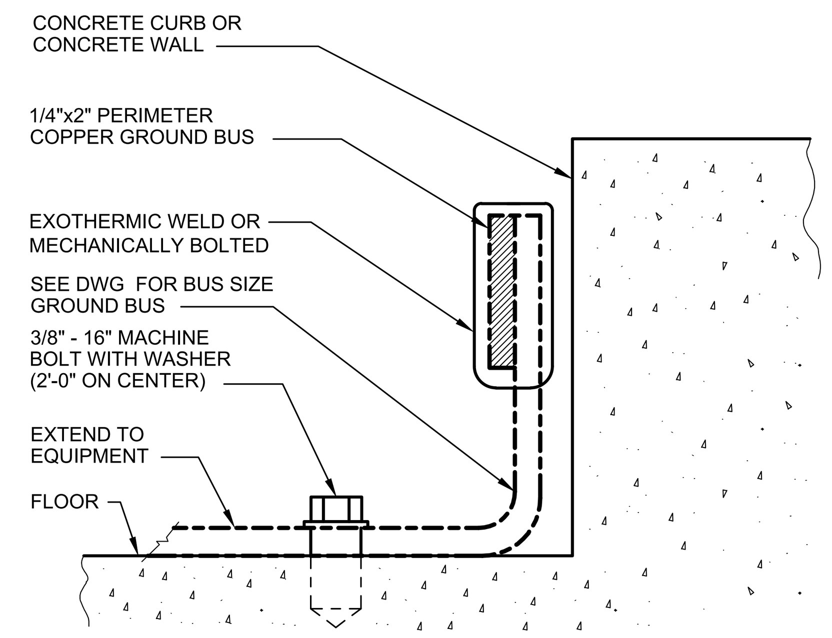

E-909 CONDUIT ENTRANCE
BELOW GRADE



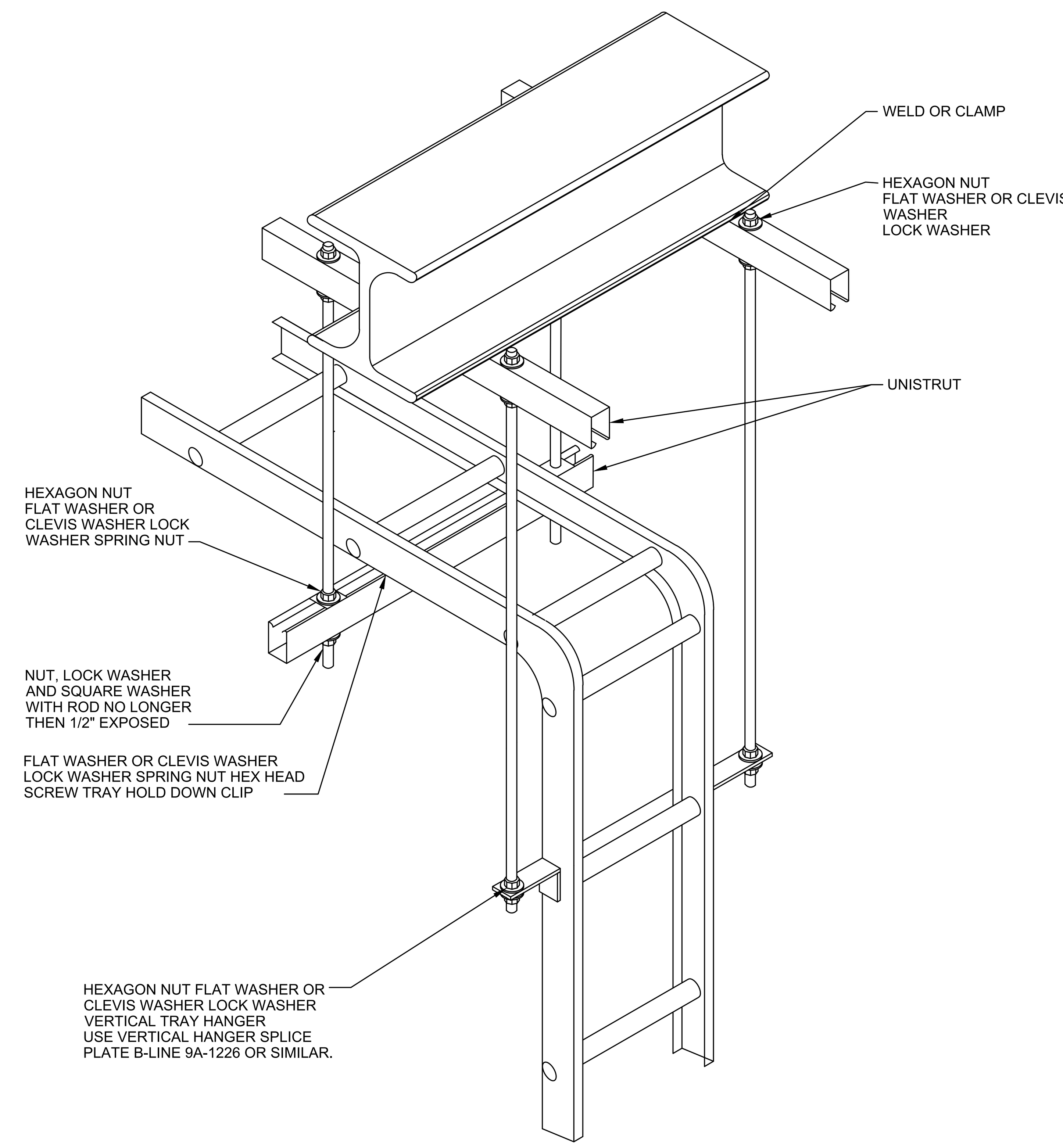

NOTES:

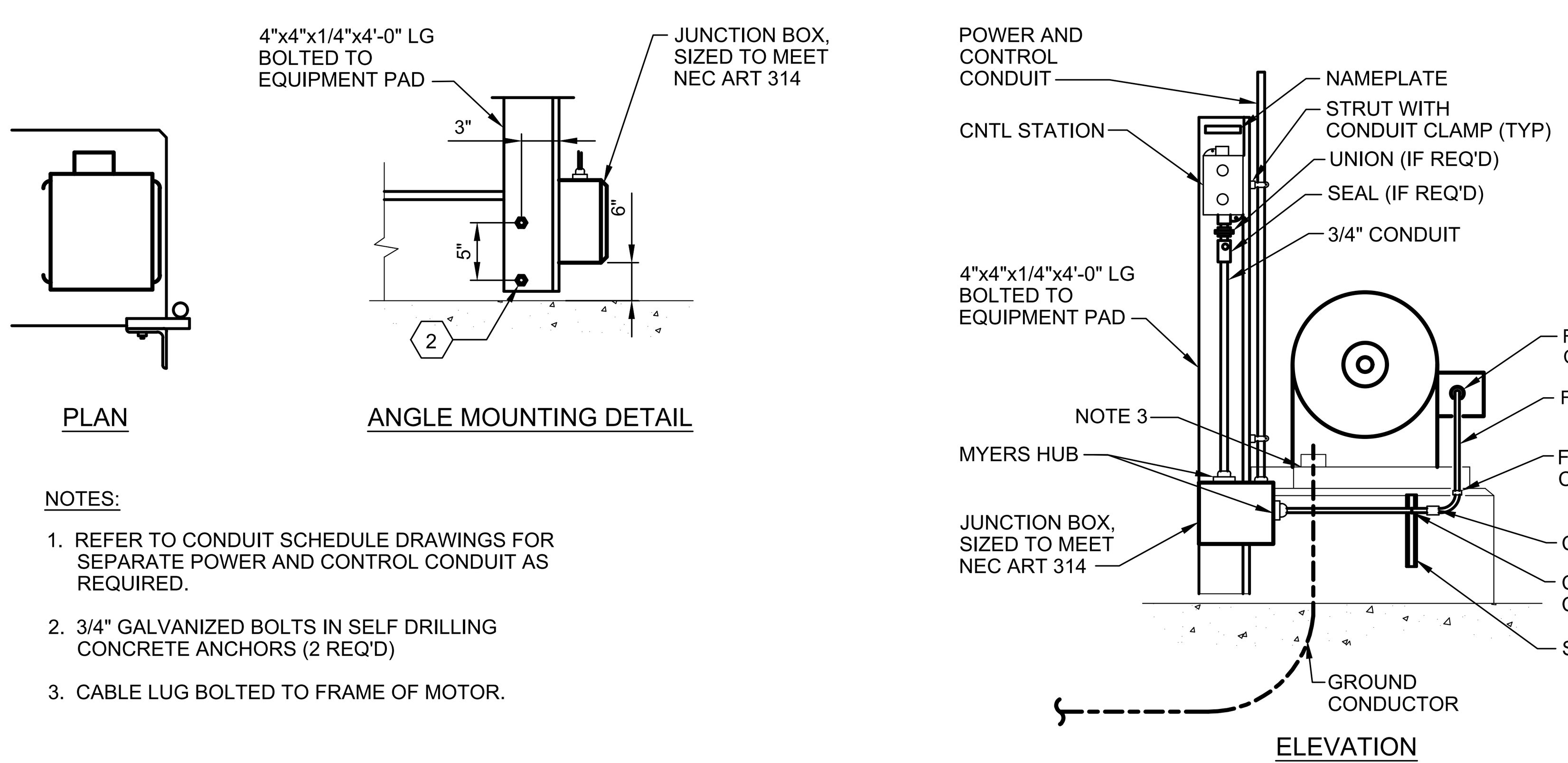
1. CABLE TRAY TO BE MOUNTED 6" MIN FROM COLUMN.

E-913 CABLE TRAY AND CONDUIT CLAMPING




E-915 FLOOR- MOUNTED GROUND BUS TO EQUIPMENT

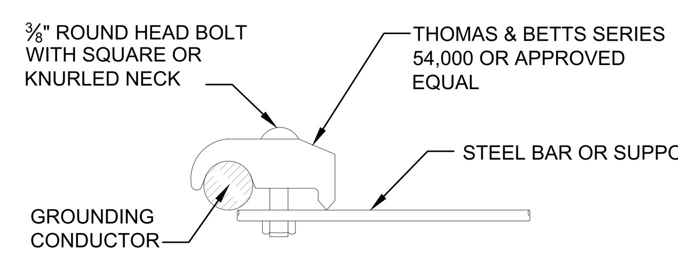



NOTES:

1. REFER TO CONDUIT SCHEDULE DRAWINGS FOR SEPARATE POWER AND CONTROL CONDUIT AS REQUIRED.
2. 3/4" GALVANIZED BOLTS IN SELF DRILLING CONCRETE ANCHORS (2 REQ'D)
3. CABLE LUG BOLTED TO FRAME OF MOTOR.

E-917 MOTOR CONDUIT CONNECTION
ABOVE GRADE FEED




E-924 EXPOSED CABLE-TO-BAR CONNECTION

E-916 CABLE SUPPORT IN VERTICAL TRAYS

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH KRPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

| File Name: 24768-E-004.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
STANDARD DETAILS - II

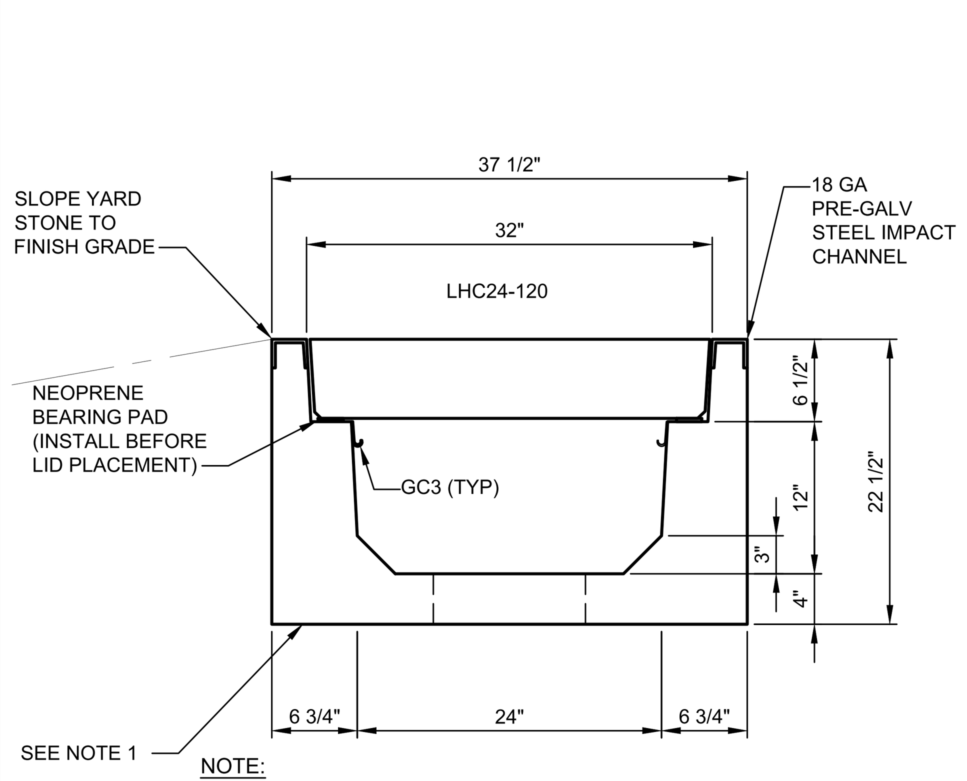
Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-004
Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\GENERAL SHEETS\24768-E-004.DWG
12/12/2025 9:42 AM

ORIGINAL SHEET - ARCH D

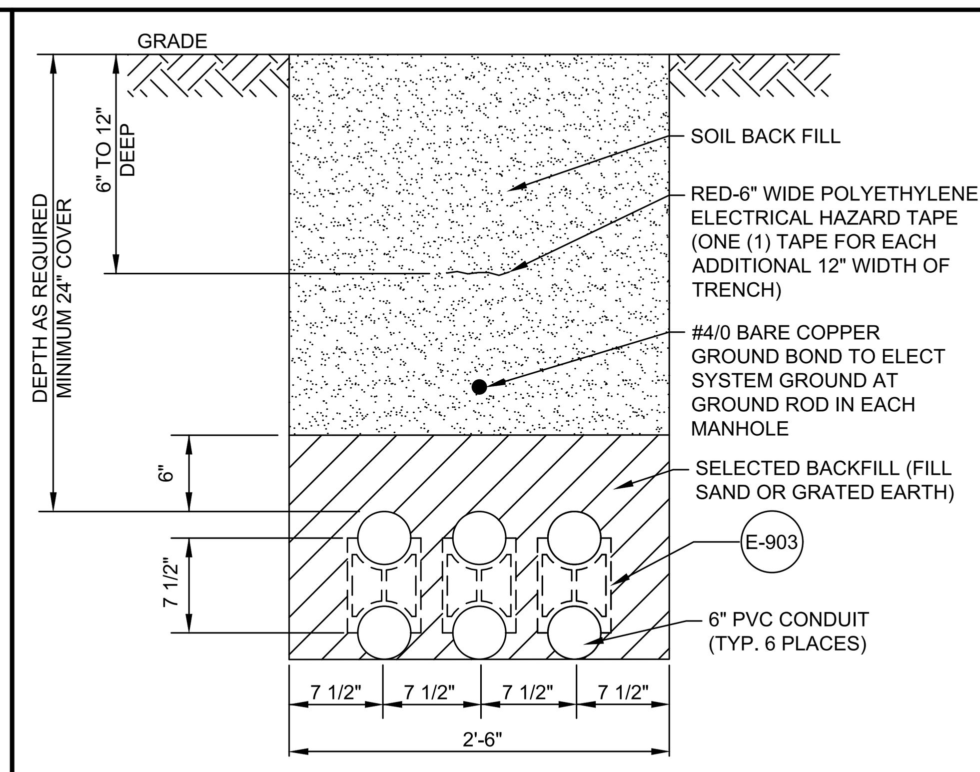
Dwg Updated: 12/12/2025 9:42:21 AM By: smohite




NOTE:

1. REFER TO CATALOG BHC2412-120 OR EQUIVALENT.

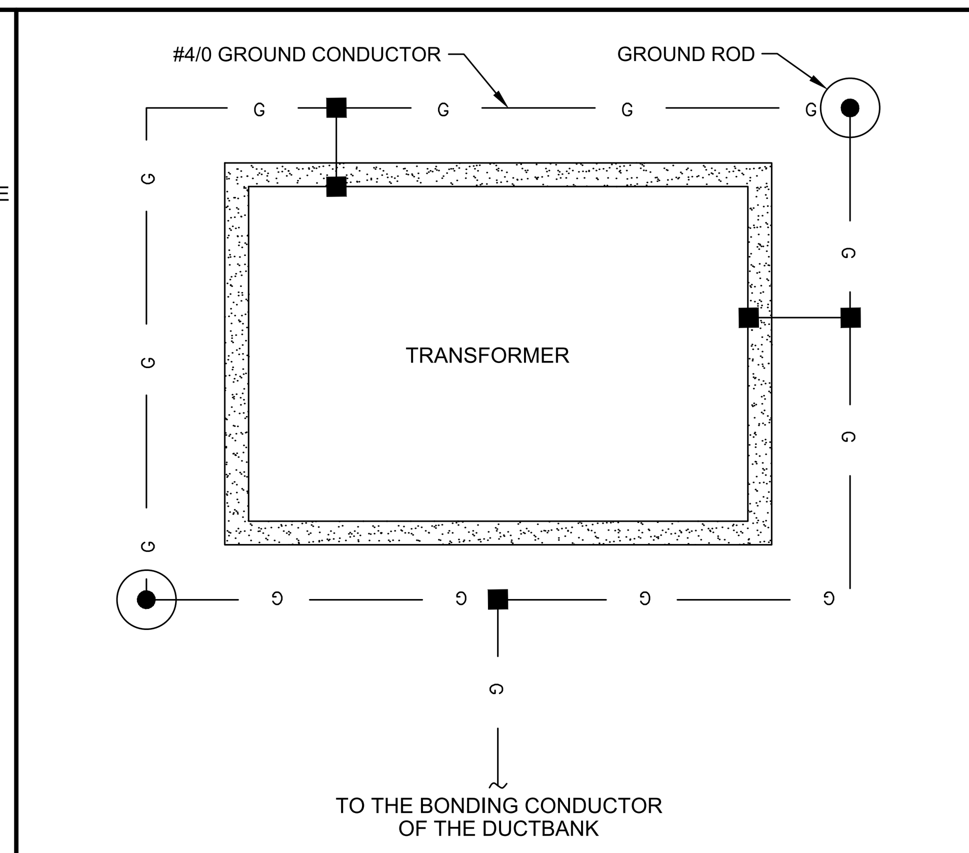
## E-926 CABLE TRENCH SECTION SECTION 24"W x 12"D



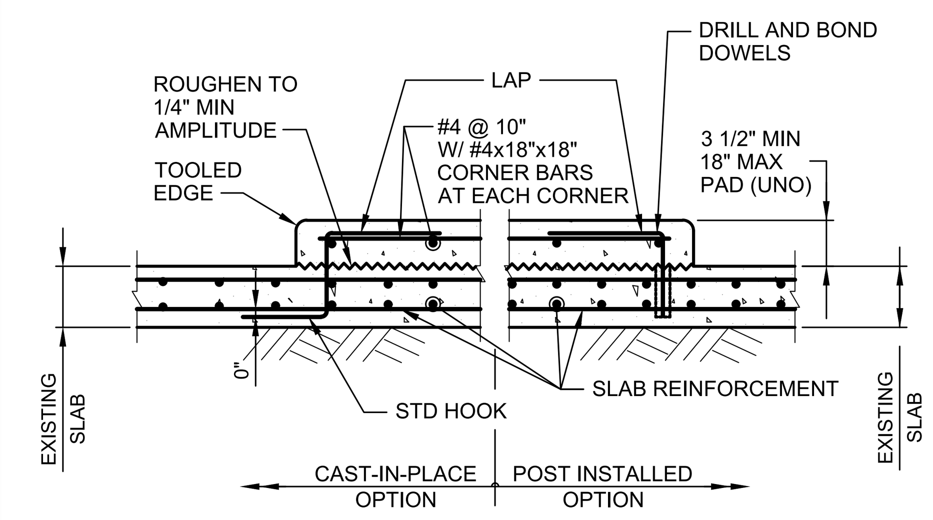

NOTE:

1. FOR CONDUIT SIZE SEE DUCT BANK SECTION.

## E-927 TYPICAL DIRECT BURIED CONDUIT INSTALLATIONS



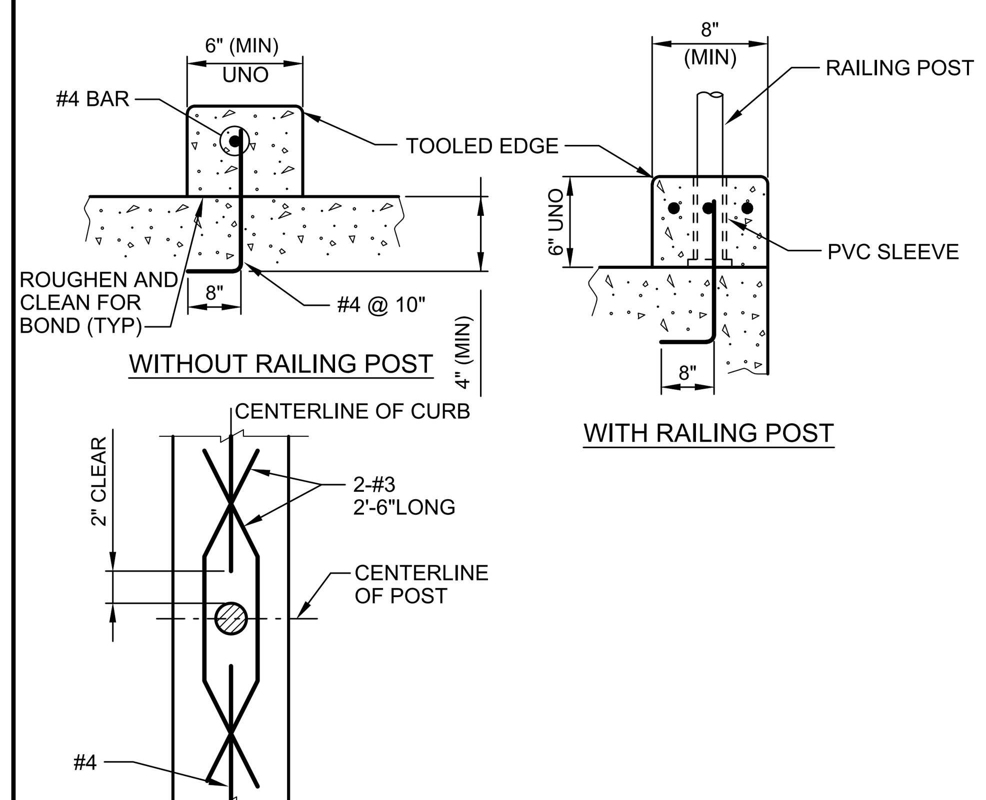

## E-928 TRANSFORMER GROUNDING




NOTES:

1. WHERE SLAB THICKNESS IS LESS THAN REQUIRED FOR POST-INSTALLED ANCHOR EMBEDMENT, USE CAST-IN-PLACE OPTION.
2. LOCATE AND AVOID ALL REINFORCEMENT PRIOR TO DRILLING INTO CONCRETE.
3. THE DETAIL APPLIES WHERE EQUIPMENT PADS OR HOUSEKEEPING PADS ARE INDICATED ON THE CONSTRUCTION DOCUMENTS.
4. CONTRACTOR TO COORDINATE DIMENSIONS RELATED TO MECHANICAL/ELECTRICAL EQUIPMENT BEFORE CONSTRUCTION.
5. CONTRACTOR MUST CONFIRM ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS PRIOR TO WORK.
6. VERIFY DETAILS BASED ON ACTUAL SITE CONDITIONS AND PROJECT-SPECIFIC LOADS.
7. CONTRACTOR IS FULLY RESPONSIBLE FOR DESIGN ADEQUACY AND ACCURACY.
8. DESIGN ASSUMPTIONS:
   - CONCRETE: 3000 PSI
   - REINFORCEMENT: GRADE 60
   - SOG LOADING: 250 PSF

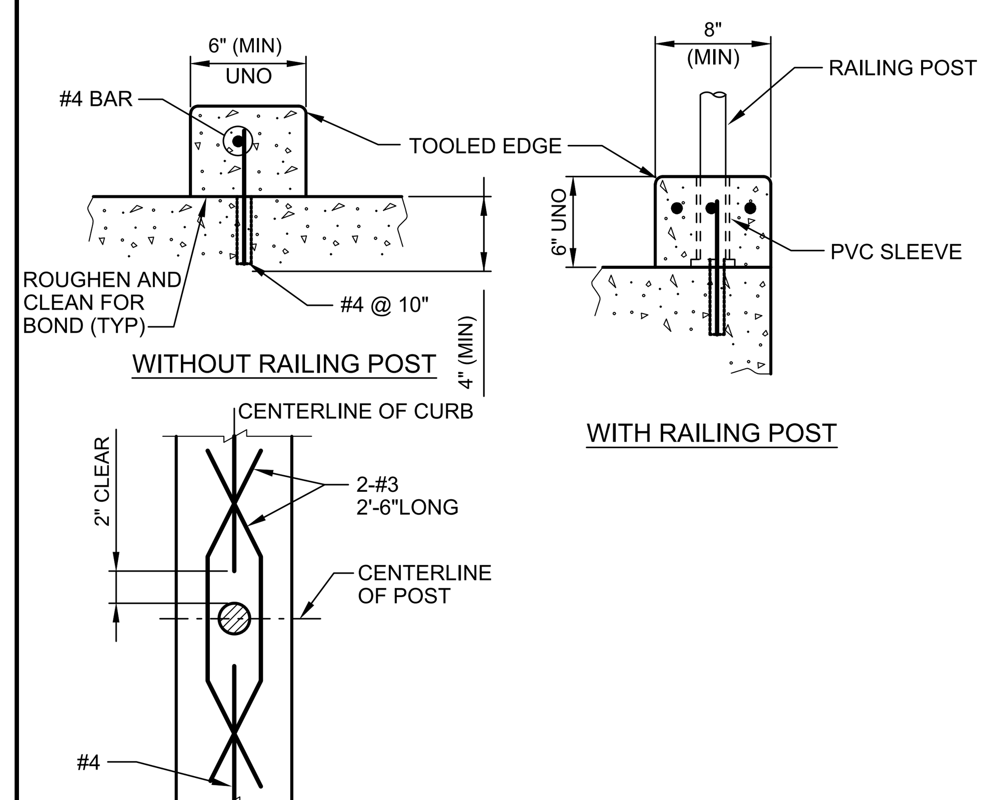
## E-929 EQUIPMENT PAD ON SLAB




NOTES:

1. CURBS SHALL BE OF EQUAL WIDTH IN THEIR ENTIRE LENGTH.
2. DETAIL ALSO APPLIES TO TOPS OF WALLS REINFORCED WITH ONE CURTAIN OF STEEL.
3. POST INSERTS NOT ALLOWED IN APPLICATIONS SUBJECT TO FREEZING.
4. IN EXISTING SLABS USE #4@10" W/ 4" EMBED, DRILL AND GROUT INTO SLAB.
5. CONTRACTOR TO COORDINATE DIMENSIONS RELATED TO MECHANICAL/ELECTRICAL EQUIPMENT BEFORE CONSTRUCTION.
6. CONTRACTOR MUST CONFIRM ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS PRIOR TO WORK.
7. VERIFY DETAILS BASED ON ACTUAL SITE CONDITIONS AND PROJECT-SPECIFIC LOADS.
8. CONTRACTOR IS FULLY RESPONSIBLE FOR DESIGN ADEQUACY AND ACCURACY.
9. DESIGN ASSUMPTIONS:
   - CONCRETE: 3000 PSI
   - REINFORCEMENT: GRADE 60
   - SOG LOADING: 250 PSF

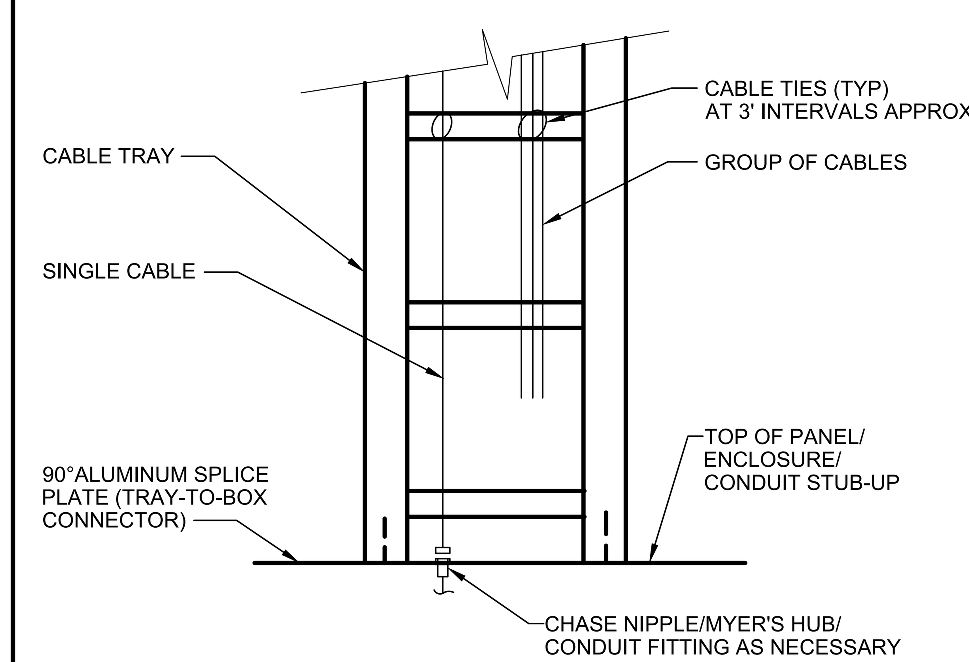
## E-930 CONCRETE CURB




NOTES:

1. CURBS SHALL BE OF EQUAL WIDTH IN THEIR ENTIRE LENGTH.
2. DETAIL ALSO APPLIES TO TOPS OF WALLS REINFORCED WITH ONE CURTAIN OF STEEL.
3. POST INSERTS NOT ALLOWED IN APPLICATIONS SUBJECT TO FREEZING.
4. IN EXISTING SLABS USE #4@10" W/ 4" EMBED, DRILL AND GROUT INTO SLAB.
5. CONTRACTOR TO COORDINATE DIMENSIONS RELATED TO MECHANICAL/ELECTRICAL EQUIPMENT BEFORE CONSTRUCTION.
6. CONTRACTOR MUST CONFIRM ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS PRIOR TO WORK.
7. VERIFY DETAILS BASED ON ACTUAL SITE CONDITIONS AND PROJECT-SPECIFIC LOADS.
8. CONTRACTOR IS FULLY RESPONSIBLE FOR DESIGN ADEQUACY AND ACCURACY.
9. DESIGN ASSUMPTIONS:
   - CONCRETE: 3000 PSI
   - REINFORCEMENT: GRADE 60
   - SOG LOADING: 250 PSF

## E-931 CONCRETE CURB ON EXISTING SLAB




## E-932 VERTICAL CABLE DROP WITH CABLES STRAPPED TO RUNG

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



SDSTA
YATES ELECTRICAL REHAB

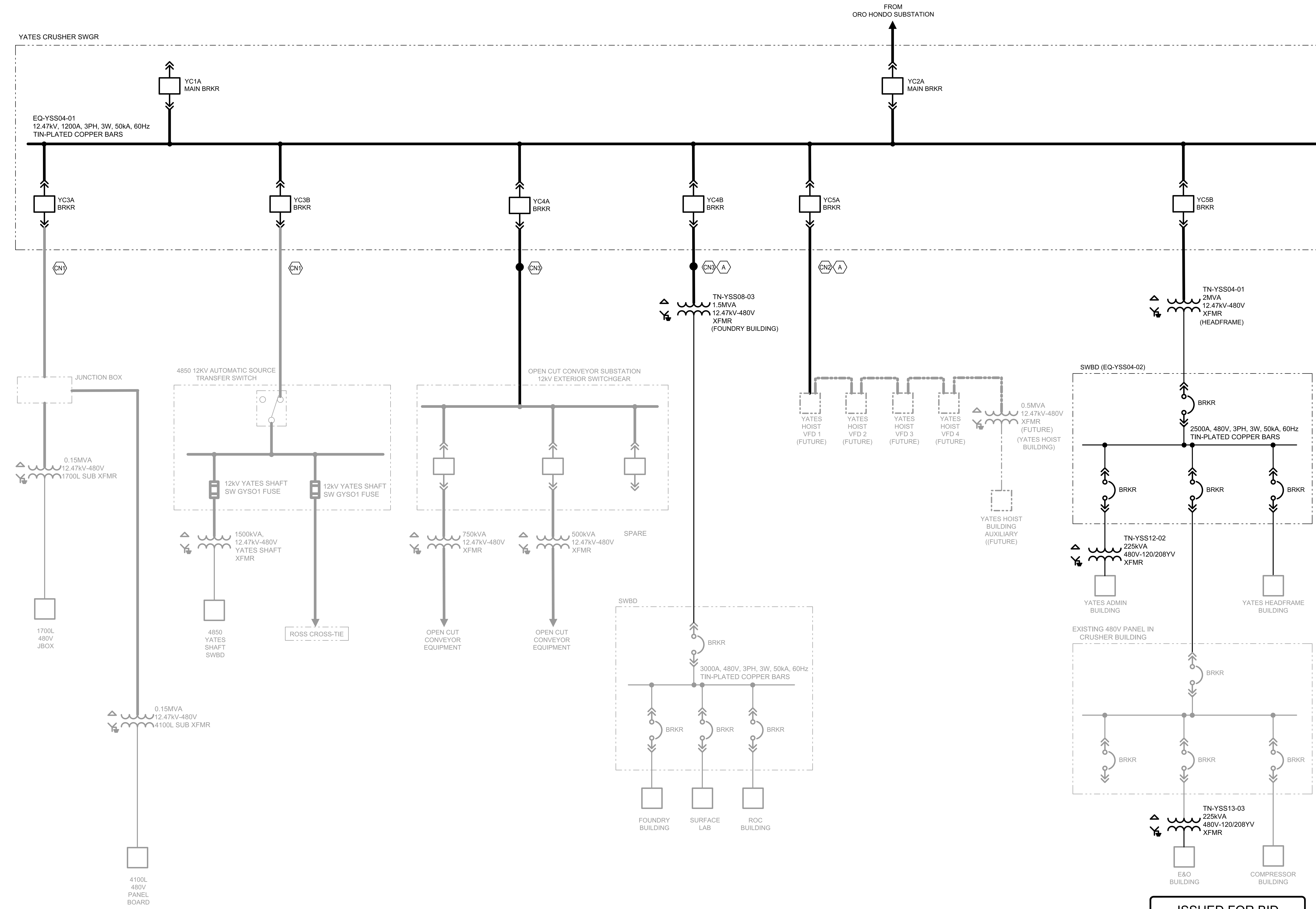
SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

| File Name: 24768-E-005.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
STANDARD DETAILS - III

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-005
Revision 1




## GENERAL SHEET NOTES

1. ALL CABLE SHALL BE SPLICED USING MANUFACTURER'S STANDARD PRACTICE. ALL SPLICE SHALL BE WEATHER PROTECTED SPLICES DESIGNED FOR PROLONGED SUBMERSIBLE IN WATER.

## SHEET KEYNOTES

GENERAL NOTES

A. #3/0 AWG CABLE SHALL BE SPLICED WITH #500KCMIL IN MANHOLE (MH1); IN VAULT BY EAST SWITCHYARD #500KCMIL CABLE SHALL BE SPLICED WITH A #2 AWG CABLE.

B. #2 AWG CABLE SHALL BE SPLICED WITH A #2 AWG CABLE IN VAULT BY EAST SWITCHYARD.

C. PARALLEL SET OF CABLE SHALL BE ROUTED FROM THE NEW TRANSFORMER TO THE EXISTING JUNCTION BOX. PARALLEL CABLE RUN SHALL MATCH (COUNT AND SIZE) THE EXISTING RUN FROM THE EXISTING JUNCTION BOX TO THE EXISTING MCC.

CONSTRUCTION NOTE (CN):

CN1. CABLE SHALL BE PULLBACK AS NECESSARY FROM TRAMWAY AND ROUTED TO THE SWITCHGEAR IN YATES CRUSHER BUILDING. CABLE ROUTED BY SDSTA TEAM OR THEIR DESIGNEE BETWEEN THE ENDS OF PHASE I AND PHASE II.

CN2. DURING PHASE I, PARALLEL RUN OF #2/0 AWG FEEDER CABLES SHALL BE ROUTED FROM YATES CRUSHER SWITCHGEAR EQ-YSS04-01 TO YATES MG SET ROOM BASEMENT THROUGH THE TUNNEL. CONTRACTOR SHALL COIL 250FT OF CABLE IN THE MG SET BASEMENT TO ALLOW FOR THE ROUTING OF THE CABLE FOR HOIST UPGRADE WITHOUT ANY CABLE SPLICES. CABLES ON BOTH THE END SHALL HAVE PROTECTIVE CAP OR BOOT INSTALLED TO PREVENT MOISTURE OR CONTAMINANTS FROM ENTERING THE CABLE CORES. BOTH CABLES ON SWITCHGEAR END SHALL BE TRAINED TO PREVENT IT FOR ACCIDENTALLY TOUCHING ANY LIVE COMPONENTS OR BREAKER TERMINALS. CABLES IN MG SET BASEMENT SHALL BE SUPPORTED AND TRAINED TO EXISTING HANGERS/SUPPORT FOR THE FULL LENGTH OF THE EXTRA LENGTH TO PREVENT THE CABLE FROM DAMAGE DURING NORMAL OPERATION AND FUTURE CONSTRUCTIONS.

CN3. #3/0 AWG CABLE SHALL BE SPLICED WITH EXISTING #500KCMIL IN MANHOLE (MH1) DURING PHASE I; IN EXISTING VAULT BY EAST SWITCHYARD #500KCMIL CABLE SHALL BE SPLICED WITH A NEW #2 AWG CABLE DURING PHASE II.

CN4. #2 AWG CABLE SHALL BE SPLICED WITH A #2 AWG CABLE IN EXISTING VAULT BY EAST SWITCHYARD DURING PHASE II.

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

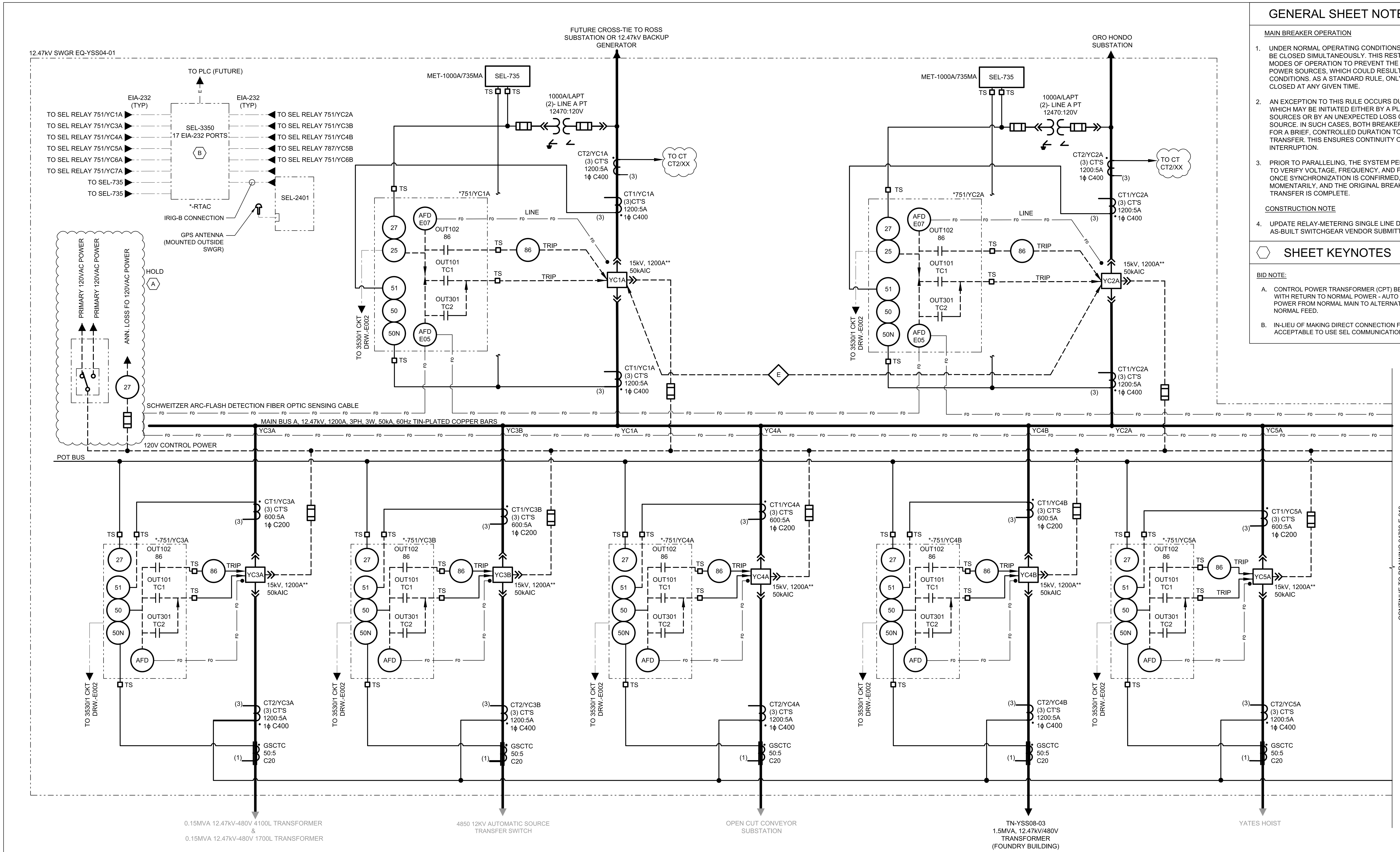
| File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|---|
| 24768-E-011.dwg | SPM | VIC | SAD | 25.11.07 |

Title

OVERALL SINGLE LINE DIAGRAM

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-011
Revision 1




## GENERAL SHEET NOTES

MAIN BREAKER OPERATION

1. UNDER NORMAL OPERATING CONDITIONS, MAIN BREAKERS 1A AND 2A SHALL NOT BE CLOSED SIMULTANEOUSLY. THIS RESTRICTION IS ENFORCED ACROSS ALL MODES OF OPERATION TO PREVENT THE PARALLELING OF TWO INDEPENDENT POWER SOURCES, WHICH COULD RESULT IN EQUIPMENT DAMAGE OR UNSAFE CONDITIONS. AS A STANDARD RULE, ONLY ONE MAIN BREAKER MAY REMAIN CLOSED AT ANY GIVEN TIME.
2. AN EXCEPTION TO THIS RULE OCCURS DURING A CONTROLLED TRANSITION, WHICH MAY BE INITIATED EITHER BY A PLANNED TRANSFER BETWEEN POWER SOURCES OR BY AN UNEXPECTED LOSS OF POWER TO THE CURRENTLY ACTIVE SOURCE. IN SUCH CASES, BOTH BREAKERS MAY BE CLOSED SIMULTANEOUSLY FOR A BRIEF, CONTROLLED DURATION TO FACILITATE A MAKE-BEFORE-BREAK TRANSFER. THIS ENSURES CONTINUITY OF POWER SUPPLY WITHOUT INTERRUPTION.
3. PRIOR TO PARALLELING, THE SYSTEM PERFORMS A SYNCHRONIZATION CHECK TO VERIFY VOLTAGE, FREQUENCY, AND PHASE ALIGNMENT BETWEEN SOURCES. ONCE SYNCHRONIZATION IS CONFIRMED, THE SECOND BREAKER IS CLOSED MOMENTARILY, AND THE ORIGINAL BREAKER IS OPENED IMMEDIATELY AFTER THE TRANSFER IS COMPLETE.

CONSTRUCTION NOTE

4. UPDATE RELAY-METERING SINGLE LINE DIAGRAM TO MATCH AS-CONFIRMED OR AS-BUILT SWITCHGEAR VENDOR SUBMITTAL.

## SHEET KEYNOTES

BID NOTE:

A. CONTROL POWER TRANSFORMER (CPT) BE PROVIDED FOR BOTH MAIN BREAKERS WITH RETURN TO NORMAL POWER - AUTO TRANSFER RELAY TO TRANSFER CONTROL POWER FROM NORMAL MAIN TO ALTERNATE MAIN. ORO HONDO SUBSTATION FEED IS NORMAL FEED.

B. IN-LIEU OF MAKING DIRECT CONNECTION FROM SEL DEVICES TO SEL-3350, IT IS ACCEPTABLE TO USE SEL COMMUNICATION SWITCH FOR CONVENIENCE.

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



File Name: 24768-E-012.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

Title

SINGLE LINE DIAGRAM
12.47kV SWGR EQ-YSS04-01
SHEET 1 OF 2

Project No. 182924768 | Scale NO SCALE

Drawing No. 24768-E-012 | Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SLD\24768-E-012.DWG
12/12/2025 10:11 AM

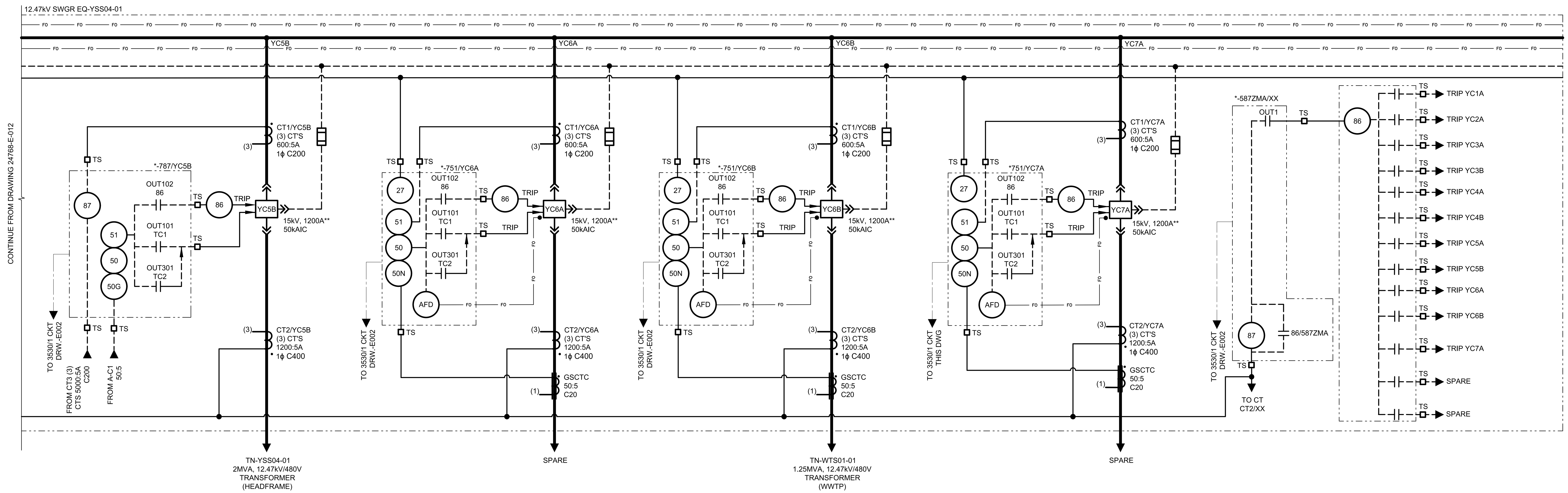
ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 10:10:34 AM By: smohite

## GENERAL SHEET NOTES

CONSTRUCTION NOTE

1. UPDATE RELAY-METERING SINGLE LINE DIAGRAM TO MATCH AS-CONFIRMED OR AS-BUILT SWITCHGEAR VENDOR SUBMITTAL.




ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH KRIPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-013.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title

SINGLE LINE DIAGRAM
12.47kV SWGR EQ-YSS04-01
SHEET 2 OF 2

Project No. 182924768 | Scale NO SCALE

Drawing No. 24768-E-013 | Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SLD\24768-E-013.DWG
12/12/2025 10:11 AM

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 10:11:37 AM By: smohite

## SHEET KEYNOTES

CONSTRUCTION NOTES (CN):

CN1. CONTRACTOR TO CONFIRM THE BUS AND MAIN BREAKER RATING OF THE 480V PANEL IN CRUSHER BUILDING; IF THE BUS AND MAIN BREAKER IS LESS THAN 800A AND 600A RESPECTIVELY THEY SHOULD BE REPLACED DURING PHASE I. PANEL SHOULD BE RETAIN TO BE REUSED OR HAND IT OVER TO SDSTA TEAM.

CN2. CONTRACTOR TO CONFIRM THE BUS AND MAIN BREAKER RATING OF THE 480V PANEL IN HEADFRAME BUILDING; UPDATE THE BREAKER AND CABLE DURING PHASE I.

| | | | | | |
|---|---|---|---|---|---|
| PANELBOARD: | EQ-YSS04-02 | BUS AMPS: | 2500 | VOLTS: | 480 |
| LOCATION: | CRUSHER BUILDING | MAIN BKR AMPS: | 2000 | PHASE: | 3 |
| MOUNTING: | FLOOR MOUNTED | | | WIRE: | 4 |

| LOAD DESCRIPTION | KVA A | KVA B | KVA C | CKT CTO | BKR INT | | BKR INT | CKT CTO | KVA A | KVA B | KVA C | LOAD DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TN-YSS12-02 ADMIN BUILDING TRANSFORMER | 75.0 | | | 1 | 350A/3P | | 600A/3P | 2 | 166.67 | | | EXISTING 480V PANEL IN CRUSHER BUILDING CN1 |
| | | 75.0 | | 3 | | | | 4 | | 166.67 | | |
| | | | 75.0 | 5 | | | | 6 | | | 166.67 | |
| SPARE | 0.0 | | | 7 | 20/3P | | 600A/3P | 8 | 133.33 | | | CN2 HEADFRAME 480V PANEL |
| | | 0.0 | | 9 | | | | 10 | | 133.33 | | |
| | | | 0.0 | 11 | | | | 12 | | | 133.33 | |
| SPARE | 0.0 | | | 13 | 20/3P | | 20/3P | 14 | 0.0 | | | SPARE |
| | | 0.0 | | 15 | | | | 16 | | 0.0 | | |
| | | | 0.0 | 17 | | | | 18 | | | 0.0 | |
| SPARE | 0.0 | | | 19 | 20/3P | | 20/3P | 20 | 0.0 | | | SPARE |
| | | 0.0 | | 21 | | | | 22 | | 0.0 | | |
| | | | 0.0 | 23 | | | | 24 | | | 0.0 | |
| SPACE | 0.0 | | | 25 | | | | 26 | 0.0 | | | SPACE |
| | | 0.0 | | 27 | | | | 28 | | 0.0 | | |
| | | | 0.0 | 29 | | | | 30 | | | 0.0 | |
| SPACE | 0.0 | | | 31 | | | | 32 | 0.0 | | | SPACE |
| | | 0.0 | | 33 | | | | 34 | | 0.0 | | |
| | | | 0.0 | 35 | | | | 36 | | | 0.0 | |
| SPACE | 0.0 | | | 37 | | | | 38 | 0.0 | | | SPACE |
| | | 0.0 | | 39 | | | | 40 | | 0.0 | | |
| | | | 0.0 | 41 | | | | 42 | | | 0.0 | |
| | 75.0 | 75.0 | 75.0 | TOTAL | | | | | 300.0 | 300.0 | 300.0 | |
| | PHASE LOAD | | | TOTAL LOAD | | | | | | | | |
| | 375.0 | 375.0 | 375.0 | 1125.0 | KVA | | 1354.8 | Amps | | | | |

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec
3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

| File Name: | 24768-E-014.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|---|
| | | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
SWITCHBOARD EQ-YSS04-02 SCHEDULE

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-014
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 10:14:48 AM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEDULE\24768-E-014.DWG
12/12/2025 10:15 AM

N


FROM ORO HONDO SUBSTATION

0 60 120

## ELECTRICAL DEMOLITION PLAN

ISSUED FOR BID

## GENERAL SHEET NOTES

CONSTRUCTION NOTES:

1. ALL ABANDONED IN PLACE (AIP) CABLE AND EQUIPMENT SHALL BE PLACED IN SAFE AND DE-ENERGIZED CONDITION. CABLES OPEN ENDS SHALL BE CUT AND TAPED. ALL BREAKER SHALL BE DE-ENERGIZED AND REMOVED FROM THE BREAKER SLOTS OR COMPARTMENT.
2. ALL EXISTING EQUIPMENT REQUIRING REPLACEMENT AND IS INTERFERING OR OBSTRUCTING THE CONSTRUCTION OF YATES ELECTRICAL REHABILITATION PROJECT WILL BE DEMOLISHED REGARDLESS OF IT BEING MARKED ON DRAWINGS OR NOT. ALL REMAINING EQUIPMENT THAT IS GETTING REPLACED WILL BE ABANDONED IN PLACE AS INDICATED. ANY DEVIATION SHALL BE APPROVED BY SDSTA PRIOR TO PERFORMING THE ACTIVITY.

## SHEET KEYNOTES

CONSTRUCTION NOTES (CN):

CN1. 12.47KV SWITCHGEAR, 2400V SWITCHGEAR, ASSOCIATED TRANSFORMER AND CABLING SHALL REMAIN IN OPERATION TILL YATES HOIST UPGRADE PROJECT IS SUCCESSFULLY IMPLEMENTED.

CN2. DE-ENERGIZED OR UNUSED CABLES ROUTED IN TUNNEL ON THE HANGER SHOULD BE REMOVED AS NECESSARY TO SUPPORT INSTALLATION OF NEW CABLES DURING PHASE I.

CN3. E&O BUILDING SUB-STATION WILL REMAIN IN OPERATION TILL INSTALLATION AND COMMISSIONING OF NEW SWITCHGEAR, TRANSFORMER, SWITCHBOARD AND EXISTING PANEL LOCATED IN YATES HEADFRAME BUILDING DURING PHASE I. SDSTA TO DETERMINE THE DEMOLITION SCHEDULE FOR THE E&O SUBSTATION.

CN4. ADMIN BUILDING EXISTING OUTDOOR ELECTRICAL EQUIPMENT WILL REMAIN IN OPERATION TILL ALL NEW EQUIPMENT IN HEADFRAME BUILDING ARE COMMISSIONED DURING PHASE I, EXISTING CABLE FROM THE TRANSFORMER TO THE PANEL INSIDE THE ADMIN BUILDING WILL BE REUSED FOR RE-FEEDING, PROPER CAUTIONARY MEASURES NEEDS TO BE ADHERED TO DURING DEMOLITION.

CN5. DURING PHASE II, MAIN FEEDER CABLES AND FEEDS TO THE WWTP SHALL BE MEGGER TESTED. IF THE CABLE TEST RESULTS ARE GREATER THAN 100 MEGAOHMS THEN PULL THE CABLES BACK TO THE VAULT FOR RE-FEEDING AND POWER PURPOSE. IF THE CABLE FAILS, CONTACT SDSTA ENGINEERING FOR FURTHER DIRECTION. IF THE CABLE FEEDING THE WWTP ARE NOT PASSING THROUGH THE EXISTING VAULT, THE WWTP FEED TO COMPRESSOR BUILDING SHALL BE RE-ROUTED TO THE EXISTING VAULT VIA MODIFICATION TO THE EXISTING CONDUIT (DIRECT BURIED) ROUTE. CABLE FEEDING YATES HOIST BUILDING SHALL BE AIP.

CN6. OVERHEAD LINE AND ASSOCIATED TRANSFORMER TO WWTP WILL REMAIN IN OPERATION TILL THE DIRECT BURIED CONDUIT AND NEW TRANSFORMER FOR THE NEW FEED TO WWTP IS IN PLACE AND READY FOR OPERATION DURING PHASE III.

CN7. SEE SDSTA DRAWING EE0730 FOR DUCT BANK ALIGNMENT AND MANHOLE LOCATION.

CN8. SEE WPE DRAWING U07010E1-E3 ELECTRICAL SITE PLAN.

CN9. CABLES FOR YS01 AND YS02 CURRENTLY ROUTED IN THE TRAMWAY WILL BE PULLED BACK BY THE SDSTA TEAM OR THEIR DESIGNEE TO THE YATES SHAFT UTILITY COMPARTMENT AND ROUTED TO THE YATES CRUSHER SWITCHGEAR EQ-YSS04-01 BETWEEN THE ENDS OF PHASE I AND PHASE II.

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-ED100.DWG
12/12/2025 10:17 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-ED100.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
ELECTRICAL DEMOLITION PLAN

Project No. 182924768
Scale AS SHOWN

Drawing No. 24768-ED100
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/10/2025 1:31:17 PM By: smohite

N

## GENERAL SHEET NOTES

CONSTRUCTION NOTES:

1. ALL ABANDONED IN PLACE (AIP) CABLE AND EQUIPMENT SHALL BE PLACED IN SAFE AND DE-ENERGIZED CONDITION. CABLES OPEN ENDS SHALL BE CUT AND TAPPED. ALL BREAKER SHALL BE DE-ENERGIZED AND REMOVED FROM THE BREAKER SLOTS OR COMPARTMENT.
2. ALL EXISTING EQUIPMENT REQUIRING REPLACEMENT AND IS INTERFERING OR OBSTRUCTING THE CONSTRUCTION OF YATES ELECTRICAL REHABILITATION PROJECT WILL BE DEMOLISHED REGARDLESS OF IT BEING MARKED ON DRAWINGS OR NOT. ALL REMAINING EQUIPMENT THAT IS GETTING REPLACED WILL BE ABANDONED IN PLACE AS INDICATED. ANY DEVIATION SHALL BE APPROVED BY SDSTA PRIOR TO PERFORMING THE ACTIVITY.

## SHEET KEYNOTES

CONSTRUCTION NOTES (CN):

CN1. OVERHEAD LINE AND ASSOCIATED TRANSFORMER TO WWTP WILL REMAIN IN OPERATION TILL THE DIRECT BURIED CONDUIT AND NEW TRANSFORMER FOR THE NEW FEED TO WWTP IS IN PLACE AND READY FOR OPERATION DURING PHASE III.

CN2. SEE WPE DRAWING U07010E1-E3 ELECTRICAL SITE PLAN.


FROM YATES COMPRESSOR SWITCHGEAR

ELECTRICAL DEMOLITION PLAN WWTP AREA

0 60 120

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title | Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| | | 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-ED101.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
ELECTRICAL DEMOLITION PLAN WWTP AREA

Project No. 182924768

Scale AS SHOWN

Drawing No. 24768-ED101

Revision 1

Dwg Updated: 12/9/2025 1:39:20 PM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-ED101.DWG
12/12/2025 10:17 AM

ORIGINAL SHEET - ARCH D

N


FROM ORO HONDO SUBSTATION

0 60 120

ELECTRICAL SITE PLAN

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-100.DWG
12/12/2025 10:20 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.
The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-100.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
ELECTRICAL SITE PLAN

Project No. 182924768
Scale AS SHOWN

Drawing No. 24768-E-100
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 10:19:57 AM By: smohite

## SHEET KEYNOTES

CONSTRUCTION NOTES (CN):

CN1. PARALLEL SET OF NEW CABLE SHALL BE ROUTED FROM THE NEW TRANSFORMER TO THE EXISTING JUNCTION BOX DURING PHASE III. PARALLEL CABLE RUN SHALL MATCH (COUNT AND SIZE) THE EXISTING RUN FROM THE EXISTING JUNCTION BOX TO THE EXISTING MCC.

CN2. NEW CABLES FROM THE TRANSFORMER 480V SIDE SHALL BE TERMINATED WITH OR SPLICED TO THE EXISTING CABLE IN THE EXISTING JUNCTION BOX DURING PHASE III.

CN3. ALL MANHOLES ARE NOT SHOWN FOR THIS RUN. MANHOLE SHALL BE PLACED AT EVERY 500 FEET DURING PHASE III. ALL NEW MANHOLES SHALL BE INSTALLED AS PER DETAIL E-901 ON SHEET 24768-E-003.

CN4. OVERHEAD LINE AND ASSOCIATED TRANSFORMER TO WWTP WILL REMAIN IN OPERATION TILL THE DIRECT BURIED CONDUIT AND NEW TRANSFORMER FOR THE NEW FEED TO WWTP IS IN PLACE AND READY FOR OPERATION DURING PHASE III.

## GENERAL SHEET NOTES

1. "*" DENOTES '24768-'.

## SHEET KEYNOTES

A. IF DIRECT BURIED CONDUIT AS SHOWN IN DETAIL A IS NOT FEASIBLE, IT IS ACCEPTABLE TO INSTALL TRENCH PER DETAIL E-926 WITH VENTILATED STEEL COVER OR HS20 DEPENDING ON TRAFFIC MOVEMENT IN THE AREA.

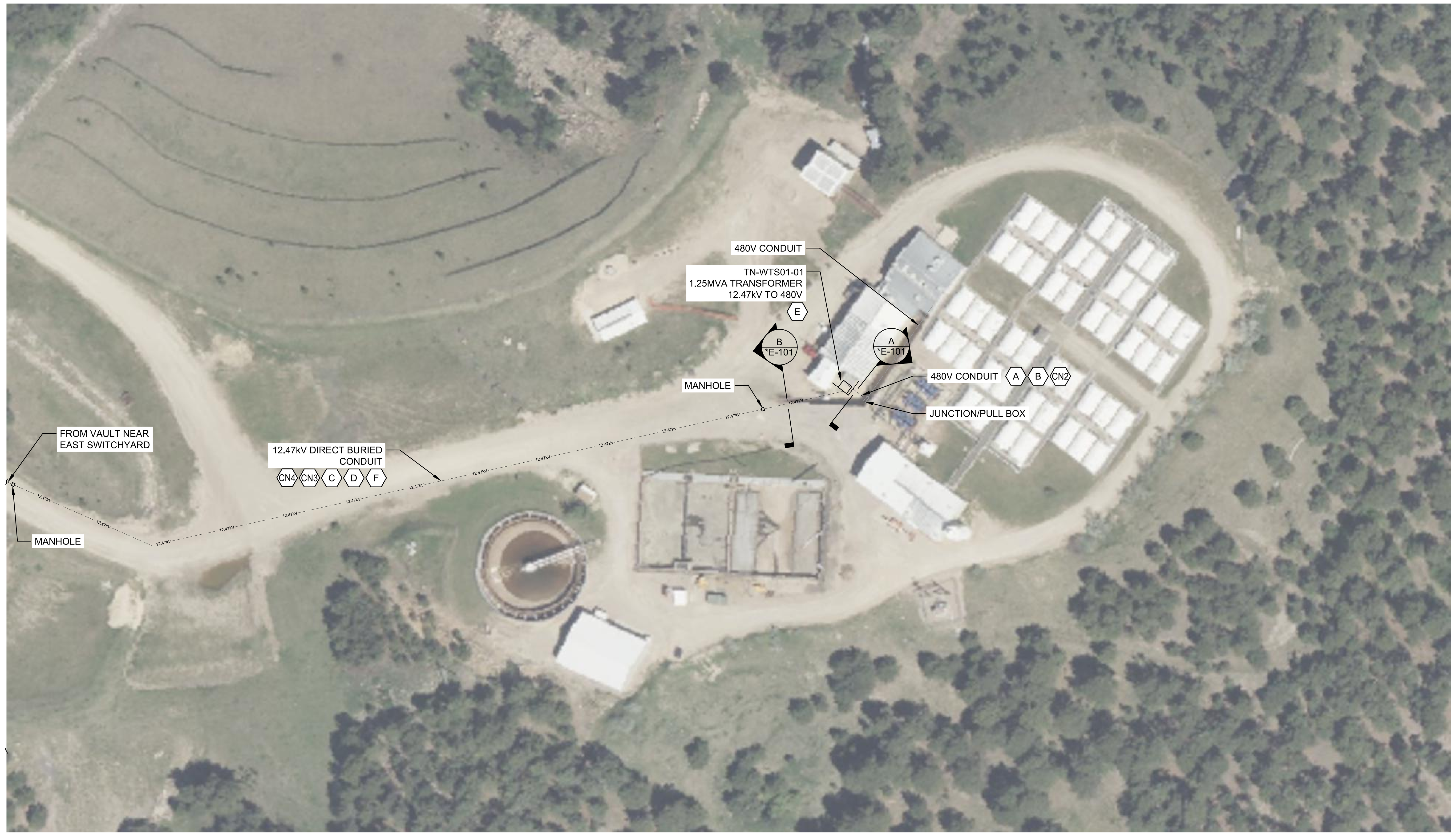
B. NEW CABLES FROM THE TRANSFORMER 480V SIDE SHALL BE TERMINATED WITH OR SPLICED TO THE EXISTING CABLE IN THE EXISTING JUNCTION BOX DURING PHASE III.

C. ALL MANHOLES ARE NOT SHOWN FOR THIS RUN. MANHOLE SHALL BE PLACED AT EVERY 500 FEET DURING PHASE III. ALL NEW MANHOLES SHALL BE INSTALLED AS PER DETAIL E-901 ON SHEET 24768-E-003.

D. OVERHEAD LINE AND ASSOCIATED TRANSFORMER TO WWTP WILL REMAIN IN OPERATION TILL THE DIRECT BURIED CONDUIT AND NEW TRANSFORMER FOR THE NEW FEED TO WWTP IS IN PLACE AND READY FOR OPERATION DURING PHASE III.

E. REFER DETAIL '7' ON SHEET 24768-E-108 FOR WWTP TRANSFORMER.

F. REFER DETAIL E-927 ON SHEET 24768-E-005 FOR TYPICAL DIRECT BURIED CONDUIT INSTALLATIONS.




ELECTRICAL SITE PLAN WWTP AREA

A1 A2 A3 A4
A5 A6 A7 A8

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE CN1 | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| A1 | 5P/I | TNWTS0101-LV1 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A2 | 5P/I | TNWTS0101-LV2 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A3 | 5P/I | TNWTS0101-LV3 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A4 | 5P/I | TNWTS0101-LV4 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A5 | 5P/I | TNWTS0101-LV5 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A6 | 5P/I | TNWTS0101-LV6 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | TN-WTS01-01 | JUNCTION BOX | 20 |
| A7 | 5P | SPARE | | TN-WTS01-01 | JUNCTION BOX | 20 |
| A8 | 5P | SPARE | | TN-WTS01-01 | JUNCTION BOX | 20 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

A
*E-101
SECTION - A

B1 B2
B3 B4

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| B1 | 4P | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15KV MV-105, 133% NL-EPR, PVC | VAULT (NEAR EAST SWITCHYARD) | TN-WTS01-01 | 2024 |
| B2 | 4P | POWER SPARE | | VAULT (NEAR EAST SWITCHYARD) | TN-WTS01-01 | 2024 |
| B3 | 4P | SPARE | | VAULT (NEAR EAST SWITCHYARD) | TN-WTS01-01 | 2024 |
| B4 | 4P | FIBER SPARE | | VAULT (NEAR EAST SWITCHYARD) | TN-WTS01-01 | 2024 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

B
*E-101
SECTION - B

0 60 120

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-101.DWG
12/12/2025 10:20 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH
ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

| File Name: 24768-E-101.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
ELECTRICAL SITE PLAN WWTP AREA

Project No. 182924768
Scale AS SHOWN

Drawing No. 24768-E-101
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 4:49:17 PM By: smohite

N

## SHEET KEYNOTES

CONSTRUCTION NOTES (CN):

CN1. PULL BACK 500KCMIL CABLES FROM SWITCHGEAR IN EAST SWITCHYARD TO EXISTING VAULT DURING PHASE II.

CN2. TWO NEMA 4X JUNCTION BOX BE INSTALLED IN EXISTING VAULT DURING PHASE II. SEE GENERAL SHEET NOTE 3 FOR ADDITIONAL DETAIL.

## GENERAL SHEET NOTES

1. "*" DENOTES '24768-'.
2. PULL BACK 500KCMIL CABLES FROM SWITCHGEAR IN EAST SWITCHYARD TO EXISTING VAULT DURING PHASE II.
3. TWO NEMA 4X JUNCTION BOX BE INSTALLED IN EXISTING VAULT DURING PHASE II.
   - I. BOX 1 WILL HAVE 1ST - SET OF EXISTING 500KCMIL CABLE SPLICED WITH CABLE B1 FOR FEEDING FOUNDRY BUILDING.
   - II BOX 1 WILL HAVE 2ND - SET OF EXISTING 500KCMIL CABLE SPLICED WITH CABLE B2 FOR FEEDING CONVEYOR BUILDING.
   - III. BOX2 WILL HAVE CABLE H8 ROUTED IN EXISTING DUCT BANK FROM HEAD CRUSHER BUILDING SPLICED TO CABLE POWERING THE WWTP VIA COMPRESSOR BUILDING.

## SHEET KEYNOTES

A. SEE DETAIL B ON E-101 FOR DIRECT BURIED CONDUIT DETAIL.

B. CENTER LINE OF THE DUCT BANK SHALL BE MINIMUM 6'FT AWAY FROM THE EDGE OF THE SLOPE. IF NECESSARY MOVE THE DUCT BANK A FOOT OR SO TO THE INTERIOR EDGE OF THE ROAD.

C. REFER DETAIL '6' ON SHEET 24768-E-108 FOR FOUNDRY TRANSFORMER.

D. REFER DETAIL E-927 ON SHEET 24768-E-005 FOR TYPICAL DIRECT BURIED CONDUIT INSTALLATIONS.

E. REFER DETAIL E-902 ON SHEET 24768-E-003 FOR TYPICAL DUCTBANK.

F. REFER TO NOTES ON SHEET 24768-E-011 FOR ADDITIONAL DETAIL.


CONTINUED TO SHEET 24768-E-104

CONTINUED TO SHEET 24768-E-103

### EAST SWITCHYARD AND FOUNDRY BUILDING AREA ELECTRICAL PLAN

C1 C2
C3 C4

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| C1 | 4P | TNCNVYOR-MV2 | 3/C #2AWG w/ #6 GND, 15kV MV-105, 133% NL-EPR, PVC | TUNNEL | VAULT | 365 |
| C2 | 4P | FIBER SPARE | | TUNNEL | VAULT | 365 |
| C3 | 4P | SPARE | | TN-YSS08-03 | VAULT | 355 |
| C4 | 4P | TNYSS0803-MV2 | 3/C #2AWG w/ #6 GND, 15kV MV-105, 133% NL-EPR, PVC | TN-YSS08-03 | VAULT | 355 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

C *E-102 SECTION - C

D1 D2 D3 D4
D5 D6 D7 D8

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| D1 | 5P/I | TNYSS0803-LV1 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D2 | 5P/I | TNYSS0803-LV2 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D3 | 5P/I | TNYSS0803-LV3 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D4 | 5P/I | TNYSS0803-LV4 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D5 | 5P/I | TNYSS0803-LV5 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D6 | 5P/I | TNYSS0803-LV6 | 3-1/C #500KCMIL W/ #2 GND, 600V XLPE XHHW-2 PVC TYPE TC-ER | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D7 | 5P | SPARE | | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |
| D8 | 5P | SPARE | | SWITCHBOARD (FOUNDRY BLDG) | TN-YSS08-03 | 30 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

D *E-102 SECTION - D

0 24 48

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO. 17397
SAURABH ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-102.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title

GENERAL ARRANGEMENT
EAST SWITCHYARD AND FOUNDRY BUILDING
AREA ELECTRICAL PLAN

Project No. 182924768
Scale AS SHOWN

Drawing No. 24768-E-102
Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-102.DWG
12/12/2025 11:47 AM

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/12/2025 10:22:24 AM By: smohite

CONTINUED TO SHEET 24768-E-102


CONTINUED TO SHEET 24768-E-104

FROM ORO HONDO SUBSTATION

## HEADFRAME, E&O AND ADMIN BUILDING AREA ELECTRICAL PLAN

## GENERAL SHEET NOTES

1. "*" DENOTES '24768-'.

## SHEET KEYNOTES

A. SEE HDR AS-BUILT DRAWINGS FROM "REPLACE POWER CABLE TO EAST SWITCHYARD PROJECT" FOR POLE LOCATION.

CONSTRUCTION NOTES (CN):

CN1. EXISTING CABLE SECURED AT THE ADMIN BUILDING SHALL BE REROUTED TO THE NEW TRANSFORMER DURING PHASE I; THEREFORE INSTALL THE TRANSFORMER SUCH THAT CABLES CAN REACH THE TRANSFORMER WITHOUT ANY SPLICE.

CN2. DURING PHASE I, PULL BACK 480V METAL CLAD CABLE BACK FROM THE E&O SUBSTATION AND RE-ROUTE IT TO THE NEW 225kVA - 480 - 120/208Y DRY TYPE TRANSFORMER LOCATED OUTSIDE E&O BUILDING. IF CABLE IS NOT LONG ENOUGH IT IS ACCEPTABLE TO PERFORM INLINE SPLICE OR A USING TERMINATION BOX FOR EXTENDING THE CABLE AS NECESSARY. LOCATE THE TRANSFORMER, WHERE FEASIBLE. THE TRANSFORMER SHOULD BE LOCATED IN E&O SUBSTATION AFTER DEMOLITION OR TO BE LOCATED AT PAD AS TRANSFORMER.

CN3. DURING PHASE I, PARALLEL RUN OF #2/0 AWG FEEDER CABLES SHALL BE ROUTED FROM YATES CRUSHER SWITCHGEAR EQ-YSS04-01 TO YATES MG SET ROOM BASEMENT THROUGH THE TUNNEL. CONTRACTOR SHALL COIL 250FT OF CABLE IN THE MG SET BASEMENT TO ALLOW FOR THE ROUTING OF THE CABLE FOR HOIST UPGRADE WITHOUT ANY CABLE SPLICES. CABLES ON BOTH THE END SHALL HAVE PROTECTIVE CAP OR BOOT INSTALLED TO PREVENT MOISTURE OR CONTAMINANTS FROM ENTERING THE CABLE CORES. BOTH CABLES ON SWITCHGEAR END SHALL BE TRAINED TO PREVENT IT FOR ACCIDENTALLY TOUCHING ANY LIVE COMPONENTS OR BREAKER TERMINALS. CABLES IN MG SET BASEMENT SHALL BE SUPPORTED AND TRAINED TO EXISTING HANGERS/SUPPORT FOR THE FULL LENGTH OF THE EXTRA LENGTH TO PREVENT THE CABLE FROM DAMAGE DURING NORMAL OPERATION AND FUTURE CONSTRUCTIONS.

CN4. ALL CABLES STUBBING UP OUTSIDE THE CRUSHER BUILDING SHALL BE ROUTED TO THE NEW SWITCHGEAR AS NECESSARY DURING PHASE I AND PHASE II.

E1 E2

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| E1 | 4P | TNYSS1202-LV | 7-1/C #4/0AWG, 600V XHHW-2, XLPE | STUB-UP | CRUSHER BUILDING | 41 |
| E2 | 4P | SPARE | | STUB-UP | CRUSHER BUILDING | 41 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

### E *E-103 SECTION - E

F1

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| F1 | 4I | TNYSS1202-LV | 7-1/C #4/0AWG, 600V XHHW-2, XLPE | TN-YSS12-02 | STUB-UP | 34 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

### F *E-103 SECTION - F

G1 G2 G3 G4
G5 G6 G7 G8
CN4

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| G1 | 6P | EQYSS0401-MV1 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G2 | 6P | EQYSS0401-MV2 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G3 | 6P | SPARE | | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G4 | 6P | SPARE | | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G5 | 4P | FIBER SPARE | | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G6 | 4P | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15KV MV-105, 133% NL-EPR, PVC | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G7 | 4P | TNYSS0803-MV1 | 3/C #3/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |
| G8 | 4P | TNCNVYOR-MV1 | 3/C #3/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC | CRUSHER BLDG EXT. STUBUP | MANHOLE MH1 | 101 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

### G *E-103 SECTION - G

H1 H2 H3 H4
H5 H6 H7 H8

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| H1 | 6P | EQYSS0401-MV1 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | UTILITY POLE | 5 |
| H2 | 6P | EQYSS0401-MV2 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | UTILITY POLE | 5 |
| H3 | 6P | SPARE | | MANHOLE MH1 | STUB UP BY POLE | 5 |
| H4 | 6P | SPARE | | MANHOLE MH1 | STUB UP BY POLE | 5 |
| H5 | 4P | FIBER SPARE | | MANHOLE MH1 | DUCK BANK SPARE CONDUIT | 5 |
| H6 | 4P | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15KV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | DUCK BANK SPARE CONDUIT | 5 |
| H7 | 4P | TNYSS0803-MV1 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | DUCK BANK SPARE CONDUIT | 5 |
| H8 | 4P | TNCNVYOR-MV1 | 3/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | DUCK BANK SPARE CONDUIT | 5 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

### H *E-103 SECTION - H

0 24 48

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH
ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-103.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
HEADFRAME, E&O AND ADMIN BUILDING
AREA ELECTRICAL PLAN

Project No. 182924768
Scale AS SHOWN

Drawing No. 24768-E-103
Revision 1

Dwg Updated: 12/9/2025 2:14:44 PM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-103.DWG
12/12/2025 10:22 AM

ORIGINAL SHEET - ARCH D


## HOIST BUILDING AREA ELECTRICAL PLAN

## GENERAL SHEET NOTES

1. "*" DENOTES '24768-'.

## SHEET KEYNOTES

A. WORK TO BE PERFORMED AND COMPLETED BY YATES HOIST UPGRADE PROJECT.

B. REFER DETAIL 'A' FOR EXISTING DUCT BANK ON DRAWING 24768-E-107.

C. REFER DETAIL E-927 ON SHEET 24768-E-005 FOR TYPICAL DIRECT BURIED CONDUIT INSTALLATIONS.

CONSTRUCTION NOTE (CN):

CN1. DURING PHASE I, PARALLEL RUN OF #2/0 AWG FEEDER CABLES SHALL BE ROUTED FROM YATES CRUSHER SWITCHGEAR EQ-YSS04-01 TO YATES MG SET ROOM BASEMENT THROUGH THE TUNNEL. CONTRACTOR SHALL COIL 250FT OF CABLE IN THE MG SET BASEMENT TO ALLOW FOR THE ROUTING OF THE CABLE FOR HOIST UPGRADE WITHOUT ANY CABLE SPLICES. CABLES ON BOTH THE END SHALL HAVE PROTECTIVE CAP OR BOOT INSTALLED TO PREVENT MOISTURE OR CONTAMINANTS FROM ENTERING THE CABLE CORES. BOTH CABLES ON SWITCHGEAR END SHALL BE TRAINED TO PREVENT IT FOR ACCIDENTALLY TOUCHING ANY LIVE COMPONENTS OR BREAKER TERMINALS. CABLES IN MG SET BASEMENT SHALL BE SUPPORTED AND TRAINED TO EXISTING HANGERS/SUPPORT FOR THE FULL LENGTH OF THE EXTRA LENGTH TO PREVENT THE CABLE FROM DAMAGE DURING NORMAL OPERATION AND FUTURE CONSTRUCTIONS.

| | |
|---|---|
| K1 | K2 |
| K3 | K4 |

B

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| K1 | 6P | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15kV MV-105, 133% NL-EPR, PVC | MANHOLE MH1 | MANHOLE MH2 | 381 |
| K2 | 6P | SPARE | | MANHOLE MH1 | MANHOLE MH2 | 381 |
| K3 | 6P | TNYSS0803-MV1 | 3/C #500KCMIL W/ #2 GND, 15kV MV-105, 133% NL-EPR, PVC (EXISTING) | MANHOLE MH1 | MANHOLE MH2 | 381 |
| K4 | 6P | TNCNVYOR-MV2 | 3/C #500KCMIL W/ #2 GND, 15kV MV-105, 133% NL-EPR, PVC (EXISTING) | MANHOLE MH1 | MANHOLE MH2 | 381 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

K *E-104 SECTION - K

| | |
|---|---|
| J1 | J2 |
| J3 | J4 |

B

| CONDUIT ID | CONDUIT SIZE | CABLE TAG | CABLE SIZE | TO EQUIPMENT | FROM EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| J1 | 6P | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15kV MV-105, 133% NL-EPR, PVC | MANHOLE MH2 | EAST SWITCHYARD VAULT | 226 |
| J2 | 6P | SPARE | | MANHOLE MH2 | EAST SWITCHYARD VAULT | 226 |
| J3 | 6P | TNYSS0803-MV1 | 3/C #500KCMIL W/ #2 GND, 15kV MV-105, 133% NL-EPR, PVC (EXISTING) | MANHOLE MH2 | EAST SWITCHYARD VAULT | 226 |
| J4 | 6P | TNCNVYOR-MV2 | 3/C #500KCMIL W/ #2 GND, 15kV MV-105, 133% NL-EPR, PVC (EXISTING) | MANHOLE MH2 | EAST SWITCHYARD VAULT | 226 |

WHERE :
P - PVC CONDUIT
I - RGS RISER

J *E-104 SECTION - J

0 24 48

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-104.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title

GENERAL ARRANGEMENT
HOIST BUILDING AREA ELECTRICAL PLAN

Project No. 182924768
Scale AS SHOWN
Drawing No. 24768-E-104
Revision 1

Dwg Updated: 12/9/2025 4:43:08 PM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-104.DWG
12/12/2025 10:23 AM

ORIGINAL SHEET - ARCH D

## SHEET KEYNOTE

CONSTRUCTION NOTES (CN):

CN1. DURING PHASE I, CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGNING THE SECONDARY CONTAINMENT BASED ON INDUSTRY STANDARD PRACTICE FOR THE LIQUID VOLUME IN THE TRANSFORMER. DESIGN DETAIL SHALL BE PROVIDED TO SDSTA TEAM FOR APPROVAL PRIOR TO INSTALLATION.

CN2. DURING PHASE I, PARALLEL RUN OF #2/0 AWG FEEDER CABLES SHALL BE ROUTED FROM YATES CRUSHER SWITCHGEAR EQ-YSS04-01 TO YATES MG SET ROOM BASEMENT THROUGH THE TUNNEL. CONTRACTOR SHALL COIL 250FT OF CABLE IN THE MG SET BASEMENT TO ALLOW FOR THE ROUTING OF THE CABLE FOR HOIST UPGRADE WITHOUT ANY CABLE SPLICES. CABLES ON BOTH THE END SHALL HAVE PROTECTIVE CAP OR BOOT INSTALLED TO PREVENT MOISTURE OR CONTAMINANTS FROM ENTERING THE CABLE CORES. BOTH CABLES ON SWITCHGEAR END SHALL BE TRAINED TO PREVENT IT FOR ACCIDENTALLY TOUCHING ANY LIVE COMPONENTS OR BREAKER TERMINALS. CABLES IN MG SET BASEMENT SHALL BE SUPPORTED AND TRAINED TO EXISTING HANGERS/SUPPORT FOR THE FULL LENGTH OF THE EXTRA LENGTH TO PREVENT THE CABLE FROM DAMAGE DURING NORMAL OPERATION AND FUTURE CONSTRUCTIONS.

## SHEET KEYNOTE

A. FIELD ROUTE RGS CONDUIT FROM THE CABLE TRAY TO THE CONDUIT STUB-UP LOCATED OUTSIDE THE BUILDING, CONDUIT SHALL BE SIZE EITHER TO MATCH THE CONDUIT STUB UP OR TO MEET NEC CONDUIT FILL REQUIREMENT. IT IS ACCEPTABLE TO USE LB FITTING AND REDUCERS AS NECESSARY.

B. FIELD ROUTE RGS CONDUIT FROM THE CABLE TRAY TO YATES CRUSHER TRANSFORMER.

C. REFER DETAIL E-931 ON SHEET 24768-E-005 FOR CONCRETE CURB ON EXISTING SLAB.

D. FIELD TO ROUTE RGS CONDUIT FROM CABLE TRAY TO CRUSHER BUILDING POWER PANEL AND HEADFRAME BUILDING POWER PANEL RESPECTIVELY.

E. CABLE SHALL BE ROUTED IN TRIPLEX CONFIGURATION.

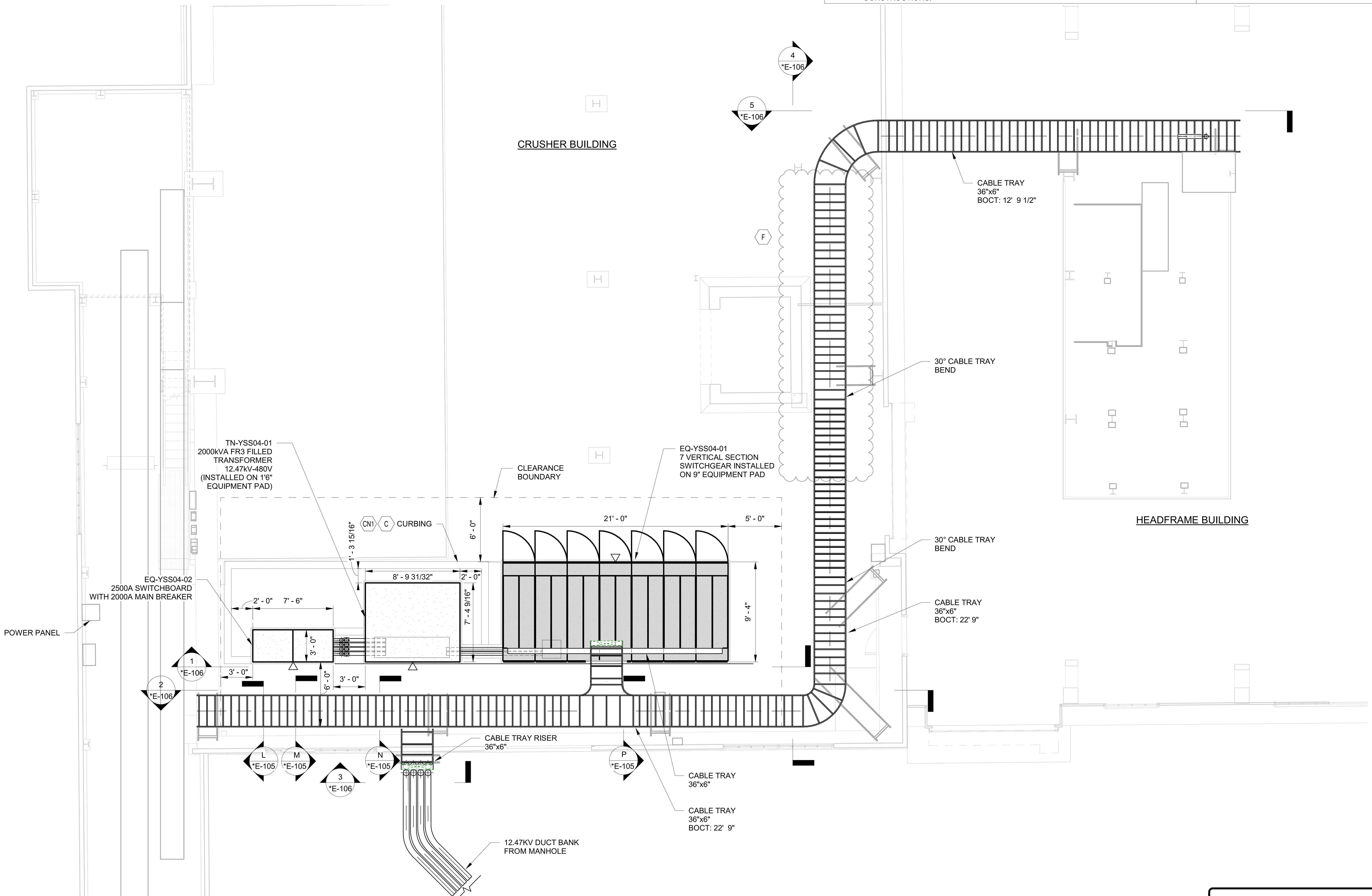
F. TRAY IN THE CLOUDED AREA IS SHOWN DIAGRAMMATICALLY ONLY, CONTRACTOR TO ADJUST CABLE TRAY TO AVOID INTERFERENCES IN CRUSHER BUILDING.

## GENERAL SHEET NOTE

1. '*' DENOTES '24768-'.
2. △ DENOTES FRONT OF THE EQUIPMENT.

CABLE NOTES:

3. SEE TRAY SECTION DETAIL L FOR CABLE LENGTH.
4. SINGLE LAYER CABLE TO BE ROUTED IN A TRIPLEX CONFIGURATION FOR THE CABLE TRAY, SEE NEC ARTICLE 392.
5. CABLE ROUTED IN RANDOM FILL CONFIGURATION FOR THE CABLE TRAY, SEE NEC ARTICLE 392.




## HEADFRAME/CRUSHER BUILDING ELECTRICAL PLAN

SCALE: 3/16" = 1'-0"

DIVIDER LA (24") | LB (12")

| TRAY SECTION | NO. | CABLE ID | CABLE DESCRIPTION | FROM EQUIPMENT | TO EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| LA | 1 | EQYSS0402-LV1 | 3-1/C #350KCMIL W/ #2 GND, 600V XHHW-2, XLPE | EQ-YSS04-02 | A STUB UP OUTSIDE BLDG | 50 |
| LA | 2 | EQYSS0402PPL-LV1 | 3-1/C #350KCMIL W/ #2AWG GND, 600V XHHW-2, XLPE | EQ-YSS04-02 | CRUSHER BUILDING POWER PANEL | 32 |
| LA | 3 | EQYSS0402PPL-LV2 | 3-1/C #350KCMIL W/ #2AWG GND, 600V XHHW-2, XLPE | EQ-YSS04-02 | HEADFRAME BLDG POWER PANEL | 145 |
| LB | | | NO CABLE | | | |

D E

### L DETAIL L
*E-105

DIVIDER MA (24") | MB (12")

| TRAY SECTION | NO. | CABLE ID | CABLE DESCRIPTION | FROM EQUIPMENT | TO EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| MA | | | NO CABLE | | | |
| MB | 1 | EQYSS04HDFRM-LV1 | 3/C #4/0AWG W/ #2 GND, 600V XHHW-2, XLPE | HEADFRAME TRANSFORMER | EQ-YSS04-02 | 20 |

B

### M DETAIL M
*E-105

DIVIDER NA (24") | NB (12")

| TRAY SECTION | NO. | CABLE ID | CABLE DESCRIPTION | FROM EQUIPMENT | TO EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| NA | 1 | EQYSS0401-MV1 | (3) 1/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 4) | EQ-YSS04-01 | CRUSHER BLDG EXT. STUB UP | 75 |
| NA | 2 | EQYSS0401-MV2 | (3) 1/C #500KCMIL W/ #2 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 4) | EQ-YSS04-01 | CRUSHER BLDG EXT. STUB UP | 75 |
| NA | 3 | TNWTS0101-MV1 | 3/C #2AWG W/ #6 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 5) | EQ-YSS04-01 | CRUSHER BLDG EXT. STUB UP | 75 |
| NA | 4 | TNYSS0803-MV1 | 3/C #3/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 5) | EQ-YSS04-01 | CRUSHER BLDG EXT. STUB UP | 75 |
| NA | 5 | TNCNVYOR-MV1 | 3/C #3/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 5) | EQ-YSS04-01 | CRUSHER BLDG EXT. STUB UP | 75 |
| NB | 1 | EQYSS04HDFRM-LV | 3-1/C #350KCMIL W/ #2AWG GND, 600V XHHW-2, XLPE | EQ-YSS04-02 | HEADFRAME BLDG POWER PANEL | NOTE 3 |

### N DETAIL N
*E-105

DIVIDER PA (24") | PB (12")

| TRAY SECTION | NO. | CABLE ID | CABLE DESCRIPTION | FROM EQUIPMENT | TO EQUIPMENT | LENGTH (FEET) |
|---|---|---|---|---|---|---|
| PA | 1 | EQYSS04EL1700-MV | 3/C 250 MCM HI-TENSILE VERLOK (NOTE 5) | EQ-YSS04-01 | EL1700 JUNCTION BOX | 145 |
| PA | 2 | EQYSS04EL4850-MV | 3/C 250 MCM HI-TENSILE VERLOK (NOTE 5) | EQ-YSS04-01 | EL 4850 ATS | 145 |
| PA | 3 | HOISTBLDGFD-MV1 | 3/C #2/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 4) | EQ-YSS04-01 | MG SET BASEMENT | 145 |
| PA | 4 | HOISTBLDGFD-MV2 | 3/C #2/0AWG W/ #4 GND, 15KV MV-105, 133% NL-EPR, PVC (NOTE 4) | EQ-YSS04-01 | MG SET BASEMENT | 145 |
| PB | 1 | EQYSS04HDFRM-LV | 3-1/C #350KCMIL W/ #2AWG GND, 600V XHHW-2, XLPE | EQ-YSS04-02 | HEADFRAME BLDG POWER PANEL | NOTE 3 |

CN2

### P DETAIL P
*E-105

**ISSUED FOR BID**

| Rev. | Description | Date | By | Chk | Eng | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

12/12/2025 10:48:16 AM

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: stn_182924768e-md.rvt

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
HEADFRAME/CRUSHER BUILDING
ELECTRICAL PLAN

Project No. 182924768

Scale 3/16" = 1'-0"

Drawing No. 24768-E-105

Revision 1

Dwg Updated: 12/12/2025 10:48:16 AM

## SHEET KEYNOTE

E. REFER TO NOTES ON SHEET 24768-E-105.

F. REFER TO DETAIL E-932 ON SHEET 24768-E-005 FOR TRAINING FOR CABLE ON VERTICAL RISER.

CONSTRUCTION NOTES (CN):

CN1. DURING PHASE I, FIELD ROUTE CONDUIT AS NECESSARY TO SUPPORT THE OUTGOING FEEDS FROM THE SWITCHBOARD. IN LIEU OF USING TRAY AS SHOWN ON SHEET 24768-E-105 DETAIL 'L', IT IS ACCEPTABLE TO ROUTE RGS CONDUIT FROM THE SWITCHBOARD TO THE LOADS IN CRUSHER BUILDING.

CN2. DURING PHASE I, FIELD ROUTE CONDUIT TO THE 480V DISTRIBUTION FOR THE HEADFRAME BUILDING AS NECESSARY.

CN3. DURING PHASE I, CONTRACTOR TO DESIGN THE VERTICAL RISER SUPPORT. SUPPORT SHALL BE DESIGN CONSIDERING FUTURE CAPACITY IN MIND.

## GENERAL SHEET NOTE

1. "*" DENOTES '24768-'.

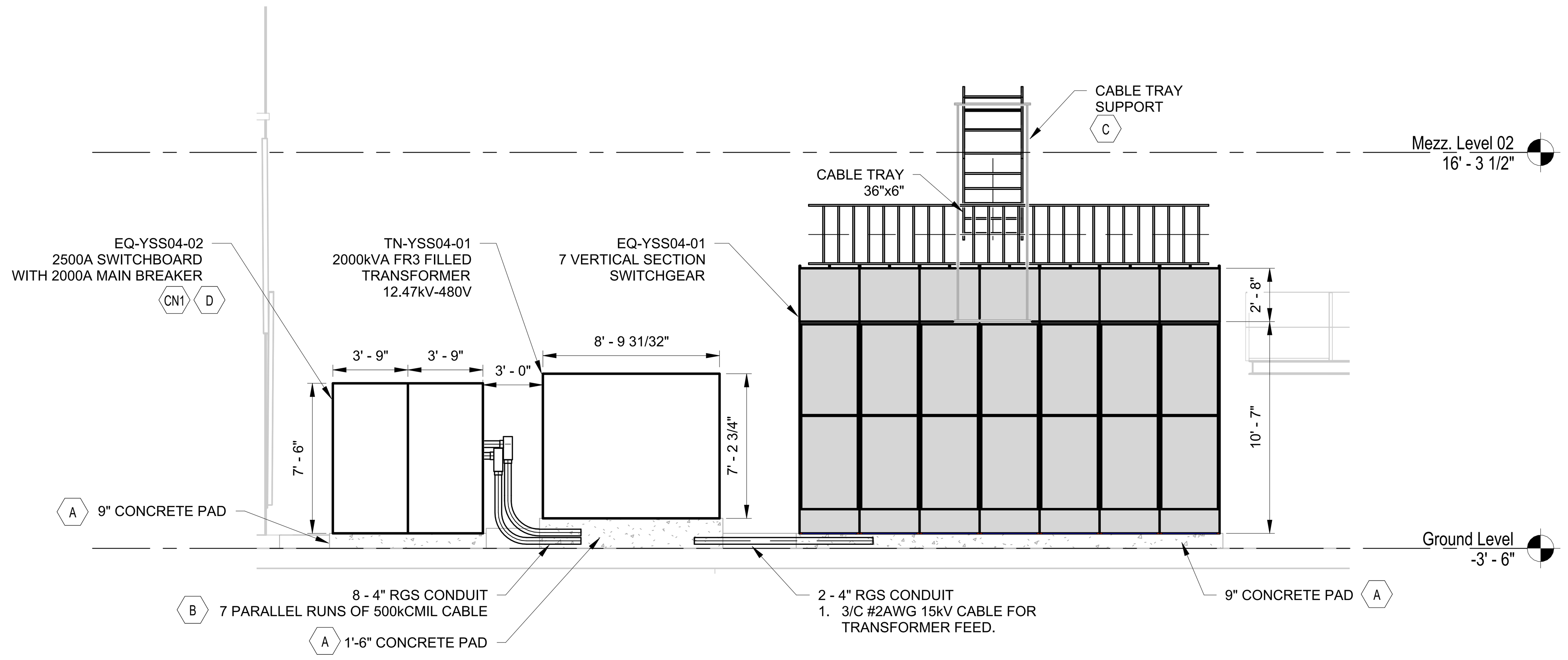
## SHEET KEYNOTE

A. REFER DETAIL E-929 ON SHEET 24768-E-005 FOR EQUIPMENT PAD ON SLAB.

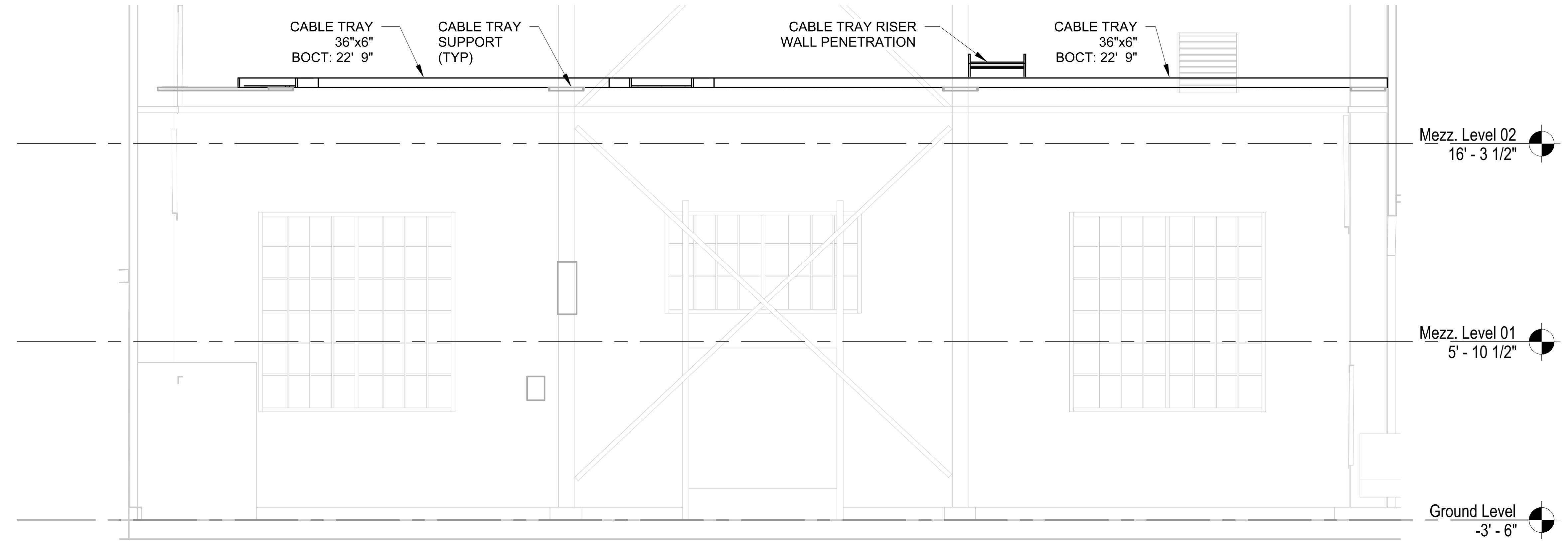
B. IN LIEU OF VERTICAL CONDUIT RISER, VENTILATED WIREWAY CAN BE USE TO ROUTE CABLE TO THE SWITCHBOARD. CONDUIT AND WIREWAY SHALL BE PROPERLY SUPPORTED.

C. CABLE TRAY SHALL BE SUPPORTED FROM THE SWITCHGEAR STRUCTURE. SWITCHGEAR MANUFACTURER SHALL BE CONSULTED PRIOR TO ATTACHING CABLE TRAY SUPPORT STRUCTURE ON THE SWITCHGEAR STRUCTURE.

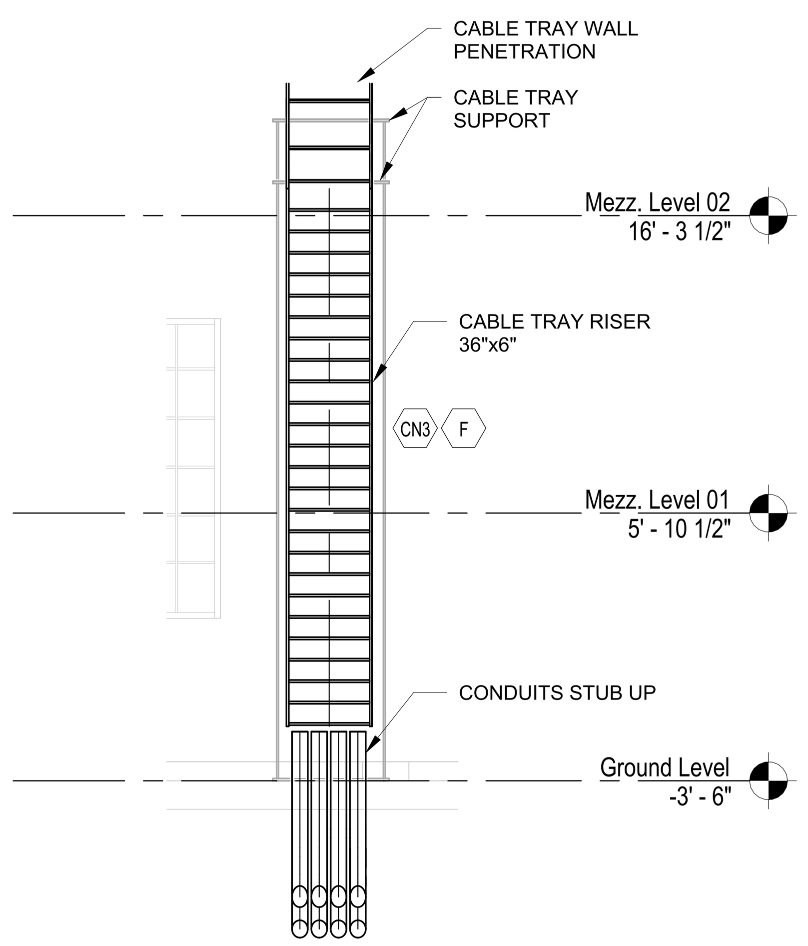
D. FIELD ROUTE CONDUIT AS NECESSARY TO SUPPORT THE OUTGOING FEEDS FROM THE SWITCHBOARD. IN LIEU OF USING TRAY AS SHOWN ON SHEET 24768-E-105 DETAIL 'L', IT IS ACCEPTABLE TO ROUTE RGS CONDUIT FROM THE SWITCHBOARD TO THE LOADS IN CRUSHER BUILDING.



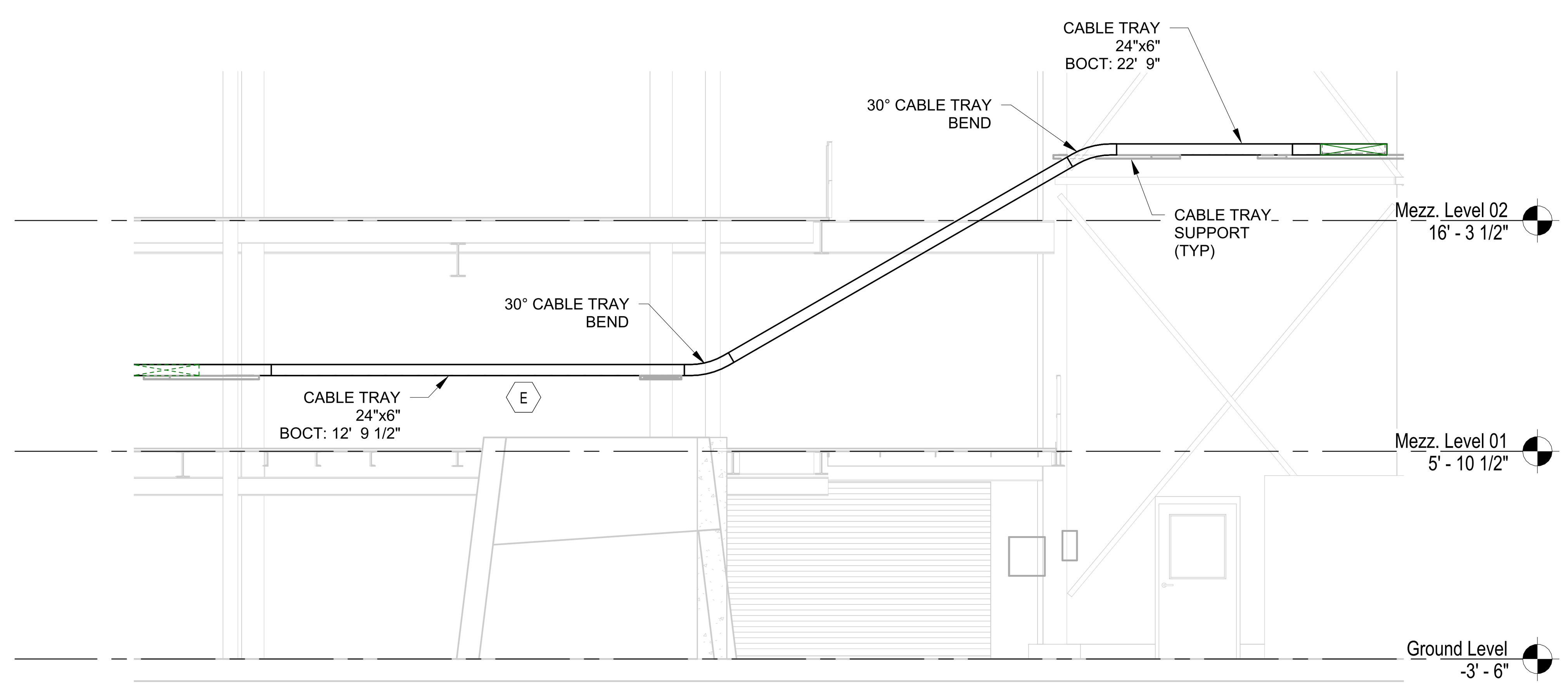

1 SECTION - 1
*E-106 SCALE: 3/16" = 1'-0"



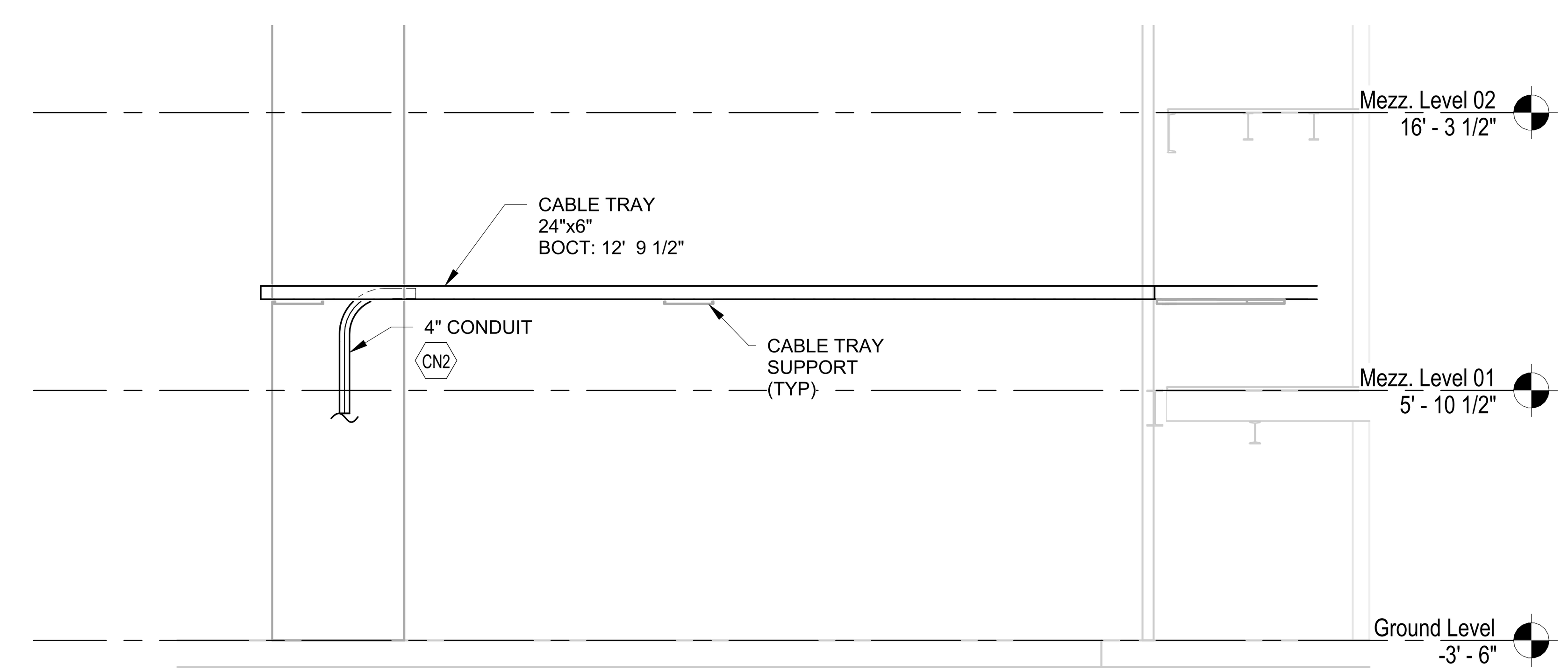

2 SECTION - 2
*E-106 SCALE: 3/16" = 1'-0"




3 SECTION - 3
*E-106 SCALE: 3/16" = 1'-0"




4 SECTION - 4
*E-106 SCALE: 3/16" = 1'-0"




5 SECTION - 5
*E-106 SCALE: 3/16" = 1'-0"

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: stn_182924768e-md.rvt | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title

GENERAL ARRANGEMENT
HEADFRAME/CRUSHER BUILDING
SECTIONS

Project No. 182924768 | Scale 3/16" = 1'-0"

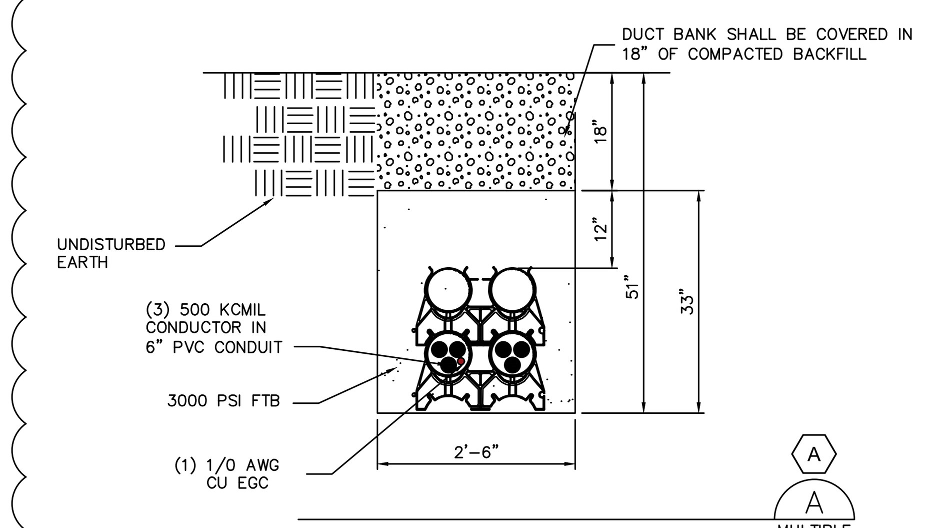
Drawing No. 24768-E-106 | Revision 1

12/12/2025 6:20:04 PM

Dwg Updated: 12/12/2025 6:20:04 PM

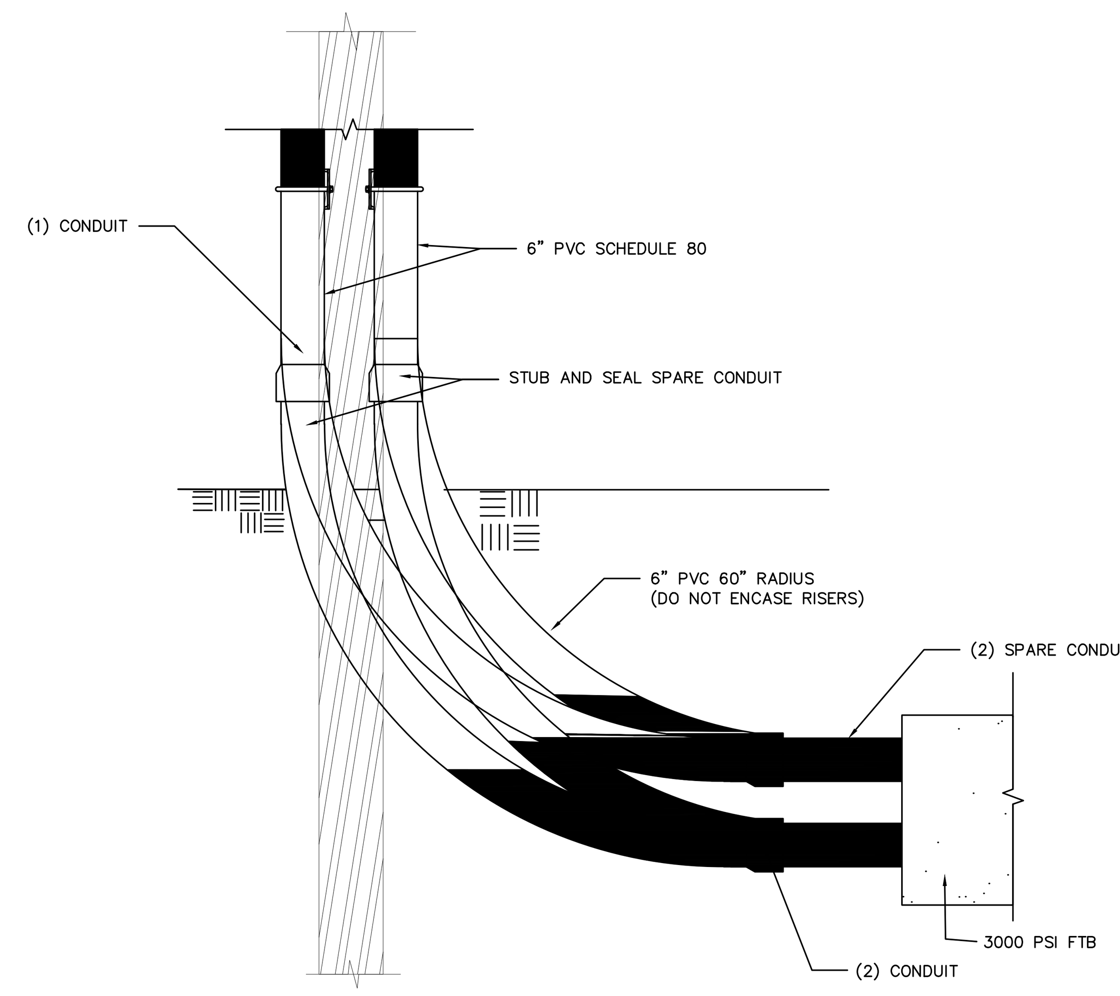
## SHEET KEYNOTES

A. SEE DRAWING 24768-E-104 FOR CONDUIT DETAIL.




A
MULTIPLE

NOTE:
1. CONCRETE BACKFILL TO HAVE A TEST RHO VALUE OF 90 C*m/W MAXIMUM
2. DUCT BANK CONCRETE SHOULD CONTAIN A RED DYE ELSE MARKER TAPE SHOULD BE INSTALLED 12 INCHES ABOVE THE TOP OF THE DUCT BANK




B

NOTE:
1. FIELD TO OVER EXCAVATE AS REQUIRED TO INSTALL SPACERS AND AVOID POLE.
2. CONCRETE BLOCKS MAY BE SUBSTITUTED FOR SPACERS WHEN IN A HORIZONTAL CONFIGURATION. NON METALLIC STRAPS MUST BE USED TO HOLD CONDUITS TO CONCRETE BLOCKS.
3. CONCRETE BACKFILL TO HAVE A TEST RHO VALUE OF 90 C*m/W MAXIMUM
4. NOT TO SCALE

NOTES:

1 RIGID CONDUIT

A. NEW CONDUIT FOR MV CABLE TO BE 6-INCH: SCHEDULE 40 PVC CONDUIT, GRAY, WHEN BURIED; SCHEDULE 80 PVC CONDUIT, GRAY, WHEN ABOVE GROUND
1. POLYVINYL-CHLORIDE (PVC) PLASTIC COMPOUND WHICH INCLUDES INERT MODIFIERS TO IMPROVE WEATHERABILITY AND HEAT DISTRIBUTION.
2. RATED FOR DIRECT SUNLIGHT EXPOSURE.
3. FIRE RETARDANT AND LOW SMOKE EMISSION.
4. SHALL BE SUITABLE FOR USE WITH 90 DEGC WIRE AND SHALL BE MARKED "MAXIMUM 90 DEGC".
5. STANDARDS: NEMA TC 2, UL 651.

B. CONDUIT BENDS
1. BENDS AT RISERS SHALL BE 60" RADIUS

C. CONDUIT SPACERS
1. CONDUIT SPACERS TO ACCOMMODATE 2 EA. 6" CONDUITS WITH 3" DUCT-TO-DUCT (9" CENTER-TO-CENTER SEPARATION) SIMILAR TO CARLON SNAP-N-STAC SP6W30-2
2. CONDUIT SPACERS TO PLACED AT INTERVALS WITH NO LESS THAN 5' OF SEPARATION AND NO MORE THAN 8' OF SEPARATION

D. ALL CONDUIT SYSTEM TO BE NON-MAGNETIC, INCLUDING CLAMPS, SUPPORTS, BOLTS, ETC.

2 VAULTS AND MANHOLES
1. INTERIOR DIMENSIONS NO LESS THAN 7' HIGH BY 7' WIDE BY 7' DEEP
2. SIMILAR TO OLDCASTLE INFRASTRUCTURE 7X7X7 MANHOLE 2

B. STANDARDS: NEMA 250, UL 50.
3. CABLE PULLING

A. REMOVE MOISTURE AND DEBRIS FROM CONDUIT BEFORE WIRE IS PULLED INTO PLACE.
B. PULL MANDREL AND DIAMETER NOMINALLY 1/4 IN SMALLER THAN THE INTERIOR OF THE CONDUIT, TO REMOVE OBSTRUCTIONS.
C. SWAB CONDUIT BY PULLING A CLEAN, TIGHT-FITTING RAG THROUGH THE CONDUIT.
D. TIGHTLY PLUG ENDS OF CONDUIT WITH TAPERED WOOD PLUGS, PLASTIC CAPS OR PLASTIC INSERTS UNTIL WIRE IS PULLED.
E. CABLE LUBRICANT SHALL BE APPLIED SO AS TO ACHIEVE A DYNAMIC COEFFICIENT OF FRICTION OF 0.2 OR LESS.

| ISSUE | DATE | DESCRIPTION |
|---|---|---|
| 2 | 2/23/24 | AS_BUILT |
| 1 | 6/30/22 | TRANSITION_DETAIL |
| 0 | 6/8/22 | ISSUE_FOR_CONSTRUCTION |

PROJECT MANAGER Trevor Hauck
PROJECT NUMBER 10333743

Sanford Underground Research Facility
South Dakota Science and Technology Authority

**EAST SUBSTATION CABLE REPLACEMENT**
**DUCT DETAILS**

0 1" 2"
0 17" 34"

FILENAME SURF_E108
SCALE SCALE
SHEET E108

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH
ARPANKUMAR DESAI
SOUTH DAKOTA
12/12/2025

Stantec


3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com




SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

| File Name: | 24768-E-107.dwg | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|---|
| | | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
GENERAL ARRANGEMENT
EXISTING DUCT BANK DETAIL

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-107
Revision 1

Dwg Updated: 12/9/2025 4:43:04 PM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\LAYOUT\24768-E-107.DWG
12/12/2025 10:24 AM

ORIGINAL SHEET - ARCH D

## GENERAL SHEET NOTE

1. '*' DENOTES '24768-'.
2. △ DENOTES FRONT OF THE EQUIPMENT.

## SHEET KEYNOTE

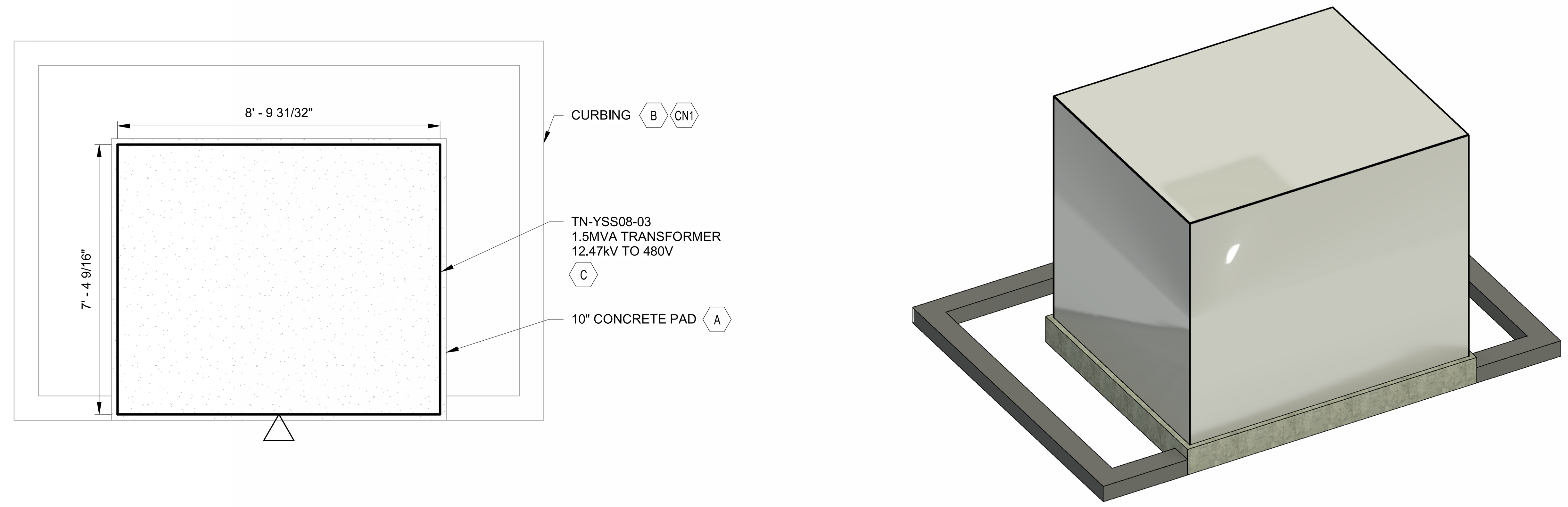
A. REFER DETAIL E-617 ON SHEET 24768-E-003 FOR ELECTRICAL EQUIPMENT PAD.

B. REFER DETAIL E-930 ON SHEET 24768-E-005 FOR CONCRETE CURB.

C. REFER DETAIL E-928 ON SHEET 24768-E-005 FOR TRANSFORMER GROUNDING.

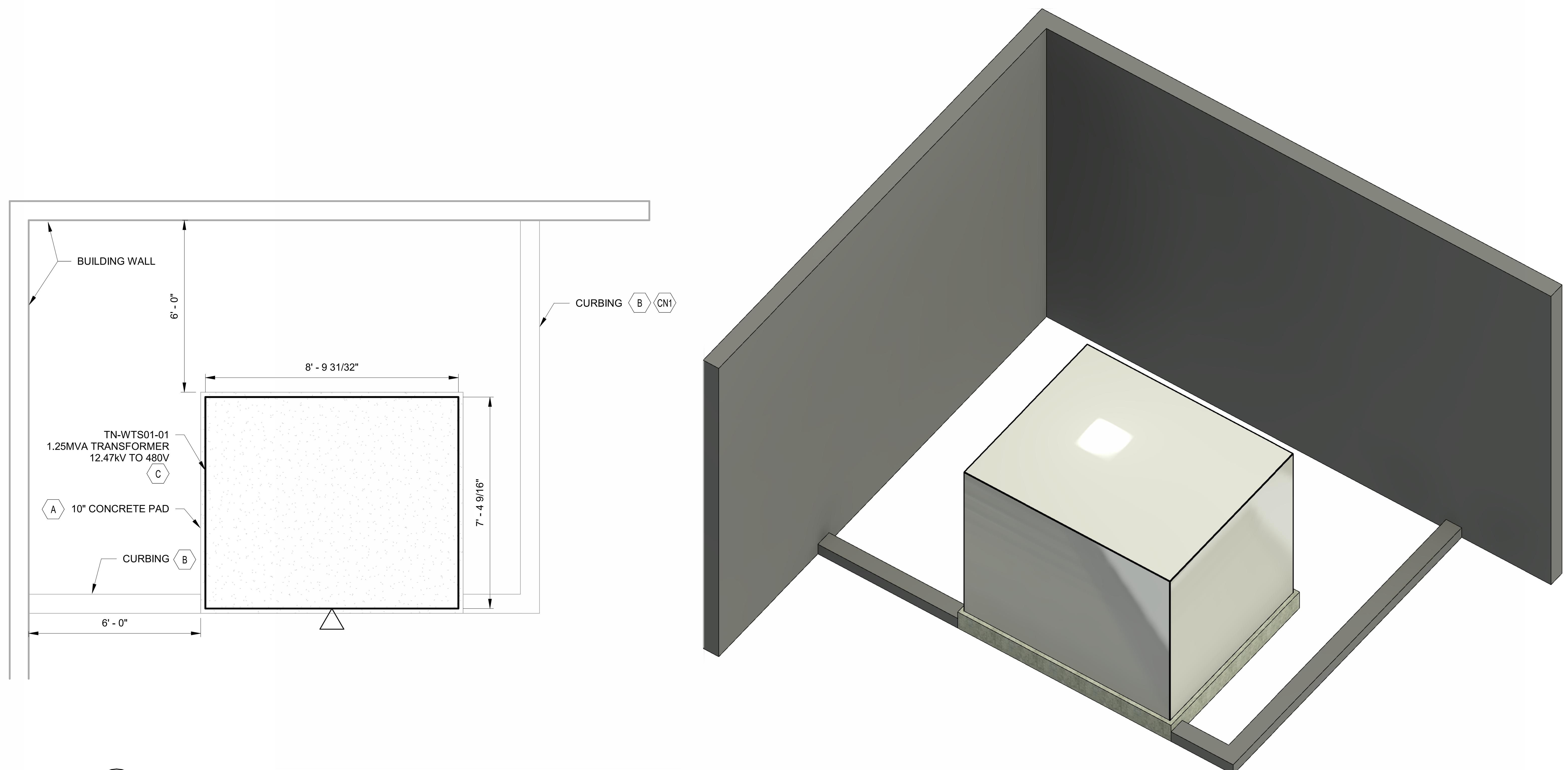
CONSTRUCTION NOTE (CN):

CN1. DURING PHASE II FOR THE FOUNDRY TRANSFORMER AND DURING PHASE III FOR THE WWTP TRANSFORMER, CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGNING THE SECONDARY CONTAINMENT BASED INDUSTRY STANDARD PRACTICE FOR THE LIQUID VOLUME IN THE TRANSFORMER. DESIGN DETAIL SHALL BE PROVIDED TO SDSTA TEAM FOR APPROVAL PRIOR TO INSTALLATION.




6 *E-108 FOUNDRY BUILDING TRANSFORMER DETAIL WITH ISOMETRIC VIEW

SCALE: 3/8" = 1'-0"




7 *E-108 WWTP TRANSFORMER DETAIL WITH ISOMETRIC VIEW

SCALE: 3/8" = 1'-0"

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

LICENSED PROFESSIONAL ENGINEER REG. NO. 17397 SAURABH ARPANKUMAR DESAI SOUTH DAKOTA 12/12/2025

Stantec



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

| File Name: stn_182924768e-md.rvt | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

GENERAL ARRANGEMENT
FOUNDRY BUILDING AND WWTP
TRANSFORMER DETAIL

Project No. 182924768

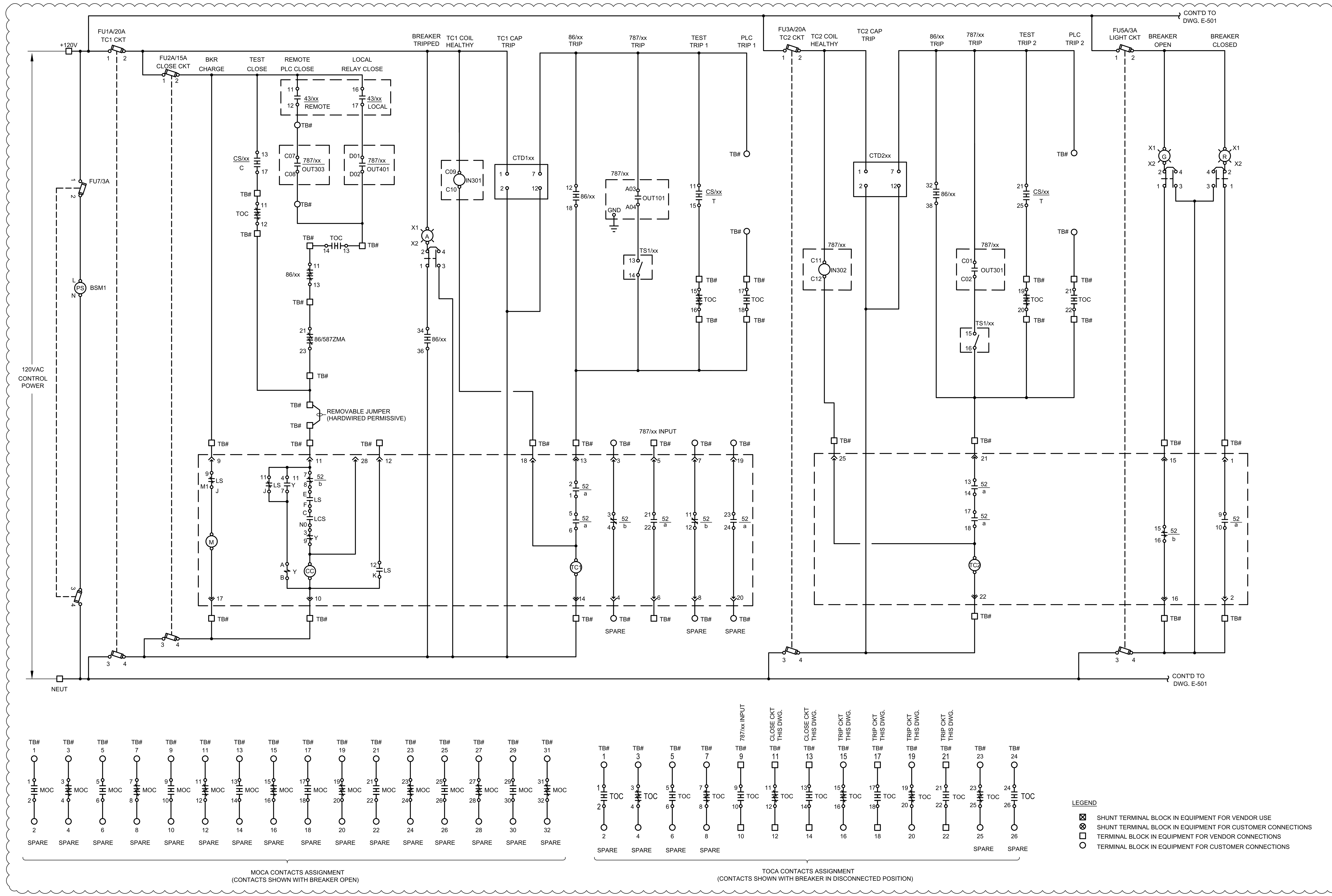
Scale 3/8" = 1'-0"

Drawing No. 24768-E-108

Revision 1

12/12/2025 11:02:03 AM

Dwg Updated: 12/12/2025 11:02:03 AM




PRELIMINARY DRAWING, VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

LEGEND

- ⊠ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR VENDOR USE
- ⊗ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
- □ TERMINAL BLOCK IN EQUIPMENT FOR VENDOR CONNECTIONS
- ○ TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-500.DWG
12/12/2025 11:05 AM

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-500.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

CONTROL SCHEMATIC
MV TRANSFORMER FEEDER BREAKER
TYPICAL - SHEET 1 OF 2

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-500
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:20:54 PM By: smohite


ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-501.DWG
12/12/2025 11:06 AM

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. | Ref. Dwg. Title

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.
The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-501.dwg

| Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|
| SPM | VIC | SAD | 25.11.07 |

Title

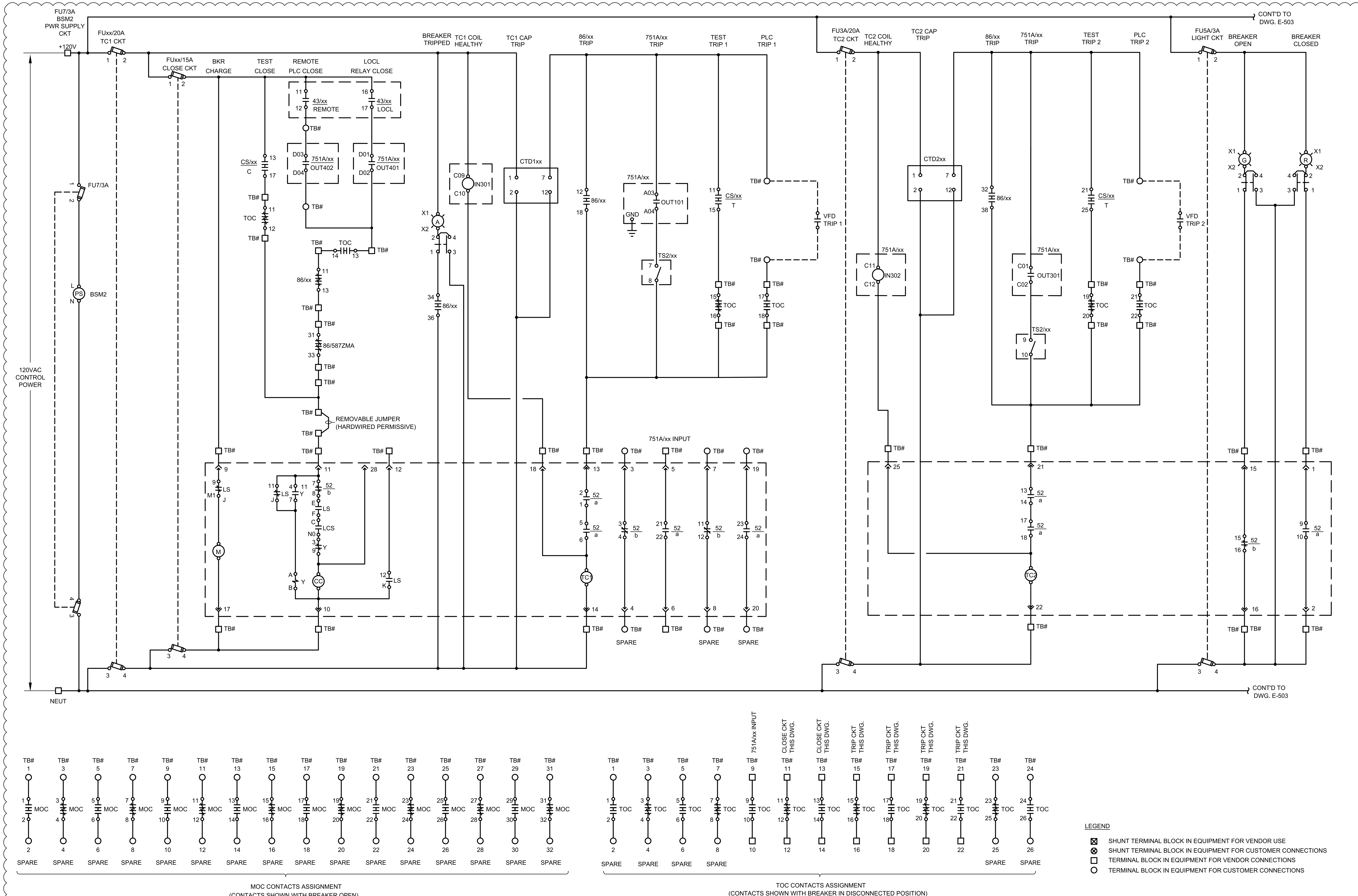
CONTROL SCHEMATIC
MV TRANSFORMER FEEDER BREAKER
TYPICAL - SHEET 2 OF 2

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-501
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:22:38 PM By: smohite




PRELIMINARY DRAWING, VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.
The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-502.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

CONTROL SCHEMATIC
MV VFD NO DISCONNECT FDR BREAKER
TYPICAL - SHEET 1 OF 2

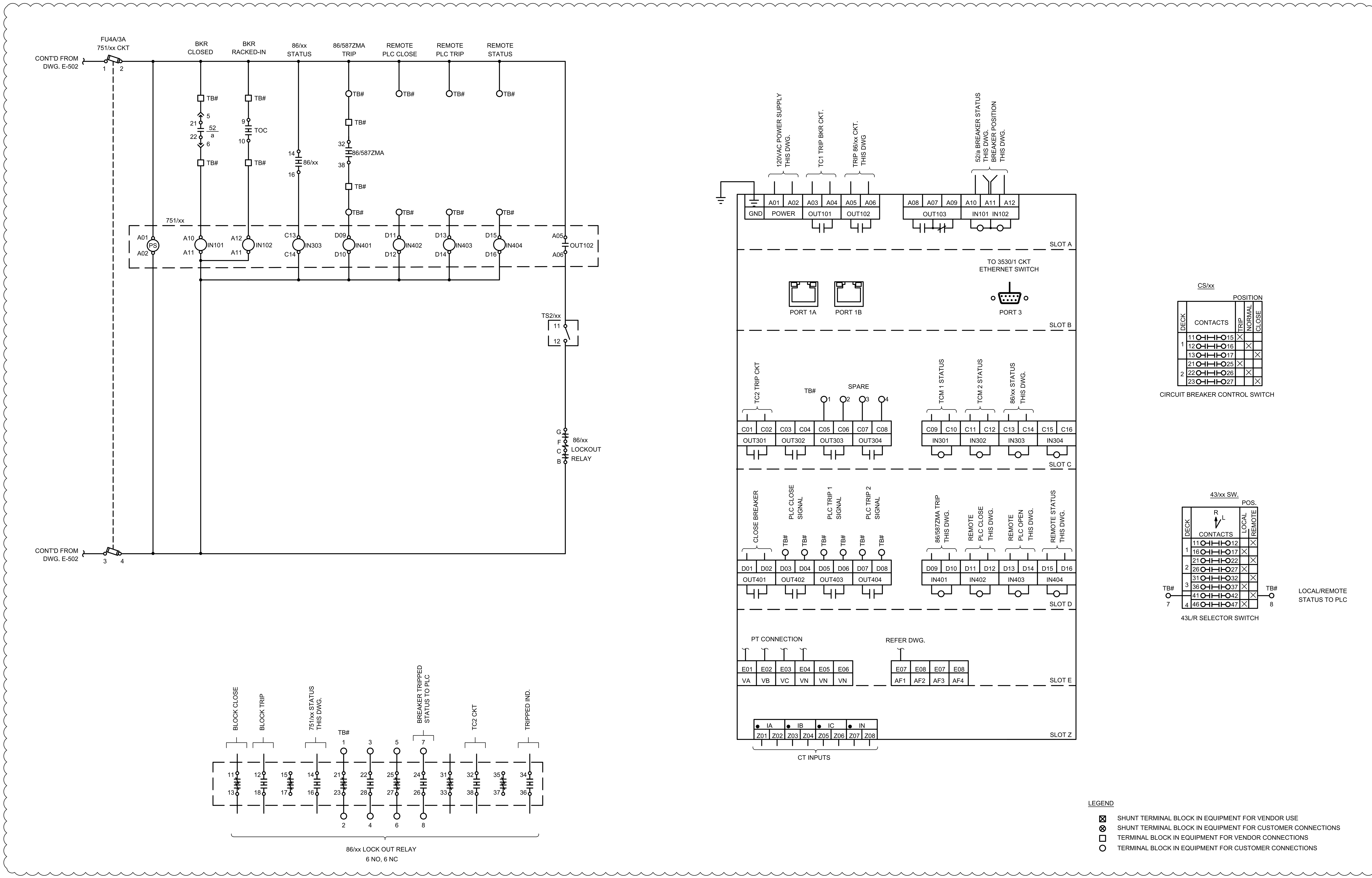
Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-502
Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-502.DWG
12/12/2025 11:06 AM

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:23:32 PM By: smohite




ISSUED FOR BID

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-503.dwg | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title

CONTROL SCHEMATIC
MV VFD NO DISCONNECT FDR BREAKER
TYPICAL - SHEET 2 OF 2

Project No. 182924768
Scale NO SCALE

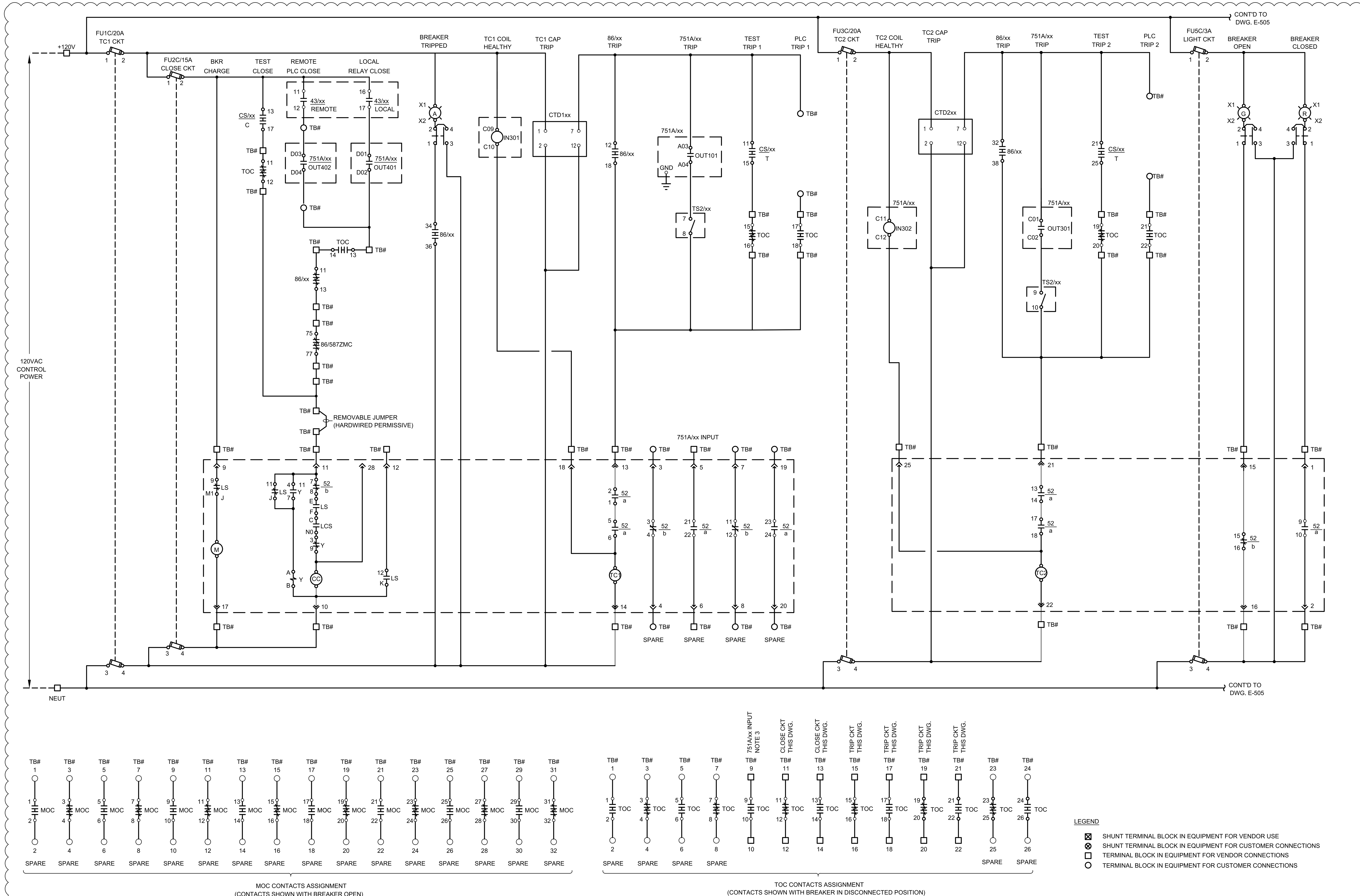
Drawing No. 24768-E-503
Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-503.DWG
12/12/2025 11:07 AM

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:24:35 PM By: smohite

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-504.DWG
12/12/2025 11:07 AM




PRELIMINARY DRAWING. VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

LEGEND

- ⊠ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR VENDOR USE
- ⊗ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
- □ TERMINAL BLOCK IN EQUIPMENT FOR VENDOR CONNECTIONS
- ○ TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

ISSUED FOR BID

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

SDSTA
YATES ELECTRICAL REHAB

File Name: 24768-E-504.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

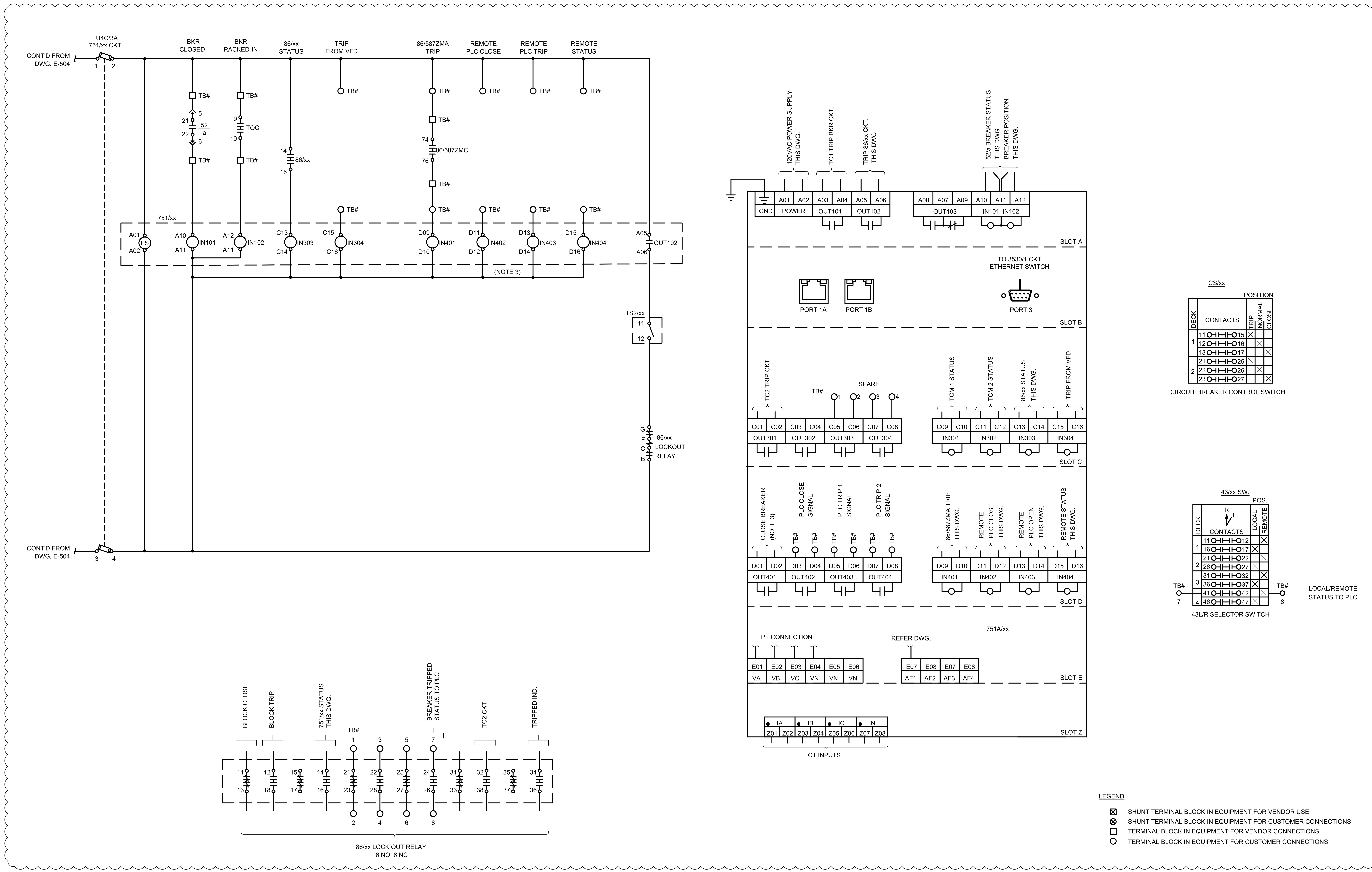
CONTROL SCHEMATIC
MV VFD W/DISCONNECT FDR BREAKER
TYPICAL - SHEET 1 OF 2

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-504
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:25:16 PM By: smohite




PRELIMINARY DRAWING. VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

LEGEND

- ☒ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR VENDOR USE
- ⊗ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
- ☐ TERMINAL BLOCK IN EQUIPMENT FOR VENDOR CONNECTIONS
- ○ TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-505.DWG
12/12/2025 11:09 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-505.dwg

| Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|
| SPM | VIC | SAD | 25.11.07 |

Title

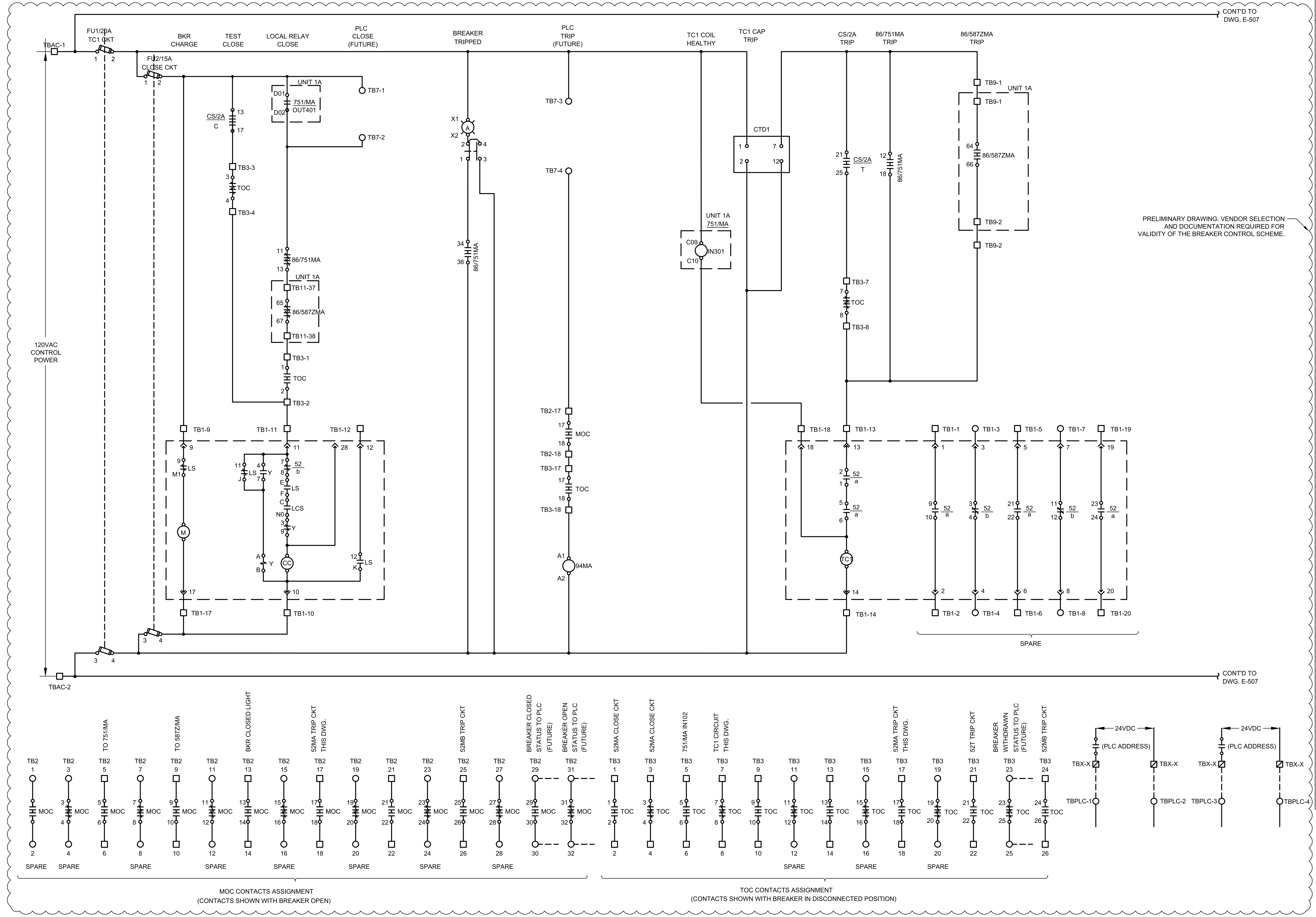
CONTROL SCHEMATIC
MV VFD W/DISCONNECT FDR BREAKER
TYPICAL - SHEET 2 OF 2

Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-505
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:25:54 PM By: smohite




# GENERAL SHEET NOTES

INTERLOCKING

1. BOTH MAIN BREAKERS 1A AND 2A MAY NOT BE CLOSED SIMULTANEOUSLY TO PREVENT PARALLELING OF SOURCES. THIS IS ACTIVE IN ALL MODES OF OPERATION UNTIL THERE IS A TRANSITION BETWEEN THE MAIN BREAKERS IN THE EVENT OF LOSS OF UTILITY POWER AT EITHER OF THE MAIN BREAKERS.
2. MAIN BREAKERS 1A AND 2A WILL CLOSE SIMULTANEOUSLY FOR A VERY SHORT DURATION WHILE MAKING A TRANSITION BEFORE ONE OF THE BREAKERS OPEN IN THE EVENT OF LOSS OF UTILITY POWER AT EITHER OF THE MAIN BREAKERS.

LOCK -OUT

1. OVER CURRENT TRIP (OT) ON MAIN BREAKERS ARE INCORPORATED IN THE CONTROL SCHEME SUCH THAT THERE WILL BE NO CLOSURE OF ANY BREAKER TO A FAULT.

NORMAL CONDITIONS

1. MAIN BREAKER 2A CLOSED.
2. 1A IS OPENED.
3. RED LIGHT TURNS ON.

SEQUENCE OF AUTOMATIC TRANSFER

A. LOSS OF UTILITY POWER AT MAIN BREAKER 2A
   1. RELAY 751MA/2A DETECTS LOSS OF NORMAL VOLTAGE.
   2. TIME DELAY OF 3 SECONDS.
   3. MAIN BREAKER 2A OPENS.
   4. FEEDS TO WWTP, FOUNDRY BUILDING, OPEN CONVEYOR BLDG., HOIST VFD OPEN.
   5. RELAY 751MA/1A DETECTS OPENING OF MAIN BREAKER 2A.
   6. TIME DELAY OF 3 SECONDS.
   7. MAIN BREAKER 1A CLOSES.
B. LOSS OF UTILITY POWER AT MAIN BREAKER 1A (FUTURE - ROSS SUBSTATION)
   1. RELAY 751MA/1A DETECTS LOSS OF NORMAL VOLTAGE.
   2. TIME DELAY 3 SECONDS.
   3. MAIN BREAKER 1A OPENS.
   4. FEEDS TO WWTP, FOUNDRY BUILDING, OPEN CONVEYOR BLDG., HOIST VFD OPEN.
   5. RELAY 751MA/2A DETECTS OPENING MAIN BREAKER 1A.
   6. TIME DELAY OF 3 SECONDS.
   7. MAIN BREAKER 2A CLOSES.
C. STAND-BY GENERATOR TURNS ON
   1. RELAY 751MA DETECTS NORMAL VOLTAGE.
   2. TIME DELAY OF 3 SECONDS.
   3. GENERATOR BREAKER CLOSED.
   4. TIME DELAY OF 3 SECONDS.
   5. RELAY 751MA/2A DETECTS CLOSURE OF GENERATOR BREAKER.
   6. RED LIGHT TURNS OFF.
   7. GREEN & BLUE LIGHTS TURNS ON.
   8. FEEDS TO WWTP, FOUNDRY BUILDING, OPEN CONVEYOR BLDG., HOIST VFD CLOSED (MANUALLY).
D. LOSS OF UTILITY POWER AT MAIN BREAKERS 1A AND 2A.
   1. NO ACTION IS TAKEN.
E. RETURN OF UTILITY POWER
   1. RELAY 751MA/2A DETECTS NORMAL VOLTAGE.
   2. TIME DELAY OF 3 SECONDS.
   3. GENERATOR TURNS OFF.
   4. GENERATOR BREAKER OPENED.
   5. RELAY 751MA/2A DETECTS OPENING OF GENERATOR BREAKER.
   6. TIME DELAY OF 3 SECONDS.
   7. GREEN & BLUE LIGHTS TURNS OFF.
   8. MAIN BREAKER 2A CLOSE.
   9. TIME DELAY OF 3 SECONDS.
   10. RED LIGHT TURNS ON.

LEGEND
- SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS.
- TERMINAL BLOCK IN EQUIPMENT FOR POWELL CONNECTIONS.
- TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
- TERMINAL BLOCK IN PLC

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-506.DWG
12/12/2025 11:10 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

Stantec

3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

| File Name: 24768-E-506.DWG | SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

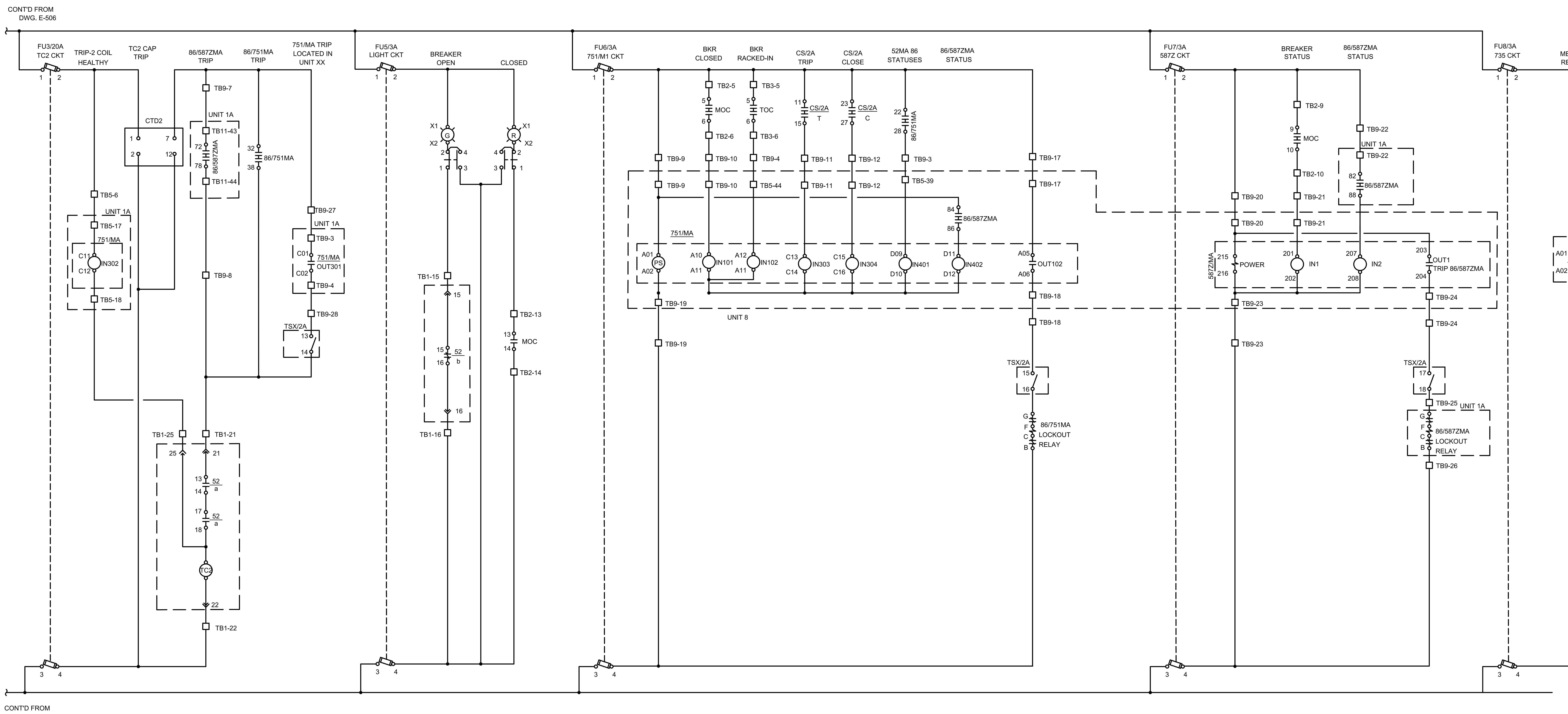
CONTROL SCHEMATICS
MAIN BREAKER 2A
SHEET 1 OF 3

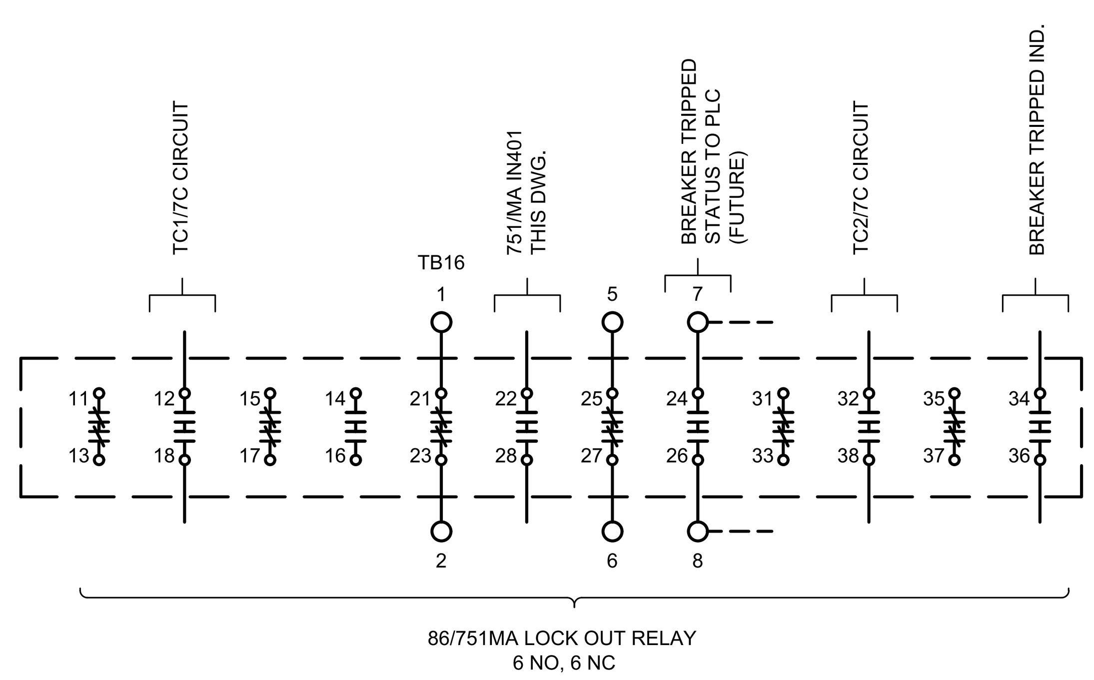
Project No. 182924768
Scale NO SCALE

Drawing No. 24768-E-506
Revision 1

ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:26:39 PM By: smohite




CS/2A

| DECK | CONTACTS | TRIP | NORMAL | CLOSE |
|---|---|---|---|---|
| 1 | 11–15 | X | | |
| | 12–16 | | X | |
| | 13–17 | | | X |
| 2 | 21–25 | X | | |
| | 22–26 | | X | |
| | 23–27 | | | X |

CIRCUIT BREAKER CONTROL SWITCH

LEGENDS
○ TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
⊗ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS.

PRELIMINARY DRAWING. VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

ISSUED FOR BID

## REFERENCE DRAWING

1. REFER DRAWING E-506 FOR GENERAL SHEET NOTES.

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

Stantec
3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com



Client/Project
SDSTA
YATES ELECTRICAL REHAB
SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-507.DWG | SPM Dwn. | VIC Chkd. | SAD Dsgn. | 25.11.07 YY.MM.DD

Title
CONTROL SCHEMATICS
MAIN BREAKER 2A
SHEET 2 OF 3

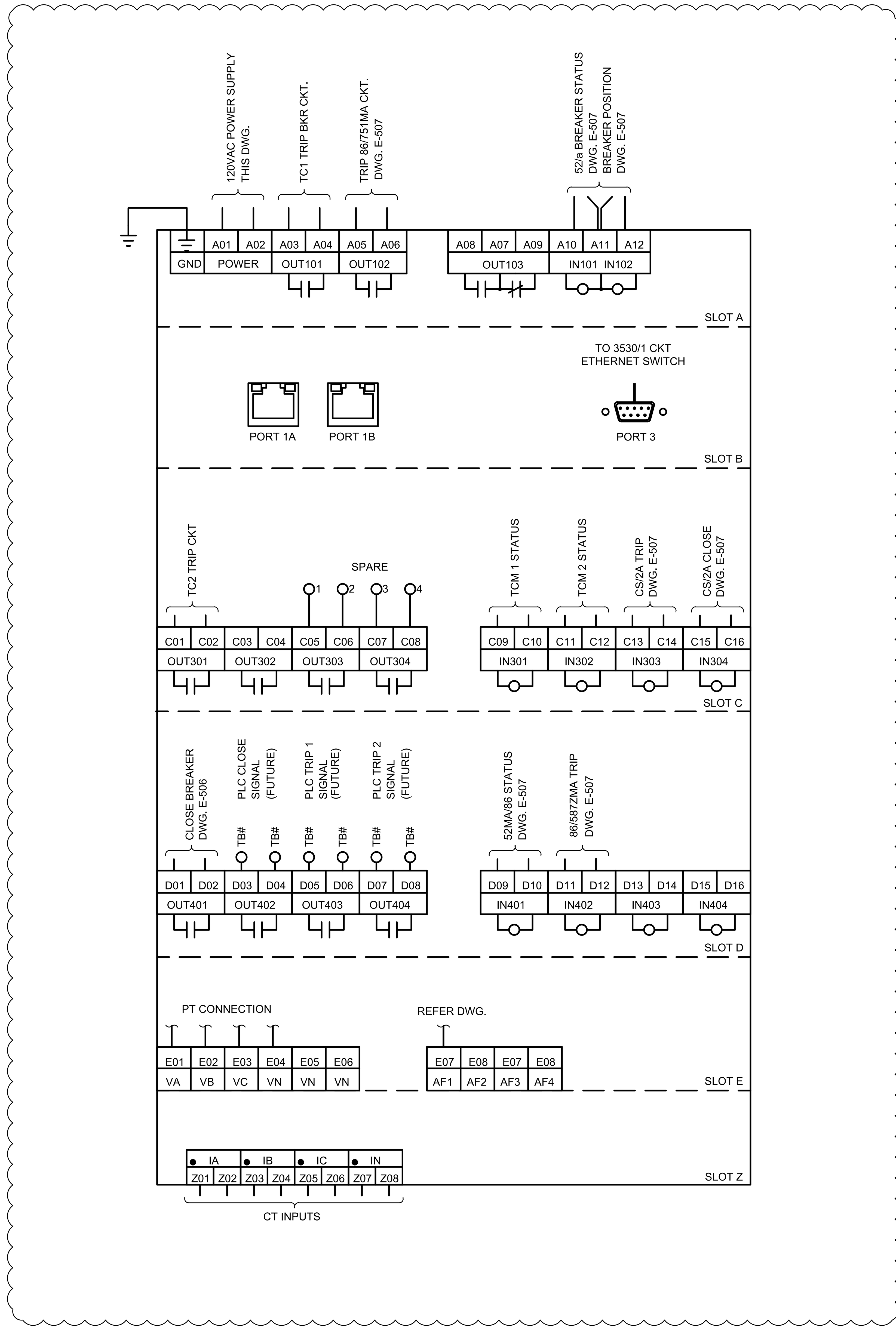
Project No. 182924768
Scale NO SCALE
Drawing No. 24768-E-507
Revision 1

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-507.DWG
12/12/2025 11:11 AM

ORIGINAL SHEET - ARCH D
Dwg Updated: 12/9/2025 3:27:21 PM By: smohite

## REFERENCE DRAWING

1. REFER DRAWING E-506 FOR GENERAL SHEET NOTES.




PRELIMINARY DRAWING. VENDOR SELECTION AND DOCUMENTATION REQUIRED FOR VALIDITY OF THE BREAKER CONTROL SCHEME.

LEGEND

- ⊠ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR VENDOR USE
- ⊗ SHUNT TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS
- □ TERMINAL BLOCK IN EQUIPMENT FOR VENDOR CONNECTIONS
- ○ TERMINAL BLOCK IN EQUIPMENT FOR CUSTOMER CONNECTIONS

ISSUED FOR BID

C:\USERS\SMOHITE\DC\ACCDOCS\STANTEC CONSULTING\182924768-YATESELECREHAB\PROJECT FILES\01_WIP\13_ELECTRICAL\SHEET_FILES\SCHEMATIC\24768-E-508.DWG
12/12/2025 11:11 AM

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| 1 | 100% ISSUED FOR BID - ADMINISTRATIVE REVISION ONLY | 25-12-12 | SPM | VIC | SAD | |
| 0 | 100% ISSUED FOR BID | 25-11-07 | SPM | VIC | SAD | |

Permit-Seal

Stantec


3133 West Frye Road, Suite 300
Chandler, Arizona 85226
www.stantec.com




Client/Project

SDSTA
YATES ELECTRICAL REHAB

SANFORD UNDERGROUND RESEARCH FACILITY
SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

File Name: 24768-E-508.dwg

| SPM | VIC | SAD | 25.11.07 |
|---|---|---|---|
| Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title

CONTROL SCHEMATICS
MAIN BREAKER 2A
SHEET 3 OF 3

Project No. 182924768

Scale NO SCALE

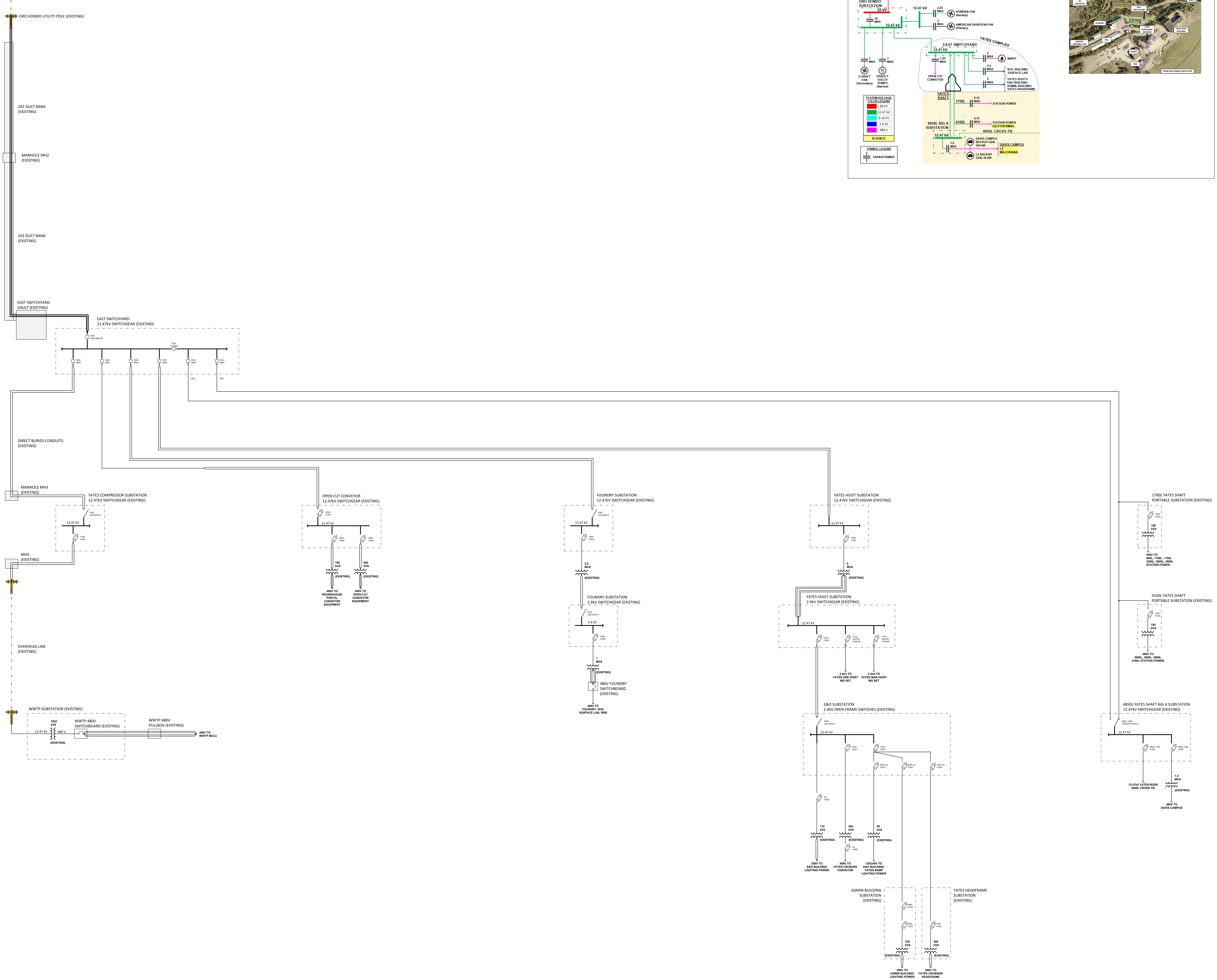
Drawing No. 24768-E-508

Revision 1

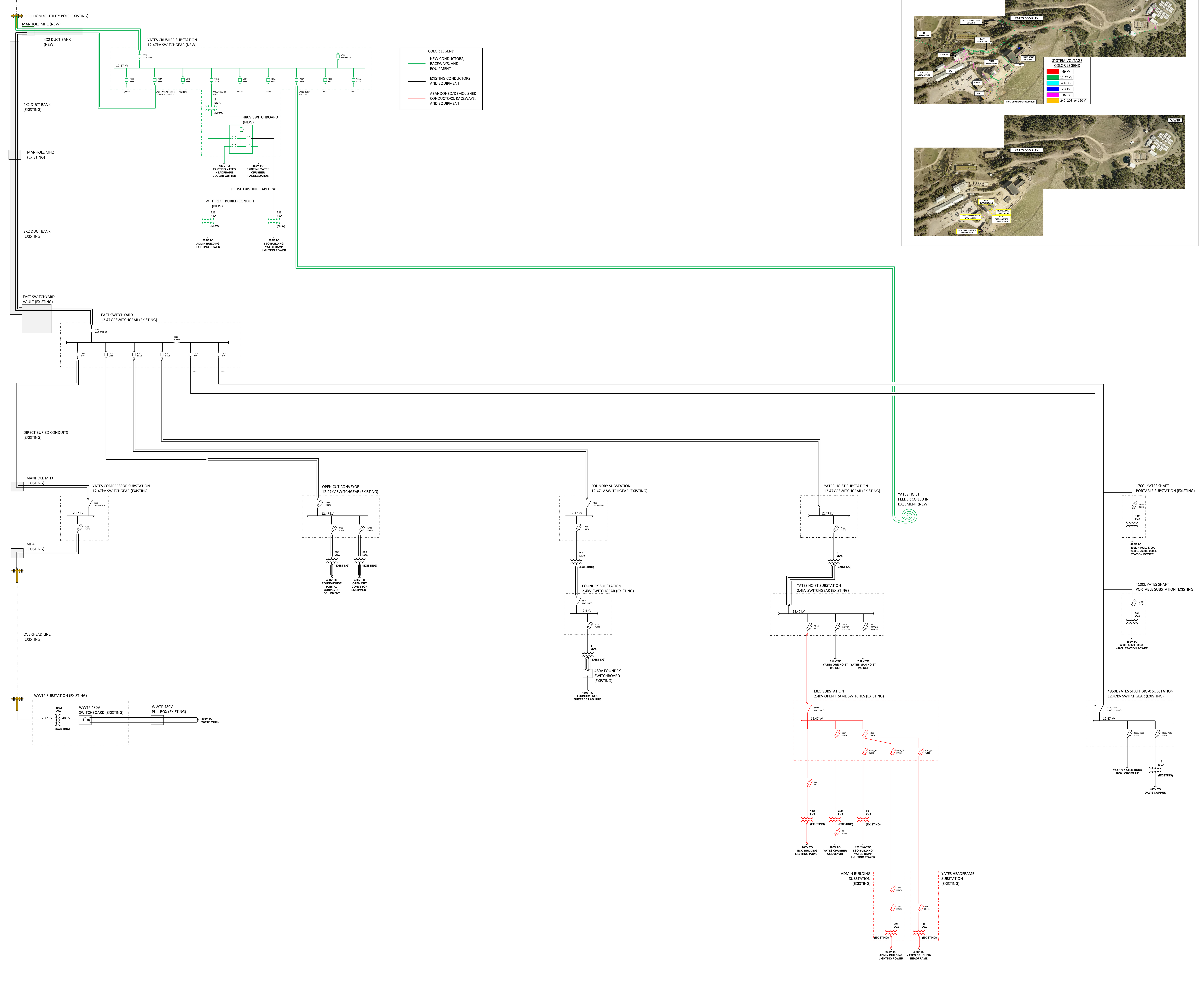
ORIGINAL SHEET - ARCH D

Dwg Updated: 12/9/2025 3:28:15 PM By: smohite

# EXISTING LAYOUT



# PHASE I CONSTRUCTION



| SPECIFICATION SECTION INDEX | | |
|---|---|---|
| **SR.NO.** | **SECTION NUMBER** | **SECTION NAME** |
| 1 | 01 11 00 | SUMMARY OF WORK |
| 2 | 01 30 00 | ADMINISTRATIVE REQUIREMENTS |
| 3 | 01 32 00 | CONSTRUCTION PROGRSS SCHEDULES |
| 4 | 01 33 00 | SUBMITTAL PROCEDURES |
| 5 | 01 35 23 | SAFETY AND ENVIRONMENTAL REQUIREMENTS |
| 6 | 01 45 00 | QUALITY CONTROL FOR CONSTRUCTION |
| 7 | 01 50 00 | TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS |
| 8 | 01 78 00 | CLOSEOUT SUBMITTALS |
| 9 | 01 93 00 | OPERATION AND MAINTENANCE DATA |
| 10 | 26 00 00 | ELECTRICAL WORK, GENERAL |
| 11 | 26 01 26 | ELECTRICAL TESTS |
| 12 | 26 05 19 | WIRE AND CABLING |
| 13 | 26 05 26 | GROUNDING |
| 14 | 26 05 33 | ELECTRICAL RACEWAY SYSTEMS |
| 15 | 26 05 36 | WIRING DEVICES |
| 16 | 26 05 43 | UNDERGROUND RACEWAY SYSTEMS |
| 17 | 26 05 53 | IDENTIFICATION FOR ELECTRICAL SYSTEM |
| 18 | 26 05 73 | PROTECTIVE DEVICE STUDIES |
| 19 | 26 12 13 | LIQUID-FILLED MEDIUM VOLTAGE TRANSFORMERS |
| 20 | 26 13 13 | MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR |

# SDSTA DIVISION 01 SPECIFICATION

Yates Complex Electrical Rehabilitation

## TABLE OF CONTENTS

## Section 01 11 00 Summary of Work

1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The scope of work for the Yates Complex Electrical Rehabilitation Project encompasses the full procurement, construction, and commissioning of a new centralized 12.47kV substation within the Yates Crusher Building to modernize and consolidate the aging electrical infrastructure at the Sanford Underground Research Facility (SURF). This includes installation of new duct banks, manholes, switchgear, transformers, cable trays, and feeder conductors, as well as reconfiguration of existing circuits to improve reliability and support future upgrades. Incidental work includes the installation of new transformers at both the Administration Building and the Education & Outreach (E&O) Building, replacing outdated 2.4kV systems with modern 480V and 208V configurations. Additional tasks involve trenching and conduit installation, electrical testing of existing feeders, and provisions for future integration of YS01 and YS02 shaft feeder cables. The contractor is also responsible for finalizing the design using certified vendor data, performing arc flash and coordination studies, and submitting updated documentation and commissioning reports to meet SDSTA's technical and safety standards.

1.1.2 Location

The work is located at the Yates Complex of the Sanford Underground Research Facility.

1.2 OCCUPANCY OF PREMISES

Building and/or location of work will be occupied during performance of work under this contract.

Before work is started, arrange with the Project Manager a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.3 EXISTING WORK

Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Project Manager. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF EXISTING UTILITIES

Obtain digging permits prior to start of excavation and comply with facility requirements for locating and marking underground utilities. Contact local utility locating service a minimum of 72 hours prior to excavating, to mark utilities, and within sufficient time required if work occurs on a Monday or after a holiday. Verify existing utility locations indicated on contract drawings, within area of work.

1.4.1 Notification Prior to Excavation

Notify the Project Manager at least 15 days prior to starting excavation work.

**--- End of Section ---**

## Section 01 30 00 Administrative Requirements

1 GENERAL

1.1 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly digital photographs showing the sequence and progress of work to clearly capture the work performed during that period, in particular areas that will be covered as part of the scope of work. Submit photographs with the monthly invoice. Photographs provided are for unrestricted use by the SDSTA.

1.2 SUPERVISION

1.2.1 MINIMUM REQUIREMENTS

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of contract work. The Quality Control (QC) representative must also have fluent English communication skills.

1.2.2 SUPERINTENDENT QUALIFICATIONS

The project superintendent must have a minimum of 10 years experience in construction with at least 2 of those years as a superintendent on projects similar in size and complexity. The individual must have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

For routine projects where the superintendent is permitted to also serve as the Quality Control (QC) Manager as established in Section QUALITY CONTROL, the superintendent must have qualifications in accordance with that section.

1.2.2.1 Duties

The project superintendent is primarily responsible for managing and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend weekly progress meetings, and quality control meetings if applicable. The superintendent or qualified alternate must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.2.3 NON-COMPLIANCE ACTIONS

The project superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.3 PRECONSTRUCTION

After award of the contract but prior to commencement of any work at the site, the Contractor must meet with the Project Manager to discuss and develop a mutual understanding relative to the administration of the quality control, safety program, preparation of the schedule of prices, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work must also attend.

**--- End of Section ---**

## Section 01 32 00 Construction Progress Schedules

1 GENERAL

1.1 SUBMITTALS

Construction Schedule

Monthly Schedule Updates

1.2 ACCEPTANCE

Prior to the start of work, prepare and submit to the Project Manager for acceptance a construction schedule in the form of a Network Analysis Schedule (NAS) or Bar Chart Schedule.

The acceptance of a Baseline Construction Schedule is a condition precedent to:

- The Contractor starting work on the demolition or construction stage(s) of the contract.
- Processing Contractor's invoice(s) for construction activities.
- Review of any schedule updates.

Submittal of the Baseline Schedule, and subsequent schedule updates, is understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the contract documents, represents the Contractor's plan on how the work will be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced.

1.3 SCHEDULE FORMAT

1.3.1 Network Analysis Schedule (NAS)

Use the critical path method (CPM) to schedule and control project activities. Prepare and maintain project schedules using Microsoft Project or an approved alternative. Build the schedule as follows:

a. The Project Schedule must show all on-site construction, major inspections, and closeout activities. SDSTA and Contractor on-site work activities must be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

b. With the exception of the Contract Award and End Contract milestone activities, no activities shall be open-ended. No activity must have open start or open finish logic.

1.3.2 Bar Chart Schedule

The Bar Chart must, as a minimum, show work activities, major material/equipment delivery, on-site construction, key inspections, and closeout activities. The Bar Chart must be time-scaled and generated using an electronic spreadsheet program.

1.3.3 Schedule Submittals and Procedures

Submit Network Analysis Schedules (NAS) or Bar Chart Schedules and updates in an electronic format that is acceptable to the Project Manager.

1.4 SCHEDULE MONTHLY UPDATES

Update the Construction Schedule at monthly intervals or when the schedule has been revised. The updated schedule must be kept current, reflecting actual progress and plan for completing the remaining work.

1.5 CONTRACT MODIFICATION

Submit a schedule analysis with each cost and time proposal for a proposed change. The analysis must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available project float and extends the Projected Finish beyond the Contract Completion Date. Identify types of delays as follows:

- Excusable Delay: Force-Majeure (e.g. unusual weather) - Contractor may receive time extension, but time will not be compensable.
- Inexcusable Delay: Contractor Responsibility - Contractor will not receive time extension.
- Compensable Delay: SDSTA Responsibility - Contractor may receive compensable time extension.

If a combination of any of the delay types outlined above occurs, it is considered a Concurrent Delay, which will require an analysis of the facts to determine compensability and entitlement to any time extension under the applicable contract clauses.

## 1.6 WEEKLY PROJECT STATUS MEETING AND 3-WEEK LOOK AHEAD SCHEDULE

Each week during the active construction period, a Weekly Status Meeting will be held. At a minimum, the project superintendent and QC Manager should attend representing the contractor. Meeting minutes will be taken by the superintendent or other designated rep to capture the discussions. As part of the process, the contractor will prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Construction Schedule. Additionally, include upcoming outages, closures, etc. The detailed work plans are to be bar chart type schedules, separate from the Construction Schedule and in an electronic format acceptable to the Project Manager. In additional to schedule discussions, the Weekly Status meeting should discuss status of submittal reviews and approvals, Requests For Information (RFI), outstanding change orders, and other relevant project coordination issues.

**--- End of Section ---**

## Section 01 33 00 Submittal Procedures

1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittal requirements in addition to those noted below may be specified in the technical specification sections and drawings.

Preconstruction Submittals

Submittals required prior to start of construction:

- List of Proposed Subcontractors
- Construction Progress Schedule
- Submittal Register
- Schedule of Prices
- Health and Safety Plan
- Quality Control (QC) Plan
- Environmental Protection Plan

Shop Drawings

Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on a sample taken from the job site, on a portion of work during or after installation.

Certificates

Statements created using the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system, or material attesting that the product, system, or material meets specification requirements. Statements must be dated after award of project contract and clearly name the project.

Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

## 1.2 SUBMITTAL REGISTER

### 1.2.1 Use of Submittal Register

Submit a register of submittals, arranged in chronological order by dates required by construction schedule. For this project, the Contractor is required to establish a project specific account through Submittal Exchange for the processing of all submittals. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

Initial Submittal. Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

Submit revised submittal schedule to reflect changes in current status and timing for submittals.

Format. Arrange the following information in a tabular format. (As applicable)

a. Scheduled date for first submittal.
b. Specification/RFP Section number and title.
c. Name of subcontractor.
d. Description of the Work covered.
e. Scheduled date for final release or approval.
f. Scheduled date of fabrication.
g. Scheduled dates for purchasing.
h. Scheduled dates for installation.
i. Activity or event number.

## 1.3 VARIATIONS

Variations from contract requirements require both A/E and SDSTA approval and will be considered where advantageous to SDSTA.

### 1.3.1 Considering Variations

Discussion with Project Manager and A/E (if applicable) prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals.

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the rejection and removal of such work at no additional cost to the SDSTA.

### 1.3.2 Proposing Variations

When proposing variation, deliver a written request to the Project Manager, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to SDSTA. If lower cost is a benefit, also include an estimate of the cost savings. In addition to the documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

### 1.3.3 Warranting that Variations are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record (if applicable), warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

### 1.3.4 Review Schedule Extension

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the A/E and SDSTA of submittals with variations.

## 1.4 SCHEDULING

Schedule and submit interrelated submittals concurrently, such as component items forming a system. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

- Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- Resubmit register and annotate monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required.
- Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved Submittal Register.

### 1.4.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

- Submittals marked "accepted" authorize the Contractor to proceed with the work covered.
- Submittals marked "accepted as noted" or "accepted as noted, resubmittal not required," authorize the Contractor to proceed with the work covered, provided Contractor takes no exception to the corrections.

- Submittals marked “revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.
- Submittals marked "not reviewed" will indicate that the submittal has been previously reviewed and accepted, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it has not been reviewed. Resubmit submittals that have been returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

## 1.5 REJECTED SUBMITTALS

If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, notice must be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the SDSTA requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

## 1.6 ACCEPTED SUBMITTALS

The acceptance of submittals is not to be construed as a complete check and indicates only that acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under Section QUALITY CONTROL FOR CONSTRUCTION requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been accepted, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

## 1.7 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not to be construed to change or modify any contract requirements. Before submitting samples, the Contractor will ensure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract.

Samples of various materials or equipment delivered on the site or in place may be taken by the SDSTA for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor will replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples does not relieve the Contractor of his responsibilities under the contract.

**--- End of Section ---**

## Section 01 35 23 Safety and Environmental Requirements

1 GENERAL

1.1 CONTRACTOR'S RESPONSIBILITY FOR PROJECT SAFETY AND ENVIRONMENTAL PROTECTION

1.1.1 The Contractor recognizes the importance of performing the work in a safe and responsible manner to prevent damage, injury, or loss to individuals, the environment, and the work itself, including materials and equipment incorporated into the work or stored on-site or off-site. Contractor assumes responsibility for implementing and monitoring all Environment, Safety and Health (ESH) precautions and programs related to the performance of the work.

1.1.2 The Contractor and subcontractors shall comply with all legal and SDSTA-specific reporting requirements relating to ESH set forth in the contract documents. The Contractor will verbally notify of any injury, loss, damage, or accident arising from the work to Project Manager and to the SDSTA ESH Safety Representative (ESH Safety Rep), to the extent mandated by legal requirements, to all government or quasi-government authorities having jurisdiction over safety-related matters involving the project or the work. All persons injured while working at SURF will be immediately evaluated, and treated as necessary, by a medical professional before returning to work. Contractor and its subcontractors will immediately report to the Project Manager all spills of a regulated substance of one gallon or greater, and all other significant impacts to the environment (soil, water, air) in performance of the work. Contractor will also immediately notify the Project Manager of any failure to comply with state and federal environmental laws, rules, and regulations.

1.1.3 The Contractor's responsibility for ESH under this specification is not intended in any way to relieve subcontractors and sub-subcontractors of their own contractual and legal obligations and responsibilities.

1.1.4 The Contractor is responsible for screening all subcontractors with respect to safety and to adopt a safety selection process consistent with requirements defined herein. In addition, Contractor is responsible for flowing down all ESH requirements of the Contract to its subcontractors, including monitoring and enforcing compliance.

1.2 ESH REQUIREMENTS AND COORDINATION

1.2.1 Safety and protection of the environment are of the utmost concern on this contract. Safety in this context refers to the health and safety of people and the protection of the environment. Nothing contained herein relieves the Contractor from complying with all applicable standards and regulations found in 29 CFR Part 1926 (OSHA construction standard), 40 CFR (Federal environmental regulations, and Part 74 of the Administrative Rules of South Dakota (State environmental regulations), where applicable. Site specific safety requirements are defined in the SDSTA ESH Manual located at: https://www.sanfordlab.org/esh. Mine Safety and Health Administration (MSHA) compliance may be acceptable, where applicable.

1.2.2 The Contractor will address the safety requirements defined herein and in the SDSTA ESH Manual. Contractor costs associated with the implementation of the requirements will be borne by the Contractor. Safety deficiencies discovered after the award will be remedied at no cost to SDSTA and may at the Contracting Officer's discretion be deducted from the contract amount.

1.2.3 The Contractor shall have a designated Safety Representative (SR), approved by SDSTA, present on the Project at all times when work is physically being performed. The SR may have other minor duties, but the position's primary role is to oversee safety of the worksite and work being performed by the Contractor, as well as that of its subcontractors. The superintendent or qualified designee may act as the SR. If shift work will be utilized, the Contractor must have a SR for each shift. In the case of shift work, the Contractor will designate one SR as the lead for the project. The training requirements for the second SR are the same as the lead and are as follows:

- The SR shall have underground safety experience and training (e.g., MSHA part 48) when applicable.
- The SR shall be certified in CPR, AED, and First Aid.
- The SR is responsible for administering the Contractor's ESH program.
- The SR will escort the ESH Safety Rep on a monthly ESH site visit.
- The SR will provide training to all employees working on their behalf in regard to oil pollution prevention, solid and hazardous waste management, and storm water management, if applicable.
- The Contractor will supply a weekly ESH report to the ESH Safety Rep, detailing any ESH related items.

1.2.4 The Contractor shall have at least one individual certified in CPR, AED, and First Aid onsite at all times.

1.2.5 The Contractor is responsible for identifying the need for Qualified and/or Competent Persons for specific tasks as defined in 29 CFR 1926.

1.2.6 The Contractor must have a documented Site-Specific Environment, Safety and Health Program/Plan in place and accepted by SDSTA before work will be authorized to start. This program must be consistent with the requirements in the SDSTA ESH Manual. The program will be based on the hazards inherent to the Means and Methods adopted by the Contractor and its associated work environment. The scope of work will dictate the required program elements for this contract. Program elements may include those listed on the ESH Manual of the SURF website at https://www.sanfordlab.org/esh.

- If the Contractor chooses to adopt one or more specific elements of the SDSTA ESH program, it must adopt that element in its entirety.

1.2.7 The Contractor is expected to follow a work planning and controls process that is aligned with the SDSTA. (See SURF website ESH Manual at https://www.sanfordlab.org/esh.) The work planning and controls process must be conducted and documented prior to the start of work in the form of a Job Hazards Analysis (JHA). A JHA, developed by the SR, approved by the Project Manager and ESH Safety Rep. The JHA will be reviewed with the individual(s) expected to perform the work prior to work starting on a specified task. The SR is expected to review all JHAs. Copies of JHA(s) must be present at the location where work is being performed and accessible to the individuals performing the work and to SDSTA representatives.

1.2.8 The Contractor will conduct a daily crew work planning meeting (tailgate/toolbox talk), including, when necessary, subcontractor employees, prior to the beginning of each shift. This talk will include the plan of work for the day, a review of hazards and potential regulatory issues, inspection/removal of loose puncture hazards as part of a general daily cleanup requirement of the work area, and the review of applicable JHAs. These documented talks will be submitted to the Project Manager or uploaded to a designated electronic database at the end of each day, or by the end of the work week.

1.2.9 The Contractor is responsible for assuring that all Contractor employee safety training is completed in compliance with SDSTA guidelines, standards, and associated regulations. The following training is required for all Contractor personnel before they start work:

- Sanford Underground Research Facility (SURF) Surface and/or Underground Orientation Training, if onsite for less than 40 hours in a 12-month period
- Cultural Awareness video
- Any specific equipment training (e.g.: crane operator)
- Site specific training for environmental compliance (e.g.: spill prevention, Hazmat, storm water, etc.)

For contractor personnel working on-site more than 40 hours in a 12-month period, the following training is required:

- General Safety Basic Training (Surface and/or Underground)

1.2.10 The Contractor must have an individual trained and qualified as a SURF Guide for each area that the Contractor will be working. The Guide must be onsite with the workers at all times. Refer to ESH-(1000-S)-73189 Facility Access Standard or the SURF Training Department for Contractor Guide training.

1.2.11 The Contractor shall provide all common Personal Protective Equipment (PPE) required for the work (ANSI Type 2 hard hats with chin straps, safety toe boots, safety glasses with side shields, ANSI Class 2 hi-visibility clothing and required fall protection equipment including suspension trauma straps, and full body harness (ANSI A10.14 approved). All contractor personnel shall follow the ESH-(7000-S)-71493 PPE Standard, ESH-(7000-A)-202795 PPE Guidelines for Common Tasks, ESH-(7000-A)-202796 PPE Requirements for Specific Locations and supporting documents.

- Unique PPE required for aerial lift equipment:
  - Anyone working from an aerial lift must wear a personal fall restraint system or SRL following manufacturer's recommendations.
  - Fall protection must be attached to the manufacturer's designated anchor point.
- Unique PPE required for any underground work will be provided by SDSTA for the duration of the project and at a minimum includes:
  - W65 Self Rescuers (must be maintained according to MSHA requirements) (always required when working underground)
  - Gas Tester(s) (M40M or equivalent)
  - Cap lamps

1.2.12 Smoking, use of tobacco products, including vapor, alcohol, controlled substances, or weapons are not allowed within the boundaries of SURF. All property owned and operated by the SDSTA is designated as tobacco and vapor-free. This applies to all areas of the surface and the underground. The Contractor shall manage and maintain a drug and alcohol policy that aligns with that of SDSTA written policy and procedures. The ESH department review of this document may be required.

1.2.13 If SDSTA perceives the Contractor has created or is exposed to an imminent danger, unacceptable risk, or a non-compliance situation, SDSTA will stop work until safe conditions are re-established. Such work stoppages will be at the expense of the Contractor and will not add time to the completion date of the contract. All personnel have the right and responsibility to authorize a stop work onsite whenever encountering an unsafe condition or act. Refer to the ESH-(2000-S)-202124 Stop Work Standard.

1.2.14 In the event of an incident, Contractor will notify the Project Manager and/or ESH Safety Rep immediately and never later than the end of shift on the day of incident. Contractor shall complete the ESH-(3000-F)-173324 First Report form and submit to the Project Manager or ESH Safety Rep. Contractor shall conduct an incident investigation in accordance with the SDSTA Standard. The investigation will include preparing a written report summarizing the results of the investigation, corrective actions taken to prevent a reoccurrence, and any lessons learned. SDSTA may at its discretion participate in and facilitate the incident investigation. Time and expense incurred by Contractor performing an incident investigation will be at the Contractor's expense.

1.2.15 The Contractor may, with SDSTA written permission, operate SURF-owned equipment. The Incidental Operator must first meet SDSTA requirements for the operation of said equipment. The Contractor shall regularly inspect, test, and calibrate as necessary all equipment, machinery, tools, or other items furnished by SDSTA that are employed in Contractor's work. Contractor shall take reasonable precautions to avoid damage to facility structures and utilities. If apparent defects are found in SDSTA-provided materials or equipment, defective equipment shall be taken out of service and Contractor shall promptly notify the Project Manager of such defect(s) in writing. Contractor provided equipment shall be inspected and maintained prior to arriving on-site and before each use. Failure of Contractor-provided equipment shall not be entitled to any compensation for downtime or delays or schedule extensions.

1.2.16 When working in the headframes, the Contractor will maintain six-foot distance away from an open shaft hole when the cage gate is open or have 100% tied-off (Fall Arrest) protection.

1.2.17 The Contractor acknowledges that periodic evacuation drills and exercises are required by SDSTA to validate the adequacy and effectiveness of the ESH-(6000-S)-185207 Emergency Management Standard. Contractor also recognizes that such drills and exercises enhance its employees' understanding of Emergency Management Standard. Contractor agrees to participate in quarterly evacuation drills, which may or may not be scheduled in advance, during the term of this contract. It is understood that Contractor will not be entitled to any additional compensation for participating in these evacuation drills or exercises.

1.2.18 The Contractor agrees to assess whether Contractor's employees have the physical, mental, and emotional capacity to perform assigned tasks competently and in a manner that does not unreasonably threaten safety, health, or property, including participation in emergency procedures applicable to Contractor's work location. The ESH-(2000-S)-15209 Fatigue Management Standard regulates the impacts of fatigue for safety, health, and productivity onsite. Refer to the SURF website ESH Manual at https://www.sanfordlab.org/esh for further information.

1.2.19 The Contractor shall follow use of ladders and shall meet the requirements of OSHA 1926.1053 (Subpart X) and OSHA 1910.23 (Subpart D). Prior to using a ladder, the following shall be considered:

- Alternative methods, such as platform/podium ladder, scaffolding, scissor lift, or aerial lift.
- Fall protection is required when working from a standard ladder at a height greater than four feet.
- Fall protection is required when working from the platform of a three-sided podium ladder at a height greater than six feet.
- Additional fall protection is not required when working from a four-sided podium ladder.

For further information on the ESH-(7000-S)-73415 Fall Protection and Prevention Standard, refer to the SURF website ESH Manual at https://www.sanfordlab.org/esh.

1.2.20 The Contractor shall manage all waste, both solid and hazardous, as well as all obsolete, expired, or unused materials procured by the Contractor, including the cost of disposal. The Contractor shall manage and dispose of all wastes generated in compliance with all applicable state and federal laws and regulations. The Contractor shall minimize, to the extent practical, the generation and accumulation of waste during the lifespan of the project. Waste shall not be allowed to accumulate to the point of becoming a threat to the environment (air, land, water) and must not be stored on the ground for longer than a single work shift. Where large amounts of waste are anticipated, a roll off bin should be used. When a roll off bin is not used, wastes must be removed from the work site on a regular basis.

All clean-up and disposal costs associated with Contractor spills or equipment leaks of environmentally regulated substances in the performance of their work are the responsibility of the Contractor. Spills and leaks must be cleaned up immediately, and leaks must be repaired to prevent further environmental contamination.

If the Contractor will be disturbing one or more acres, it is the responsibility of the Contractor to obtain a South Dakota Stormwater Construction Permit and to comply with that permit, including the installation and maintenance of stormwater pollution controls. Stormwater flowing off the work site must be clean, with no visible sheen or solids. Any existing stormwater pollution controls that are altered during Contractor activities must be returned to full operating condition as soon as possible.

Work that results in the storage of petroleum products (55 gallons or greater in a single container) or the installation of oil-filled operational equipment with a volume of 55 gallons or greater must be reported to the Environmental Department, and secondary containment must be installed.

Visible air emissions occurring from roads, stockpiles, conveyors, etc. used during Contractor work must be controlled by the Contractor.

1.2.21 All chemicals to be used at SURF must be pre-approved by SDSTA and Safety Data Sheets (SDS) must be maintained by the Contractor and be readily available to workers on site.

1.2.22 Flammables (defined in 30 CFR Part §57.4460 Storage of flammable liquids underground) are not allowed underground. Flammables used on the surface are to be stored in engineered flammable cabinets or in containers with a minimum one-hour fire resistance.

1.2.23 Combustibles in the underground work areas shall be managed as per 30 CFR Part 57.4104 - 57.4531, as applicable.

1.2.24 Tier 4 engines are required at SURF for underground use. Lower Tier 3 equipment may be allowed underground but only with SDSTA permission. All underground diesel equipment must be approved by SDSTA prior to usage.

1.2.25 SDSTA reserves the right to restrict or deny access of any Contractor employee to the work location.

1.2.26 The Contractor shall report the hours worked on site by Contractor's employees on a monthly basis to the Project Manager named in the contract. Hours shall be emailed to the Project Manager no later than the 3rd day of the month for hours worked the previous month.

**--- End of Section ---**

## Section 01 45 00 Quality Control for Construction

1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- Preconstruction Submittals
- QC Plan;

Submit a QC plan within 15 calendar days of Notice to Proceed.

1.2 INFORMATION REQUIREMENTS

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Project Manager. The report forms will consist of the Contractor Daily Report, Rework Items List, and Testing Plan and Log.

Deliver the following to the Project Manager and the designated SDSTA QA Rep:

- DAILY Report: By 10:00am the next working day after each day that work is performed, or by the time determined and accepted by the team;
- Field Test Reports: One copy, within one week after the test is performed;
- QC Certifications: As required by the paragraph entitled "QC Certifications."

1.3 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a QC plan, a Project Preconstruction Conference, Weekly Status Meeting, submittal review, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction, and operations that comply with the requirements of this contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site.

1.3.1 Preliminary Work Authorized Prior to Acceptance

The only work that is authorized to proceed prior to the acceptance of the QC plan is the mobilization of storage and office trailers, the installation of temporary utilities, and surveying.

1.3.2 Acceptance

Acceptance of the QC plan is required prior to the start of construction. SDSTA reserves the right to require changes in the QC plan and operations as necessary, including removal of personnel, to ensure the specified quality of work.

1.3.3 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the Contracting Officer.

1.4 QC ORGANIZATION

1.4.1 QC Manager

1.4.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. In addition to implementing and managing the QC program, the QC Manager may perform the duties of project superintendent. The QC Manager is required to attend the Preconstruction Conference, conduct the QC meetings (If separate from the Weekly Status meeting), perform submittal review, ensure testing is performed, and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating documentation performed by others.

#### 1.4.1.2 Qualifications

An individual with a minimum of 5 years combined experience as a superintendent, inspector, QC manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this contract. The individual must be familiar with and have experience in the areas of hazard identification and safety compliance.

### 1.4.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

## 1.5 QC PLAN

### 1.5.1 Requirements

Provide a QC plan that covers both on-site and off-site work and includes the following with a table of contents listing the major sections identified with tabs.

I. QC ORGANIZATION: A chart showing the QC organizational structure and its relationship to the production side of the organization.

II. NAMES AND QUALIFICATIONS: In resume format, for each person in the QC organization.

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Of each person in the QC organization.

IV. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

V. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval.

VI. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

VII. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

VIII. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track and complete rework items.

IX. DOCUMENTATION PROCEDURES: Use SDSTA formats or agreed upon formats with SDSTA QA Manager and Contractor.

X. PROCEDURES FOR COMPLETION INSPECTION: See the paragraph entitled "COMPLETION INSPECTIONS".

## 1.6 PROJECT PRECONSTRUCTION CONFERENCE

During the Preconstruction Conference and prior to the start of construction, discuss the QC program required by this contract. The purpose is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, and the coordination of the Contractor's management, production and the QC personnel. At the meeting, the Contractor will be required to explain how quality control will be implemented for key features of work. Contractor's personnel required to attend shall include the QC Manager, Project Manager, and superintendent.

## 1.7 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this contract.

### 1.7.1 Test Results

Cite applicable contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the Contracting Officer immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Project Manager.

## 1.8 QC CERTIFICATIONS

### 1.8.1 Invoice Certification

Furnish a certificate with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

### 1.8.2 Completion Certification

Upon completion of work under this contract, the QC Manager shall furnish a certificate attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

## 1.9 COMPLETION INSPECTIONS

### 1.9.1 Final Inspection

Near the completion of all work, a Final Inspection is scheduled with the QC Manager and SDSTA project team, including the A/E. During this inspection, the QC Manager develops a punch list of items which do not conform to the approved drawings and specifications. Include in the punch list any remaining items on the "Rework Items List" which were not corrected prior to the Final Inspection. The punch list includes the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the Project Manager. Any items noted on the punch list shall be corrected in a timely manner and shall be accomplished before the Contract Completion Date. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify SDSTA that the project is ready for the SDSTA Final Acceptance Inspection. A pre-final walkthrough with the PM is recommended to ensure the Contractor is adequately prepared for the Final Inspection.

### 1.9.2 Final Acceptance

When all items on the punch list have been completed, a Final Acceptance inspection is performed. The QC Manager, superintendent or other Contractor management personnel, and SDSTA project team will attend this inspection to verify that the facility is complete and ready to be occupied.

## 1.10 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities. Reports are required for each day work is performed. Account for each calendar day throughout the life of the contract. The superintendent and the QC Manager (if separate) must prepare and sign the Contractor Daily Report. The reporting of work shall be identified by terminology consistent with the construction schedule. In the "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

### 1.10.1 As-Built Drawings

The QC Manager is required to review the as-built drawings and ensure they are kept current on a regular basis and marked to show deviations, which have been made from the contract drawings and shop drawings. Ensure each deviation has been identified with the appropriate modifying documentation, e.g. modification number, RFI number, etc. The QC Manager shall initial each deviation or revision.

## 1.11 NOTIFICATION ON NON-COMPLIANCE

The Project Manager or QA Rep will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action. If the Contractor fails or refuses to correct the non-compliant work, the Contracting Officer will issue a non-compliance notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to such stop orders the subject of claim for extension of time, for excess costs, or damages.

**--- End of Section ---**

## Section 01 50 00 Temporary Construction Facilities and Controls

1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511 Standard for Reduced-Pressure Principle Backflow Prevention Assembly (latest edition)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations (latest edition)

NFPA 70 National Electrical Code (latest edition)

1.2 SUBMITTALS

Submit the following in accordance with Section SUBMITTAL PROCEDURES:

- Construction Site Plan
- Traffic Control Plan

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

2.1 TEMPORARY TRAFFIC CONTROL

2.1.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.1.2 Fencing

Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people.

- The safety fencing must be a high visibility orange colored, high-density polyethylene grid or approved equal, a minimum of 1.2 m (48 inches) high and maximum mesh size of 50 mm (2 inches), supported and tightly secured to steel posts located on maximum 3 m (10 foot) centers, constructed at the approved location. Install fencing to be able to restrain a force of at least 114.00 kg (250 pounds) against it.

2.2 TEMPORARY WIRING

Provide temporary wiring in accordance with NFPA 241 and NFPA 70. The Contractor is required to conduct frequent inspections of all installed equipment and apparatus and report this on the daily report.

## 3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the Project Manager. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the SDSTA installation.

## 3.2 AVAILABILTIY AND USE OF UTILITY SERVICES

### 3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, must not create unsafe conditions, and must not violate applicable codes and standards.

### 3.2.2 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Project Manager and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any district or commercial sanitary sewer system. Any penalties and/or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Project Manager and follow sanitary district regulations and procedures when discharging into the sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. SDSTA toilet facilities will not be available to Contractor's personnel.

### 3.2.3 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

## 3.3 TRAFFIC PROVISIONS

### 3.3.1 Maintenance of Traffic

Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic except with written permission of the Project Manager at least 15 calendar days prior to the proposed modification date and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. Contractor may move oversized and slow-moving vehicles to the worksite provided the requirements of the highway authority have been met.

Conduct work so as to minimize obstruction of traffic and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

### 3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Project Manager. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to persons and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

### 3.3.3 Dust Control

Dust control methods and procedures must be approved by the Project Manager. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

## 3.4 CONTRACTOR'S TEMPORARY FACILITIES

### 3.4.1 Storage Area

Construct a temporary 1.8 m (6 foot) high chain link fence around trailers and materials. Include colored plastic strip inserts so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Project Manager away from the vicinity of the construction site but within SURF boundaries. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

### 3.4.2 Appearance of Temporary Facilities

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair.

b. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles, gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project.

#### 3.4.3 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment.

### 3.5 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store any salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

### 3.6 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore areas used by the Contractor for the storage of equipment or material, or other use to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

**--- End of Section ---**

## Section 01 78 00 Closeout Submittals

1 GENERAL

1.1 DEFINITIONS

1.1.1 As-Built Drawings

As-built drawings are developed and maintained by the Contractor and depict actual conditions, including deviations from the contract documents. These deviations and additions may result from coordination required by, but not limited to, contract modifications, official responses to Contractor submitted Requests for Information, direction from the Contracting Officer, designs which are the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site. These files serve as the basis for the creation of the record drawings.

1.1.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

1.2 SUBMITTALS

Submit the following in accordance with Section SUBMITTAL PROCEDURES:

- Product Data
- Spare Parts Data
- Manufacturer's Instructions
- Posted Instructions
- As-Built Drawings
- Final Approved Shop Drawings

2 PRODUCTS

2.1 AS-BUILT DRAWINGS

2.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the as-built drawing. Show what was changed, how it was changed, where item(s) were relocated, and change related details. These working as-built markups must be neat, legible, and accurate.

2.1.2 As-Built Drawings Content

Show the following information on the as-built drawings:

- The actual location, kinds, and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.
- The location and dimensions of any changes within the building structure.
- Layout and schematic drawings of electrical circuits and piping.
- Correct grade, elevations, cross section, or alignment of roads, earthwork, structures, or utilities if any changes were made from contract plans.

- Changes in design details or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- The topography, invert elevations, and grades of drainage installed or affected as part of the project construction.
- Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.
- Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.
- Actual location of anchors, construction and control joints, etc., in concrete.
- Unusual or uncharted obstructions that are encountered in the contract work area during construction.

2.2 CLEANUP

Leave premises "broom clean." Remove waste, surplus materials, rubbish, and construction facilities from the site.

**--- End of Section ---**

## Section 01 93 00 Operation and Maintenance Data

1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- Operation and Maintenance Data
- Training Plan

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.2.2 Commissioning Authority Review and Approval

Submit the commissioned systems and equipment submittals to the Commissioning Authority (CxA) to review for completeness and applicability. Obtain validation from the CxA that the systems and equipment provided meet the requirements of the contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CxA communicates deficiencies to the Contracting Officer. Submit the O&M manuals to the Contracting Officer upon a successful review of the corrections and with the CxA recommendation for approval and acceptance of these O&M manuals. This work is in addition to the normal review procedures for O&M data.

1.3 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Include a complete electronically linked operation and maintenance directory.

1.3.1 O&M MANUAL LABEL REQUIREMENTS

Provide the following information on the label:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared By: (Name, title, phone number and email address)

f. Date

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are detailed descriptions of the data package items required.

### 1.4.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

#### 1.4.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 SDSTA SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

#### 1.4.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

#### 1.4.1.3 Startup, Shutdown and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

#### 1.4.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

#### 1.4.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

#### 1.4.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

#### 1.4.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

#### 1.4.1.8 Additional Requirements for HVAC Control Systems

a. Narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of checkout tests and calibrations performed by the Contractor (not Cx tests).

### 1.4.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

#### 1.4.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

#### 1.4.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

a. Define the anticipated time required to perform each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics, diagrams, and diagnostic techniques necessary to operate and troubleshoot the system after acceptance.

### 1.4.3 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

#### 1.4.3.1 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement.

#### 1.4.3.2 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components of the system.

#### 1.4.3.3 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

#### 1.4.3.4 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

# 2 PRODUCTS

Not Used

# 3 EXECUTION

## 3.1 TRAINING

Prior to acceptance of the facility for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the electrical maintenance personnel. Training must include classroom or field lectures based on the system's operating requirements. The location of classroom training requires approval by the Project Manager.

### 3.1.1 Training Plan

Submit a written training plan to the Project Manager for approval. The training plan must be approved by the Quality Control Manager prior to forwarding to the SDSTA. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

### 3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC Manager is responsible for overseeing and approving the content and adequacy of the training. Include the following for each system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

**--- End of Section ---**

# SECTION 26 00 00 – ELECTRICAL WORK, GENERAL

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 00 00 – ELECTRICAL WORK, GENERAL

## PART 1 -- GENERAL

### 1.1 PROJECT OVERVIEW

This General Work Specification defines the scope, context, and expectations for the Yates Complex Electrical Infrastructure Upgrade Project at the Sanford Underground Research Facility (SURF), administered by the South Dakota Science and Technology Authority (SDSTA). The Yates Complex (Figure 1), originally constructed in the 1930s and 1940s by the Homestake Mining Company, was developed to support deep underground gold mining operations. Since 2007, the site has been repurposed to support SURF's mission in scientific research, with the Yates Shaft serving as a critical access point for personnel and materials to reach underground laboratories.

**Figure 1 - SDSTA Yates Complex**

### 1.2 BACKGROUND AND NEED

The electrical infrastructure at the Yates Complex includes some of the oldest equipment still in operation at SURF, with components dating back nearly a century. A 2022 medium-voltage condition assessment by HDR concluded that, with the exception of the Open Cut Conveyor substations, all substations in the Yates Complex will have exceeded their expected service life by 2032. The system currently suffers from:

A. Equipment at or beyond end-of-life

B. Deferred testing and maintenance

C. Abandoned but energized legacy equipment

D. Asbestos-containing electrical components

E. Lack of redundancy and interconnection

F. Inefficiencies introduced during the transition from mining to research operations

These conditions present operational, safety, and environmental risks that necessitate a comprehensive modernization effort.

1.3 Project Scope

The primary objective of this project is to consolidate and replace the aging substations with a new, centralized 12.47kV switchgear system located in the Crusher Building. The project is divided into three major phases:

A. Phase I – Yates Crusher Substation Installation:
Installation of a new 7-section 12.47kV switchgear lineup and a 2.0MVA transformer in the Crusher Building. This phase includes distribution upgrades to the Yates Hoist, Foundry, Admin, E&O, and Headframe buildings, as well as underground feeders.

B. Phase II – East Switchyard Modifications:
Decommissioning of the existing East Switchyard switchgear and associated infrastructure. This phase includes evaluation of routing alternatives and the installation of a new 1.5MVA transformer outside of the Foundry building following the abandonment of the Tramway tunnel due to structural concerns.

C. Phase III – WWTP Refeed:
Re-routing of power to the Wastewater Treatment Plant (WWTP) from the new Crusher Substation. This includes the installation of a new 1.25MVA transformer and direct-buried conduit along Apperson Place.

1.4 USE OF THIS SPECIFICATION

This specification is intended to serve as a comprehensive reference for all prospective bidders. It outlines the technical requirements, site-specific constraints, and coordination expectations necessary for successful execution of the work. Bidders are expected to:

A. Review the document in its entirety

B. Interpret the scope in conjunction with referenced drawings and site conditions

C. Coordinate with SDSTA personnel as needed

D. Consider legacy infrastructure and operational continuity in their proposals

This document is not a prescriptive checklist but a framework to guide the development of complete, compliant, and cost-effective bids that align with SURF's long-term operational goals.

1.5 THE SUMMARY

A. Provide the electrical WORK, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.

C. The WORK of this Section is required for the operation of electrically driven equipment provided under Specifications in other Divisions.

D. The CONTRACTOR'S attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment Specifications.

E. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various Sections of Division 26 is included as a part of the WORK under the respective Sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

F. Equipment supports and foundations shall be in conformance with manufacturer standard requirements.

1.6 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.7 REFERENCES SPECIFICATIONS, CODES, AND STANDARDS

| | |
|---|---|
| National Electrical Code (NEC) | |
| NEC (NFPA 70) | National Electrical Code: Latest Edition 2023 |
| International Electrical Testing Association (NETA) | |
| National Electrical Manufacturers Association (NEMA) | |
| NEMA 250 | Enclosure for Electrical Equipment (1000 Volts Maximum) |
| South Dakota Science and Tech Auth Standards | |
| NECA 1-2023 Good Workmanship in Electrical Construction (ANSI) | |

A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL)/an OSHA Nationally Recognized Testing Laboratory or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

## 1.8 SIGNAGE AND MARKINGS

A. Identification

1. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements.

B. Local Disconnect Switches

1. Legibly mark each local disconnect switch for motors and equipment in order to indicate its purpose, unless the purpose is indicated by the location and arrangement.

C. Warning Signs

1. Label electrical equipment with Arc Flash and Shock protection labels in accordance to NFPA 70E, printed with indelible ink.

2. 600 Volts Nominal, or Less

    a. Mark entrances to rooms and other guarded locations that contain live parts with conspicuous signs prohibiting unqualified persons from entering.

3. Greater than 600 Volts

    a. Buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at greater than 600 volts nominal shall be lockable.

    b. Provide permanent and conspicuous warning signs reading as follows: DANGER – HIGH VOLTAGE – KEEP OUT.

4. Mark indoor electrical installations that are open to unqualified persons and contain metal-clad switchgear, unit substations, transformers, and other similar associated equipment over 600 volts nominal, with appropriate caution signs.

5. Outside Branch Circuits and Feeders over 600 Volts

    a. Post warning signs in plain view where unauthorized persons might come in contact with live parts: WARNING – HIGH VOLTAGE – KEEP OUT.

D. Isolating Switches

1. Provide isolating switches not interlocked with an approved circuit-interrupting device with a sign warning against opening them under load.

## 1.9 SUBMITTALS

A. General

1. Furnish submittals in accordance with the requirements of Contract Documents.

2. Custom-prepare Shop Drawings.

3. Drawings or data indicating "optional" or "as required" equipment will not be accepted.

4. Cross out options not proposed or delete from the Shop Drawings.

B. Shop Drawings: Include the following:

1. Complete material lists stating manufacturer and brand name of each item or class of material.
2. Shop Drawings for grounding WORK not specifically indicated.
3. Front, side, rear elevations, and top views with dimensional data.
4. Location of conduit entrances and access plates.
5. Component data.
6. Connection diagrams, terminal numbers, wire size ranges, internal wiring diagrams, conductor size, and cable numbers.
7. Method of anchoring, seismic requirements, weight, center of gravity.
8. Types of materials, enclosure rating and finish.
9. Nameplates.
10. Temperature limitations, as applicable.
11. Voltage requirement, phase, and current, as applicable.
12. Front and rear access requirements including ventilation spaces.
13. Test reports
14. Grounding requirements

C. Catalog Cuts

1. Submit catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material.
2. Stamp the catalog data sheets in order to indicate the Project name, project tag number, applicable Specifications Section and Paragraph, model number, and options.

D. Materials and Equipment Schedules

1. Within 90 Days of the commencement date in the Notice to Proceed, deliver to the ENGINEER a complete list of materials, equipment, apparatus, and fixtures that are proposed for use.
2. Include in the list the type, size, name of manufacturers, catalog number, and such other information as required to identify the item.

E. Technical Manuals

1. Submit complete information in accordance with the requirements of contract documents.

2. As-Built Drawings

   a. CONTRACTOR shall provide as-built data, showing invert and top elevations and routing of duct banks and concealed below-grade electrical installations.

   b. Furnish the drawings to the OWNER in accordance with the requirements of the contract document.

1.10 AREA DESIGNATIONS

A. General

1. Designations for raceway system enclosures shall comply with the requirements of Section 26 05 33 – Electrical Raceway Systems.

2. Designations for electrical WORK specifically indicated in other Sections shall comply with the requirements of those Sections unless indicated otherwise.

3. Designations for work in electrical rooms with a controlled environment and weather protected ventilated spaces shall be NEMA 12 or NEMA 1 Gasketed.

4. Designations for electrical WORK in all other locations shall be NEMA 4X or NEMA 3R.

5. Installations in hazardous locations shall conform strictly to the requirements of the indicated Class, Group, and Division.

B. Material Requirements

1. Provide sealing fittings in chlorine and hydrofluosilicic (HFS) acid areas.

2. Construct NEMA 4X enclosures of Type 304 or 316 stainless steel, except in chlorine and HFS areas where non-metallic PVC or Fiberglass or Gel-coated enclosures shall be provided.

3. Do not coat NEMA 4X enclosures, unless required by the production process

4. Construct NEMA 7 enclosures of cast aluminum where used with aluminum conduit, and of cast iron when used with galvanized steel conduit.

5. Do not coat NEMA 7 and 9 enclosures.

6. Construct NEMA 1, 3R, and 12 enclosures of steel, and prime and coat with ANSI 61 light grey paint or White (to reflect heat for an outdoor location).

1.11 TESTS

A. The SUPPLIER shall be responsible for field tests indicated in Division 26, as required by the ENGINEER, and as required by other authorities having jurisdiction.

B. Furnish necessary testing equipment.

C. Reporting

1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.

2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.

3. Submit field test reports for review prior to Substantial Completion.

D. Remove and replace equipment or material that fails a test, or, if the ENGINEER approves, repair and retest for compliance.

E. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.12 DEMOLITION AND RELATED WORK

A. General

1. The CONTRACTOR is cautioned that demolition WORK may also be indicated on electrical Drawings.

2. Coordinate with all trades regarding electrical de-energization, disconnection, and removal, and the overall sequence of construction.

B. Electrical Requirements for Removed Equipment

1. CONTRACTOR shall obtain a Lock-Out, Tag-Out Clearance from OWNER prior to any demolition work.:

2.

3. Remove dedicated wiring and exposed conduits back to the source.

4. Abandon in place wiring that shares conduits with other equipment wiring remaining in-service. The tape ends with orange electrical tape.

5. Abandon in place cables in tray. Tape ends with orange electrical tape.

6. Encased Conduits

   a. Abandon in place wiring routed through encased conduits.

   b. Cut encased conduits flush to the floor and grout flush with the floor. Remove exposed conduit to the first fitting/coupling before encasement. Remove the fitting/coupling and replace it with a 5-thread conduit cap.

7. Remove remote-mounted starters, disconnect switches, circuit breakers, sensors, and transmitters.

C. Where new lighting and receptacles are installed, remove old lighting, receptacles, switches, wiring, and conduits.

D. Junction Boxes

1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.

2. Provide a junction box with a NEMA rating in accordance with the area in which it is located and sized as required.

3. Properly identify wires and terminals before disconnection.

E. Removed materials and equipment not indicated to be returned to the OWNER shall, upon removal, become the CONTRACTOR'S property and shall be disposed of off- Site.

## 1.13 CONSTRUCTION SEQUENCING

A. General

1. Because the continuance of operation during demolition is critical, the SUPPLIER & CONTRACTOR shall carefully examine the WORK to be provided in, on, or adjacent to existing equipment.

2. Schedule the WORK, subject to OWNER's approval, to minimize required shutdown time.

3. Submit a written sequencing request, including the sequence and duration of activities to be performed during plant shutdown.

4. In no case shall the SUPPLIER & CONTRACTOR begin any WORK in, on, or adjacent to existing equipment without written authorization from the OWNER.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.

2. Perform modifications to existing equipment, panels, and cabinets in a professional manner.

3. Repair coatings to match existing.

4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the WORK.

C. Existing Utilities

1. Exercise extreme caution when digging trenches to not damage existing underground utilities.

2. The cost of repairs of damages caused during construction shall be included as a part of the WORK.

D. Field Verifications

1. The lack of knowledge will not be accepted as justification for extra compensation to perform the WORK.

2. The cost for the above verifications shall be included as part of the WORK.

E. Installation of Temporary Equipment

1. To facilitate the continuous operation of existing equipment, provide the temporary equipment as indicated.

2. Submit installation and connection details for review and acceptance by the ENGINEER and OWNER.

3. Costs associated with these temporary installations shall be included as part of the WORK.

4. Temporary wiring and equipment shall remain the property of the CONTRACTOR unless indicated otherwise.

**PART 2 -- PRODUCTS**

2.1 GENERAL

A. Provide equipment and materials that are new and are the products of experienced and reputable manufacturers in the industry.

B. Provide equipment and materials listed by an OSHA Nationally Recognized Testing Laboratory where listed and marked requirements apply.

C. Provide similar items in the WORK as products of the same manufacturer.

D. Provide equipment and materials of industrial grade standard of construction.

E. On devices indicated to display dates, display the year as 4 digits.

F. Temperature Ratings of Equipment Terminations

1. Provide terminations and lugs rated for 75-degree C or higher as indicated on design drawings.

2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings unless specifically noted otherwise.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Provide fastening hardware like nuts, bolts, and washers with mismatched stainless steel material to prevent potential galling .

2. Provide 3/8-inch diameter minimum threaded rods for trapeze supports constructed from continuous threaded galvanized steel for NEMA 1 and NEMA 12 areas, and 316 stainless steel for NEMA 4X areas. Mismatched stainless steel hardware shall be used to prevent galling.

3. Struts

a. Construct struts for mounting of conduits and equipment of galvanized steel for NEMA 1 and NEMA 12 areas and 316 stainless steel in NEMA 4X areas. Mismatched stainless steel hardware shall be used to prevent galling.

b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.

c. Do not use aluminum strut for free-standing support frames.

d. Strut Manufacturer, or Equal: Unistrut; B-Line.

4. End Caps

a. Provide plastic protective end caps for all exposed strut ends.

b. End Caps Manufacturer, or Equal: Unistrut, Model P2860.

5. Anchors

   a. Anchor shall meet the industry accepted and SDSTA approved standards.

   b. Provide 316 stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings.

   c. Wood plugs will not be accepted.

   d. Anchor Manufacturer, or Equal: "Power-Bolt" or "Power-Stud" as manufactured by Power Fasteners, Inc.; similar by Star.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates Fabricate nameplates from Black-letter, white-face laminated plastic engraving stock, such as Formica Type ES-1 or equal.

   1. Securely fasten each nameplate, using fasteners constructed of brass, cadmium-plated steel, or stainless steel, and screwed into inserts or tapped holes as required. Field issued label can be adhesive mounted.

   2. Provide engraved characters of the block style, with no characters smaller than 1/8-inch top to bottom.

B. Conductor and Equipment Identification

   1. Provide imprinted plastic-coated cloth marking devices, such as manufactured by Brady, Thomas & Betts, or equal.

   2. Alternatively, provide heat-shrunk plastic tubing or wrap around label (for conductors greater than 8AWG), imprinted split-sleeve markers cemented in place.

**PART 3 -- EXECUTION**

3.1 GENERAL

A. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items.

2. Follow the locations on the Drawings, however, as closely as possible.

3. Conduits

    a. Where conduit development drawings or "home runs" are indicated, route the conduits in accordance with those requirements.

    b. Provide exposed or encased routings as indicated, except conceal conduit in finished areas unless indicated otherwise.

    c. Size conduits encased in a slab for conduit OD not to exceed 1/3 of the slab thickness and lay out and space as to not impede concrete flow.

4. Placement

    a. Install conduit and equipment in such a manner as to avoid creating obstructions, to preserve headroom, and to keep openings and passageways clear.

    b. Locate luminaires, switches, convenience outlets, and similar items within finished rooms as indicated.

        1) If equipment is installed without instruction and must be moved, the cost of moving shall be included as part of the WORK.

        2) Slightly adjust luminaire locations in order to avoid obstructions and to minimize shadows.

5. Circuits

    a. Provide #10AWG minimum wiring, and 3/4-inch minimum conduits (exposed) and one-inch minimum conduits (encased).

6. Workmanship

    a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer and using workers skilled in the WORK.

    b. Coordinate installation in the field with other trades in order to avoid interferences.

    c. Electrical workmanship shall meet or exceed ANSI/NECA 1-2023.

7. Protection of Equipment and Materials

    a. Fully protect materials and equipment against damage from any cause.

b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint.

c. Keep moving parts clean and dry and lubricated as necessary.

d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

## 3.2 CORE DRILLING

A. Perform core drilling as required for the installation of raceways through concrete walls and floors.

B. Install Schedule 10 stainless steel sleeve through all wall/floor core drilled openings. Floor sleeves shall protrude 4” above the finished floor and have 3 welded securing tabs equally spaced at floor level. All sleeves shall be grouted in place on both sides of wall/floor.

C. Base the locations of floor penetrations, as may be required, on field conditions.

D. Verify exact core drilling locations based on equipment actually furnished as well as exact field placement.

E. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities.

F. Repair damage to encased conduits, wiring, and piping as part of the WORK.

## 3.3 CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.

B. Extend housekeeping pads for equipment, including future units, 6 inches above the surrounding finished floor or grade, and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.

C. Provide concrete housekeeping curbs for conduit stub-ups in indoor locations that are not concealed by equipment enclosures.

## 3.4 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment and raceways shall be anchored in place by methods that will meet seismic requirements in the area where the Project is located.

B. Provide wall-mounted panels that weigh more than 500 pounds or that are within 18 inches of the floor with fabricated steel support pedestals.

C. If the supported equipment is a panel or cabinet enclosed within removable side plates, match supported equipment in physical appearance and dimensions.

D. Provide transformers hung from 4-inch stud walls and weighing more than 300 pounds with auxiliary floor supports.

E. Provide leveling channels anchored, shims and/or grout to the concrete pad for MCC’s, switchgear and other electrical equipment mounted on housekeeping pads to level if needed.

F. Manufacturer's Recommendations

1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract.

2. Submit such recommendations as Shop Drawings as indicated.

3.5 EQUIPMENT IDENTIFICATION

A. Provide nameplates for panelboards, control and instrumentation panels, starters, switches, and pushbutton stations.

B. In addition to nameplates, equip control devices with standard collar-type legend plates.

C. Identify control devices within enclosures as indicated and similar to the subparagraph above.

D. Provide suitable inscribed finish plates for toggle switches that control loads out of sight of switches and for multi-switch locations of more than 2 switches.

E. Use equipment names and tag numbers, where indicated, on nameplates.

F. Provide typewritten circuit directories for panelboards, that accurately reflect the outlets connected to each circuit.

G. Terminal Blocks

1. Label termination points on terminal blocks by identifiers on the blocks.

2. Provide identifiers that have been preprinted by the terminal manufacturer or custom-printed.

3. Hand-lettered markers will not be accepted.

3.6 CLEANING

A. Before final acceptance, thoroughly clean the electrical WORK of cement, plaster, and other materials.

B. Remove temporary tags, markings, stickers, and the like.

C. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.

D. Apply touch-up paint to scratches on panels and cabinets.

E. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets.

F. Clean luminaires inside and out. Replace failed lamps.

G. Properly dispose of cleaning debris and refuse off-site.

**END OF SECTION**

## SECTION 26 01 26 – ELECTRICAL TESTING

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 01 26 – ELECTRICAL TESTING

## PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section specifies the work necessary to be performed by CONTRACTOR for testing, Start-up and commissioning of electrical system based on the requirement as specified by Specification Section 26 01 26, “Electrical Tests”.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated here in and functional testing of power and controls, shall be completed before commencement of the 7 Day. This scope may require the CONTRACTOR to activate circuits, shut down circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.

C. The requirements of Section 26 00 00 - Electrical Work, General, apply to the WORK of this Section.

D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

| | |
|---|---|
| **American National Standards Institute (ANSI)** | |
| **Institute of Electrical and Electronics Engineers, Inc. (IEEE)** | |
| IEEE 400-2012 | Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems |
| IEEE 576-2000 | Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications |
| **InterNational Electrical Testing Association (NETA)** | |
| NETA-ATS (Latest Edition) | Standard for Acceptance Testing Specification for Electrical Power Equipment and Systems |
| **Telecommunication Industry Association (TIA)** | |
| TIA-526-14-C | Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant |
| TIA/EIA-568-C.3 | Optical Fiber Cabling Components Standard |
| 26 00 00 | Electrical Work, General |
| 26 01 26 | Electrical Tests |

1.4 SUBMITTALS

A. Submit in accordance with contract document.

B. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section.

3. Detailed comprehensive testing schedule including:

a. Each major piece of electrical distribution equipment.

b. Each major electrical subsystem.

c. Duration of each test.

d. Milestone test completion date.

e. Ambient Conditions at time of test.

f. Date of test results submittals following completion of the tests.

g. Names and qualifications of the individual(s) responsible for performing the testing.

C. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

D. Test result shall be submitted in one submittal.

E. Test reports shall be based on NETA's latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA's Acceptance Testing Specifications latest edition.

## 1.5 COMMISSIONING

A. Commissioning during the 7 Day test shall not be attempted until all subsystems have been found to operate satisfactorily. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

B. Current/Power Monitoring Tabulation

1. The motor current tabulation required shall reflect the values occurring during commissioning.

2. Motors which have current/power measurement capabilities shall have this data recorded every 5 minutes while operating during commissioning.

3. Switchboard ammeters and kilowatt meters shall be recorded every half-hour during the commissioning.

4. Power monitored for Medium Voltage and Low Voltage Switchgear – amperes, voltage, and kilowatts for each phase shall be recorded every 5 minutes during commissioning.

## PART 2 -- TESTING AND REPORTS

### 2.1 PRE-ENERGIZATION AND OPERATING TESTS

A. The complete electrical system shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

1. Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.

2. Protective Relays. Each protective relay shall be demonstrated to operate by injecting current or voltage, or both, at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

3. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.

4. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.

5. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.

6. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.

7. Relays and Metering Utilizing Phase Differences. All relays and metering that use phase differences for operation shall be verified by measuring phase angles at the relay under actual load conditions after operation commences.

B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the authority having jurisdiction prior to energization. Acceptance Testing shall be in accordance with NETA ATS, *For Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

### 2.2 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, include remote control, if present in system. Circuitry is in accordance with panel schedules. All interior and exterior lighting shall be checked for proper operation.

2. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that kilowatt meters are within catalog accuracy as installed.

   a. Visual and Mechanical Inspection

      1) Compare equipment nameplate data with drawings and specifications.

      2) Inspect physical and mechanical condition.

      3) Verify tightness of electrical connections.

      4) Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case-shorting contacts, as applicable.

      5) Verify freedom of movement, end play, and alignment of rotating disk(s).

   b. Electrical Tests

      1) Verify accuracy of meters at all cardinal points.

      2) Calibrate watthour meters according to manufacturer’s published data.

      3) Verify all instrument multipliers.

      4) Verify that current transformer and voltage transformer secondary circuits are intact.

3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

4. Transformer Testing – Partial Discharge Testing and Doble (Tan-Delta) testing for baseline data.

5. Low Voltage Cables-600 volts Maximum

   a. Visual and Mechanical Inspection

      1) Compare cable data with drawings and specifications.

      2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

      3) Inspect bolted electrical connections for high resistance using the following methods:

         a) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data or NETA ATS, Table 100.12.

         b) Use of low-resistance ohmmeter

      4) Inspect compression-applied connectors for correct cable match and indentation.

5) Inspect for correct identification and arrangements.

6) Inspect cable jacket insulation and condition.

b. Electrical Tests

1) Perform insulation-resistance test on each power conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable; 1000 volts dc for 600 volt rated cable and any cables over 600V shall have industry standard DC Volts applied for testing. See NETA ATS for additional test voltage. Test duration shall be one minute.

a) Motor feeders tested with motors disconnected and controller open.

b) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.

c) Panelboard feeders tested with feeder breaker open and panel-board connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.

d) Conductors of main lighting feeders, including lighting panel with branch circuits open.

e) Prior to performing insulation resistance tests on cables, verify that they are not connected to device.

f) Equipment which may be damaged during this test shall be disconnected.

g) The Engineer shall be consulted if minimum insulation values cannot be obtained.

2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3) Perform continuity test to insure correct cable connection.

c. Test Values – Visual and Mechanical

1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels should be in accordance with NETA ATS Table 100.12 unless otherwise specified by the manufacturer.

d. Test Values – Electrical

1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1 or latest edition of NETA ATS. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3) Cable shall exhibit continuity.

4) Deviations in resistance between parallel conductors shall be investigated.

6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

7. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

   a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.

   b. Verification that electrical equipment has been labeled with Arc Flash protection boundary and PPE levels, as required by Section 26 05 73 – Protective Device Studies.

   c. Circuit Breakers

   Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer.

   1) Time and pickup setting shall correspond to the recommendations of the Short Circuit Study.

   2) Setting shall be tabulated and proven for each circuit breaker in its installed position.

   3) Test results shall be certified by the person performing the tests and shall be submitted to the ENGINEER.

8. Complete ground testing of grounding electrodes per requirements below prior to operating the equipment.

B. All lighting panels, circuits and fixtures; and power panels, circuits and receptacles shall be tested for proper operation.

C. Provide ground resistance tests on the main grounding electrode or system in the presence of the ENGINEER and submit results

1. Visual and Mechanical Inspection

   a. Verify ground system is in compliance with drawings and specifications.

2. Electrical Tests

   a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.

   b. The earth resistance of each ground electrode shall be measured and recorded before electrodes are connected to the grounding loop.

   c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

3. Test Values

   a. The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner.

   b. Investigate point-to-point resistance values which exceed 0.5 ohm.

## 2.3 TEST REPORTS

A. The test report shall include the following:

1. Summary of project.
2. Description of equipment tested.
3. Description of test.
4. Test data.
5. Analysis and recommendations.
6. M&TE information including calibration and expiration date.

B. Test data records shall include the following minimum requirements:

1. Identification of the testing organization.
2. Equipment identification.
3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.
4. Date of inspections, tests, maintenance, and/or calibrations.
5. Identification of the testing technician.
6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
7. Indication of expected results when calibrations are to be performed.

8. Indication of “as-found” and “as-left” results.

9. Sufficient spaces to allow all results and comments to be indicated.

C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

**PART 3 -- TEST RECORD SHEETS**

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

| Sheet No. | Title |
|---|---|
| 1 | Insulation Resistance (Power, Control Wire, and Cable) Test Record |
| 2 | Insulation Resistance (Instrument Wire and Cable) Test Record |
| 3 | Ground Electrode Testing Test Record |
| 4 | Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record |
| 5 | Bonding Resistance Readings (Electrical Equipment) Test Record |
| 6 | Insulation Resistance (Transformer) Test Record |
| 7 | Insulation Resistance (Equipment) Test Record |
| 8 | Insulation Resistance (Rotating Equipment) Test Record |
| 9 | Equipment Absorption Ratio and Polarization Index Test Record |
| 10 | Record Feeder Breaker (SWITCHBOARD) Test Record |
| 11 | Electric Motor Run-in Test Record |
| 12 | Thermographic Inspection Test Record |

**INSULATION RESISTANCE**
**(POWER, CONTROL WIRE, AND CABLE)**
**TEST RECORD**

TEST EQUIPMENT: ________________________ TEST VOLTAGE: __________________________

TEST EQUIPMENT: ________________________ TEST VOLTAGE: __________________________

AMBIENT TEMPERATURE: ___ ºC _____ ºF DATE: ____________________________________

NOTES:1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.

1. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.
2. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

| Panel No. Circuit No. Feeder No. | Wire Tagging | Cable Rated Voltage | Wire or Cable Quantity | Insulation Size | From | To | Resistance (megohms)* | Initials |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

*Minimum acceptable values:

| Cable Rated Voltage | Test Duration | Resistance for Cable Only | Cable/Wire Size or Amperage (megohms) | Resistance When Cable Connected to Equipment (ohms) |
|---|---|---|---|---|

DISTRIBUTION:

CONTRACTOR/Date ____________

**INSULATION RESISTANCE**
**(INSTRUMENT WIRE AND CABLE)**
**TEST RECORD**

TEST EQUIPMENT: ____________________________ TEST VOLTAGE: ______________________________

TEST EQUIPMENT: ____________________________ TEST VOLTAGE: ______________________________

AMBIENT TEMPERATURE: ______ ºC ______ ºF DATE: ________________________________________

NOTES: 1. Record only the lowest value.
2. MP - Multi-pair cable. SP - Single pair cable.
3. Megger with instruments disconnected.
4. Use 250 volt (or lower voltage, when specified) range on DC test set.
5. Readings will vary with temperature and cable length.*

| Cable Number or Instrument Number | Indicate MP or SP Type (2) | Conductor to Conduit (Single Pair Non-Shielded Cables) (megohms) | Conductor to Conductor (megohms) (1) | Shield to Conductor to Shield (megohms) (1) | Overall Shield to Shield (Multipair Cables Only) (megohms) (1) | Lead and Armor (Multipair Cables Only (megohms) | Shield to Conduit (Single Pair Cables Only) (megohms) | Initials |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

DISTRIBUTION:

CONTRACTOR/Date _____________

Sheet 3

**GROUND ELECTRODE TESTING**
**TEST RECORD**

TEST EQUIPMENT: ______________________________ ______________________________________________
(Note 1) (Note 2)
REFERENCE DRAWING: ________________________ ______________________________________________

NOTES: 1. Record resistance-to-earth for each electrode with all other conductors disconnected. Resistance not to exceed 25 ohms for any single anode.

2. Check continuity from each electrode to any test bar or other electrode such that the complete ground loop is tested.

| Rod Number | Resistance to Earth (ohms) | Ambient Temperature (ºC/ºF) | Weather | Taps (□) | Initials/Date |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

DISTRIBUTION:

CONTRACTOR/Date _____________

**BONDING RESISTANCE READINGS**
**(NONELECTRICAL EQUIPMENT/STRUCTURES)**
**TEST RECORD**

TEST EQUIPMENT USED: ______________________ WEATHER: ___________________________________

NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.

2. Measure resistance from ground wire tap (or anchor bolt) to tagged equipment frame or structural steel.

| EQUIPMENT TAG NO. OR STRUCTURE | DRAWING | MEASURED RESISTANCE (ohms) | INITIALS/DATE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

DISTRIBUTION:

CONTRACTOR/Date _____________

**BONDING RESISTANCE READINGS**
**(ELECTRICAL EQUIPMENT)**
**TEST RECORD**

TEST EQUIPMENT USED: ______________________ WEATHER: ___________________________________

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.

2. Measure resistance from ground wire tap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

| EQUIPMENT TAG NO. OR STRUCTURE | DRAWING | MEASURED RESISTANCE (ohms) | INITIALS/DATE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

DISTRIBUTION:

CONTRACTOR/Date _____________

**INSULATION RESISTANCE**
**(TRANSFORMER)**
**TEST RECORD**

SUBSTATION NO.: ____________________________ TEST EQUIPMENT: ____________________________

NOTES: 1. Use 1,000-V test set for 600-volt equipment and below, 2,500-V test set for equipment rated 601 - 5,000 volts, and 5,000-V test set for equipment rated over 5,000 volts.

2. Test voltage to be applied for 1-minute duration, and reading taken.

3. Neutral must be disconnected from ground during test.

4. Record temperature of surrounding air temperature for dry-type transformers.

5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet “measured” or “temperature corrected.”

| Equipment Tag No. | RESISTANCE IN (megahoms) * | | | | | | Pri to Sec | Voltage Rating (kV) | Pri-Sec or Air | Liquid Temp. (ºC/ºF) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | | | Secondary | | | | | | |
| | ∅A to G | ∅B to G | ∅C to G | ∅A to G | ∅B to G | ∅C to G | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

*Minimum acceptable values:

VOLTAGE CLASS RESISTANCE (megohms)

TESTER’S INITIALS/DATE

_____________________________________________

DISTRIBUTION:

CONTRACTOR/Date _____________

## INSULATION RESISTANCE (EQUIPMENT)
## TEST RECORD

TEST EQUIPMENT: ___________________________ SUBSTATION: ________________________________

AMBIENT TEMPERATURE: ______ ºC ______ ºF DATE: _______________________________________

REFERENCE DRAWING: _______________________ REF. SEC.: ___________________________________

NOTES: 1. Use 1,000-V test set for equipment rated 600 volts and below, 2,500/5,000-V test set for equipment rated over 600 volts.

2. For equipment with solid state control circuits, consult manufacturer's literature for maximum test voltages.

| Switchboard | INSULATION RESISTANCE (megohms) * | | | | | | Test Voltage (kV) | Rated Voltage (kV) | Initials/ Date |
|---|---|---|---|---|---|---|---|---|---|
| | ∅A to G | ∅B to G | ∅C to G | ∅A to ∅B | ∅B to ∅C | ∅C to ∅A | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

*Minimum acceptable values:

<u>EQUIPMENT VOLTAGE CLASS</u> <u>RESISTANCE</u>
<u>(megohms)</u>

TESTER'S INITIALS/DATE

_____________________________________________

DISTRIBUTION:

CONTRACTOR/Date _____________

**INSULATION RESISTANCE (ROTATING EQUIPMENT)**
**TEST RECORD**

TEST EQUIPMENT: ____________________________ TEST VOLTAGE: _______________________________

AMBIENT TEMPERATURE: ______ ºC ______ ºF DATE: ________________________________________

EQUIP. TEMP., IF KNOWN: ______ ºC ______ ºF HOW KNOWN: _________________________________

NOTES:
1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. Test duration shall be 1 minute, note if otherwise: _______________.
3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.
4. Document testing of low voltage and medium voltage equipment on separate sheets.
5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet “measured” or “temperature corrected.”

| Equipment Tag No. | INSULATION RESISTANCE (megohms) * | | | | | | Rated Voltage | Equipment Initial/Date |
|---|---|---|---|---|---|---|---|---|
| | ∅A to G | ∅B to G | ∅C to G | ∅A to ∅B | ∅B to ∅C | ∅C to ∅A | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

*Minimum acceptable values:

<u>VOLTAGE CLASS</u> <u>RESISTANCE (megohms)</u>

---

DISTRIBUTION:

CONTRACTOR/Date _____________

Sheet 9

# EQUIPMENT ABSORPTION RATIO AND POLARIZATION INDEX TEST RECORD

TEST EQUIPMENT: ____________________________ TEST VOLTAGE: ______________________________

AMBIENT TEMPERATURE: ______ ºC ______ ºF DATE: ________________________________________

EQUIP. TEMP., IF KNOWN: ______ ºC ______ ºF REL. HUMIDITY: ______________________________

NOTES:
1. Perform test as indicated on Test Records for each individual equipment type. Reference the following sheets:
   - Transformers 8
   - Equipment 9
   - Motors and Generators 10
2. Absorption Ratio = 1-Minute Resistance Value / 30-Second Resistance Value
3. Polarization Index = 10-Minute Resistance Value / 1-Minute Resistance Value

| OHMS TO GROUND 30-SECOND READING ∅A TO GROUND | OHMS TO GROUND 1-MINUTE READING ∅A TO GROUND | OHMS TO GROUND 10-MINUTE READING ∅A TO GROUND | DIELECTRIC ABSORPTION RATIO | POLARIZATION INDEX |
|---|---|---|---|---|
| | | | | |
| OHMS TO GROUND 30-SECOND READING ∅B TO GROUND | OHMS TO GROUND 1-MINUTE READING ∅B TO GROUND | OHMS TO GROUND 10-MINUTE READING ∅B TO GROUND | DIELECTRIC ABSORPTION RATIO | POLARIZATION INDEX |
| | | | | |
| OHMS TO GROUND 30-SECOND READING ∅C TO GROUND | OHMS TO GROUND 1-MINUTE READING ∅C TO GROUND | OHMS TO GROUND 10-MINUTE READING ∅C TO GROUND | DIELECTRIC ABSORPTION RATIO | POLARIZATION INDEX |
| | | | | |

TESTER'S INITIALS/DATE ____________________________________

DISTRIBUTION:

CONTRACTOR/Date _______________

**FEEDER BREAKER (SWITCHBOARD)**
**TEST RECORD**

| | | |
|---|---|---|
| EQUIPMENT DESIGNATION | | |
| LOAD (kW/kVA) | VOLTAGE | F.L.A. |
| CIRCUIT BREAKER MFG. | RATING | SETTING |
| CONDUCTOR SIZE | POWER | GROUND |

1. Check nameplate data of breaker against approved vendor drawings. ______________________
2. Check breaker components for cleanliness. ______________________
3. Check mechanical function of breaker. ______________________
4. Check wiring for proper identification. ______________________
5. Check conduits/cables for tagging. ______________________
6. Check components for identification. ______________________
7. Check equipment for conformance of area classification. ______________________
8. Check installation for seals, breathers, and drains. ______________________
9. Verify power conductor continuity. ______________________
10. Check that power cable insulation resistance test (megger) is completed. ______________________

DISTRIBUTION:

CONTRACTOR/Date ____________

Sheet 11

**ELECTRIC MOTOR RUN-IN**
**TEST RECORD**

TEST EQUIPMENT: ___________________________ REFERENCE DRAWING: ______________________

NOTES: 1. Duration of tests to comply with specifications.

| TEST | REMARKS | INITIALS/DATE |
|---|---|---|
| RESISTANCE:<br>Bonding resistance measured from motor frame to main ground/earth system tap.<br>________________ ohms | | |
| VOLTAGE:<br>Actual voltage measured at Motor Control Center.<br>________________ volts | | |
| ROTATION CHECK:<br>Bump motor to verify rotation. Motor to be uncoupled. | | |
| NO LOAD CURRENT:<br>At beginning of test __________ amps<br>At end of test __________ amps | | |
| TEMPERATURE OF BEARING:<br>Check bearing for high temperature:<br>Before start:<br>15 minutes after start<br>30 minutes after start<br>1 hour after start<br>2 hours after start<br>3 hours after start | | |
| VIBRATION:<br>Make visual inspection during run-test. Record any unusual vibration in remarks column. | | |
| NOISE:<br>Record any unusual noise in remarks column. | | |

DISTRIBUTION:

CONTRACTOR/Date _______________

## THERMOGRAPHIC INSPECTION
## TEST RECORD

EQUIPMENT: ______________________________

### THERMAL AND ELECTRICAL INFORMATION

| THERMAL DATA (°F/°C) AND RISE | | | | MANUAL READINGS | | | |
|---|---|---|---|---|---|---|---|
| A Phase | ____/____ | Reference | ______°F | A Phase | ________ A | A/ B Volts | ______V |
| B Phase | ____/____ | Temperature | ______° C | B Phase | ________ A | B/C Volts | ______V |
| C Phase | ____/____ | ΔT | ______°F | C Phase | ________ A | A/C Volts | ______V |
| Neutral | ____/____ | or Rise | ______° C | Neutral | ________ A | A/N Volts | ______V |
| **ANOMALY TEMP(°F/°C)** | | | | | | | |
| **PROBLEM DESCRIPTION:** | | | | | | | |
| **RECOMMENDATION:** | | | | | | | |

### ANOMALY PRIORITY

**CRITICAL** - IMMEDIATE ATTENTION SUGGESTED

**SEVERE** - PROBABLE FAILURE, PROMPT ACTION RECOMMENDED

**INTERMEDIATE** - MONITOR PROBLEM, SCHEDULE MAINTENANCE

**MINOR** - SCHEDULE ROUTINE MAINTENANCE AT NEXT OPPORTUNITY

DISTRIBUTION:

CONTRACTOR/Date ___________

END OF SECTION

## SECTION 26 05 19 – WIRING AND CABLING

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

SECTION 26 05 19 – WIRE AND CABLING

**PART 1 – GENERAL**

1.1 SUMMARY

A. The CONTRACTOR shall provide wire and cable, complete and operable, in accordance with this specification.

B. The CONTRACTOR shall furnish and install fiber optic cables in accordance with the accordance with the manufacturer's standard requirements. In addition, the submittals shall include cable pulling plan and procedure that specifies the sequence of work tasks, materials, and equipment

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specification section cross-reference:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |
| 26 01 26 | Electrical Tests |
| 26 05 53 | Identification for Electrical Systems |

1.4 ACTION SUBMITTALS

1. The CONTRACTOR shall submit Shop Drawings in accordance with contract document and 26 00 00 – Electrical Work, General. Submit cable test results in accordance with this Section as well as Section 26 01 26 – Electrical Tests.

2. Product Submittal

3. Catalog cut of the fiber optic cable for review.

B. Testing Documentation

1. Test Procedures

a. General

1) All fiber optic cable test results, whether specified or at the CONTRACTOR's option, shall be transmitted to the ENGINEER for informational purposes. Test methods shall be submitted for review.

2) Published fiber optic cable specifications shall be submitted along with all test results.

3) All test submittals shall include the test date, make, model and serial number of the equipment used, fiber identification number, locations of test points, wavelength tested, and signatures of the technician that performed the tests and any witnesses to the tests.

4) The CONTRACTOR shall document any corrective action that was taken to pass any of the tests.

5) The Optical Time Domain Reflectometer (OTDR) test results shall be submitted in both printed and electronic format, and a copy of the software required to view the test results shall be supplied to the OWNER.

b. Factory Tests: Prior to shipping the fiber optic cable to the field, the CONTRACTOR shall submit for review by the ENGINEER, the results of the continuity (pass/fail) and fiber attenuation tests. The fiber attenuation tests shall include, as a minimum, the OTDR trace for each fiber and the attenuation of each fiber strand in dB/km.

c. Post-Installation Tests: Following the completion of the fiber optic cable installation, the CONTRACTOR shall submit for review by the ENGINEER, the results of the OTDR and fiber attenuation tests. Following is a description of the submittal requirements for each of these tests:

1) Material and Equipment

a) A list of test equipment which will be used by the CONTRACTOR during the course of the cable testing.

b) The manufacturer's specification sheets for each item of test equipment.

c) Blank copies of the test forms proposed.

d) Notification to the OWNER of any special requirements in manpower or operating conditions that need action on the part of the OWNER for the test to take place.

e) A list of personnel who will conduct the fiber testing and a summary of their qualifications.

2) OTDR: The CONTRACTOR shall provide a test sheet for each fiber strand documenting the OTDR tests. This shall include, as a minimum, the OTDR trace and supplemental test data which show the overall fiber length, the distance of splice and connector points from the source, splice and connector loss, and fiber attenuation in dB/km. The CONTRACTOR shall also submit the results of the Excess Fiber Coefficient (EFC) test.

C. Fiber Attenuation: The CONTRACTOR shall provide test documentation showing the overall end-to-end attenuation of each fiber strand at both 1310 and 850 nm and in both directions along the fiber. The CONTRACTOR shall also show that the attenuation does not exceed the maximum loss allowed.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. The CONTRACTOR shall protect all cables from damage at all times.

B. Cable ends shall be protected from water entry in accordance with the manufacturer’s recommended procedures. Each cable shall be kept sealed except when termination work is being performed. This includes cable stored on reels. The ends of all cables rated above 600V shall be sealed with heat or cold shrinkable caps. Cap sizes shall be as recommended by the cap or cable manufacturer for the cable OD and insulation. Caps shall form a positive watertight seal capable of withstanding complete immersion. Shrinkable caps shall be manufactured by Raychem Corporation, 3M or equivalent.

C. Cables shall be pulled into raceways in accordance with the manufacturer’s requirements. Under no circumstances shall cable pulling tensions, nor minimum cable bending radius, exceed the manufacturer’s written instructions.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

## PART 2 -- PRODUCTS

### 2.1 WIRE AND CABLE

A. Conductors shall be copper or aluminium cables, and grounding conductors, shall be stranded copper. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end, following the requirement of Section 26 05 53.

B. Low Voltage Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for power and lighting circuits shall be single or multiconductor conductor, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project, except as specifically permitted within control panels.

2. Multi-conductor cables shall have an overall PVC jacket.

3. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600 volt class power and lighting shall be **Okonite**, **General Cable**, **Southwire**, or approved equal.

C. Low Voltage Control Wire

1. Low voltage control wire in duct or conduit shall be XLPE insulation with PVC jacket and multiconductor.

2. Control wiring shall be color coded per E2 standards.

3. Control wiring shall be No.16 AWG.

4. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by **American**, **General Cable**, **Belden, Allied Wire & Cable, Southwire** or approved equal.

D. Instrumentation Cable

1. Instrumentation cable shall be rated at 600 volts, minimum

2. Instrumentation cable shall be multiconductor or single pair.

3. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-white for 2 conductor cable and black-red-white for 3 conductor cable.

4. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 or larger AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.047-inches.

5. Single pair, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8719**, similar by **General Cable**, or approved equal. Insulation shall be color coded polyethylene: black-white for 2 conductor cable and black-red-white for 3 conductor cable.

6. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8618**, similar by **General Cable**, or approved equal. Insulation shall be color coded polyethylene: black-white for 2 conductor cable and black-red-white for 3 conductor cable.

E. VFD Power Cable

1. VFD power cable shall be three (3) conductor, stranded copper, PVC jacketed, shielded type copper braid, tray cable (TC) rated 2000 volts with three (3) symmetrical ground conductors. The individual conductors shall be UL listed as Type XHHW-2 or RWH-2 rated for 90 degrees C at wet and dry locations, with XLPE insulation.

2. VFD Cables shall be as manufactured by Service Wire & Cable, Southwire, Belden, Alpha, General Cable, or approved equal.

F. Medium Voltage Cable - General

1. Individual conductors shall be copper, Class B, stranded.

G. Medium Voltage -2kV-35 KV Cable

1. Cable used in conduit or duct shall be composed of a single conductor, ethylene-propylene rubber (EPR) insulation rated at 105 degrees C, shield and black polyvinyl chloride (PVC) outer jacket. Insulation level shall be 133 percent. Shield shall be copper tape type, or corrugated drain wire type. Cable shall be UL Type MV-105 in accordance with UL 1072 and ICEA-S-93-639/NEMA-WC74 as manufactured by **Okonite, Southwire**, **General Cable,** or approved equal.

H. Ethernet Patch Cable or approved equal

1. Ethernet patch cables shall be non-plenum EIA/TIA rated category 6A and shall be compatible with patch panel and faceplate assemblies specified herein. Patch cables shall be center-tuned for optimal connection. Cables shall be snag-less plug design. Provide adequate quantities to patch at field device and at network cabinet. Network cabinet cables shall be 3' length. Field equipment patch cables shall have length as necessary, but shall be 3', 7', or 15' length. Patch cables shall have a white jacket. Provide the following as required:

2. 3' cables: Ortronics OR-MC610-03-09.

3. 7' cables: Ortronics OR-MC610-07-09.

4. 15' cables: Ortronics OR-MC610-15-09.

I. Ethernet Cable

1. Ethernet bulk cables shall be non-plenum, Category 6A cable as per ANSI/TIA-568-C.

2. Conductor material: solid bare copper.

3. Conductor size and type: 23 AWG unshielded twisted pairs.

4. Number of conductor pairs: 4 (with rip cord).

5. Conductor insulation: Polyolefin.

6. Jacket material: PVC.

7. Impedance: 100 Ohms.

8. Maximum capacitance unbalanced: 50 pf/100m.

9. UL approved / NRTL LISTED.

10. Product and Manufacturers: Belden cable for indoor/outdoor use or approved equal.

J. Antenna Cable

1. The transmission cable between the antenna and the radio shall be low-loss jacketed ½" foam-helix. This cable shall be installed in conduit as shown on the drawings, which shall have a minimum bend radius of 12 inches. The antenna cable shall be manufactured by Andrew Corporation.

2. Lightning suppressors shall be provided for all antenna feed lines. They shall be rated for the operating power and frequency. For antenna cable connections to a control panel, surge arrestors shall be bulkhead mounted through the panel exterior. Lightning suppressors shall be provided by PolyPhasor Corporation or approved equal. Antenna installation, cabling and grounding shall be certified by lightning protection engineer.

K. Cable Splices and Terminations

1. Where cable lugs are required for power cable terminations, utilize compression lugs – **3M** Scotchlok 30000 and 31100 Series, **Penn Union** HBBLU and BLU, **Burndy** Hylug, or approved equal. Utilize compression tools as recommended by the manufacturer. Pressure type, twist-on connectors (wire nuts) will not be acceptable.

2. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or approved equal.

3. General purpose insulating tape shall be **Scotch No. 33**, **Plymouth Slip-knot**, or approved equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M,** or approved equal.

4. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **W.H. Brady, 3M**, or approved equal.

5. Stress cone material for make-up of medium voltage shielded cable shall be as manufactured by **Raychem, 3M**, or approved equal.

6. Shielded power cable shall be spliced using kits specifically designed to splice medium voltage, shielded power cables. Splice kits shall be designed for continuous submergence. Heat shrink splice kits shall be **Raychem "Type HVS"** or approved equal. "Cold" shrink splice kits shall be **3M "5760 Series" or** approved equal. The CONTRACTOR's personnel shall be trained by the splice kit manufacturer for proper installation of the splices and shall submit certification of training as a shop drawing. A certified trainee shall perform the splice work.

## PART 3 -- EXECUTION

### 3.1 INSTALLATION

A. The CONTRACTOR shall provide, terminate and test all power, control, fiber, and instrumentation conductors.

B. The CONTRACTOR shall, as a minimum, provide the number of control wires listed in the cable & conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.

C. Conductors shall not be pulled into any raceway until raceway has been cleared of water and debris.

D. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

E. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be neatly fanned out to terminals.

F. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

### 3.2 FIELD ASSEMBLY

A. General

1. Wire taps and splices shall be properly taped and insulated according to their respective classes.

2. In general, there shall be no cable splices in underground manholes or pull boxes. If splices are necessary, the cables shall be spliced using submersible cable splices, suitable for continuous submergence. Splices in underground manholes and pull boxes may be made only with the approval of the ENGINEER.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped and be neatly coiled.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

3. The CONTRACTOR shall provide as a minimum the number of control wires listed in the cable & conduit schedule or as indicated in the Contract Documents. Excess wires shall be treated as spares.

4. The CONTRACTOR shall provide wire ferrules on all instrumentation and control wiring.

C. Instrumentation Wire and Cable

1. All instrument cable shields shall be connected through junction boxes, including the overall shield on multipair or multitriad cables, shall be kept floating at the transducer and final control element ends (thermocouples, transmitters, analyzers, etc.) and shall be terminated and grounded in the PLC cabinets. The overall shield on multi-pair or multi-triad cables shall be terminated on the instrument ground bus.

D. Power Wire and Cable

1. 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the ENGINEER, ENGINEER shall approve splices via RFI. Cables rated above 2,000 volts shall be spliced or terminated only at equipment terminals indicated.

2. Lighting and receptacle branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR.

3. Motor lead terminations shall be bolted together with the ring tongue type terminals and tin-plated bolts of the appropriate size Terminations shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

4. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable and terminal manufacturer. The CONTRACTOR shall submit the proposed termination procedure as a Shop Drawing.

5. VFD shielded power cables shall have the shield grounded at the motor and the VFD PE ground terminal only. The 3 symmetrical ground wires shall be twisted together, covered with heat shrink, and routed/secured within the VFD cabinet to the VFD PE terminal. VFD shielded power cables shall be terminated in accordance with the VFD manufacturer's instructions.

E. Cable Identification

1. General: Wire and cable shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall be installed at every termination point per Section 26 05 53.

2. Identification Numbers: The ENGINEER shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to conductors will be terminated according to engineering documents; changes will be communicated in real time so that engineering documents stay

current. Identification numbers shall appear within 3-inches of conductor terminals. "Control and Instrumentation Conductors" shall be defined as any conductor used for control, interlock, alarm, annunciator, or signal purposes.

a. 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, and Neutral - White. The 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs. Color coding tape shall be used where colored insulation is not available. Colored identification tape may be used on conductors between the local disconnect and the load, where permitted by the NEC. Any phase changes necessary for proper rotation shall be made at the driven equipment where colored insulation is used. Phase changes may be made on the load side of the local disconnect, where phase colors are identified using tape.

b. General purpose AC control cable shall be red. General purpose DC control cable shall be blue.

c. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

d. Terminal strips shall be identified by computer printable, self-sticking marker strips attached under the terminal strip.

## 3.3 FIELD QUALITY CONTROL

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01 33 00 – Contractor Submittals, prior to shipment of cable. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests) shall be the minimum requirements:

1. Insulation resistance testing, using a DC megohmeter, shall be performed on cables operating at more than 2,000 volts to ground. Time-resistance readings shall be taken and recorded at intervals of 30 seconds and one minute. Time-resistance voltage levels shall be per the cable manufacturer's recommendations.

2. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter as per NETA ATS 2021.

3. Field testing shall be done after cable is installed in the raceways.

4. Field tests shall be performed by a NETA-certified test organization. Field megger testing may be performed by the CONTRACTOR or a NETA-certified test organization. When tested by the CONTRACTOR, submit test equipment calibration sheets prior to performing any field testing. Test results shall be submitted (via normal documentation process) to the ENGINEER for review and acceptance.

5. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cable in service.

C. When power equipment is used to install fiber optic cables, low speeds shall be used so that a rate of 30 meters per minute is not exceeded. The tensile and bending limitation for fiber optic cables shall not be exceeded under any circumstances. Large diameter wheels, pulling sheaves, and cable guides shall be used to maintain the specified bending radius. Tension monitoring shall be accomplished using commercial dynamometers or load-cell instruments. All conduit shall be cleaned and tested prior to installation.

1. All conduits shall have a lubricant applied at each conduit ingress and egress location and during the pull operation. Lubricant shall be Polywater Type F or approved equal.

2. FOC shall be installed using a hydraulic capstan or winch equipped with a recording running line dynamotor graph which measures and records pulling tensions. All equipment shall be designed to prevent a preset pulling tension from being exceeded. The pulling tension setpoint shall be determined by the FOC manufacturer. If during the pulling operation excessive tension is detected, all operations shall cease, and the ENGINEER shall be notified.

3. After the cables are installed and spliced, the innerduct/cable shall be secured and conduits and innerducts sealed with duct plugs. A minimum of 50 feet of FOC shall be stored at each end of one splice. Racking shall conform to the following:

a. Innerduct/cable shall be secured to the manway wall.

b. Imprinted plastic-coated cloth identification/warning tags shall be securely attached to the innerduct/cable in at least two locations in each manway/pullbox.

c. All coiled cable shall be suitably placed into a slack enclosure to prevent damage

3.4 SITE ACCEPTANCE TEST

A. After the completion of installation and testing, a walkthrough shall be performed to verify the Contract items not addressed by the fiber testing. The inspection shall be performed at a time agreeable to all parties. The final inspection checklist will include, but not be limited to the following:

1. Fiber splices shall be neatly organized.

2. All connectors shall be capped and undamaged.

3. All cabling shall be organized with no excessive bending.

4. The specified amount of coiled cable shall be present in the splice cabinet. Cable entrances to the cabinets shall be secured.

5. Unused cable shall be delivered to the OWNER.

6. All cables shall be properly identified. Directories shall be installed in each fiber cabinet.

B. Discrepancies found during the inspection of the fiber installation will be listed and provided to the CONTRACTOR in the form of a punch list. The CONTRACTOR shall correct all punchlist items at no increase in CONTRACT time or cost. The CONTRACTOR shall inform the OWNER upon completion of the punchlist items. If the remedial actions are shown to be acceptable, system testing shall proceed.

**END OF SECTION**

# SECTION 26 05 26 – GROUNDING

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 05 26 – GROUNDING

## PART 1 -- GENERAL

### 1.1 THE SUMMARY

A. Provide the electrical grounding system, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

### 1.2 ACTION SUBMITTALS

A. Furnish submittals in accordance with the requirements of contract documents and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1. Submit manufacturer's product information for connectors, clamps, and all grounding system components, showing compliance with the requirements of this Section.

### 1.3 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

F. FIELD ENGINEER – Contractor representative with responsibility over construction progress tracking and in process quality assurance.

1.4 REFERENCES SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Codes

The indicated WORK shall conform to or exceed the applicable requirements of the National Electrical Code (NEC), provided that where a local code or ordinance is in conflict with the NEC, the provisions of the local code or ordinance shall take precedence.

| **Institute of Electrical and Electronic Engineers, Inc. (IEEE)** | |
|---|---|
| IEEE 80 | Guide for safety in AC substation grounding |
| IEEE 81 | Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System |

B. Specification section cross-reference:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |
| 26 01 26 | Electrical Tests |

**PART 2 -- PRODUCTS**

2.1 EQUIPMENT

A. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

B. Grounding System

1. Grounding loop conductors shall be bare annealed tin-plated copper conductors for corrosive area. For non-corrosive area bare annealed copper conductor is acceptable.

2. Conductors shall be No. #4/0 AWG stranded bare copper unless indicated otherwise.

3. Ground Rods

a. Unless indicated otherwise, provide ground rods minimum of 3/4 inch in diameter, 10 feet long, and with a uniform covering of electrolytic copper metallically bonded to a rigid steel core.

b. Provide corrosion-resistant copper-to-steel bond.

c. The rods shall conform to UL 467.

d. The rods shall be of the sectional type, joined by threaded copper alloy couplings.

4. Make buried, concrete-encased, or otherwise inaccessible cable-to-cable and cable-to-ground rod connections using exothermic welds by Cadweld, Thermoweld, or approved equal. Alternatively, non-reversible, compression connectors may be used for inaccessible grounding connections, constructed of high-copper alloy, and manufactured specifically for the particular grounding application. The connectors shall be Burndy "Hyground", similar by Thomas and Betts, or approved equal.

5. Exposed Connectors

   a. Exposed grounding connectors shall be of the compression type (connector-to-cable), constructed of high-copper alloy, and manufactured specifically for the particular grounding application.

   b. The connectors shall be Burndy, O.Z. Gedney, or approved equal.

6. Use grounding clamps to bond each separately-derived system to the grounding electrode conductors.

7. Equipment Grounding Circuit Conductors

   a. The conductors shall be the same type and insulation as the load circuit conductors.

   b. The minimum size shall be as indicated. Where not indicated, sizes shall conform to Table 250.122 of the National Electrical Code.

   c. Metallic conduit systems shall have an equipment grounding wires as well as being equipment grounding conductors themselves.

8. Grounding Materials Manufacturer, or approved Equal

   a. Copperweld

   b. Thermoweld

   c. Burndy

   d. Thomas and Betts

   e. OZ Gedney

   f. ERICO

**PART 3 -- EXECUTION**

3.1 PREPARATION

A. Provide a separate equipment grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate equipment grounding conductor for each motor and connect at motor box. Provide a supplemental ground connection from EGC or Ground Loop, for motor shaft grounding rings, when ground pad are provided on the motor.

C. Do not use bolts for securing the motor box to the frame or the cover for grounding connectors.

D. Sizes shall be as indicated on the Conduit Schedule and in accordance with NEC Article 250.

E. Route the insulated conductors inside the raceway. If bare conductor, route the conductor attached to the outskirt of the raceway.

F. For Outdoor application, provide a grounding-type bushing or Myer's Hub with ground Lug for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.

G. For Indoor application, Locknut as specified in NEC article 250.97 can be used for for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.

H. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw, and, for grounding type devices, to the equipment grounding conductor.

I. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.

J. Interconnect the secondary switchgear MCC or panelboard neutral bus to the ground bus in the secondary switchgear compartment only at the service entrance point. For wye connected, 3 phase, separately derived systems with 3 wire distribution, connect the transformer neutral to the grounding electrode system at the transformer. Connections shall be in accordance with the NEC.

K. Provide the ductbank ground system as indicated on plant drawing, including trenching, splices, ground rods, and connections to equipment and structures.

L. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system. Provide additional grounding system testing in accordance with Section 26 01 26 – Electrical Tests.

M. Low Voltage Grounded System (600V or less)

1. A low-voltage grounded system is defined as a system where the local power supply is a transformer, with the transformer secondary grounded.

2. Grounding system connections for a premises-wired system supplied by a grounded AC service shall be provided with a grounding electrode connector connected to the grounded service conductor at each service, in accordance with the NEC.

3. The grounded circuit conductor shall not be used for grounding non-current-carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

N. Embedded Ground Connections

1. Underground and grounding connections embedded in concrete shall be UL-listed ground grid connectors.

2. The connection shall be made in accordance with the manufacturer's instructions.

3. Do not conceal or cover ground connections until the ENGINEER, FIELD ENGINEER or an authorized representative has established that every grounding connection conforms to the requirements of the Contract Documents and has given the CONTRACTOR written confirmation.

O. Ground Rods

1. Provide ground rods at the indicated locations.

2. A single electrode that does not have resistance-to-ground of 5 ohms or less shall be augmented by additional electrodes to obtain this value.

3. Take the resistance-to-ground measurement during dry weather, a minimum of 48 hours after a rainfall.

4. Rods forming an individual ground array shall be equal in length.

P. Test Station

1. Provide Test Station at the indicated locations.

2. Test Station shall be installed such that ground resistance testing can be preform from plant finish grade, regardless of the depth of the ground ring.

3. Take the resistance-to-ground measurement during dry weather, a minimum of 48 hours after a rainfall.

Q. Ground Ring

1. Furnish trenching and materials as necessary to install the ground ring as indicated.

2. The bonding conductor shall be in direct contact with the earth and of the indicated size.

3. Provide a minimum burial depth of 30 inches or as indicated on the Drawings, whichever is greater and in accordance with NEC 250

4. Re-compact disturbed soils to their original density in 6-inch lifts.

R. Duct Bank Ground

1. Embed a grounding conductor in every duct bank as indicated. The ground conductor shall be terminated at the ground grid at each end of the duct bank. Where no ground grid is installed, terminate at a suitable grounding electrode conductor near the end of the duct bank in accordance with the NEC.

S. Instrumentation Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless the approved Shop Drawings indicate that the shield will be grounded at both ends.

2. The grounding point shall be at the control panel or at the receiving end of the signal carried by the cable.

3. The termination of the shield drain wire shall be on its own terminal screw.

4. Jumper together the terminal screws, using manufactured terminal block jumpers or a No. 14 green insulated conductor.

5. Connect the ground bus via a green No. 12 conductor to the main ground bus for the panel.

**END OF SECTION**

**SECTION 26 05 33 – ELECTRICAL RACEWAY SYSTEMS**

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 05 33 – ELECTRICAL RACEWAY SYSTEMS

## PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Equipment provided shall meet all requirements of this Specification, all applicable state and local codes and must also conform to the latest applicable standards of the agencies identified below.

| | |
|---|---|
| ANSI | American National Standards Institute |
| UL | Underwriters’ Laboratories (including UL Standard 746B) |
| NEMA | National Electrical Manufacturers Association |
| OSHA | Occupational Safety and Health Administration |

B. Specification section cross-reference:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |

1.4 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Contract Document, and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. As-Built Drawings

a. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

b. Furnish the drawings to the ENGINEER in accordance with contract document.

**PART 2 -- PRODUCTS**

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid Galvanized Steel (RGS) Conduit

1. Provide rigid steel conduit manufactured from mild steel, hot-dip galvanized inside and out in accordance with ASTM A123.

2. Provide rigid steel conduit manufactured in accordance with NEMA C80.1 – Electrical Rigid Steel Conduit, and UL-6 – Electrical Rigid Metal Conduit - Steel.

3. Manufacturer, or approved Equal

a. Allied Tube & Conduit

b. Triangle

c. Wheatland Tube

B. Rigid Aluminum (ARC) Conduit

1. Provide rigid aluminum conduit manufactured from high purity 6063 aluminum alloy, T-1 temper.

2. Provide rigid aluminum conduit manufactured in accordance with (ANSI) C80.5 – Electrical Rigid Metal Conduit—Aluminum, and UL-6A – Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel.

a. Alcore

b. American Conduit

c. Wheatland Tube

C. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 PVC, as indicated, and sunlight-resistant.

2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.

3. Manufacturer, or approved Equal

a. Carlon

b. Cantex

D. Rigid PVC-Coated Galvanized Steel (RPGS) Conduit

1. The conduit shall meet the requirements for RGS conduit as indicated above.

2. Bond a PVC coating to the outer surface of the galvanized conduit.

3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.

4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.

5. Provide a PVC coating thickness not less than 40 mils.

6. The PVC-coated RGS shall be manufactured in accordance with the following standards:

a. UL-6

b. ANSI C80.1

c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

7. Manufacturer, or approved Equal

a. Robroy Industries

b. O'Kote

c. Thomas & Betts

E. Liquid-Tight Flexible Conduit

1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.

2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.

3. Manufacturer, or approved Equal

   a. Anaconda, Sealtite

   b. Electriflex, Liquatite

F. Electrical Metallic Tubing (EMT) may be used inside of electrical, mechanical and control rooms and other indoor non-process locations.

G. Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.

2. Fittings and Boxes

   a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless steel screws.

   b. Attach covers by means of holes tapped into the body of the fitting.

   c. Covers for fittings attached by means of clips or clamps will not be accepted.

3. Provide boxes larger than standard cast or malleable types manufactured of Type 304 or Type 316 stainless steel, NEMA 4X.

4. Terminations

   a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or approved equal.

   b. In other than outdoor areas, provide sealed locknuts and bushings.

5. Hazardous Locations

   a. In hazardous locations, provide conduit, fittings, and boxes suitable for the indicated Class and Division.

   b. Provide conduits terminated in NEMA 7 boxes with a male bushing, Adalet Type PEM, or approved equal, inside the box.

B. Cast Aluminum Fittings and Boxes

1. Provide cast aluminum boxes and fittings with less than 0.40 percent copper content, and use with aluminum conduit.

2. Manufacturer, or approved Equal

   a. O.Z. Gedney

   b. Appleton

   c. Crouse-Hinds

C. Malleable Iron Fittings and Boxes

1. For use with galvanized steel conduit, provide fittings and boxes constructed of malleable iron or gray-iron alloy with zinc plating.

2. Manufacturer, or approved Equal

   a. O.Z. Gedney

   b. Crouse-Hinds

   c. Appleton

D. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.

2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).

3. Manufacturer, or approved Equal

   a. Carlon

   b. Crouse-Hinds

   c. Hoffman

4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

E. PVC-Coated RGS Fittings

1. For use with PVC-coated RGS, provide PVC-coated coated that are the products of the same manufacturer as the conduit.

2. Provide male and female threads and internal surfaces with a 2-mil urethane coating.

F. Stainless Steel Boxes

1. Provide stainless steel boxes with PVC-coated RGS conduit and where indicated.

2. Provide NEMA 4X stainless steel boxes, constructed of either Type 316 or Type 304 stainless steel.

3. Provide stainless steel of a minimum of 14-gauge thickness, with a brushed finish.

4. Door Hinges

    a. Provide doors with full-length stainless steel piano hinges.

    b. Non-hinged boxes will not be accepted.

5. Manufacturer, or approved Equal

    a. Hoffman

    b. Rohn

    c. Hammond

G. Sheet Steel Boxes

1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.

2. Manufacturer, or approved Equal

    a. Raco

    b. Steel City

    c. Appleton Electric

## 2.4 WIREWAY

A. General

1. Provide wireway of the lay-in type and NEMA-rated for the area in which it is to be installed in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

2. Separate power, control, signal and communications cables by grounded metallic dividers in wireways or run in separate wireways.

B. Fittings and Covers

1. Provide fittings and sections with non-magnetic stainless-steel screws.

2. Attach covers by hinges and clamps to the bodies.

3. Covers attached by means of clips or screws will not be accepted.

4. Provide covers and bodies constructed of aluminum or minimum 14-gauge steel.

C. Grounding

1. Ground the steel and aluminum wireway bodies.

2. Provide steel dividers with steel wireways or aluminum dividers with aluminum wireways, and ground by means of an individual grounding conductor.

3. Non-metallic dividers will not be accepted.

D. Terminations

1. In indoor and outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, or approved equal.

2. In other than outdoor areas, provide sealed locknuts and bushings.

## PART 3 -- EXECUTION

3.1 GENERAL

A. Run wiring in raceway unless indicated otherwise.

B. Install raceways between equipment as indicated.

C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.

D. Bends and Offsets

1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.

2. Provide factory elbows wherever possible.

E. Routing

1. Where raceway routings are indicated, follow those routings to the extent possible.

2. Where raceways are indicated but routing is not indicated, such as home runs or on conduit developments and schedules, raceway routing shall be the CONTRACTOR's choice and provided in strict accordance with the NEC as well as customary installation practice.

3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.

4. Adjust routings in order to avoid obstructions.

F. Coordination

1. Coordinate between trades prior to installing the raceways.

2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price.

G. Support rod attachment for ceiling-hung trapeze and cable tray installations shall meet the seismic requirements in the area where the Project is located.

H. Support wireways in accordance with the manufacturer's recommendations for the seismic requirements indicated in Section 26 00 00 – Electrical Work, General.

I. Install exposed raceways parallel or perpendicular to structural beams.

J. Expansion Fittings

1. Install expansion fittings with external bonding jumpers wherever exposed raceways cross building expansion joints.

2. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.

3. Encased Expansion Fittings

a. Install encased expansion fittings wherever encased conduits cross building expansion joints.

b. Deflection type fittings shall not be required for encased conduits crossing an expansion joint within a single structure.

4. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

K. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

L. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.

M. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

## 3.2 CONDUIT

A. Provide exposed conduit manufactured of rigid galvanized steel, except as follows and unless indicated otherwise:

1. In areas with chlorine or hydrofluosilicic acid, provide PVC-coated RGS

2. In areas containing lime or ferric chloride, provide PVC-coated RGS.

3. For conduit containing only grounding system bonding conductors, provide Schedule 80 PVC conduit.

B. Conduit encased in concrete shall be constructed of Schedule 40 PVC.

C. Concrete Encasement

1. Where PVC or RGS conduit is stubbed up from a concrete encasement, provide a fiberglass vertical elbow.

2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.

3. Do not encase conduit in the bottom floor slab below grade.

D. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased conduit of 2-inch minimum trade size.

E. Install supports at distances required by the NEC and/or per manufacturer’s recommendation whichever is more conservative.

F. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.

G. Penetrations

1. Provide conduit passing through walls or floors with plastic sleeves.

2. Perform core drilling in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

3. Conduits passing through a slab, wall, or beam shall not significantly impair the strength of the construction.

H. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall meet the following requirements:

1. Conduits with their fittings embedded within a column shall not displace greater than 4 percent of the gross area of cross section;

2. Conduits shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which it is embedded; and,

3. Conduits shall not be spaced closer than 3 outside diameters on centers.

I. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.

J. Coat threads with a conductive lubricant before assembly.

K. Joints

1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.

2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.

3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.

4. Replace conduit with wrench marks.

5. Where installed in chemical or fuel containment areas, the conduit shall not have joints or fittings located below the top of the containment area to prevent entry of chemicals or fuel into the conduit system.

L. Slope

1. Wherever possible, slope the conduit runs to drain at one or both ends of the run.

2. Wherever conduit enters a substructure below grade, slope the conduit in order to drain water away from the structure.

3. Take extreme care in order to avoid pockets or depressions in the conduit.

M. Where conduits from duct banks enter building walls below grade, transition to PVC-coated RGS at least 12” outside the wall. Installation of PVC-coated rigid steel conduit though a core-drilled hole in an exterior wall below-grade shall utilize a sealing device as manufactured by **Link Seal**, or approved equal.

N. Connections

1. Make connections to lay-in-type grid lighting fixtures by using flexible metal conduit not exceeding 4 feet in length.

2. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.

3. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.

O. Provide conduit seal fittings in hazardous classified locations, in strict accordance with the NEC.

P. Provide conduit, fittings, and boxes required in hazardous classified areas that are suitably rated for the area and provide in strict accordance with NEC requirements.

Q. Duct sealant shall be foam duct sealant such as Polywater FST or approved equal. Provide duct sealant at the following locations:

1. Where required by NEC Article 300.7.
2. In areas where chlorine gas or fumes from sodium hypochlorite exist to prevent passage of gas through the raceway system.

R. Empty Conduits

1. Tag empty conduits per contract documents.
2. Where it is not possible to tag the conduit, identify the destination by means of a durable marking on an adjacent surface.
3. Install a pull-cord in each empty conduit in floors, panels, manholes, equipment, and the like.
4. Install a removable plug on empty conduits that terminate below grade, in vaults, manholes, handholes, and junction or pullboxes.

S. Identification of Conduits

1. Identify conduits at ends and at pulling points.
2. Identification shall be the unique conduit number assigned in the Contract Documents.
3. Other than 120 VAC panelboard circuits, if a conduit has not been assigned a unique number in the Contract Documents, assign a unique number following the numbering scheme used in the Contract Documents.
4. Assign a unique number to 120 VAC panelboard circuits, similar to the cable numbering scheme used in the Contract Documents.
5. Provide conduit identification by a stamped or engraved non-corroding metal tag attached to the conduit bushing.
6. Provide an engraved metal nameplate for conduit risers, and UV resistant stickers for above ground conduit in accordance with the requirements of Section 26 00 00 – Electrical Work, General.
7. Markings with a pen or paint will not be accepted.

T. Identification of Pullboxes and Junction Boxes

1. Identify Pullboxes and junction boxes.

2. Identification shall be the unique conduit number assigned in the Contract Documents, or if not assigned a unique number the CONTRACTOR shall assign one following the numbering scheme used in the Contract Documents.

3. Provide box identification by a stamped or engraved non-corroding metal tag or an engraved phenolic nameplate, in accordance with the requirements of Section 26 00 00 – Electrical Work, General, and attached to the box or enclosure.

4. Markings with a pen or paint will not be accepted.

U. Provide conduit for data cables in accordance with the equipment manufacturer's recommendations, especially regarding separation from low- and medium-voltage power raceways.

**END OF SECTION**

# SECTION 26 05 36 – WIRING DEVICES

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 05 36 – WIRING DEVICES

## PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide wiring devices, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER’S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner’s Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 SPECIFICATION SECTION CROSS-REFERENCE:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |
| 26 05 26 | Grounding |

1.4 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit complete catalog cuts of switches, receptacles, enclosures, covers and appurtenances, marked to clearly identify the proposed materials.

2. Submit documentation showing that the proposed materials comply with the requirements of NEC and U.L.

3. Submit documentation of the manufacturer's qualifications.

**PART 2 -- PRODUCTS**

2.1 GENERAL

A. Devices shall carry the U.L. label and shall be designed for use with stranded copper conductors.

B. Color

1. General purpose duplex receptacles and toggle switch handles shall be Brown everywhere except unless otherwise indicated.

2. Special purpose receptacles shall have a body color as indicated.

C. Receptacles and switches shall be of specification grade and shall conform to NEMA WD-1, Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Toggle switches shall be AC only type switch.

1. 20A, 120/277V, Single, Double, 3-Way and 4-Way, Respectively

a. Leviton: 1221-2, 1222-2, 1223-2, 1224-2

b. Hubbell: HBL1221, HBL1222, HBL1223, HBL1224

c. Pass and Seymour: PS20AC1, PS20AC2, PS20AC3, PS20AC4

d. Or Approved Equal

2. Lighted Handle Pilot Switch, 20A, 120/277V, Red, Single, Double, 3-Way

a. Hubbell: HBL1221PL, HBL1222PL, HBL1223PL

b. Pass and Seymour: PS20AC1-RPL7, PS20AC2-RPL, PS20AC3-RPL7

c. Or Approved Equal

3. Locked Key Switches, 20A, 120/277V, Single, Double, 3-Way, 4-Way

a. Leviton: 1221-2L, 1222-2L, 1223-2L, 1224-2L

b. Hubbell: HBL1201L, HBL1202L, HBL1203L, HBL1204L

c. Pass and Seymour: PS20AC1L, PS20AC2L, PS20AC3L, PS20AC4L

d. Or Approved Equal

## 2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles shall be of the polarized 3-wire type for use with a 3-wire cord with grounded lead, and one designated stud shall be permanently grounded to the conduit system in accordance with NEC article 406.4.

B. Dry Areas

1. NEMA Configuration #5-20R: duplex receptacle rated 125V, 20A

   a. Leviton: #5362

   b. Hubbell: #HBL5362

   c. Pass and Seymour: #5362A

   d. Or Approved Equal

2. NEMA Configuration #5-30R single receptacle rated 125V, 30A

   a. Leviton: #5371

   b. Hubbell: #HBL9308

   c. Or Approved Equal

C. Damp/Wet Areas

1. Receptacles for damp/wet locations shall be weather-resistant with extra duty, in-use listed covers in accordance with NEC Article 406.8.

D. GFCIs

1. Ground-fault circuit-interrupting receptacles (GFCIs) shall be installed at the indicated locations and as required by the NEC.

2. GFCIs shall be duplex receptacles, of specification grade, and tripping at 5 mA.

3. GFCI ratings shall be 125V, 20 amperes, NEMA WD-1, Configuration 5-20R, and capable of interrupting 5,000 amperes without damage.

4. GFCIs shall be weather resistant-listed in accordance with NEC Article 406.8.

5. Feed-through-type GFCIs serving standard receptacles will not be permitted.

   a. Leviton: G5362-WT

   b. Hubbel: GFR5362SG

   c. Or Approved Equal

2.4 ENCLOSURES AND COVERS

A. Surface-mounted switches and receptacles shall be housed in FS or FD-type weatherproof conduit fittings.

B. Switch and receptacle covers on surface-mounted boxes shall be constructed of die-cast copper-free aluminum.

1. Appleton: FSK
2. Crouse-Hinds: DS185 and WLRD-1
3. Hubbell Killark: FZ and FC
4. Or Approved Equal

C. In finished areas, switch and receptacle covers shall be constructed of stainless steel.

D. Wet Locations

1. Receptacles in wet locations shall be provided with a hinged non-metallic Clear cover/enclosure marked "Suitable for Wet Locations when in use" and "UL Listed."
2. Provide a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base.
    a. Appleton: WCIU
    b. Crouse-Hinds: TP74
    c. Hubbell TayMac: Extra Duty
    d. Or Approved Equal

2.5 RECEPTACLE – SPECIAL PURPOSE

A. Special purpose receptacles shall be provided with the ratings and number of poles as indicated or required for the proposed purpose.

B. Provide a matching plug with cord-grip features with each special purpose receptacle.

2.6 NAMEPLATES

A. Provide nameplates or equivalent markings on the switch enclosures to indicate the ON and OFF positions of each switch.

B. ON and OFF for 3-way or 4-way switches will not be accepted.

C. Provide receptacles for special purposes with nameplates indicating their use.

D. Nameplates shall meet the requirements of Section 26 00 00 – Electrical Work, General and shall identify the Panel Identification and Circuit number for the receptacle.

**PART 3 -- EXECUTION**

3.1 GENERAL

A. Perform WORK in accordance with the requirements of the NEC.

3.2 CONNECTION

A. Rigidly attach wiring devices in accordance with the NEC and as indicated, avoiding interference with other equipment.

B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

C. Receptacles indicated to be powered by uninterruptible power supplies (UPS) shall have a nameplate installed directly above the receptacle that reads:

1. (first line) “UPS-POWERED”

2. (second line) “NO TOOLS”

D. Nameplates shall meet the requirements of Section 26 00 00 – Electrical Work, General, and shall consist of a red plate with white letters a minimum of 1/4 inch tall.

3.3 GROUNDING

A. Devices, including switches and receptacles, shall be grounded in accordance with NEC, Article 250, and Section 26 05 26 – Grounding.

B. Switches and associated metal plates shall be grounded through the switch mounting yoke, outlet box, and raceway system.

C. Flush Receptacles

1. Flush receptacles and their metal plates shall be grounded through positive ground connections to the outlet box and grounding system.

2. Maintain the ground to each receptacle by a spring-loaded grounding contact to the mounting screw, or by a grounding jumper, each making a positive connection to the outlet box and grounding system at all times.

D. Receptacles served from an uninterruptible power supply shall be provided with an isolated grounding conductor from the serving power panelboard.

3.4 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 00 00 – Electrical Work, General.

B. Test each receptacle for polarity and ground integrity, using a standard receptacle tester.

**END OF SECTION**

# SECTION 26 05 43 – UNDERGROUND RACEWAYS SYSTEMS

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 05 43 – UNDERGROUND RACEWAYS SYSTEMS

## PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.

2. Handholes and pull boxes.

3. Manholes.

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER'S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner's Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specification section cross-reference:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |
| 26 05 26 | Grounding |
| 26 05 53 | Identification for Electrical Systems |

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.

2. Cover design.

3. Grounding details.

4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

| **Institute of Electrical and Electronics Engineers (IEEE)** | |
|---|---|
| IEEE C2 | National Electric Safety Code |
| **National Fire Protection Association (NFPA)** | |
| NFPA 70 | National Electric Code |

## PART 2 --PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or approved equal:

1. AFC Cable Systems.
2. ARNCO Corporation.
3. Beck Manufacturing.
4. Cantex, Inc.
5. CertainTeed Corp.
6. Condux International, Inc.
7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
8. Electri-Flex Company.
9. IPEX Inc.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan Wire Products; a Belden company.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC (when encased in concrete), ASTM F 512, UL 651A, Schedule 40 PVC, Schedule 80 PVC, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and retained to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2. Warning Tape: Underground-line warning tape specified in Section 26 05 53 Identification for Electrical Systems.

3. Red dye added to concrete during batching. Alternatively, red dye may be applied to the uncured surface in a manner that ensures the dye provides full red color coverage across the conduits located within the concrete.

2.3 HANDHOLES AND PULL BOXES

A. Description: Comply with SCTE 77.

1. Color: Gray.

2. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.

3. Cover: Weatherproof, spring assisted opening, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering,

a. "ELECTRIC." As indicated for each service.

b. Tier level number, indicating that the unit complies with the structural load test for that tier according to SCTE 77.

6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Fiberglass Handholes and Pull Boxes with Polymer Concrete Frame and Cover: Complying with SCTE 77 Tier 15 loading. Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. Christy Concrete Products.

d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2.4 PRECAST MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.

2. Cretex Concrete Products West, Inc.; Riverton Division.

3. Elmhurst-Chicago Stone Co.

4. Oldcastle Precast Group.

5. Oldcastle Precast Inc.; Utility Vault Division.

6. Utility Concrete Products, LLC.

7. Wausau Tile Inc.

8. Ameritex

9. Waskey

10. or approved equal

B. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.

b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.

b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bilco Company (The).
2. Campbell Foundry Company.
3. Christy Concrete Products.
4. Cretex Concrete Products West, Inc.; Riverton Division.
5. East Jordan Iron Works.
6. Elmhurst-Chicago Stone Co.
7. Hubbell Power Systems; Lenoir City Division.
8. McKinley Iron Works.
9. Neenah Foundry Company.
10. Oldcastle Precast Group.
11. Oldcastle Precast Inc.; Utility Vault Division.
12. Osburn Associates, Inc.
13. Pennsylvania Insert Corporation.
14. Underground Devices, Inc.
15. Utility Concrete Products, LLC.
16. Wausau Tile Inc.
17. or approved equal

B. Ferrous metal hardware, where indicated, shall be hot-dip galvanized complying with ASTM A 153 and ASTM A 123

C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

   1. Frame and Cover: Weatherproof, [gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches

      a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

      b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

   2. Cover Legend: Cast in. Retained to suit system.

      a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.

      b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

      c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

   3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

      a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387/C 387M, Type M, may be used.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch diameter eye, and 1-by-4-inch bolt.

   1. Working Load Embedded in 6-Inch 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch diameter eye, rated 2500-lbf minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

   1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

   1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

2. Arms: Minimum 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 42 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.

3. Insulators: High-glaze, wet-process porcelain or neoprene, arranged for mounting on cable arms.

J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 150 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Fixed Manhole Ladders: If used, arranged for attachment to roof and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

L. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

## PART 3 --EXECUTION

### 3.1 CORROSION PROTECTION

A. Aluminum shall not be installed in contact with earth or concrete.

### 3.2 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment or as shown on the electrical drawings. Slope ducts from a high point in runs between two manholes to drain in both directions or as shown on the electrical drawings.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36 inches or as shown on the electrical drawings, both horizontally and vertically, at other locations unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes: Use end bells or duct terminators, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 ft. from the end bell without reducing duct line slope and without forming a trap in the line.

2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.

3. Grout end bells into structure walls from both sides.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 ft. outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified.

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound or plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft. of duct, or within the manufacturer’s installation guidelines. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie

wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour.

   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Reinforcement: Electrical engineer shall coordinate with structural engineer where there are needs for reinforced concrete. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups. Alternatively, helix concrete mix in lieu of reinforcing rods may be used when reinforced concrete is needed for concrete encased duct banks.

5. Forms: It is permissible to use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.

8. Concrete design and rebar schedule for all concrete encased ducts shall be designed and stamped by a professional engineer.

I. Stub-ups:

1. Stub-Ups: Use manufactured rigid steel conduit or resin impregnated glass elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated.

   a. Couple conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend conduit horizontally a minimum of 60 inches from edge of base. Install plastic bushings on terminations at equipment.

2. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 12 inches of the centerline of duct bank.

J. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft. of duct, or within the manufacturer's installation guidelines. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Trench bottom must rest on undisturbed soil or road crush, compacted to 98% Standard Proctor, or better.

4. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.

5. Install ducts with a minimum of 4 inches between ducts for like services and 4 inches between power and signal ducts.

6. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.

7. Set elevation of bottom of duct bank below the frost line.

8. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

9. Install manufactured rigid steel conduit or resin impregnated glass elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

10. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

## 3.3 INSTALLATION OF CONCRETE MANHOLES

A. Precast Concrete Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.

2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.

2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.

C. Drainage: Install drains in bottom of manholes where indicated on the design documents. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular or rectangular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation shall be as per manufacturer's standards and recommendations. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Damp proofing: Apply damp proofing to exterior surfaces of manholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

H. Fixed Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.4 INSTALLATION OF HANDHOLES AND PULL BOXES

A. Install handholes and pull boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use pull box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level 6-inch- thick bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: Set so cover surface will be flush with finished grade.

D. Install handholes and pull boxes with bottom below the frost line, 12-inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Retain arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: Minimum 3000 psi, 28-day strength, complying with a troweled finish.

2. Dimensions: 10 inches wide by 12 inches deep .

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 Grounding.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 Grounding.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

**END OF SECTION**

## SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 -- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 DEFINITIONS

A. OWNER - South Dakota Science and Technology Authority-Sanford Underground Research Facility.

B. OWNER'S ENGINEERING REPRESENTATIVE - Stantec - Mining.

C. ENGINEER - Engineer retained by Owner or Owner's Engineering Representative for work on this project.

D. SUPPLIER - Suppliers who manufacture or otherwise provide equipment and/or materials associated with the specified items.

E. CONTRACTOR - Construction contractor retained by Owner to construct some or all portions of the project facilities.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Specification section cross-reference:

| | |
|---|---|
| 26 00 00 | Electrical Work, General |
| 26 05 26 | Grounding |
| 26 05 53 | Identification for Electrical Systems |

## 1.4 QUALITY ASSURANCE

| | |
|---|---|
| **American National Standards Institute (ANSI)** | |
| ANSI 13.1 | Refuse Processors and Processing Equipment |
| ANSI Z535.4 | Safety signs and labels |
| **Code of Federal Regulations (CFR)** | |
| 29 CFR 1910.144 | Safety Color Code for Marking Physical Hazards |
| 29 CFR 1910.145 | Specifications for Accident Prevention Signs and Tags |
| **Institute of Electrical and Electronics Engineers (IEEE)** | |
| IEEE C2 | National Electric Safety Code |
| **National Fire Protection Association (NFPA)** | |
| NFPA 70 | National Electrical Code |
| **Underwriters Laboratories (UL)** | |
| UL 969 | Adhesive-attached labeling materials, including label stocks, laminating adhesives, and ink used by label printers |

## 1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

**PART 2 -- PRODUCTS**

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on white labels.

2. Legend: Indicate voltage.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on white labels.

2. Legend: “DANGER—HIGH VOLTAGE—KEEP OUT."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on white labels.

2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear UV resistant, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and allowed for rotate of the label to read with minimal disturbance to the conductor after termination around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, black on white labels acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## 2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## 2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical communications and utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Material:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Thickness: 4 mils.

3. Weight: 18.5 lb/1000 sq. ft.

4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

D. Tag:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Overall Thickness: 5 mils.

3. Foil Core Thickness: 0.35 mil.

4. Weight: 28 lb/1000 sq. ft.

5. Width: 6” Minimum.

6. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

## 2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting or adhesive mounting. White letters on a black background. Minimum letter height shall be 1/4 inch. For field installed label adhesive mounted labels are acceptable.

## 2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

**PART 3 -- EXECUTION**

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturers of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

H. Outdoors: UV-stabilized nylon.

I. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above concrete encased ducts and duct banks.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors at cable termination ends use color-coding conductor tape if conductor colors are not factory applied to identify the phase

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 10 AWG.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Colors for 480-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 2 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings as much as practically possible.

D. Power-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in duct bank.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on-white-labels.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.

    b. Controls with external control power connections.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

    b. Enclosures and electrical cabinets.

    c. Access doors and panels for concealed electrical items.

    d. Switchgear.

    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

    f. Emergency system boxes and enclosures.

    g. Motor-control centers.

    h. Enclosed switches.

    i. Enclosed circuit breakers.

    j. Enclosed controllers.

k. Variable-speed controllers.

l. Power transfer equipment.

m. Power-generating units.

**END OF SECTION**

# SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:


Prepared by:

Stantec Consulting Services Inc.

| | | |
|---|---|---|
| Originator: | Sadanand Mohite | Name |
| Reviewed By | Saurabh Desai | Name |
| Project Manager or Delegate: | Shawn Storey | Name |

# SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

## PART 1 -- GENERAL

### 1.1 FILED SUB-BID REQUIREMENTS

A. This section is a part of the filed Sub-Bid for Electrical Work. Filed Sub-Bidder is responsible for review and coordination of the scope of work as defined hereafter.

### 1.2 THE SUMMARY

A. The CONTRACTOR shall perform the indicated load flow, short circuit, protective device, motor starting and arc flash studies and labelling for the electrical power system as applicable in accordance with the Design Documents.

B. The WORK of this Section shall include protection studies for motors with solid state overload and overcurrent protection devices (if applicable).

C. The WORK of this Section shall include protection studies for non-motor loads with overcurrent protection devices (as applicable).

D. It is the responsibility of the CONTRACTOR to obtain the information required from the electric utility and appropriate vendors.

### 1.3 QUALIFICATIONS

A. Load Flow studies, short circuit studies, protective device evaluation studies, arc-flash hazard analysis studies, and protective device coordination studies shall be performed by an individual/organization who have been regularly engaged in short circuit and protective device coordination study for a period of at least 15 years.

B. The indicated studies shall be signed by the professional electrical engineer or designee, registered in the State of South Dakota, responsible for the studies.

C. The studies shall utilize computer program Latest version of transient analysis program like Electrical Transient Analysis Program (ETAP) , SKM or Easy Power. Approval shall be required prior to using software above mention or alternative software to perform the study.

### 1.4 CONTRACTOR SUBMITTALS

A. The indicated studies and associated software model files shall be submitted and approved by the SDSTA ENGINEER prior to final approval of the distribution equipment Shop Drawings and release of equipment for manufacture.

B. An initial short circuit study shall be submitted and reviewed before the SDSTA ENGINEER will approve the Shop Drawings for medium-voltage switchgear, transformers, or 480-volt distribution equipment.

C. Submit an initial protective device coordination study shall be submitted within 90 days after the approval of the initial short circuit study and receipt of equipment vendor drawings.

D. The short circuit, arc-flash hazard analysis, and protective device coordination studies shall be updated prior to Project Substantial Completion; utilize characteristics of as-installed equipment and materials.

E. The adequacy of the equipment "withstand", interruption and arc flash ratings shall be approved by the SDSTA ENGINEER.

**PART 2 -- PRODUCTS (NOT USED)**

**PART 3 -- EXECUTION**

3.1 GENERAL

A. The studies shall include development of single-line and impedance diagrams of the power system.

B. The diagrams shall identify components considered in the study and the ratings of power devices, including transformers, circuit breakers, relays, fuses, busses, cables, and motor/non-motor loads shall match the equipment vendor data. Where equipment vendor data is available proper justification shall be provided along with the assumed data.

C. The resistance and reactance of cables shall be identified in the impedance diagram.

D. The studies shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

E. The studies shall include every protective device and feeder included or modified within the WORK.

F. The first upstream overcurrent device outside the WORK shall be used as a fixed reference.

G. The studies shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480-volt distribution system.

3.2 LOAD FLOW STUDY

A. The load flow study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

1. ANSI/IEEE 141 Recommended Practice for Electrical Power Distribution for Industrial Plants

B. Load flow analysis will determine if transformers, cables, reactors, bus work, or boards operate in an overloaded, overvoltage, and undervoltage condition. Load flow analysis shall be performed any time load is added or connecting means to the loads (transformer, board, etc.) are changed or replaced.

C. Voltage Drop

1. Voltage drop calculations should use industry standard methods such as **IEEE 141 section 3.11**, "Calculation of voltage drops".

2. When voltage drop calculations are performed, the most limiting source voltage is to be used to produce conservative results. If a voltage other than the most limiting is used, then an explanation of why this is acceptable is to be included in the' Assumptions and Documentation of Assumptions' section of the calculation

3.3 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

1. ANSI/IEEE 141 Recommended Practice for Electrical Power Distribution for Industrial Plants

2. ANSI/IEEE 242 Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems

3. ANSI/IEEE C 37.010 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI/IEEE C 37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures

5. IEEE 551 The Violet Book

6. IEEE 1246 IEEE Guide for Temporary Protective Grounding Systems Used in Substations

B. New breakers and boards shall be demonstrated to withstand maximum bolted 3-phase fault currents.

C. The interrupting duty calculations performed in the momentary device duty report includes the worst case asymmetry created by the DC offset component. This report represents the maximum available fault currents and is used for interrupting duty, bus bracing duty and close-latch rating verifications. Medium voltage interrupting devices automatically use the **1.5-4** cycle fault currents for interrupting device duty calculations.

3.4 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed in order to determine the adequacy of circuit breakers, molded case switches, and fuses.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the attention of the ENGINEER.

C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project.

D. Devices shall be fully rated to withstand available fault currents.

E. A protective device coordination study shall be performed in order to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

F. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the ENGINEER's attention.

3.5 TIME/CURRENT COORDINATION CURVES

A. The Motor Starting study shall be in accordance with the latest version of the following Standards:

1. IEEE 141 Application and coordination of protective devices

2. IEEE 142 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

3. IEEE 399 IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis

B. As a minimum, the time/current coordination curves for the power distribution system shall include the following items plotted on 5-cycle log-log graph paper:

1. Time/current curves for each protective relay, circuit breaker, or fuse demonstrating graphically that the settings will provide protection and selectivity within industry standards

2. Each curve shall be identified and tap, and time dial settings shall be specified.

3. Provide individual curves for each feeder unless identical to others.

4. Selectivity

a. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing.

b. Where selectivity cannot be achieved, the ENGINEER shall be notified as to the cause.

c. Recommendations shall be included for alternate methods that would improve selectivity.

5. Time/current curves and points for cable and equipment damage.

6. Circuit interrupting device operating and interrupting times

7. Indicate maximum fault values on the graph.

8. Sketch of bus and breaker arrangement

9. Magnetizing inrush points of transformers

10. Thermal limits of dry-type and liquid-insulated transformers (ANSI damage curve)

11. Every restriction of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.6 MOTOR STARTING STUDY

A. The Motor Starting study (if applicable) shall be in accordance with the latest version of the following Standards:

1. IEEE 399 Standard for Electrical Safety Requirements for Employee Workplaces

B. Static and dynamic motor starting analysis ensure the addition of new equipment will not have adverse effect on the existing power system. The results of the static and dynamic motor starting analysis shall be compliant with IEEE 399 Section 9, “Motor-Starting Studies” and compliance shall be demonstrated in the calculation.

C. A static motor starting analysis shall be performed any time a load is added, changed, or removed from an MCC. A dynamic motor starting analysis shall be performed any time a motor of 50Hp or greater is added to the system.

3.7 ARC FLASH STUDY

A. An arc flash study shall be performed with the aid of a digital computer program in order to determine the “Arc Flash Protection Boundary” and “Personal Protective Equipment” (PPE) levels for applicable electrical distribution equipment, stand-alone disconnects, starters, and VFDs in the power distribution system.

B. The arc flash study shall be performed in conjunction with short circuit calculations and protective device coordination.

C. The arc flash study shall be in accordance with the latest version of the following Standards:

1. NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces

2. IEEE 1584 IEEE guide for performing Arc Flash Hazard Calculations

3. OSHA (29 CFR PART 1910) Occupational Safety and Health Standards for General Industry

4. ANSI Z535.4 Product Safety Signs and Labels

D. The working distance for all buses in the model shall be set to 18" regardless of voltage level and board configuration. Maximum fault clearing time (FCT) of 2 seconds shall be used to limit the length of time a person is likely to remain in the location of the location of an arc flash.

E. The recommended values for the “Arc Flash Protection Boundary” and PPE levels, based on the arc flash study results, shall be tabulated in the study.

F. Labeling

1. The digital computer program shall provide the “Arc Flash Protection Boundary” and PPE values in a format that can be directly printed on to labels.

2. Arc flash label as a minimum shall have following:

a. Equipment ID

b. Flash Hazard Boundary

c. Arc Flash Energy @ 18”

d. Shock Hazard

e. Minimum Approach

f. PPE Class/Level

3. The CONTRACTOR shall provide these labels in accordance with Section 26 00 00 – Electrical Work, General.

3.8 FINAL SUMMARY REPORT

A. Summarize the results of the indicated power system studies in a final report. Report as a minimum shall have the following elements:

1. **Purpose** – The purpose is a short description stating why the calculation was initiated, what studies will be performed by the calculation, and identify the effected power system components.

2. **References** – References shall include all material that is required to reproduce the calculation. They may include the National Electric Code, IEEE standards and other applicable code.

3. **Assumptions** – Assumptions are items of information that cannot be proven. All unverified assumptions will be validated prior to implementation, and no unverified assumptions shall be used in calculation submittals. It is advisable to use limiting conditions over un-verified assumptions. The calculation shall explicitly state which parts of modified design documents are verified and which parts are unverified.

4. **Design Input Data** - Input data includes a detailed description of the change and the loads added or removed and any other supporting vendor information. The vendor information may be included in attachments to facilitate easier reading of the calculation.

5. **Computation and Analysis** – The computation and analysis section of the calculation shall include information on how each computation (Load Flow, Voltage, Short Circuit, Arc Flash, Coordination, and any system configurations studied) is prepared. This section will also include pass/fail criteria for the calculation.

6. **Summary of Results** - This section shall highlight results of the studies performed as described in the Computation and Analysis section. The results shall show compliance with criteria in Table below and provide descriptive statements of any other notable information. Results shall demonstrate the worst case scenarios.

| Calculation Pass/Fail Criteria | | | | |
|---|---|---|---|---|
| Study | Component | Pass | Pass with Ex | Fail |
| Load Flow | Cable/Reactor /Board | ≤ 100% Rating | > 100% with Justification | > 100% |
| | Transformer | ≤ 100% Base Rating | ≤ 100% Max Rating with Justification | > 80% Fan Rating |
| Over-Voltage | All | ≤ 105% | ≤ ANSI Cat B | > ANSI Cat B |
| Under-Voltage | Switchgear | ≥ 98% Nominal Voltage | ≥ ANSI Cat B | < ANSI Cat B |
| | MCC/Panel | ≥ 95% Nominal Voltage | ≥ ANSI Cat B | < ANSI Cat B |
| Short Circuit | All | ≤ 95% Nominal Voltage | ≤ 100% | > 100% |
| Arc Flash | All | ≤ 8 cal/cm$^2$ | ≤ 8 – 40 cal/cm$^2$ | > 8 cal/cm2 |
| Motor Starting | Motor Terminal | ≥ 85% Motor Rated Voltage | 85% > 80% Rated Voltage | < 80% Rated Voltage |
| | Board | ≥ 85% Board Nominal Voltage | 85% > 80% Rated Voltage | < 80% Rated Voltage |
| Coordination | All | Maintained Coordination | Existing Miss-Coordination | New Miss-Coordination |

7. **Conclusions and Recommendations** – The conclusion section shall contain a concise write-up showing if the computations passed or failed their requirements. In the case of a failure to meet a requirement, an engineering recommendation to correct existing conditions or limit operation conditions is required. Project Managers shall be notified of all limiting conditions and corrective recommendations.

B. The report shall include the following Supporting Documentation:

1. Single-line diagram
2. Impedance diagram
3. Tabulation of all protective devices identified on the single line diagram
4. Time/current coordination curves
5. Analytical Software Calculation Reports
6. Walkdown picture or data
7. Vendor data

C. The report shall include information concerning the computer program used for the study, as well as a general discussion of the procedure, items, and data considered in the preparation of the study.

D. Submit 2 bound copies of the report to the SDSTA ENGINEER. Submit electronic copy of the plant analytical model to the ENGINEER

## 3.9 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices in accordance with the recommendations in the power system coordination study.

B. Calibrate the MCPs as in accordance with the recommendations in the power system study.

C. Adjustments shall be made prior to energizing any electrical equipment.

**END OF SECTION**

**SECTION 26 12 13 – LIQUID-FILLED MEDIUM VOLTAGE TRANSFORMERS**

This document is released for the purpose of Issued for Construction under the authority of

Permit/Seal:

LICENSED PROFESSIONAL ENGINEER
REG. NO.
17397
SAURABH
ARPANKUMAR DESAI
SOUTH DAKOTA
11/07/2025

Prepared by:

Stantec Consulting Services Inc.

| | | |
|---|---|---|
| Originator: | Sadanand Mohite | Name |
| Reviewed By | Saurabh Desai | Name |
| Project Manager or Delegate: | Shawn Storey | Name |

# SECTION 26 12 13 – LIQUID-FILLED MEDIUM VOLTAGE TRANSFORMERS

## PART 1 -- GENERAL

### 1.1 WORK INCLUDED

A. This Section of the Specifications forms part of the Division 26 Contract Documents and is to be read, interpreted, and coordinated with all other parts.

B. This Section covers the furnishing of all products, labour, materials and equipment necessary to install test and make completely ready for operation the substation type power transformers. The power transformers will be supplied by the Contractor who will provide services, materials, equipment and appurtenances required to meet all design conditions, testing requirements, efficiency guarantees and warranties. Electrical power feed, conduit, wires, instrumentation, control system, and other components not provided by the Manufacturer, but required for a complete installation, shall be supplied by the Contractor. The equipment to be provided by the Contractor shall consist of:

### 1.2 REFERENCE STANDARDS

A. Conform to the following reference standards:

1. IEEE C57.12.00 – Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2. IEEE C57.12.70 – American National Standard Terminal Markings and Connections for Distribution and Power Transformers.

3. IEEE C57.12.80 – Standard Terminology for Power and Distribution Transformers.

4. IEEE C57.12.90 – Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers.

5. NEMA TR 1 (R2000) – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid Immersed Power Transformers.

6. NEMA 260 (2004) – Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.

### 1.3 SUBMITTALS

A. Shop Drawings: Provide with the related items of equipment.

B. Indicate:

1. Anchoring method and dimensioned foundation template.

2. Dimensioned cable entry locations.

3. Dimensioned cable termination height.

4. Transformer % impedance

5. Transformer % efficiency.

6. Identified internal and external component layout on assembly drawing.

7. Indicate insulating liquid capacity.

8. Wiring diagrams.

9. O&M Installation and Start-up Instructions

10. Protection and Control components – locations, wiring details.

C. Submit time current curves for transformer current limiting bayonet fuse and transformer damage curve.

## 1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Data: Provide with the related items of equipment for incorporation into the operation and maintenance manual.

**PART 2 -- PRODUCT**

2.1 GENERAL

A. The power transformer shall be a Partner Technologies Inc., Carte International Inc., Cooper Power Systems, ABB or approved equivalent.

B. Liquid filled substation type pad mounted distribution transformer complete with lockable primary and secondary conductor compartments and accessories to form complete factory assembled, self-contained, steel fabricated unit for mounting on concrete pad.

C. The transformer must meet the requirements of the local Electrical Safety Authority.

2.2 RATINGS

A. Primary voltage: 12000 V, 60 Hz delta connected, 3 phase.

B. Secondary voltage: 480YV, grounded wye connected, 3 phase, 4 wire, neutral solidly grounded. The neutral shall be a fully insulated bushing.

C. Basic Impulse Level: 125 kV primary, 30 kV secondary.

D. Four, 2.5%, voltage taps 2-FCAN, 2-FCBN, off-load tap changer with padlocking facilities.

E. Transformer insulating liquid shall be biodegradable Envirotemp® FR3 Fluid. No PCB material shall be present in all materials used.

F. The transformer shall have 55/65 ºC average winding temperature rise rating. The winding temperature rise shall not exceed 55 ºC when loaded at base kVA rating. The transformer shall provide an additional 12% capacity at the 65 ºC rating.

G. Transformer impedance shall be 5.75% nominal.

H. Extended Capacity – fan provisions only. An additional rating shall be obtained by forced air circulation (KNAF) for 33% additional capacity.

2.3 CONSTRUCTION

A. Core and coil shall be vacuum processed.

B. No exposed live parts.

C. Welded mild steel radiators.

D. Tank access.

E. Sealed tank shall be cold-rolled steel plate with welded in place lifting lugs, jacking pads and towing eye.

F. Pressure relief devices.

G. Full length bottom entry primary termination.

H. Throat type secondary termination.

I. Stainless steel nameplate and connection diagram.

J. The primary bushings shall be three sidewall mounted 200A ANSI/IEEE 386 primary bushing wells and inserts configured for radial feed with primary cable load beak elbow terminations with parking stands. Include primary load break elbow for primary cable terminations.

K. The secondary bushings shall be sidewall mounted molded epoxy bushings with 6 -hole NEMA spade. Bushings are to be laid out in a left to right configuration as viewed when standing in front of them.

L. Primary and Secondary connections shall be in a sealed lockable compartment.

M. Provide primary voltage load break Bay-O-Net assembly with dual sensing current limiting fuses.

N. Primary overvoltage protection shall consist of elbow type MOVE distribution class surge arresters in conjunction with dead front bushing wells and inserts.

O. Outdoors type structure shall be gasketed and fully tamper-proofed to CSA standards for substation type transformers.

P. Door padlocking and secured with Penta-head bolt.

Q. Warning labels shall be inside and outside to latest ANSI/IEEE C57.12.00, C57.154.

2.4 FINISH

A. Steel shall be cleaned and degreased prior to painting, all loose scale to be removed.

B. Primer shall be a 2-part epoxy system suitable for harsh marine environment

C. Top coat shall be a 2-part system with 1500 hr. salt spray rating.

D. Colour: ASA 70 Grey or ANSI #61 Light Grey. Either is acceptable.

2.5 STANDARD ACCESSORIES AND REQUIREMENTS

A. Globe type upper fill valve.

B. Globe type drain/sampling valve with filler plug.

C. The transformer shall meet the requirements of ANSI/IEEE C57.12 for pad mount dead front transformer.

D. Pressure relief device.

E. Liquid level gauge with clear liquid level indication with maximum and minimum markings, visible without opening doors/compartments.

F. Bi-metal type liquid temperature thermometer with resettable maximum temperature pointer.

G. Pressure/vacuum gauge, visible without opening doors/compartment.

H. Four (4) stainless steel ground pads.

I. Removable XO flexible ground strap that is a minimum #4/0 AWG stranded bare copper.

J. Transformer shall comply with ANSI/IEEE C57.12 for energy efficiency.

K. Voltage regulation shall be +/- 4% or better.

L. Sound level not exceed 68 db measured at 1 m in any third octave between 50 Hz and 1000 Hz.

2.6 ADDITIONAL ACCESSORIES AND FEATURES

A. Bleeder valve.

B. NEMA 4 Control Box.

C. Winding temperature indicator with two (2) Form C auxiliary contacts rated 120V, 5A.

D. Touch-up paint.

2.7 GROUNDING

A. Copper grounding bus size 6 x 50 mm.

B. Connectors for grounding conductors size as indicated on drawings.

2.8 EQUIPMENT IDENTIFICATION

A. Provide equipment identification.

B. Nameplate showing information in accordance with ANSI/IEEE C57.12.00, C57.154

2.9 WARNING SIGNS

A. Provide warning signs.

2.10 TRANSFORMER PAD

A. Provide minimum 300 mm thick, 100 above, and 200 below made of 32 MPa HS cement with 15MA 300 E.W. T&B rebar and compacted gravel fill beneath and bonding with #4/0 bare copper conductor.

## PART 3 -- EXECUTION

### 3.1 INSPECTION

A. Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

### 3.2 INSTALLATION

A. Ensure the equipment is properly installed to provide satisfactory service.

B. Ensure concrete pad is fully cured before transformer is installed.

C. Set and secure transformer unit in place, rigid plumb and square.

D. Make connections as indicated.

E. Connect transformer unit ground bus to system ground.

F. Wire first set of contacts on liquid temperature thermometer to alarm in plant control system when unsafe condition reached. Provide conduits and conductors for interface with plant control system.

G. Ensure care is taken to prevent contamination of liquid and components when field filling transformers.

H. Use only metal hose when field-filling transformer with oil: never, under any circumstances, use rubber hose.

I. Set neutral transformer tap to produce 2-5% over rated secondary voltage at no-load. Once transformer is loaded measure secondary voltage and adjust the tap to achieve voltage at or slightly above rated.

### 3.3 TESTING AND COMMISSIONING

Perform tests and document results. The tests shall be per the applicable section of the International Electrical Testing Association's (NETA) current edition of the Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems. The tests shall be performed by a NETA certified testing agency.

For each item of equipment, attach test documentation.

**PART 4 -- UNIT SUBSTATION DISTRIBUTION TRANSFORMER SHEET**

| | | |
|---|---|---|
| A. | Scope: | [ ] Outdoor |
| | | **[ X ]** Outdoor, on or adjacent to building<br>**[ ]** Indoor |
| B. | kVA: Per Section 1.1.2 | [X ] 60Hz [ ] 50Hz |
| | Temperature Rise: | **[ ]** 65°C<br>**[ ]** 75°C<br>**[ X ]** 55/65°C<br>**[ ]** 55/75°C |
| C. | Special Altitude: | 577 (1893) m (ft.) |
| D. | Cooling Class : | [ ] ONAN |
| | | **[ ]** ONAN/ONAF 15% or 25% Capacity |
| | | **[ X ]** ONAN/ONAF 33% Capacity |
| | | **[ ]** ONAN/ONAF (Future) ( (15%)) |
| E. | Liquid Type: | [ X ] Envirotemp® FR3 Fluid |
| | | **[ ]** Mineral Oil |
| F. | Primary Voltage: 12470 ϕ-ϕ V BIL: 125kV | [ X ] Aluminum [ ] Copper |
| G. | Connection: | [ ] Delta - Wye |
| | | **[ ]** Delta - Delta |
| | | **[ X ]** Delta - Grounded Wye |
| | | **[ ]** Grounded Wye - Delta |
| | | **[ ]** Grounded Wye - Grounded Wye |
| | | **[ ]** Grounded Wye – Wye |
| H. | Primary Taps: | [ ] None |
| | | **[ X ]** 2 @ +/-2 1/2% (total of 4 taps) |
| | | **[ ]** 4 @ - 2 1/2% |
| | | **[ ]** NEMA Taps |
| | | **[ ]** 2 @ +/- 1% (total of 4 taps) |
| I. | Secondary Voltage: 480ϕ-ϕ V BIL: 30kV | [ X ] Aluminum [ ] Copper |
| J. | Impedance: 5.75% | [ X ] ANSI Standard [5.3%] Minimum [ 6.35%] Maximum |
| K. | Loss Evaluation: | [ X ] Efficiency per |

[ ] Dollars/Watt (No Load): ____________

[ ] Dollars/Watt (Load): _______________

L. Primary Termination: [ ] Throat

[ ] Flange (required with primary air disconnect switch)

[ ] Bottom entry air terminal chamber

[ ] Top entry air terminal chamber

[ X ] Full length bottom entry cabinet

[ ] Full length top entry cabinet

M. Primary Bushings: [ ] Eyebolts

[ ] 2-Hole Spade

[ X ] Wells and Load-break Inserts (200A)

[ ] Loop Feed

[ X ] Radial Feed

[ ] 600A Deadbreak One-Piece Bushings

[ ] Loop Feed

[ ] Radial Feed

[ ] 900A Deadbreak One-Piece Bushings

[ ] Loop Feed

[ ] Radial Feed

N. Secondary Termination: [ ] Throat

[ ] Flange

[ ] Bottom entry air terminal chamber

[X ] Top entry air terminal chamber

[ ] Full length top entry cabinet

O. Secondary Bushings: [ X ] 6-Hole Spade

[ ] 12-Hole Spade

[ ] __- Hole Spade (please specify)

P. Primary Overcurrent Protection:

[ ] Vacuum Fault Interrupter

Time Current Curve: [ ] EF [ ] TF [ ] KF [ ] F [ ] H

[ ] IDEA iDp-210 Feeder Protection Relay (Cooper Systems)

[ ] 600A Primary Air Load-break Switch

[ ] Unfused

**[ ]** Non-Disconnect Power Fuse

**[ ]** Disconnect Power Fuse

**[ X ]** Current-Limiting Fuse

Q. Arresters: [ ] Heavy Duty MOV Distribution Class Arrester

**[X ]** MOVE Elbow Type Distribution Class Arrester

**[ ]** MOV Intermediate Class Arrester

**[ ]** Station Class Arrester

**[ ]** Arrester Mounting Provisions

R. Arrester Duty Cycle Rating: 25kV MCOV

S. Accessories:

**[ ]** Copper Low Voltage Bushings (standard with all-copper windings)

**[ ]** Bleeder Valve (standard on 2500kVA and above)

**[ ]** Nitrogen Blanket with Bleeder and Purge Valve

**[ X ]** NEMA 4 Control Box (with terminal blocks for all instruments' auxiliary contacts, pad-lockable door)

**[ ]** NEMA 4X Control Box

**[ ]** NEMA 7 Control Box

**[ ]** Rapid Pressure Rise Relay

**[ ]** Seal-In Panel for Rapid Pressure Rise Relay

**[ ]** 120VAC **[ ]** 240VAC **[ ]** 24VDC **[ ]** 48VDC **[ ]** 125VDC

**[ ]** Forced Air Fan Control Package

**[ X ]** Winding Temperature Indicator

**[X ]** Auxiliary Contacts 2 - Form 'C' 120Vac 5A.

**[ X ]** Liquid Level Gauge

**[ X ]** Dial Type Thermometer (standard with fan package)

**[ X ]** Pressure/Vacuum Gauge

**[ X ]** Pressure Relief Device

**[ X ]** Globe Type Upper Fill Valve

**[ X ]** Touch-up Paint (aerosol cans)

T. Special Features:

**[ ]** Primary Air Load-break Switch

**[ ]** 1200A Loadbreak Rating (requires 1200A copper bus bar)

**[ ]** Outer Front Door (covers viewing area and switch)

**[ ]** Key Interlocks

**[ ]** Porcelain Bus Insulators

**[ ]** Copper Bus Transition (required for 600A and greater)

**[ ]** Auxiliary Switch (remote indication of primary switch position)

**[ ]** Line-side Bus (bottom entry only)

**[ ]** Thermostat for Space Heater

**[ ]** Stainless Steel Cabinet

**[ ]** Tank Base

**[ ]** Primary Enclosure

**[ ]** Secondary Enclosure

**[ X ]** Cooling

**[ X ]** Mild Steel Radiators

**[ X ]** Welded

**[ ]** Removable

**[ ]** Stainless Steel Radiators

**[ ]** Welded

**[ ]** Removable

**[ ]** Galvanized Steel Radiators (removable and unpainted)

**[ ]** Positive Nitrogen Pressure Oil Preservation System

**[ ]** K Rated Transformer **[ ]** K4 **[ ]** K9 **[ ]** K13 **[ ]** K20

**[ ]** Current Transformers **[ ]** Relaying **[ ]** Metering

Quantity___ Bushing_______ Ratio_______ Accuracy Class___

**[ ]** IDEA iXP-420 Differential Protection Relay (Select appropriate Current Transformers for Application)

U. Colors: [ X ] ANSI #61 Light Gray or as "Other" noted below

**[ ]** ANSI #70 Sky Gray

**[ ]** Standard Munsell No. 7GY3.29/1.5 Green

**[ ]** ANSI #24 Dark Blue Gray

**[ ]** ANSI # 49 Medium Gray

**[ X ]** Other*:* ASA 70 Grey (Munsell 5.0 BG 7.0/0.4)

V. Testing: [X ] Routine (ANSI Standard)

**[ ]**

Special:_____________________________________________

**[X]** Certified Test Results

W. Drawings: [X] Approval

**[X]** Record

**[X]** CAD Drawings on CD

**END OF SECTION**

**SECTION 26 13 13 – MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR**

This document is released for the purpose of Issued for Construction under the authority of

PERMIT/SEAL:


Prepared By:

Stantec Consulting Services Inc.

| | |
|---|---|
| Originator: | Sadanand Mohite<br>Name |
| Reviewed By | Saurabh Desai<br>Name |
| Project Manager or Delegate: | Shawn Storey<br>Name |

# SECTION 26 13 13 – MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR

## PART 1 -- GENERAL

1.1 SCOPE

A. Provide medium voltage metal clad switchgear, complete and operable, in accordance with the Contract Documents

B. Work includes:

1. Design
2. Coordination with DESIGN-BID-BUILD for standard product adjustments
3. Submittals
4. Special tools and maintenance equipment
5. Shop fabrication and testing
6. Delivery to SFPUC Treasure Island WRRF
7. Delivery inspection
8. Installation verification
9. Training
10. Warranty

1.2 REFERENCE SPECIFICATIONS

A. Use this Section with the Contract Documents and following other Sections to establish the total requirements

1. 01 33 00 – Submittals
2. 01 93 00 – Operation and Maintenance Data
3. Division 26

1.3 APPLICABLE CODES AND STANDARDS

A. Commercial Standards

1. IEEE C37.6, Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Capabilities for Voltages Above 1000 V
2. IEEE C37.04, Standard Rating Structure for AC High-Voltage Circuit Breakers (includes supplements C37.04A, C37.04BI)
3. IEEE C37.20.2, Standard for Metal-Clad Switchgear

4. IEEE C57.13, Standard Requirements for Instrument Transformers

5. IEEE C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus

B. Codes

1. ANSI/NFPA 70 National Electrical Code

1.4 SUPPLIER SUBMITTALS

A. See Section 01 33 00 – Submittals

B. Additional Submittals

1. Certified copies of all Type (Design) and Verification Test Reports on a specified product.

2. Current transformer data for each current transformer including the primary current, secondary current, the accuracy class, the saturation voltage, the saturation plot of secondary voltage plotted against secondary exciting amperes, number of secondary turns, and ohms resistance of the secondary turns.

3. Calculation of relay tap settings based on current transformers used to document the tap settings for the differential relay fall within the acceptable relay setting range for proper operation and protection of the equipment. See the SEL instruction manual for calculation examples.

4. Calculation for meeting the manufacturer's criteria for each differential current transformer as recommended by the relay vendor to prevent mis-operation due to current transformer saturation when a through fault lies outside the protected zone and will be interrupted by other protective devices. For example the criteria for the SEL-587-1 relay is as follows: 262,5 ≥ (X/R +1) ● If ● Zb where X/R is the X/R ratio of the primary fault current, If is the maximum fault current in per unit of the CT rating and Zb is the total CT burden in per unit of the standard burden (that includes connecting wire resistance and CT winding turn resistance). See the SEL instruction manual for calculation examples.

5. Filled-in setting sheets for the differential relay to include the differential current protection settings, instantaneous overcurrent settings and time overcurrent settings with related delay and inhibit settings related to transformer inrush harmonics.

6. Certification that the equipment is seismically qualified in accordance with ASCE 7-16 Section 13.2.2.

1.5 QUALITY ASSURANCE

A. Follow approved Quality Assurance/Quality Control Program

B. Designate a project manager for the duration of the project to coordinate with the DESIGN-BID-BUILD.

C. Coordinate testing and setup of the transformer differential current relay located in this switchgear with testing and setup of the engine generator differential current relay located in the 480 volt switchgear.

D. Provide switchgear qualified for use in seismic areas as follows:

1. Built to comply with IEEE Std 693-2005 and qualified by IEEE Std 693-2005 for a high level seismic event

2. Seismic compliance qualified only through shake table testing. Compliance by calculation is not acceptable

## 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. See 01 73 19 – Equipment Installation and Operational Testing

**PART 2 -- PRODUCTS**

2.1 GENERAL

A. Provide switchgear consisting of breaker and auxiliary units, as indicated on drawings, assembled to form a rigid, self-supporting, metal-enclosed structure

B. All major components are provided by General Electric, Eaton Electrical, or approved equal, establishing one source of responsibility for the equipment performance and assuring high standards in quality, coordination, reliability, and service.

C. Eaton's Cutler - Hammer VCP-W Metal- Clad Switchgear, or approved equal

D. Switchgear assembly is NRTL listed and be labeled where possible

E. The bus bar is tin plated copper and fully insulated; tin plated copper is silver plated at joints. Provide full-length ground bus bar at the bottom of the switchgear enclosure.

F. Provide a control power transformer section, to power the differential relay, instruments, controls, indicating lights, auxiliaries, breaker charging spring motor and space heaters.

G. For rigidity during fault conditions all connections to roll-out potential transformer trays and control power transformer trays are rigid bus bars insulated to full voltage rating of switchgear assembly.

H. Design circuit breaker compartments to house 27.0 KV removable-element circuit breakers. Stationary primary disconnect contacts are silver-plated copper. Grounded metal safety shutters isolate all primary connections in compartment when the breaker is withdrawn from connected position.

2.2 SERVICE

A. Suitable for operation at 21 nominal kV, 3 phase, 60 Hz grounded system.

B. Have an interrupting rating of 25 kA as required.

2.3 ENCLOSURE

A. Provide an outdoor, weatherproof NEMA 3R non-walk-in type enclosure.

B. Rodent-and bird-proof.

C. The concrete pad standing outdoor switchgear to be shipped fully assembled and tested; if shipping breaks are imperative, assemble units are to be assembled and tested then broken down for shipping.

D. Energized bare parts mounted on doors are guarded where the door is opened for maintenance of equipment or removal of drawout equipment.

E. Provide full height piano hinged doors for front and rear access to each section that may be locked closed with padlock and two keys after closing door.

F. Provide enclosure to have provisions for close coupled coordination with liquid type secondary unit substation transformer.

G. Provide a mimic bus on front of the enclosure. Mimic bus is plastic and held in place with screws.

2.4 DESIGN AND CONSTRUCTION FEATURES

A. Provide incoming and outgoing sections to have ample space for stress-cone terminations and lightning arresters

B. Provide terminals and lugs of the solderless type suitable for copper cables of size indicated.

C. Main Bus

1. Tin plated copper and rated for 1200 amperes

2. Bus bars to have a continuous current rating based on temperature rise and documented by design tests

3. All joints will be silver plated with at least 2 bolts per joint

4. Bus bars will be braced to withstand magnetic stresses developed by currents equal to main power circuit breaker close, carry, and interrupt ratings

5. Access to bus bars are through removable front panels

6. Entire bus, except for terminations, are completely isolated with metal barriers and insulated as required by ANSI Standards

7. Provide bus supports to be polyester glass (standard)

D. Ground Bus

1. A ground bus (1/4 by 2 inch tin plated copper) extends throughout assembly with connections to each breaker grounding contact and cable compartment ground terminal. Joints are made up as indicated in drawings. Station ground connection points are located in each end section.

E. Circuit Breakers

1. Rated for a full load current of 1200 amperes, symmetrical interrupting current of 25 kA rms, an asymmetrical monentary close and latch interrupting current of 36 kA rms, and a peak crest withstand current of 85 kA. Circuit breakers of equal rating are interchangeable. Circuit breakers are operated by an electrically charged, mechanically and electrically trip-free, stored-energy spring. Use handle to manually charge the spring for slow closing of contacts for inspection or adjustment.

2. Equip circuit breakers with secondary disconnecting contacts which is automatically engage in the connected position

3. Provide circuit breakers of horizontal drawout type, capable of being withdrawn on rails. The breakers are operated by a motor-charged stored energy spring mechanism,

charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts are silver-plated copper.

4. Each circuit breaker is to contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, is to be easily visible when the breaker is removed from its compartment.

5. Provide each breaker compartment with a motor operated breaker rackout device with the control being cord connected allowing the operator to be 25 feet away to avoid the blast zone from an arc flash event. Using the rackout device, a breaker will be self-aligning and will be held rigidly in the operating position. In the disconnect position, breaker is to be easily removable from compartment. Breaker racking is accomplished with door closed and latched. Insert handle through a hole in front door to operate rackout device.

6. An indicating tape hows breaker position when racking breakers in or out of their connected positions.

7. Provide interlocks to prevent moving breaker to or from operating position unless main contacts are open. Operating springs are discharged automatically when breaker is rolled fully into connected or disconnected position. Provide rackout device with provisions to padlock in connected or disconnected position. When locked in disconnected position, breaker is removable from compartment using portable lifting device. Padlock does not interfere with breaker operation.

8. Automatic shutters cover primary disconnect stabs when breaker is withdrawn to test/disconnect position. Shutters to be be positively driven by linkages connected to racking mechanism. Locate stationary barrier in front of the shutters for additional safety.

9. Breaker control voltage is 120VAC.

10. Provide circuit breakers having a rated interrupting time of 3 cycles.

11. Circuit breaker installed in the lower compartment are capable of being removed from the compartment without the use of a breaker dolly once it is moved to the disconnect position (indoor and protected aisle enclosures only).

12. Provide each circuit breaker with an auxiliary switch. Provide all breakers having a 6-stage switch containing six “a” (normally open) and six “b” (normally closed) contacts. All spare contacts are wired to terminal boards.

13. Provide each circuit breaker with a position switch indicating whether the circuit breaker is in the “Connect” or Disconnect” position. All breakers are to have a 6-stage switch containing six “a” (normally open) and six “b” (normally closed) contacts. Wire all spare contacts to terminal boards.

F. Grounding Circuit Breakers

1. Provide a grounding circuit breaker to short the phases to dissipate any circulating current prior to performing maintenance on the breaker.

2.5 Automatic Transfer Control System

A. Automatic Transfer Control System

1. Manufacturers - Eaton Corporation – ATC-300+ or equivalent.

2. Dual Source, No Tie, Open Transition Automatic Transfer Control System

a. Where indicated on the drawings, provide an automatic transfer control system for control of two circuit breakers. Provide logic of the transfer control system functions via a microprocessor. Set points are field adjustable without the use of special tools.

b. A digital readout displays each option as it is functioning. The readout displays actual line-to-line voltage, line frequency and timers. When timers are functioning, the microprocessor displays the timer counting down. All set points are be capable of being re-programmed from the front of the logic panel when the transfer control system is in the program mode. Include test as part of the microprocessor. Provide microprocessor compatible with a twisted pair communication over a network to a computer for control or printer.

c. The transfer control system includes the following features:

1) Time delay normal to alternate, adjustable

2) Time delay alternate to normal, adjustable

3) Delayed transition time delay, adjustable from 0 to 120 seconds, to allow disconnection of the load during transfer in either direction to prevent excessive inrush currents due to out-of-phase switching of large inductive loads

4) LEDs to indicate normal and alternate position

5) LEDs marked “Source 1” and “Source 2” to indicate that respective source voltages are available.

6) LEDs to indicate which source is preferred

7) LED to indicate the load energized.

8) Historical transfer information via the front panel

9) Two-position selector switch permitting two modes of transfer control system operation: AUTO-MANUAL.

d. When the alternate source is an engine generator, provide the following features:

1) Adjustable time delay engine start.

2) Adjustable time delay engine cool down

3) Engine start contact

4) Frequency/voltage relay for alternate source, frequency adjustable from 45 to 60 Hz and voltage fixed at 90% pickup, 70% dropout.

5) Plant exerciser

3. Sequence of Operation – Automatic Mode

a. Transfer control system automatically transfers its load circuit to an emergency or alternate power supply upon failure of its normal or preferred source.

b. Upon loss of phase-to-phase voltage of the normal source to 80% of nominal, and after a time delay, adjustable from 0.5 to 15 seconds, to override momentary dips and/or outages, a 10-ampere, 30 volts dc contact is to close to initiate starting of the emergency or standby source power plant. Transfer to the alternate source takes place immediately upon attainment of 90% of rated voltage and frequency of that source. For systems not involving engine generator sets as the alternate source, transfer occurs after an adjustable time delay of 1 to 60 seconds to override momentary dips and outages.

c. When the normal source has been restored to 90% of rated voltage, and after a time delay, adjustable from 0.5 to 32 minutes (to ensure the integrity of the normal power source), the load is retransferred to the normal source.

d. A time delay in the neutral position, adjustable from 0.5 to 32 minutes, delays shutdown of the emergency or standby power source after retransfer to allow the generator to run unloaded for cool down, after which the generator is automatically shut down.

e. If the emergency or standby power should fail while carrying the load, transfer to the normal power supply is made instantaneously upon restoration of the normal source to satisfactory conditions.

4. Sequence of Operation – Manual Mode

a. While in manual mode, breakers are capable of being opened and closed using control switches. Provide electrical interlocking to prevent the closing of both mains and the tie simultaneously.

5. Provide a control power transformer for each source with control power transfer scheme

6. Provide electrically operated main circuit breakers

7. Provide an Eaton microprocessor-based automatic transfer controller ATC-600 with additional options 29G (type of operation – selectable automatic or manual), 32A (open transition/time delay neutral), and 48F (RS-232 and RS-485 with modbus). No substitutions allowed, controller and signals to match recently updated (E) Switchgear-4 ATC-600.

B. Main-Main Auto Transfer operation

1. Under normal operating conditions, main breakers 1A and 2A shall not be closed simultaneously. This restriction is enforced across all modes of operation to prevent the paralleling of the two independent power sources, which could result in equipment

damage or unsafe conditions. As a standard rule, only one main breaker may remain closed at any given time.

2. An exception to this rule occurs during a controlled transition, which may be initiated either by a planned transfer between power sources or by an unexpected loss of power to the currently active source. in such cases, both breakers may be closed simultaneously for a brief, controlled duration to facilitate a make-before-break transfer. This ensures continuity of power supply without interruption.

3. Prior to paralleling, the system performs a synchronization check to verify voltage, frequency, and phase alignment between sources. Once synchronization is confirmed, the second breaker is closed momentarily, and the original breaker is opened immediately after the transfer is complete.

2.6 SOLID STATE RELAYS (PROTECTION / COMMUNICATION RELAYS)

A. Provide protective relays to be SEL Microprocessor-based relays or other approved relays as indicated below:

B. The types of relays and their locations in the switchgear are as indicated. This includes an SEL-587-1 two winding differential protection relay used to protect two winding step down transformers providing differential protection and overcurrent protection of the transformer windings. The differential protection zone includes the transformer windings, primary 27 kV main breaker and secondary 480 volt main breaker in the low voltage switchgear. The relay is to have DC, 2$^{nd}$, 4$^{th}$ and 5$^{th}$ harmonic blocking features and algorithms to aid in energizing a de-energized transformer associated with inrush currents and dealing with CT saturation. Provide two adjustable differential slopes from a minimum differential operating setting. Provide the connectorized version of the relay to reduce wiring problems. Provide AcSELerator QuickSet SEL-5030 Software to aid in setting up and troubleshooting the relay at the factory and in the field.

C. Provide lockout relay (device 86) between the protective relay and the breaker tripping logic

D. On loss of utility power for a minimum adjustable time period of 2 seconds (adjustable from 0.1 to 10 seconds), the main 20.78 kV breaker for SWGR is tripped off line to reduce the inrush on the service supply when utility power returns. On sensing return of utility power an adjustable timing relay is to start timing and after 30 seconds of normal voltage and frequency it is to close a contact that automatically close the main 20.78 kV breaker re-energizing the step down transformer unless there was a fault that tripped the lockout relay device 86. This timing relay is adjustable from 3 to 300 seconds on-delay.

E. Provide protective-type relays suitable for operation at a frequency of 60 Hz with current transformers having 5 ampere secondary circuits and with potential transformers having 120 V secondary circuits.

F. A relay clock synchronizing device, such as the SEL-2401, shall be provided to ensure precise time synchronization (±100 ns accuracy) across all intelligent electronic devices (IEDs), protective relays, and fault recorders. For reliable interfacing with PLCs and other control systems relay such as SEL-3350 shall be provided that must support standard industrial protocols (e.g., Modbus, IEC 61850), offer flexible I/O options, and be capable of operating in harsh environments.

G. Protection relay SEL-751, SEL-787 and measuring relay such SEL 3350, SEL-735 shall be provided as per application and approved SLD by SDSTA.

## 2.7 METERING AND INSTRUMENTATION

A. Instrument Transformers:

1. Provide current transformers  to be the standard to match the needs of the associated differential relay to prevent false tripping and good protection. Transformer mechanical ratings equal the momentary rating of the circuit breakers. Transformers, when mounted in switchgear assemblies, are rated for the full voltage of the switchgear.

2. Voltage transformers are of drawout type, with current-limiting fuses and with BIL rating equal to the switchgear. Transformer ratios are listed on drawings.

B. Instruments and Meters

a. The primary current metering and overcurrent protection for the 20.78 kV feeder circuit is provided by the SEL-587-1 differential current relay metering and overcurrent protection feautures.

## 2.8 CONTROL POWER AND WIRING

A. Provide fuse protected control power transformers where indicated on drawings. Transformers are rated as indicated.

B. Provide secondary control wiring to be No. 16 (standard), extra flexible, stranded, tinned-copper control wire, Type SIS cross-linked polyethylene, rated 600 volts, except for specific circuits requiring larger wire.

C. Furnish crimp-type, uninsulated spade terminals on all wire ends, except where non-insulated ring terminals are used to connect to fuse blocks, instrument studs, or terminal block points with two or more wire connections.  Furnish crimp-type, insulated ring terminals on all wire ends.

D. Secondary control wires are armored where they pass through primary compartments

E. Install short circuit style terminal blocks in current transformer secondary wiring between the current transformer and all connected devices

F. Provide marking sleeves on all switchgear control wiring, heat stamped with wire origin and / or destination information

## 2.9 SURFACE PREPARATION, PAINTING AND CLEANLINESS

A. Cleanliness of the equipment furnished is such that it is smooth and free of all foreign matter such as scales, sand, blisters, weld splatters, metal chips and shavings, oil, grease, organic matter, and rust.

B. All metal enclosures are chemically cleaned and treated in a process which provides a phosphate coating, then be primed and finished with a corrosion resistant enamel paint.

1. Paint switchgear with an electrostatically applied polyester powder with final baked on average thickness between 1.5 and 2.0 mils and meet ANSI requirements for outdoor equipment.

2. All exterior surfaces of the switchgear assembly are given final finish coats of ANSI 61 gray as standard

3. Finish is to have a minimum pencil hardness of 2H as tested per ASTM D3363 and pass the SATM B117 Salt spray test for a minimum of 1000 hours.

C. Supply paint, matching each color used, for field "touch-up" after installation of the equipment. Supply two one-pint aerosol spray cans of each color per assembly.

2.10 ACCESSORIES

A. Provide two indicating lights (red and green) for each breaker and one indicating light (white) for each lockout relay. Indicating lights are LED type.

B. Provide a hand-resetable lockout relay (device 86) for each circuit breaker indicated on the drawings. The lockout relay disables closing of the corresponding circuit breaker until the relay has been reset. The lockout relay is to be a GE type HEA or approved equal.

C. Provide a two-position auto/manual selector switch in each breaker control circuit. Selecting “auto” will permit automatic operation. Selecting “manual” permits operation using the local breaker control switch. Wire contacts from the selector switch to inputs on the appropriate protective relay to allow the SCADA system to monitor the switch position. The switch is a GE type SB1 or approved equal.

D. Provide intermediate class arresters where indicated on drawings. Provide to be gapless metal-oxide type with a nominal rating of **18**kV and an MCOV of **15.3**kV. The arrester is enclosed in a polymer housing. Design and manufacture arresters in accordance with the latest revision of ANSI/IEEE C62.11. Arresters are GE type Tranquell or approved equal.

E. Furnish non-drawout style protective relays with test switches to permit trip blocking, relay isolation and testing. Test switch is GE Multilin type 515 or approved equal.

F. Furnish one set of accessories for each line-up for test, inspection, maintenance and operation, including:

1. 1 Maintenance tool for manually charging the breaker closing spring.

2. 1 Levering crank for manually moving the breaker between the test and connected positions

3. 1 Mobile lift for lifting the breaker on or off the rails

4. 1 Test cabinet to bench test, inspect and maintain the breaker

5. 1 Remote racking device including push-button, motor operator, and 25 feet of cable

2.11 NAMEPLATES

A. Black and white 1/8-inch thick lamicoid, with lettering engraved through the black surface exposing the white lamination beneath

B. Letter height is 1/8-inch minimum unless otherwise indicated

C. Fastene using 2 matching screws; adhesive tape is not acceptable

D. The switchgear is to carry a manufacturer's label stating switchgear ratings and catalog or shipping number as well as the name of the manufacturer

2.12 FACTORY TESTS

A. The switchgear equipment and circuit breakers are to receive factory production test as listed below:

1. Equipment

a. Low frequency dielectric test

b. Grounding of instrument cases

c. Control wiring and device functional test

d. Polarity verification

e. Sequence test

f. Low frequency withstand voltage test on major insulation components

g. Low frequency withstand test on secondary control wiring

2. Breakers

a. Coil check test

b. Clearance and mechanical adjustment

c. 300 Electrical and mechanical operation test

d. Timing test

e. Conductivity of current path test

f. Hi-potential testing of breaker

g. Vacuum bottle integrity test

B. Provide additional testing as indicated by IEEE C37.20.2 for Medium Voltage Metal Clad Switchgear If not specified above.

C. Provide documents verifying completion of factory production tests

## 2.13 SEISMIC QUALIFICATION

A. Provide complete equipment assemblage seismically qualified in accordance with ASCE 7-16 Section 13.2.2.

## PART 3 -- EXECUTION

3.1 DELIVERY

A. Delievery shall be handle as per manufacturer standard equipment handling instructions.

3.2 INSTALLATION

A. Installation shall be as per manufacturer instructions or industry standard practice.

B. Provide the floor channels and secure the switchgear to the channels by bolting or tack welding at the front and the rear

3.3 MANUFACTURER'S REPRESENTATIVE

A. Arrange for an experienced relay engineer to setup and test the differential current relay who has been trained on the proper safe setup and testing of the supplied differential relay for protecting the 2000 kVA, 1500 kVA and 1250 kVA step down transformer and related primary and secondary windings and conductors. Coordinate the setup and testing of the engine generator differential current relay with setup and testing of the transformer differential current relay.

3.4 FIELD TESTING

A. Perform all testing required by Section 26 01 26 – Electrical Tests.

B. Conduct differential current relay testing in a accordance with the manufacturer’s written instructions by persons trained and experienced in testing the relay

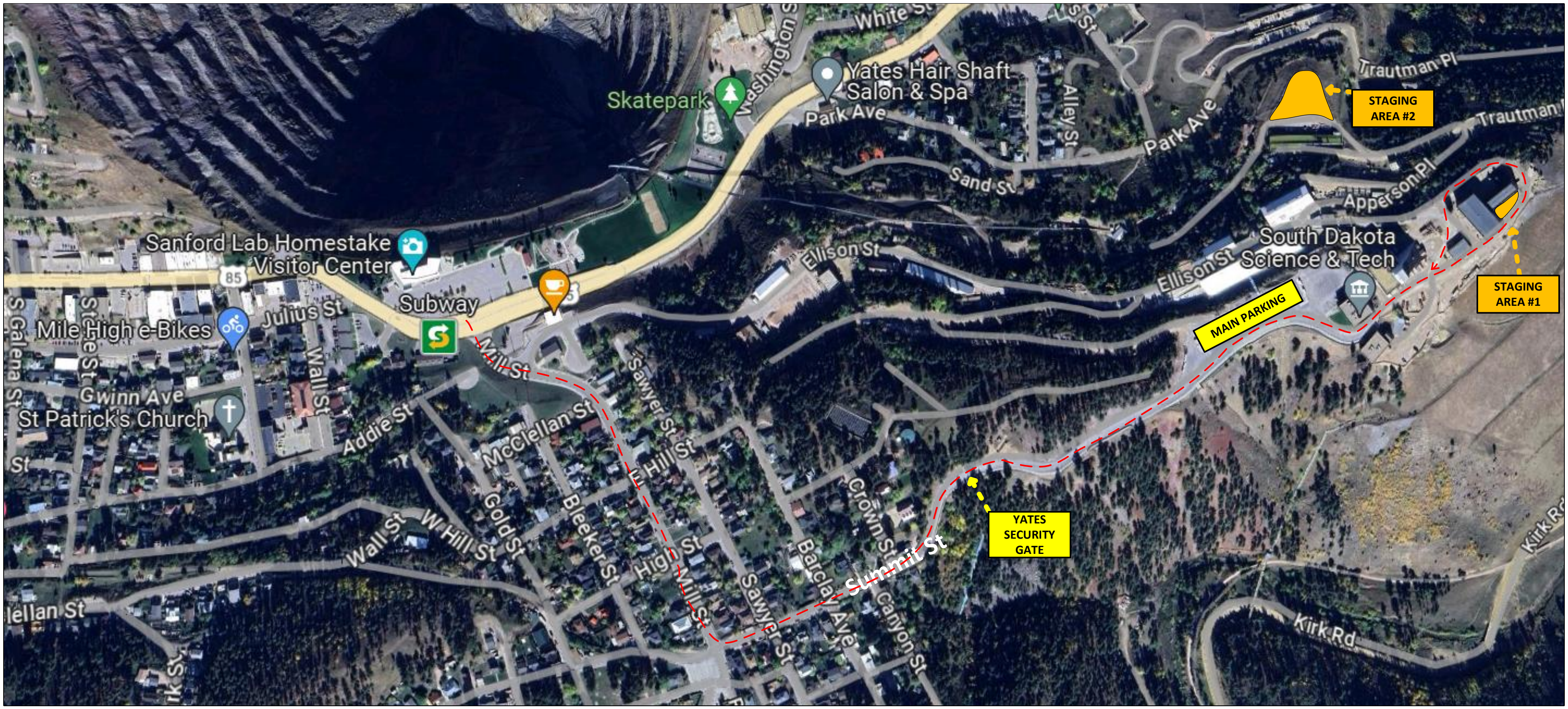
3.5 OPERATOR TRAINING

A. See 01 93 00 - Operation and Maintenance Data

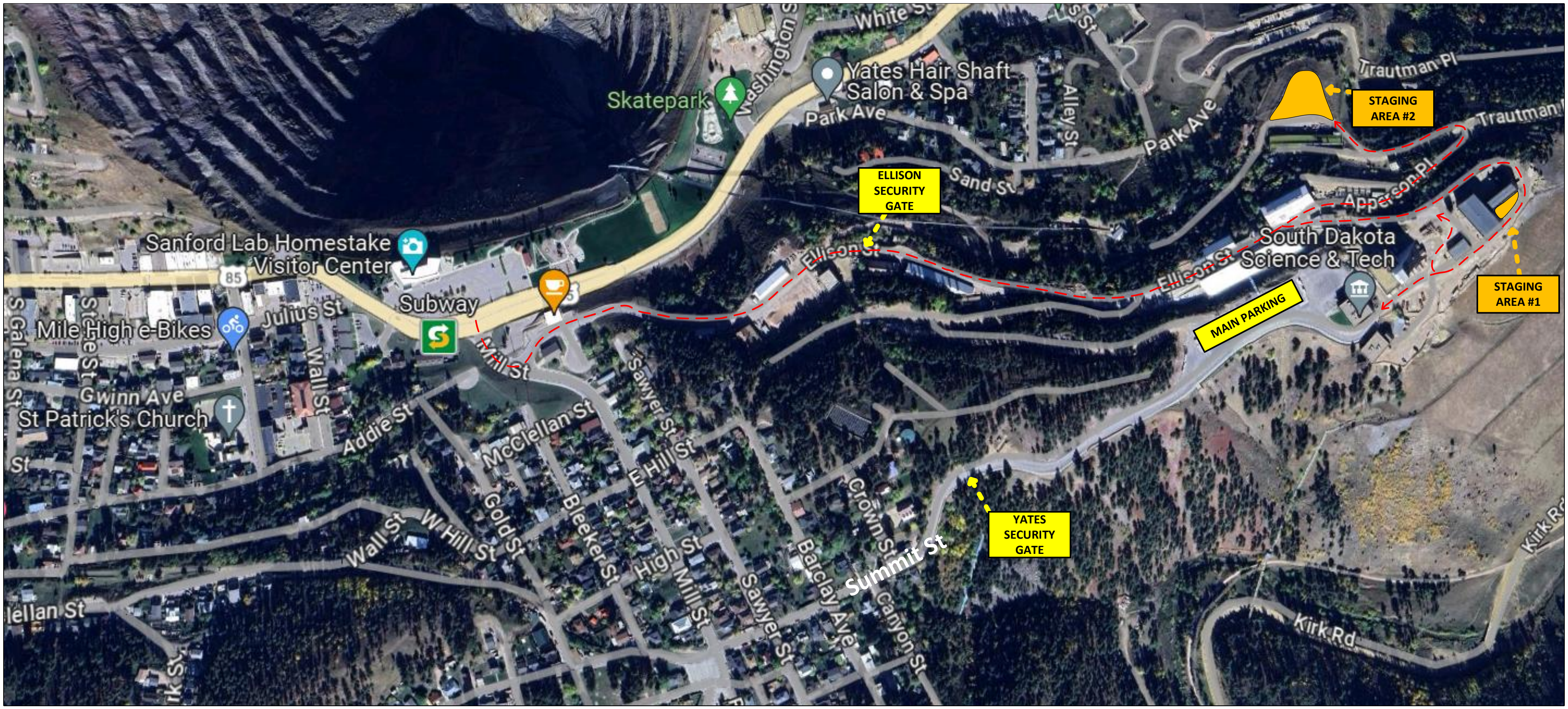
**END OF SECTION**

| A/E Submittal Requirements | | | | |
|---|---|---|---|---|
| **Sr. No** | **Spec #** | **Submittal Type** | **Submittal Description** | **Spec Parag.** |
| 1 | 26 00 00 | Shop Drawings | Complete material list | 1.9.B.1 |
| 2 | 26 00 00 | Shop Drawings | Front, side, rear elevations, and top views with dimensional data | 1.9.B.3 |
| 3 | 26 00 00 | Shop Drawings | Location of conduit entrances and access plates | 1.9.B.4 |
| 4 | 26 00 00 | Shop Drawings | Component data | 1.9.B.5 |
| 5 | 26 00 00 | Shop Drawings | Connection diagrams, terminal numbers, wire size ranges, internal wiring diagrams, conductor size, and cable numbers. | 1.9.B.6 |
| 6 | 26 00 00 | Shop Drawings | Method of anchoring, seismic requirements, weight, center of gravity. | 1.9.B.7 |
| 7 | 26 00 00 | Shop Drawings | Types of materials, enclosure rating and finish. | 1.9.B.8 |
| 8 | 26 00 00 | Shop Drawings | Nameplates | 1.9.B.9 |
| 9 | 26 00 00 | Shop Drawings | Temperature limitations, as applicable. | 1.9.B.10 |
| 10 | 26 00 00 | Shop Drawings | Voltage requirement, phase, and current, as applicable | 1.9.B.11 |
| 11 | 26 00 00 | Shop Drawings | Front and rear access requirements including ventilation spaces. | 1.9.B.12 |
| 12 | 26 00 00 | Shop Drawings | Test reports | 1.9.B.13 |
| 13 | 26 00 00 | Shop Drawings | Grounding requirements | 1.9.B.14 |
| 14 | 26 00 00 | Catalog cuts | Stamp copy of catalog/drawings data sheets etc | 1.9.C.1 |
| 15 | 26 00 00 | Materials and Equipment Schedules | List of materials, equipment, apparatus, and fixtures that are proposed for use. | 1.9.D.1 |
| 16 | 26 00 00 | Technical Manuals | As-Built data | 1.9.E.2 |
| 17 | 26 01 26 | Electrical testing | Submit complete system test procedures for review | 1.4.B |
| 18 | 26 01 26 | Electrical testing | Test procedure and reports | 1.4 |
| 19 | 26 05 19 | Testing Documentation | Test procedure and sample of fiber optic cable | 1.4 |
| 20 | 26 05 26 | Product Data | Conductors | 2.1.B |
| 21 | 26 05 26 | Product Data | Ground Rods | 2.1.B.3 |
| 22 | 26 05 26 | Product Data | Connectors | 2.1.B.5 |
| 23 | 26 05 26 | Product Data | Exothermic Weld Connections | 2.1.B.4 |
| 24 | 26 05 26 | Shop Drawings | Layout drawing with bill of material | 1.2 |
| 25 | 26 05 33 | Shop Drawings | As-Built drawings and product data | 1.4 |
| 26 | 26 05 36 | Shop Drawings | Catalogs and documentation | 1.4.B |
| 27 | 26 05 36 | Product Data | Lighting switches | 2.2 |
| 28 | 26 05 36 | Product Data | General purpose receptacles | 2.3 |
| 29 | 26 05 36 | Product Data | Enclosures and covers | 2.4 |
| 30 | 26 05 36 | Product Data | Receptacles - Special purpose | 2.5 |
| 31 | 26 05 43 | Product Data | Conduit | 2.1 |
| 32 | 26 05 43 | Product Data | Nonmetallic ducts and ducts accessories | 2.2 |
| 33 | 26 05 43 | Product Data | Handholes and pull boxes | 2.3 |
| 34 | 26 05 43 | Product Data | Precast manholes | 2.4 |
| 35 | 26 05 43 | Shop Drawings | Precast or Factory-Fabricated Underground Utility Structures | 1.4.B |
| 36 | 26 05 43 | Test Reports | Field quality-control reports. | 1.4.C |
| 37 | 26 05 53 | Product Data | Power and control raceway identification materials | 2.1 |
| 38 | 26 05 53 | Product Data | Armored and metal-clad identification materials | 2.2 |
| 39 | 26 05 53 | Product Data | Power and control cable identification materials | 2.3 |
| 40 | 26 05 53 | Product Data | Conductor identification materials | 2.4 |
| 41 | 26 05 53 | Product Data | Underground-line warning tape | 2.5 |
| 42 | 26 05 53 | Product Data | Warning labels and signs | 2.6 |
| 43 | 26 05 53 | Product Data | Equipment identification labels | 2.7 |
| 44 | 26 05 53 | Product Data | Cable ties | 2.8 |
| 45 | 26 05 53 | Product Data | Miscellaneous identification products | 2.9 |
| 46 | 26 12 13 | Shop Drawings | Layout and technical drawings | 1.3.A.B.C |
| 47 | 26 12 13 | Closeout Submittals | Operations and Maintenance Data | 1.4.A |
| 48 | 26 12 13 | Shop Drawings | Transfomers layout and technical data | 1.5.B |
| 49 | 26 12 13 | Shop Drawings | Layout and technical drawings | 1.4 |

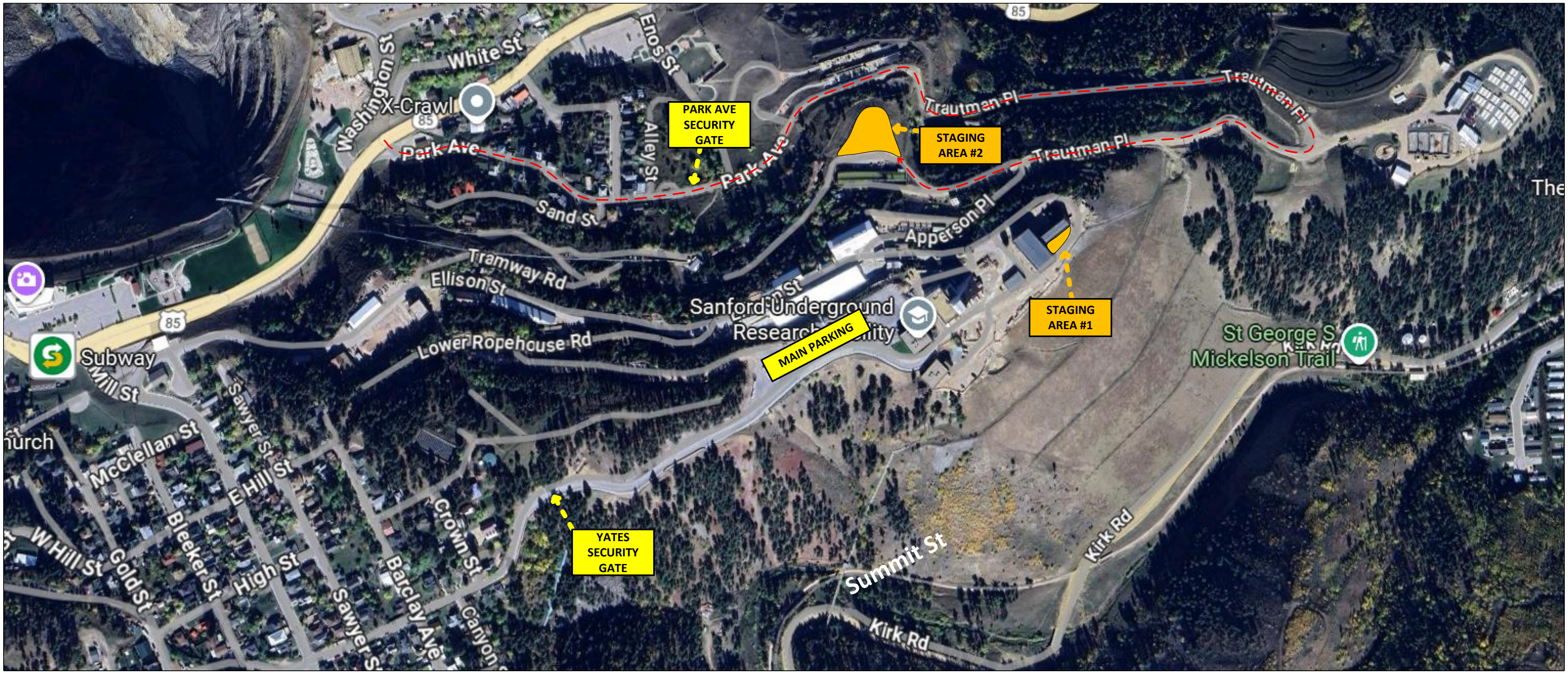
# SURF Yates Complex
# Primary Access Route



# SURF Yates Complex
# Secondary Access Route



# SURF Yates Complex
# Tertiary Access Route



# Yates Yard
# Oro Hondo Utility Pole to Yates Crusher Building
# (new duct bank and manhole MH1)

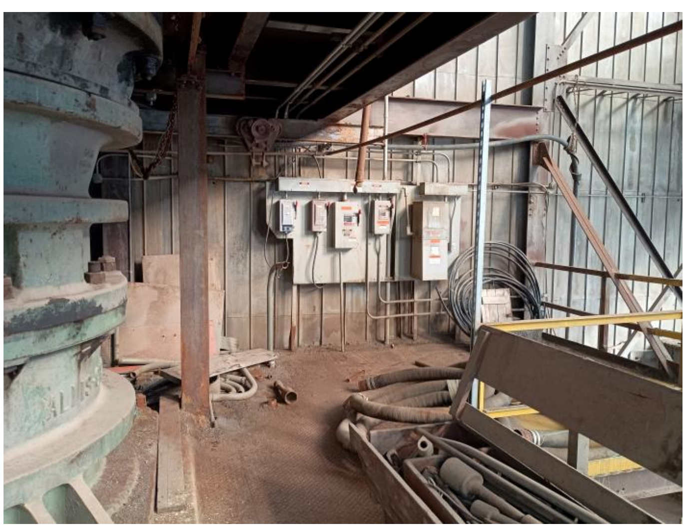


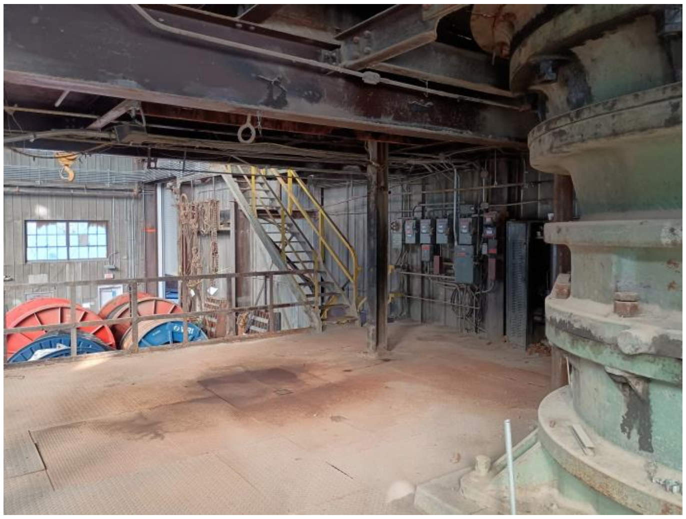



# Yates Crusher Building
# (new substation area + new cable tray route)





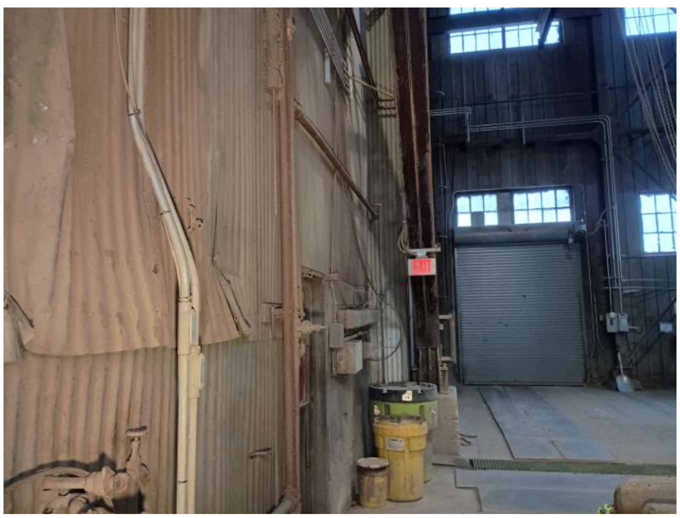


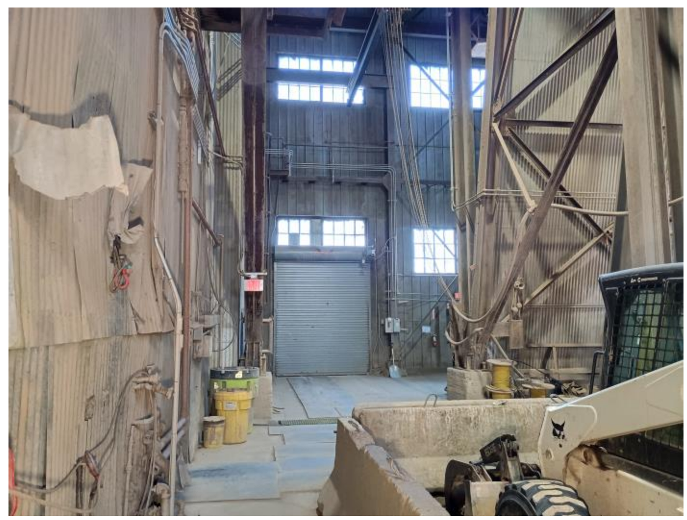



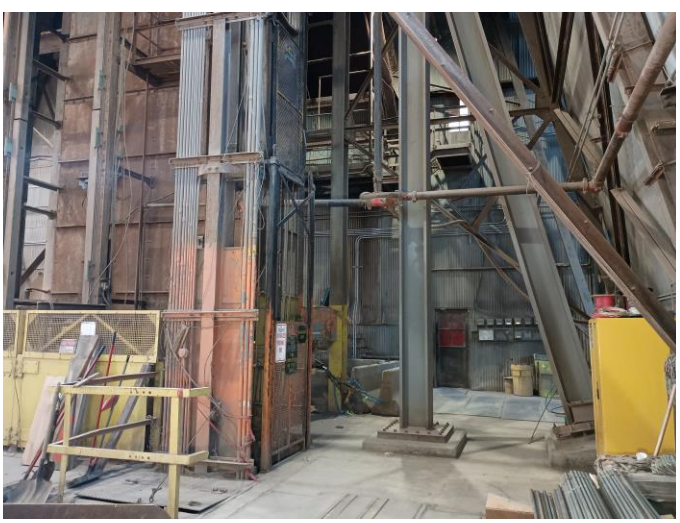

ALLIS


OKONITE

# Yates Headframe Building
# (new cable tray route)

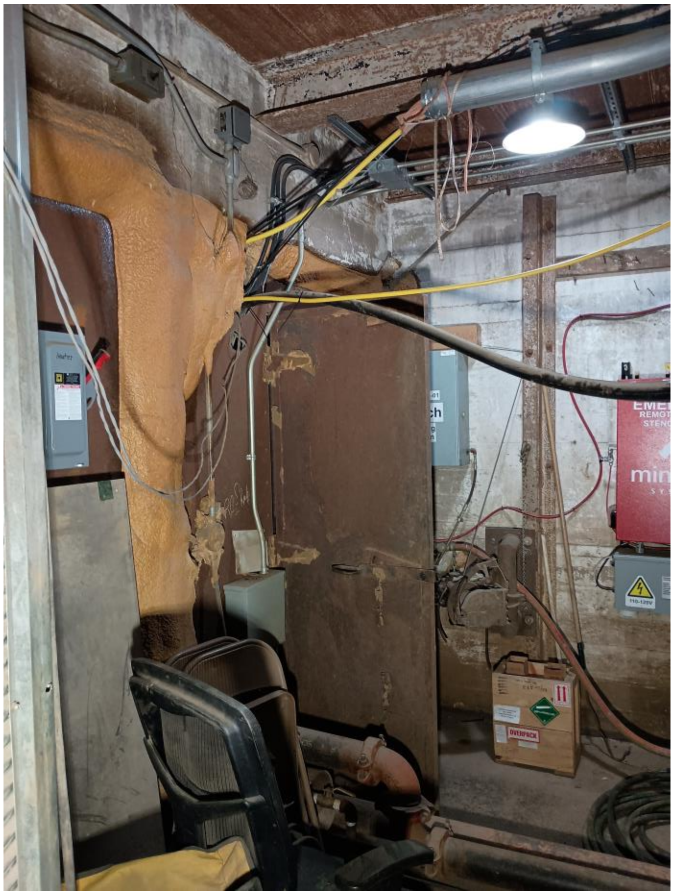







RUNABOUT
CAGE

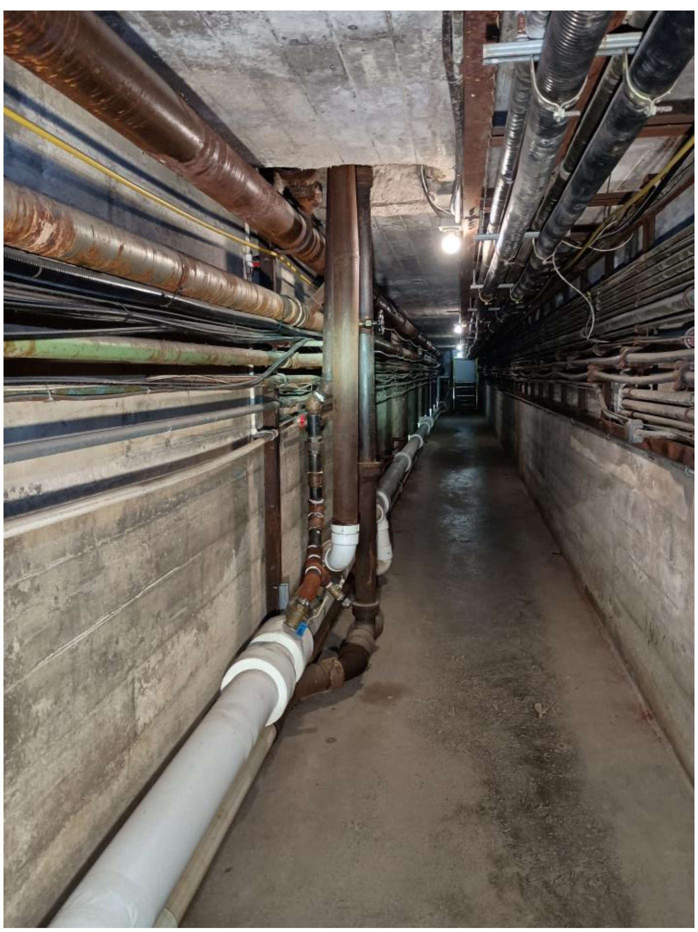
# Utility Tunnel Between Yates Headframe and Yates Hoist Building (new feeder circuit for future hoist upgrades)



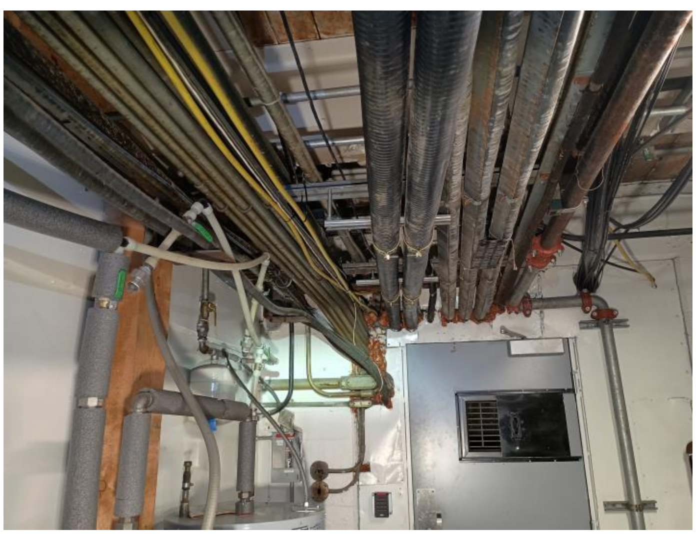


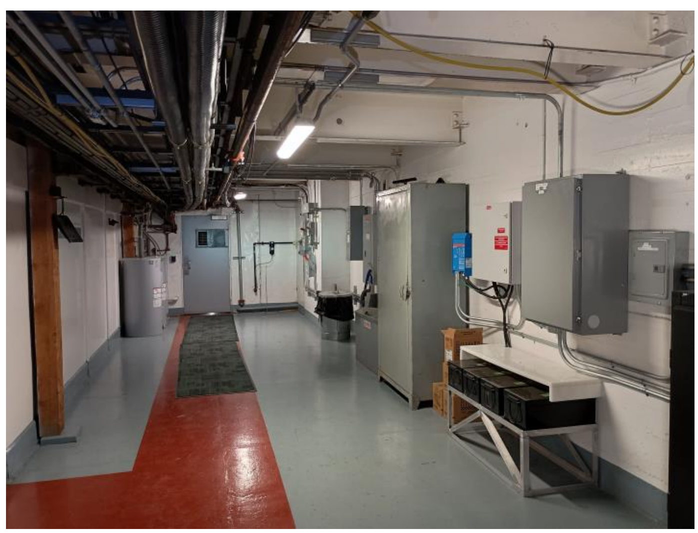
FIRE HOS
WARNING

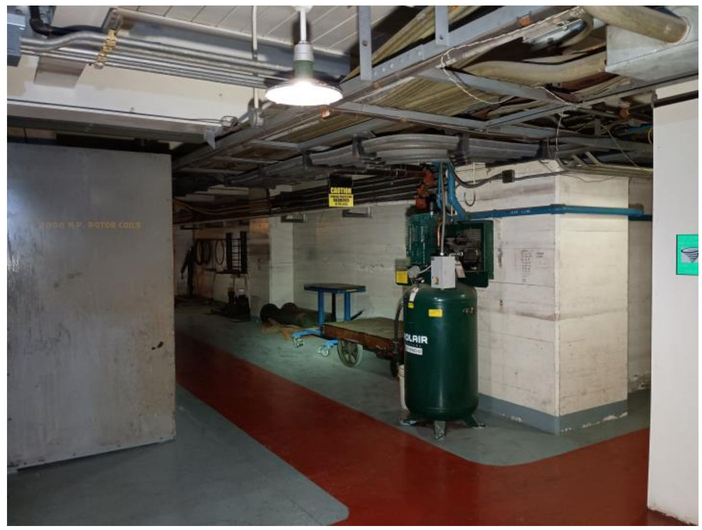




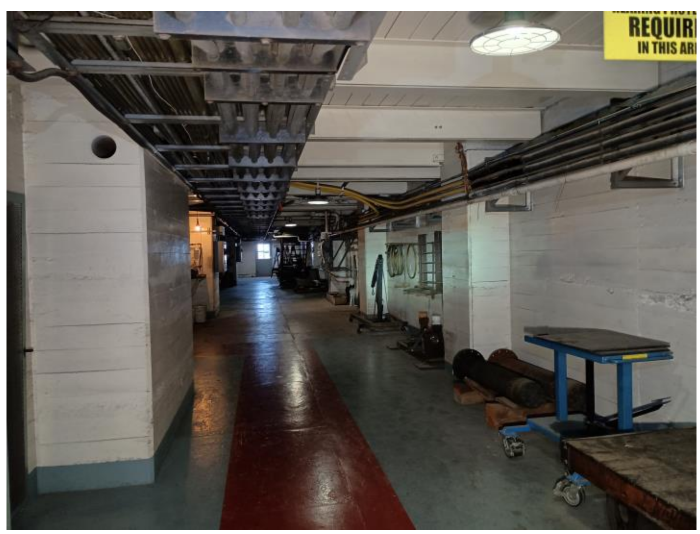

## Yates Hoist Building Basement
## (new feeder circuit for future hoist upgrades)








CAUTION
REQUIRED



# E&O Building
# (new substation area)

# Yates Admin Building
# (new substation area)