ADDENDUM NO. 1
September 19, 2024

PROJECT: CITY OF ACKERLY
NEW PWS WELL

BID DATE: OCTOBER 3, 2024

The following changes and/or additions shall be made to the Plans, Specifications, and Contract Documents for the above referenced project. Bidder shall acknowledge receipt of this Addendum by signing below and returning this Addendum with the Bid.

1) CONTRACT DOCUMENTS

a) Bid Schedule – The bid schedule has been revised to include 4" C900 DR18 PVC Waterline and Plug Existing Well.

2) PLAN SHEETS

a) Cover Sheet – Council members have been updated on this sheet.

b) Sheet G-1 – There are electrical sheets added to the sheet list.

c) Sheet C-2 – This sheet has been updated to show a 7'x12' concrete pad which was previously a 6'x12' concrete pad. The electrical panel has been moved to the right of the concrete pad. The note on the top right corner of the page has been modified. Lastly, the callout about the existing well security confinement has been modified.

d) Sheet C-3 – The entire sheet has been modified to reflect changes made by the City. The main items changed were the 2" cross stainless-steel pipe and 2" schedule 80 pipe which replaced the 2" ductile iron pipe. There was also a removal of the 2" gate valve.

e) Sheet C-5 – This sheet has been revised to show a plugging well detail.

f) Sheets E1 thru E4 – The electrical sheets with details have been added to the plan set.

3) SPECIFICATIONS

a) 010301 – M&P – Measurement and Payment – Has been added to the SPECS

b) Division 26 – Electrical Specifications – Has been added to the SPECS

4) GENERAL

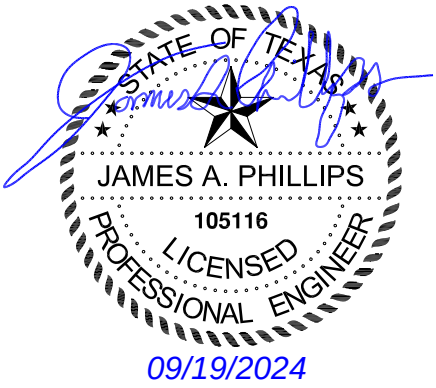
a) The TCEQ approval has been added as an exhibit.

Prepared by:

JACOB | MARTIN
TBPE Firm No. 2448

_____
Bidder's Acknowledgment

_____
Date



CITY OF ACKERLY
NEW PWS WELL
BASE BID SCHEDULE

Show prices in numerals. Round off unit prices to two decimal places only.
These Bid Prices must include all labor, materials, equipment, insurance, overhead, superintendence, transportation, taxes, permits, profits & incidentals to cover the finished Work called for in the Contract Documents.

For all Labor, Materials, Equipment and Incidentals to Furnish and Install the Following:

Bid Item	Description	Est. Qty.	Unit	Unit Price	Extended Amount
1	Mobilization, Bonds, and Insurance	1	LS	$	$
2	Drill and complete new 8-inch, 180-foot water well, including casing, gravel pack, cement seal, well development, testing pumping, chemical water sampling, etc.	1	LS	$	$
3	Install permanent 80 gpm submersible pumping unit set at 175 feet with pipe, wire, control panel, well disinfection and bacteriological testing at well site	1	LS	$	$
4	Furnish & Install concrete well slab and wellhead improvements (valves, flowmeter, and piping) *	1	LS	$	$
5	Electrical Work. Furnish & install new electrical service pole, service disconnect and other electrical components at well site	1	LS	$	$
6	4" C900 DR18 PVC Waterline	75	LF	$	$
7	Plug Existing Well	1	LS	$	$
8	4" Gate Valve	1	EA	$	$
9	4" Waterline Connection	1	EA	$	$
	TOTAL BASE BID A (Items 1 - 5)				**$**

PROPOSED NUMBER OF DAYS FOR COMPLETION*	**DAYS**

* Bidder must enter proposed number of days both on the Bid Schedule and on pages BP-1 and BP-3 of the Bid Proposal.

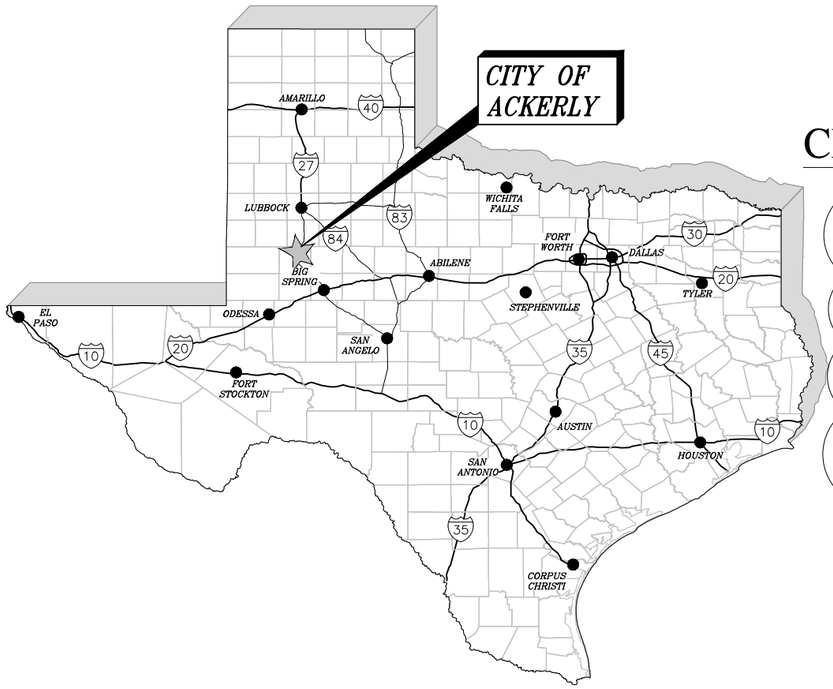
For all Labor, Materials, Equipment and Incidentals to Furnish and Install the Following:

Bid Item	Description	Est. Qty.	Unit	Unit Price	Extended Amount
A1	Add or Deduct for more or less than 180-foot deep water well (including drilling, gravel pack, sealing, etc.)	1	LF	$	$
A2	Add or deduct for more or less than the specified pump motor horsepower, including pipe, wire, etc. (7.5 hp specified)	1	1HP	$	$
	TOTAL ALTERNATE BID (Items A1 - A2)				**$**

Note: Owner reserves the right to accept any combination of base bid and additive alternate bid items.

* Note: All above ground stainless steel and Schedule 80 PVC at well head shall be included in item 4.

PLANS FOR
CITY OF ACKERLY
NEW PWS WELL
JUNE 2024



CITY OF ACKERLY CITY COUNCIL

KORNELIUS ENNS - MAYOR

SCOTT RAGLE - MAYOR PRO-TEM

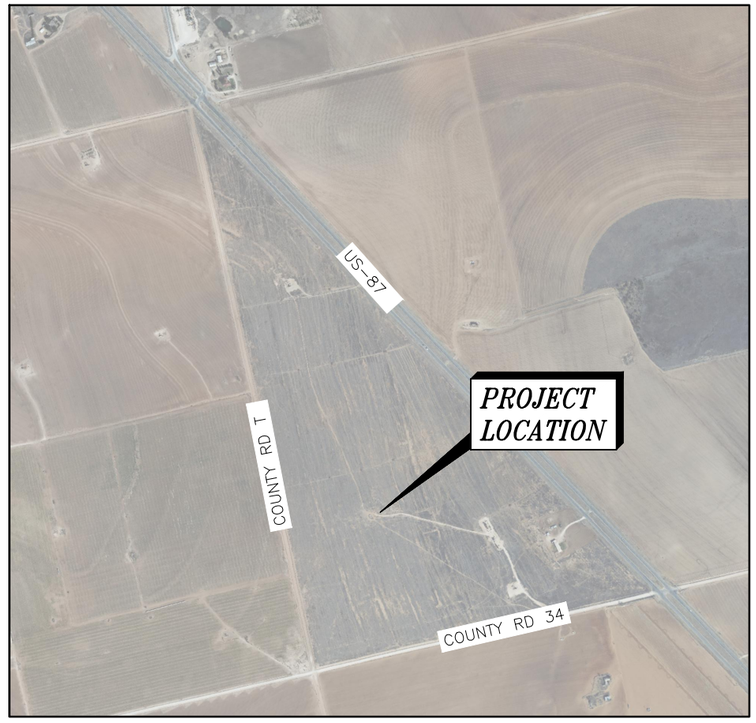
DANIEL FRANCO RALF GOMEZ

CHRIS SPIVEY JERAD STAGGS

RANDY MATHIS

NELDA SALDIVAR FRANCO - CITY SECRETARY

EDITED: 9/19/2024



PROJECT VICINITY MAP

N.T.S.

NORTH

STATE OF TEXAS
JAMES A. PHILLIPS
105116
LICENSED
PROFESSIONAL ENGINEER
06/24/24

JACOB MARTIN

FIRM# F-2448

3465 CURRY LANE
ABILENE, TX 79606
325-695-1070

1508 SANTA FE DR, STE 204
WEATHERFORD, TX 76086
817-594-9880

4920 S. LOOP 289, STE 106
LUBBOCK, TX 79414
806-368-6375

PROJECT LOCATION MAP

N.T.S.

NORTH

SHEET LIST:

GENERAL

CIVIL

ELECTRICAL

⚠

L E G E N D

	PROPOSED WATER LINE
	PROPOSED WATER LINE ENCASEMENT
	PROPOSED GATE VALVE
	PROPOSED FLUSH VALVE
	PROPOSED TEE
	PROPOSED REDUCER
	PROPOSED BEND
	PROPOSED AIR VALVE
	PROPOSED CHECK VALVE
	VALVE & ROW MARKER
OE OE OE	EXISTING OVERHEAD ELECTRIC LINE
W W W W	EXISTING WATER LINE
	EXISTING PROPERTY LINE
X X X X	EXISTING FENCE
X X X X	EXISTING GATE
GAS GAS	EXISTING GAS LINE
UT UT UT	EXISTING UNDERGROUND TELEPHONE LINE
WM	EXISTING WATER METER
GM	EXISTING GAS METER
	EXISTING GATE VALVE
	EXISTING FIRE HYDRANT
MH	EXISTING MANHOLE
	EXISTING UTILITY POLE
	EXISTING GUY WIRE WITH ANCHOR
	EXISTING SIGN

ABBREVIATIONS

WL	WATER LINE	PVC	POLYVINYL CHLORIDE
SL	SEWER LINE	CC	CONCRETE STEEL CYLINDER
GV	GATE VALVE	DI	DUCTILE IRON
BV	BUTTERFLY VALVE	CI	CAST IRON
FH	FIRE HYDRANT	VC	VITRIFIED CLAY
MJ	MECHANICAL JOINT	AC	ASBESTOS CEMENT
FE	FLANGED END	MH	MANHOLE
CAV	COMBINATION AIR VALVES		
ROW	RIGHT OF WAY		
UE	UTILITY EASEMENT		
E	EASEMENT		
EE	ELECTRIC EASEMENT		
WLE	WATER LINE EASEMENT		
STA	STATION		
FL	FLOW LINE		

STATE OF TEXAS
JAMES A. PHILLIPS
105116
LICENSED
PROFESSIONAL ENGINEER
06/24/24

ISSUED FOR REVIEW

JACOB MARTIN
TBPE FIRM # 2448 | TBAE FIRM # BR 2261 | TBPELS FIRM # 10194493

ACKERLY, TEXAS
NEW PWS WELL

SHEET INDEX AND LEGEND

NO.	REVISION	DATE
1	ADDENDUM #1	09/19/2024

PROJECT # 24263 | SCALE NTS | BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

SEQ. 01/09 | SHEET G-1

Plotted by: sarah davis Plot Date: 9/19/2024 4:23 PM
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SURVEY NOTES:

1. INFORMATION PROVIDED ON THESE PLANS MAY OR MAY NOT SHOW ALL CURRENTLY EXISTING STRUCTURES AND UTILITIES ABOVE OR BELOW THE GROUND. THE SURVEY INFORMATION DOES NOT INCLUDE THE LOCATION OF ALL EXISTING TREES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VISITING THE ENTIRE PROJECT SITE PRIOR TO SUBMITTING A BID.
2. CONTRACTOR SHALL MARK ALL UTILITIES FOUND DURING CONSTRUCTION ON AS-BUILT DRAWINGS. NOTES SHALL INCLUDE TYPE, SIZE, LOCATION AND ELEVATIONS. DRAWINGS SHALL DIFFERENTIATE BETWEEN NEW AND EXISTING UTILITIES.
3. CONSTRUCTION STAKING SHALL BE PROVIDED BY THE OWNER.
4. CONTRACTOR MUST TAKE CARE TO PRESERVE ALL CONSTRUCTION STAKES SET. ALL RESTAKING WILL BE PAID FOR BY CONTRACTOR.

YARD PIPING NOTES:

1. LOCATIONS AND ELEVATIONS SHOWN FOR EXISTING UNDERGROUND PIPING, UTILITIES AND OTHER UNDERGROUND STRUCTURES AND APPURTENANCES ARE BASED ON ORIGINAL CONSTRUCTION PLANS. THE OWNER AND ENGINEER DO NOT ASSUME RESPONSIBILITY FOR FAILURE TO SHOW ANY OR ALL OF THESE UNDERGROUND FACILITIES OR TO SHOW THEM IN THE EXACT LOCATION. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY THE ACTUAL LOCATIONS OF ALL EXISTING STRUCTURES AND UNDERGROUND UTILITIES THAT COULD AFFECT WORK PRIOR TO CONSTRUCTION, AND TO CONTACT OWNER'S REPRESENTATIVE IF GRADE MODIFICATIONS ARE NECESSARY AT THESE LOCATIONS.
2. CONTRACTOR SHALL PROVIDE ALL FITTINGS AND APPURTENANCES NECESSARY TO MAKE ALL CONNECTIONS AS SHOWN ON THESE PLANS.
3. SUPPORT AND PROTECT EXISTING LINES AS NECESSARY DURING CONSTRUCTION TO MAINTAIN SERVICE AT ALL TIMES. PROTECT EXISTING STRUCTURES, PIPING, AND EQUIPMENT, WHICH ARE TO REMAIN. REPLACE ITEMS DAMAGED BY CONSTRUCTION OR DEMOLITION AT NO ADDITIONAL COST TO THE OWNER.
4. PROVIDE MINIMUM 3 FEET OF COVER ON ALL YARD PIPING UNLESS OTHERWISE SHOWN.
5. MECHANICAL THRUST AND CONCRETE BLOCKING RESTRAINTS ARE REQUIRED AT ALL VALVES AND FITTINGS INCLUDING BENDS, TEES, WYES, REDUCERS AND ENDS EXCEPT FOR PIPE 2" AND SMALLER.
6. PIPELINE STATIONING IS ALONG THE CENTERLINE OF PIPES.
7. THE CONTRACTOR SHALL FULLY COMPLY WITH ALL TCEQ REGULATIONS PERTAINING TO SEPARATION DISTANCES AS DESCRIBED IN TCEQ DESIGN CRITERIA FOR WATER DISTRIBUTION LINES,
   30 TAC 290 SUBCHAPTER D 290.44(e)

GENERAL CONSTRUCTION NOTES:

1. COORDINATE WORK AND ACTIVITIES WITH OTHER CONTRACTORS WORKING ON SITE AS APPLICABLE. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING REQUIRED SECURITY TO PROTECT HIS OWN PROPERTY, EQUIPMENT, AND WORK IN PROGRESS.
2. TRENCH SAFETY SYSTEM SHALL MEET, AS A MINIMUM, THE REQUIREMENTS OF OSHA SAFETY AND HEALTH REGULATIONS PART 1920, SUBPART P; THE OWNER'S SAFETY REQUIREMENTS, AND DIVISION 31 SECTION 310401 "TRENCH EXCAVATION SAFETY PROTECTION SYSTEM"
3. AT LEAST 3 DAYS BEFORE COMMENCEMENT OF CONSTRUCTION, THE CONTRACTOR SHALL FILE A NOTICE OF INTENT (NOI) WITH TCEQ. THE NOTICE SHALL BE SENT TO THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY, STORM WATER & GENERAL PERMITS TEAM, MC-228, P.O. BOX 13087, AUSTIN, TEXAS 78711-3087. THE NOI FORM AND CONTRACTOR SHALL PREPARE A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND OBTAIN AND FULLY COMPLY WITH THE TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM (TPDES) PERMIT TXR 150000. QUESTIONS CONCERN THE NOI AND PERMIT REQUIREMENTS MAY BE ADDRESSED TO TCEQ AT 512-239-4524.
4. PROTECT EXISTING STRUCTURES, PIPING, AND EQUIPMENT. CONTRACTOR SHALL REPLACE OR REPAIR ITEMS DAMAGED DURING CONSTRUCTION OR DEMOLITION AT NO ADDITIONAL COST TO THE OWNER. TOUCH-UP ITEMS THAT ARE AFFECTED DURING CONSTRUCTION.
5. ALL ANCHOR BOLTS AND ALL HARDWARE SHALL BE TYPE 316 STAINLESS STEEL UNLESS OTHERWISE NOTED.
6. TAG ALL NEW EQUIPMENT, INSTRUMENTS, AND CONTROL PANELS PER SPECIFICATIONS.
7. EQUIPMENT INSTALLATION:
   A. PROVIDE EQUIPMENT PADS FOR ALL EQUIPMENT AND ELECTRICAL EQUIPMENT AS SHOWN ON THE DRAWINGS. ALL EQUIPMENT PADS HAVE NOT BEEN DESIGNATED ON THE DRAWINGS.
   B. STORE AND PROTECT EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S INSTRUP CTIONS.
   C. EQUIPMENT WILL BE INSTALLED AS SHOWN AS THE DRAWINGS AND IN ACCORDANCE WITH MANUFACTURE'S INSTRUCTIONS. PROVIDE AT THE SITE ONE COPY OF THE MANUFACTURER'S INSTRUCTIONS.
8. ALL BURIED VALVES SHALL HAVE A VALVE BOX OR BURIED OPERATOR PER THE STANDARD DETAILS.
9. CONTRACTOR SHALL INSULATE ALL WATER CONTAINING OR FREEZABLE PIPING THAT ARE 8 INCH IN DIAMETER AND SMALLER PER SPECIFICATIONS.
10. PROVIDE A ½" THICK EXPANSION JOINT MATERIAL AROUND ALL PIPE PENETRATIONS THROUGH CONCRETE.
11. REFERENCE ELECTRICAL PLANS FOR LOCATION OF ELECTRICAL CONDUIT, DUCT BANKS, RACEWAYS, LIGHT POLES AND MANHOLES.
12. CONTRACTOR SHALL COORDINATE ELECTRICAL, INSTRUMENTATION, AND PIPING.
13. THE CONTRACTOR SHALL CONTROL EROSION AND SEDIMENTATION PER THE APPLICABLE PERMITS, LAWS, AND REGULATIONS.
14. THE CONTRACTOR SHALL REPAIR IMMEDIATELY OR HAVE REPAIRED AT HIS COST ALL DAMAGED UTILITIES. REPAIRS SHALL BE MADE WITH SIMILAR OR BETTER MATERIALS.
15. NO CHANGE IN THE WORK PERFORMED REQUIRING MONETARY CHANGES SHALL BE AUTHORIZED WITHOUT WRITTEN APPROVAL BY THE ENGINEER.

TCEQ WATER DISTRIBUTION SYSTEM GENERAL CONSTRUCTION NOTES:

1. THIS WATER DISTRIBUTION SYSTEM MUST BE CONSTRUCTED IN ACCORDANCE WITH THE CURRENT TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) RULES AND REGULATIONS FOR PUBLIC WATER SYSTEMS 30 TEXAS ADMINISTRATIVE CODE (TAC) CHAPTER 290 SUBCHAPTER D. WHEN CONFLICTS ARE NOTED WITH LOCAL STANDARDS, THE MORE STRINGENT REQUIREMENT SHALL BE APPLIED. CONSTRUCTION FOR PUBLIC WATER SYSTEMS MUST ALWAYS, AT A MINIMUM, MEET TCEQ'S RULES AND REGULATIONS FOR PUBLIC WATER SYSTEMS.
2. AN APPOINTED ENGINEER SHALL NOTIFY IN WRITING THE LOCAL TCEQ'S REGIONAL OFFICE WHEN CONSTRUCTION WILL START. PLEASE KEEP IN MIND THAT UPON COMPLETION OF THE WATER WORKS PROJECT, THE ENGINEER OR OWNER SHALL NOTIFY THE COMMISSION'S WATER SUPPLY DIVISION, IN WRITING, AS TO ITS COMPLETION OF THE AND ATTEST TO THE FACT THAT THE WORK HAS BEEN COMPLETED ESSENTIALLY ACCORDING TO THE PLANS AND CHANGE ORDERS ON FILE WITH THE COMMISSION AS REQUIRED IN 30 TAC §290.39(h)(3).
3. ALL NEWLY INSTALLED PIPES AND RELATED PRODUCTS MUST CONFORM TO AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)/NSF INTERNATIONAL STANDARD 61 AND MUST BE CERTIFIED BY AN ORGANIZATION ACCREDITED BY ANSI, AS REQUIRED BY 30 TAC §290.44(a)(1).
4. PLASTIC PIPE FOR USE IN PUBLIC WATER SYSTEMS MUST BEAR THE NSF INTERNATIONAL SEAL OF APPROVAL (NSF-PW) AND HAVE AN ASTM DESIGN PRESSURE RATING OF AT LEAST 150 PSI OR A STANDARD DIMENSION RATIO OF 26 OR LESS, AS REQUIRED BY 30 TAC §290.44(a)(2).
5. NO PIPE WHICH HAS BEEN USED FOR ANY PURPOSE OTHER THAN THE CONVEYANCE OF DRINKING WATER SHALL BE ACCPTED OR RELOCATED FOR USE IN ANY PUBLIC DRINKING WATER SUPPLY, AS REQUIRED BY 30 TAC §290.44(a)(3).
6. WATER TRANSMISSION AND DISTRIBUTION LINES SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. HOWEVER, THE TOP OF THE WATER LINE MUST BE LOCATED BELOW THE FROST LINE AND IN NO CASE SHALL THE TOP OF THE WATER LINE BE LESS THAN 24 INCHES BELOW GROUND SURFACE, AS REQUIRED BY 30 TAC §290.44(a)(4).

TCEQ WATER DISTRIBUTION SYSTEM GENERAL CONSTRUCTION NOTES CONT.:

7. Pursuant to 30 TAC §290.44(a)(5), THE HYDROSTATIC LEAKAGE RATE SHALL NOT EXCEED THE AMOUNT ALLOWED OR RECOMMENDED BY THE MOST CURRENT awwa FORMULAS FOR PVC PIPE, CAST IRON AND DUCTILE IRON PIPE. INCLUDE THE FORMULAS IN THE NOTES ON THE PLANS.
   7.1. THE HYDROSTATIC LEAKAGE RATE FOR POLYVINYL CHLORIDE (PVC) PIPE AND APPURTENANCES SHALL NOT EXCEED THE AMOUNT ALLOWED OR RECOMMENDED BY FORMULAS IN AMERICA WATER WORKS ASSOCIATION (AWWA) C-605 AS REQUIRD IN 30 TAC §290.44(a)(5). PLEASE ENSURE THAT THE FORMULA FOR THIS CALCULATION IS CORRECT AND MOST CURRENT FORMULA IS IN USE;

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

   WHERE:
   - Q = THE QUANTITY OF MAKEUP WATER IN GALLONS PER HOUR,
   - L = THE LENGTH OF THE PIPE SECTION BEING TESTED, IN FEET,
   - D = THE NOMINAL DIAMETER OF THE PIPE IN INCHES, AND
   - P = THE AVERAGE TEST PRESSURE DURING THE HYDROSTATIC TEST IN POUNDS PER SQUARE INCH (PSI)

   7.2. THE HYDROSTATIC LEAKAGE RATE FOR DUCTILE IRON (DI) PIPE AND APPURTENANCES SHALL NOT EXCEED THE AMOUNT ALLOWED OR RECOMMENDED BY FORMULAS IN AMERICA WATER WORKS ASSOCIATION (AWWA) C-600 AS REQUIRED IN 30 TAC §290.44(a)(5). PLEASE ENSURE THAT THE FORMULA FOR THIS CALCULATION IS CORRECT AND MOST CURRENT FORMULA IS IN USE;

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

   WHERE:
   - L = THE QUANTITY OF MAKEUP WATER IN GALLONS PER HOUR,
   - S = THE LENGTH OF THE PIPE SECTION BEING TESTED, IN FEET,
   - D = THE NOMINAL DIAMETER OF THE PIPE IN INCHES, AND
   - P = THE AVERAGE TEST PRESSURE DURING THE HYDOSTATIC TEST IN POUNDS PER SQUARE INCH(PSI)

8. THE MAXIMUM ALLOWABLE LEAD CONTENT OF PIPES, PIPE FITTINGS, PLUMBING FITTINGS, AND FIXTURES TO 0.25 PERCENT.
9. THE SYSTEM MUST BE DESIGNED TO MAINTAIN A MINIMUM PRESSURE OF 35 PSI AT ALL POINTS WITHIN THE DISTRIBUTION NETWORK AT FLOW RATES OF AT LEAST1.5 GALLONS PER MINUTE PER CONNECTION. WHEN THE SYSTEM IS INTENDED TO PROVIDE FIREFIGHTING CAPABILITY, I MUST ALSO BE DESIGNED TO MAINTAIN A MINIMUM PRESSURE OF 20 PSI UNDER COMBINED FIRE AND DRINKING WATER FLOW CONDITIONS AS REQUIRED BY 30 TAC §290.44(d).

TCEQ WATER DISTRIBUTION SYSTEM GENERAL CONSTRUCTION NOTES CONT.:

10. THE CONTRACTOR SHALL INSTALL APPROPRIATE AIR RELEASE DEVICES IN THE DISTRIBUTION SYSTEM AT ALL POINTS WHERE TOPOGRAPHY OR OTHER FACTORS MAY CREATE AIR LOCKS IN THE LINES. ALL VENT OPENINGS TO THE ATMOSPHERE SHALL BE COVERED WITH 16-MESH OR FINER, CORROSION RESISTANT SCREEN MATERIAAL OR AN ACCEPTABLE EQUIVALENT AS REQUIRED BY 30 TAC §290.44(d)(1).
11. PURSUANT TO 30 TAC §290.44(d)(4), ACCURATE WATER METERS SHALL BE PROVIDED. SERVICE CONNECTIONS AND METER LOCATIONS SHOULD BE SHOWN ON THE PLANS.
12. PURSUANT TO 30 TAC §290.44(d)(5), SUFFICIENT VALVES AND BLOWOFFS TO MAKE REPAIRS. THE ENGINEER REPORT SHALL ESTABLISH CRITERIA FOR THIS DESIGN.
13. PURSUANT TO 30 TAC §290.44(d)(6), THE SYSTEM SHALL BE DESIGNED TO AFFORD EFFECTIVE CIRCULATION OF WATER WITH A MINIMUM OF DEAD ENDS. ALL DEAD-END MAINS SHALL BE PROVIDED WITH ACCEPTABLE FLUSH VALVES AND DISCHARGE PIPING. ALL DEAD-END LINES LESS THAN TWO INCHES IN DIAMTER WILL NOT REQUIRE FLUSH VALVES IF THEY END AT A CUSTOMER SERVICE. WHERE DEAD ENDS ARE NECESSARY AS A STAGE IN THE GROWTH OF THE SYSTEM, THEY SHALL BE LOCATED AND ARRANGED TO ULTIMATELY CONNECT THE ENDS TO PROVIDE CIRCULATION.
14. THE CONTRACTOR SHALL MAINTAIN A MINIMUM SEPARATION IN ALL DIRECTIONS OF NINE FEET BETWEEN THE PROPOSED WATERLINE AND WASTEWATER COLLECTION FACILITIES INCLUDING MANHOLES AND SEPTIC TANK DRAINFIELDS. IF THIS DISTANCE CANNOT BE MAINTAINED, THE CONTRACTOR MUST IMMEDIATELY NOTIFY THE PROJECT ENGINEER FOR FURTHER DIRECTION. SEPARATION DISTANCES, INSTALLATION METHODS, AND MATERIALS UTILIZED MUST MEET 30 TAC §290.44(e)(1-4) OF THE CURRENT RULES.
15. PURSUANT TO 30 TAC §290.44(e)(5), THE SEPARATION DISTANCE FROM A POTABLE WATERLINE TO A WASTEWTER MAIN OR LATERAL MANHOLE OR CLEANOUT SHALL BE A MINIMUM OF NINE FEET. WHERE THE NIN-FOOT SEPARATION DISTNCE CANNOT BE ACHIEVED, THE POTABLE WATERLINE SHALL BE ENASED IN A JOINT OF AT LEAST 150 PSI PRESSURE CLASS PIPE AT LEAST 18 FEET LONG AND TWO NOMINAL SIZES LARGER THANTHE NEW CONVEYANCE. THE SPACE AROUND THE CARRIER PIPE SHALL BE SUPPORTED AT FIVE-FOOT INTERVALS WITH SPACERS OR BE FILLED TO THE CROSSING AND BOTH ENDS SEALED WITH CEMENT GROUT OR MANUFACTURED SEALANT.
16. PURSUANT TO 30 TAC §290.44(e)(6), FIRE HYDRANTS SHALL NOT BE INSTALLED WITHIN NINE FEET VERTICALLY OR HORIZONTALLY OF ANY WASTEWATER LINE, WASTEWATER LATERAL, OR WASTEWATER SERVICE LINE REGARDLESS OF CONSTRUCTION.
17. PURSUANT TO 30 TAC §290.44(e)(7), SUCTION MAINS TO PUMPING EQUIPMENT SHALL NOT CROSS WASTEWATER MAINS, WASTEWATER LATERALS, OR WASTEWATER SERVICE LINES. RAW WATER SUPPLY LINES SHALL NOT BE INSTALLED WITHIN FIVE FEET OF ANY TILE OR CONCRETE WASTEWATER MAIN, WASTEWATER LATERAL, OR WASTEWATER SERVICE LINE.
18. PURSUANT TO 30 TAC §290.44(e)(8), WATERLINES SHALL NOT BE INSTALLED CLOSER THAN TEN FEET TO SEPTIC TANK DRAINFIELDS.

TCEQ WATER DISTRIBUTION SYSTEM GENERAL CONSTRUCTION NOTES CONT.:

19. PURSUANT TO 30 TAC §290.44(f)(1), THE CONTRACTOR SHALL NOT PLACE THE PIPE IN THE WATER OR WHERE IT CAN BE FLOODED WITH WATER OR SEWAGE DURING ITS STORAGE OR INSTALLATION.
20. PURSUANT TO 30 TAC §290.44(f)(2), WHEN WATERLINES ARE LAID UNDER ANY FLOWING OR INTERMITTENT STREAM OR SEMI-PERMANENT BODY OF WATER THE WATER MAIN SHALL BE INSTALLED IN A SEPARATE WATERTIGHT PIPE ENCASEMENT. VALVES MUST BE PROVIDED ON EACH SIDE OF TE CROSSING WITH FACILITIES TO ALLOW THE UNDERWATER PORTION OF THE SYSTEM TO BE ISOLATED AND TESTED.
21. THE CONTRACTOR SHALL DISINFECT THE NEW WATER MAINS IN ACCORDANCE WITH AWWA STANDARD C-651 AND THEN FLUSH AND SAMPLE THE LINES BEFORE BEING PLACED INTO SERVICE. SAMPLES SHALL BE COLLECTED FOR MICROBIOLOGICAL ANALYSIS TO CHECK THE EFFECTIVENESS OF THE DISINFECTION PROCEDURE WHICH SHALL BE REPEATED IN CONTAMINATION PERSISTS. A MINIMUM OF ONE SAMPLE FOR EACH 1,000 FEET OF COMPLETED WATER LINE WILL BE REQUIRED OR AT THE NEXT AVAILABLE SAMPLING POINT BEYOND 1,000 FEET AS DESIGNATED BY THE DESIGN ENGINEER, IN ACCORDANCE WITH 30 TAC §290.44(f)(3).

STATE OF TEXAS
JAMES A. PHILLIPS
105116
LICENSED
PROFESSIONAL ENGINEER
06/24/24

ISSUED FOR REVIEW

JACOB MARTIN
TBPELS FIRM # 10194493
TBAE FIRM # BR 2261
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

GENERAL NOTES

NO.	REVISION	DATE

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING.
CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263
SCALE NTS
SEQ. 02/09
SHEET G-2

Plotted by: sarah davis Plot Date: 9/19/2024 4:23 PM
Saved By: jbaker Save Time: 6/24/2024 3:02 PM
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TCEQ PROPOSED WATER WELL GENERAL CONSTRUCTION NOTES

1. These water well facilities must be constructed in accordance with the current Texas Commission on Environmental Quality (TCEQ) Rules and Regulations for Public Water Systems 30 Texas Administrative Code (TAC) Chapter 290 Subchapter D. When conflicts are noted with local standards, the more stringent requirement shall be applied. At a minimum, construction for public water systems must always meet TCEQ's "Rules and Regulations for Public Water Systems.

2. The premises, materials, tools, and drilling equipment shall be maintained so as to minimize contamination of the groundwater during drilling operation.

3. Water used in any drilling operation shall be of safe sanitary quality. Water used in the mixing of drilling fluids or mud shall contain a chlorine residual of at least 0.5 milligrams per liter (mg/l).

4. The slush pit shall be constructed and maintained so as to minimize contamination of the drilling mud.

5. No temporary toilet facilities shall be maintained within 150 feet of the well being constructed unless they are of a sealed, leakproof type.

6. The construction, disinfection, protection, and testing of a well to be used as a public water supply source must meet the following conditions.

   a. The casing material used in the construction of wells for public use shall be new carbon steel, high strength low alloy steel, stainless steel or plastic. The material shall conform to the most recent American Water Works Association (AWWA) standards. The casing shall extend a minimum of 18 inches above the elevation of the finished floor of the pump room or natural ground surface and a minimum of one inch above the sealing block or pump motor foundation block when provided. The casing shall extend at least to the depth of the shallowest water formation to be developed and deeper, if necessary, in order to eliminate all undesirable water bearing strata. Well construction materials containing more than 0.25 percent lead are prohibited.

   b. The space between the casing and drill hole shall be sealed by using enough cement under pressure to completely fill and seal the annular space between the casing and the drill hole. The well casing shall be cemented in this manner from the top of the shallowest formation to be developed to the earth's surface. The driller shall utilize a pressure cementation method in accordance with the AWWA standard for water wells (A100-15) or most recent, Appendix C: Section C.2 (Positive Displacement Exterior Method); Section C.3 (Interior Method Without Plug); Section C.4 (Positive Placement, Interior Method, Drillable Plug); and Section C.5 (Placement Through Float Shoe Attached To Bottom Of Casing).

   c. The grouting mixture used to pressure cement the annular space shall be neat cement as specified in the most recent AWWA Standard for Water Wells and to which a maximum of 6%, by dry weight, bentonite and 2%, by dry weight, calcium chloride may be added. The minimum annular space between the outside diameter of the casing pipe and the borehole shall be no less than 1 1/2 inches in radial thickness or three inches in net diametrical difference and the pressure grouting shall be from the bottom upward utilizing one of the methods listed in this subparagraph for all public water system groundwater well construction.

   d. All gravel shall be of selected and graded quality and shall be thoroughly disinfected with a 50 mg/l chlorine solution as it is added to the well cavity.

   e. Safeguards shall be taken to prevent possible contamination of the water or damage by trespassers following the completion of the well and prior to installation of permanent pumping equipment.

   f. Upon well completion, or after an existing well has been reworked, the well shall be disinfected in accordance with recent AWWA Standard C654-13 or most recent for well disinfection except that the disinfectant shall remain in the well for at least 12-hours.

7. Dechlorination of disinfecting water shall be in strict accordance with current AWWA Standard C655-09 or most recent.

8. The well site shall be fine graded so that the site is free from depressions, reverse grades, or areas too rough for proper ground maintenance so as to ensure that surface water will drain away from the well. In all cases, arrangements shall be made to convey well pump drainage, packing gland leakage, and floor drainage away from the wellhead. Suitable drain pipes located at the outer edge of the concrete floor shall be provided to collect this water and prevent its ponding or collecting around the wellhead. This wastewater shall be disposed of in a manner that will not cause any nuisance from mosquito breeding or stagnation. Drains shall not be directly connected to storm or sanitary sewers.

9. A concrete sealing block extending at least three feet from the well casing in all directions, with a minimum thickness of six inches and sloped to drain away at not less than 0.25 inches per foot shall be provided around the wellhead.

10. Wellheads and pump bases shall be sealed by a gasket or sealing compound and properly vented to prevent the possibility of contaminating the well water. A well casing vent shall be provided with an opening that is covered with 16-mesh or finer corrosion resistant screen, facing downward, elevated and located so as to minimize the drawing of contaminants into the well. Wellheads and well vents shall be at least two feet above the highest known watermark or 100 year flood elevation, if available or adequately protected from possible flood damage by levees.

11. If a well blow off line is provided, its discharge shall terminate in a downward direction and at a point which will not be submerged by flood waters.

12. A suitable sampling cock shall be provided on the discharge pipe of each well pump prior to any treatment.

13. Flow measuring devices shall be provided for each well to measure production yields and provide for the accumulation of water production data. These devices shall be located to facilitate daily reading.

14. All completed well units shall be protected by intruder resistant fences, the gates of which are provided with locks or shall be enclosed in locked, ventilated well houses to exclude possible contamination or damage to the facilities by trespassers. The gates or well houses shall be locked during periods of darkness and when the plant is unattended.

15. An all-weather access shall be provided to each well site.

16. An air release device shall be installed in such a manner as to preclude the possibility of submergence or possible entrance of contaminants. In this respect, all openings to the atmosphere shall be covered with 16-mesh or finer, corrosion resistant screening material or an acceptable equivalent.

STATE OF TEXAS
JAMES A. PHILLIPS
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LICENSED
PROFESSIONAL ENGINEER
06/24/24

ISSUED FOR REVIEW

JACOB MARTIN
TBAE FIRM # BR 2261
TBPELS FIRM # 10194493
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

GENERAL NOTES CONTINUED

NO.	REVISION	DATE

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING.
CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263
SCALE NTS

SEQ. 03/09
SHEET G-3

NOTE:

1) PROPERTY BOUNDARIES ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.
2) PROPERTY BOUNDARIES SUPPLIED FROM TNRIS DATAHUB.
3) ALL GAS TRANSMISSION LINES AND PRODUCTION FACILITIES LOCATIONS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.
4) GAS TRANSMISSION LINES AND PRODUCTION FACILITIES LOCATIONS SUPPLIED FROM TEXAS RAIL ROAD COMMISSION.

1320'
500'
300'
150'
50'

SEC 45 BLK 34T4N ABST 62 N/2 320.000 ACRES
ENNS HEINRICH Z AND
320.00 ACRES

SEC 45 BLK 34T4N ABST 62 PT OF SE/4
154.500 ACRES
KENNEMER MARK
154.50 ACRES

COUNTY RD 1

US-87

NORTH

PLUGGED OIL WELL
SOUTHERN UNION
PRODUCTION CO.

PROPOSED CITY GROUND WATER WELL SEE SHEET 5 FOR DETAILS
LAT: 32°32'58"N 101°44'22"W
LONG:101°44'22"W

PLUGGED OIL WELL
HIBERNIA RESOURCES IV, LLC

PLUGGED OIL WELL
LPR ENERGY, LLC

EXISTING WATER WELL
TX WELL NO. 539522

PROPOSED CITY OF ACKERLY
WATER WELL TO BE PLUGGED
FACILITY ID NO. G058011D

EXISTING OVERHEAD
ELECTRICAL

EXISTING OIL-WATER
SEPARATORS

OIL WELL
LPR ENERGY, LLC

EXISTING CRUDE OIL
TRANSMISSION
PLAINS PIPELINE LP

SEC 46 BLK 34T4N ABST 1289 & 1320 PT
OF NW/4 & PT OF SW/4
TALBOTT WALLACE MARY ANN
194.00 ACRES

SEC 3 BLK 34T3N ABST 36 W/2 320.00
ACRES
M Y BOWLIN FAMILY
320.00 ACRES

COUNTY RD 34

EXISTING OIL WELL
HIBERNIA RESOURCES IV,LLC

EXISTING WATER WELL
TX WELL #2827410

EXISTING CITY OF
ACKERLY WATER WELL
FACILITY ID NO. G058011B

EXISTING CITY OF
ACKERLY WATER WELL
FACILITY ID NO. G058011C

STATE OF TEXAS
JAMES A. PHILLIPS
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06/24/24

ISSUED FOR REVIEW

JACOB MARTIN
TBPE FIRM # 2448
TBAE FIRM # BR 2261
TBPELS FIRM # 10194493

ACKERLY, TEXAS
NEW PWS WELL
PROPOSED WELL SITE MAP

NO.	REVISION	DATE

PROJECT # 24263
SCALE 1"=300'
BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

SEQ. 04/09
SHEET C-1

Plotted by: sarah davis Plot Date: 9/19/2024 4:23 PM
Saved By: rgrace Save Time: 7/23/2024 11:08 AM
X:\CL_Ackerly\24263 - New PWS Well - City of Ackerly\Drafting_Plans_C_Civil\04-OVERALL SYSTEM MAP.dwg

NOTE:

1) CONTRACTOR TO PLUG EXISTING WELL BEFORE ANY WORK CAN BE DONE ON THE PROPOSED WELL.

PROPOSED 7' X 12' CONCRETE PAD

PROPOSED GROUNDWATER WELL SEE SHEET C-3 FOR DETAILS

PROPOSED WELL SEALING BLOCK SEE SHEET C-3 FOR DETAILS

PROPOSED ELECTRICAL METER AND CONTROL PANEL SEE ELECTRICAL FOR DETAILS

PROPOSED 4" C900 DR18 PVC WATERLINE

PROPOSED ELECTRICAL METER AND CONTROL PANEL SEE ELECTRICAL FOR DETAILS

PROPOSED 4" 22.5° BEND

NEW WELL TO BE LOCATED 50' NORTH OF EXISTING WELL

EXISTING GROUNDWATER WELL TO BE PLUGGED

EXISTING WELL SECURITY CONFINEMENT TO BE REMOVED, RELOCATED, AND INSTALLED BY THE CITY AROUND PROPOSED WELL.

EXISTING ELECTRICAL CONTROL AND SCADA PANEL AND ANTENNA

PROPOSED 4" WATERLINE CONNECTION
4" 90° BEND
4" GV + BOX
4" COUPLING

PROPOSED 4" 90° BEND

EXISTING 4" PVC WATERLINE TO CITY OF ACKERLY

EXISTING ALL WEATHER ACCESS ROAD

EXISTING UNDERGROUND ELECTRICAL SECONDARY

EXISTING OVERHEAD ELECTRICAL PRIMARY AND POLE

NORTH

STATE OF TEXAS
JAMES A. PHILLIPS
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PROFESSIONAL ENGINEER
06/24/24

ISSUED FOR REVIEW

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ACKERLY, TEXAS
NEW PWS WELL

WELL YARD PIPING

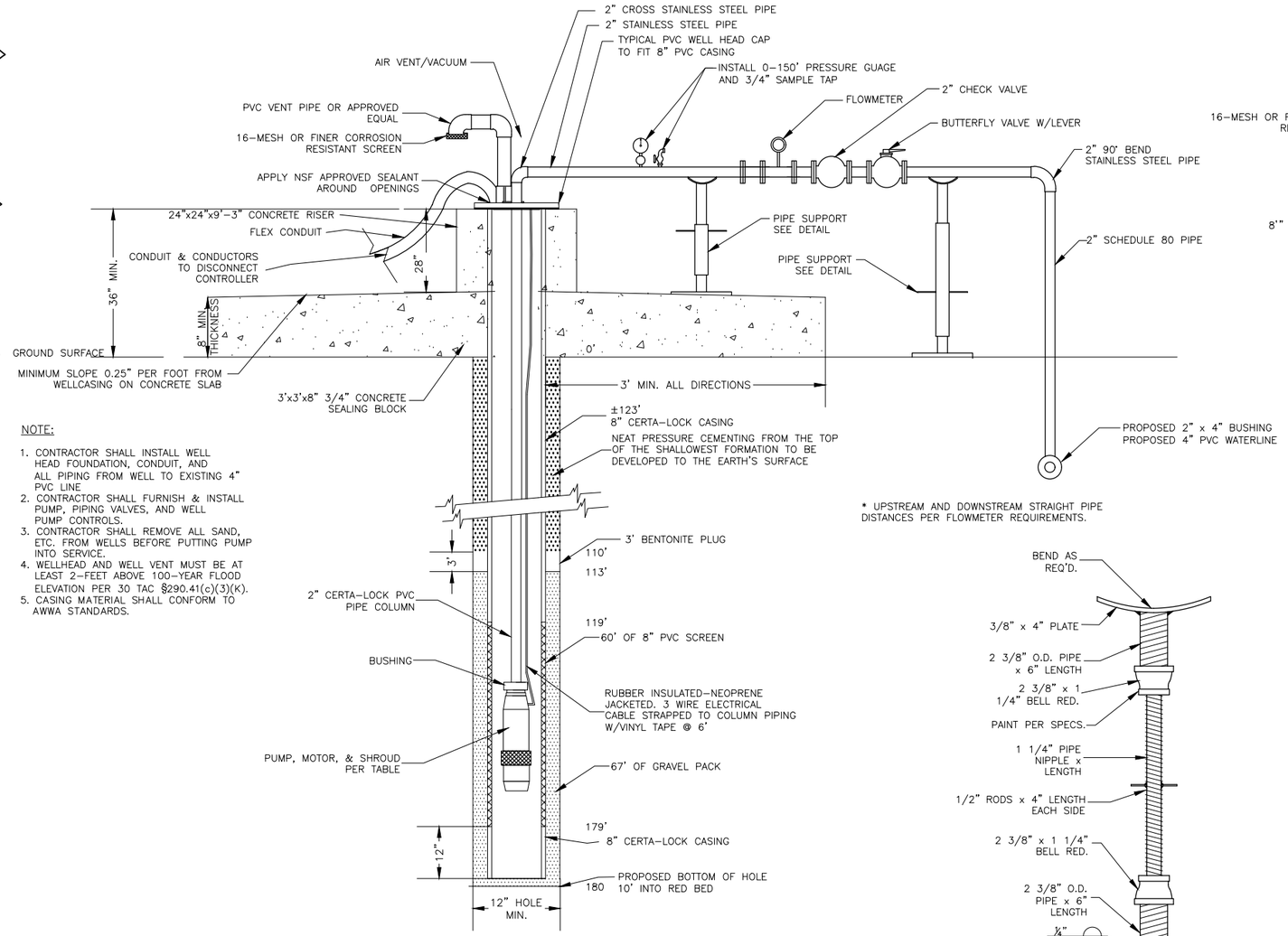
NO.	REVISION	DATE
1	ADDENDUM #1	09/19/2024

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING.
CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263
SCALE 1"=XXX'

SEQ. 05/09
SHEET C-2

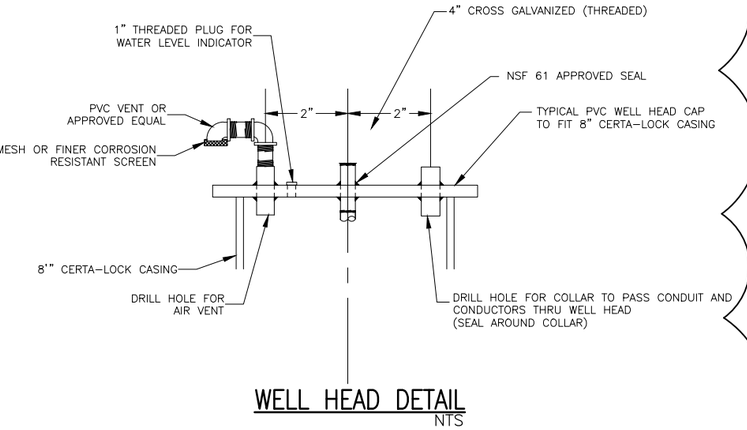
**NOTE: ALL STAINLESS STEEL PIPING SHALL BE 304.



WELL SECTION
NTS

NOTE:

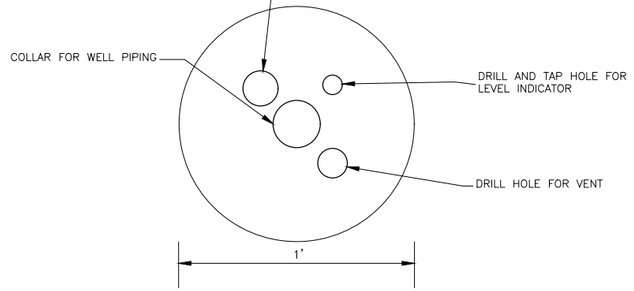
1. CONTRACTOR SHALL INSTALL WELL HEAD FOUNDATION, CONDUIT, AND ALL PIPING FROM WELL TO EXISTING 4" PVC LINE
2. CONTRACTOR SHALL FURNISH & INSTALL PUMP, PIPING VALVES, AND WELL PUMP CONTROLS.
3. CONTRACTOR SHALL REMOVE ALL SAND, ETC. FROM WELLS BEFORE PUTTING PUMP INTO SERVICE.
4. WELLHEAD AND WELL VENT MUST BE AT LEAST 2-FEET ABOVE 100-YEAR FLOOD ELEVATION PER 30 TAC §290.41(c)(3)(K).
5. CASING MATERIAL SHALL CONFORM TO AWWA STANDARDS.



WELL HEAD DETAIL
NTS

* UPSTREAM AND DOWNSTREAM STRAIGHT PIPE DISTANCES PER FLOWMETER REQUIREMENTS.

PIPE SUPPORT
NTS



ALTERNATE WELL HEADS MUST BE SUBMITTED FOR APPROVAL IF THIS DESIGN IS NOT UTILIZED.

COVER DETAIL
NTS

NOTE:

1) THE WELL CONTRACTOR SHALL NOTIFY THE DESIGN ENGINEER AT LEAST 7 CALENDER DAYS PRIOR TO DRILLING ACTIVITIES, SO THAT THE APPROPRIATE TCEQ NOTIFICATIONS CAN BE MADE.
2) THE CONTRACTOR SHALL SUPPLY THE REQUIRED WELL AS BUILT INFORMATION, PUMP TESTS, PASSING, BAC-T'S, AND WATER ANALYSIS AS OUTLINED IN TCEQ'S PUBLIC WELL COMPLETION DATA CHECKLIST FOR INTERIM APPROVAL.
3) DISINFECTION OCCURS BY THE GROUND STORAGE AND PUMPING FACILITIES
4) CONTRACTOR SHALL FURNISH AND INSTALL HEAT TAPE AND INSULATION ON PIPING, ETC. SUBJECT TO FREEZING.

GENERAL NOTES:

1. FOR PUMP SIZE SEE TABLE.
2. CONTRACTOR SHALL FURNISH & INSTALL AIR VALVE, CHECK VALVE, FLOWMETER, BUTTERFLY VALVE, PIPING, FITTINGS & CONNECTIONS TO WATERLINE. SEE TABLE FOR SIZES.

Well #	Ground Elevation	Estimated Casing Depth	Pump Column & Discharge Pipe Size	Proposed WL Size	Design Flow	Motor Horsepower	GOULDS PUMP MODEL & RPM
PROPOSED WELL	2831.7	123"	2"	4"	80 gpm	7.5 HP	75GS75 3450RPM

PUMP DATA

STATE OF TEXAS
JAMES A. PHILLIPS
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LICENSED PROFESSIONAL ENGINEER
06/24/24

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TBAE FIRM # BR 2261
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

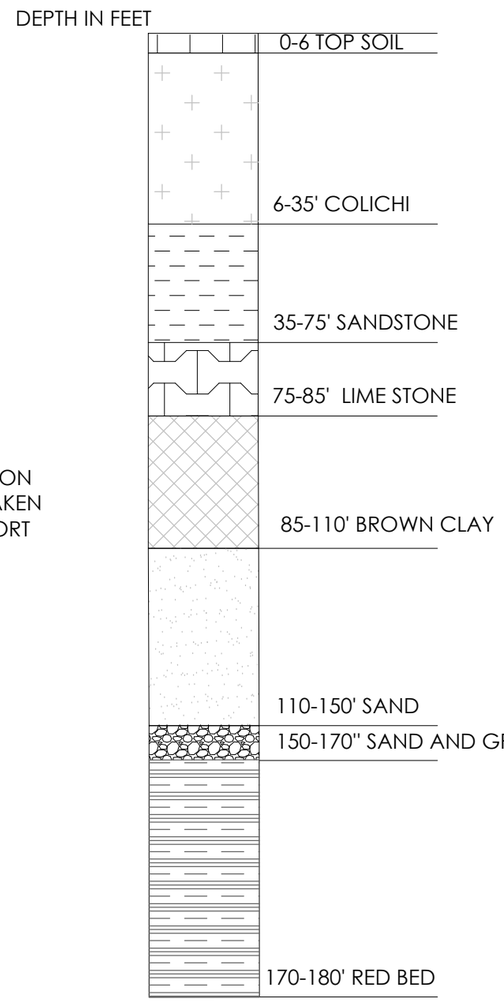
PROPOSED WELL DETAILS

NO.	REVISION	DATE
1	ADDENDUM #1	09/19/2024

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263 | SCALE NTS

SEQ. 06/09 | SHEET C-3



*WELL LOG INFORMATION
FROM NEARBY WELL TAKEN
FROM STATE WELL REPORT
NO. 539322

WELL LOG – STATE WELL #539322

STATE OF TEXAS
JAMES A. PHILLIPS
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06/24/24

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ACKERLY, TEXAS
NEW PWS WELL

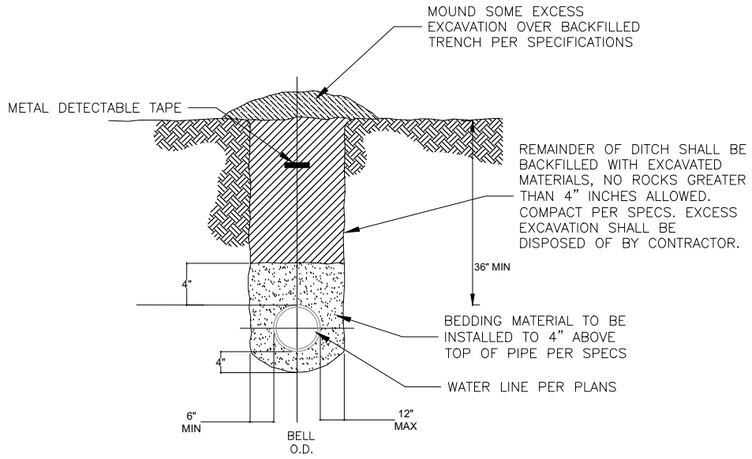
PROPOSED WELL DETAILS CONTINUED

NO.	REVISION	DATE

PROJECT # 24263
SCALE
BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING.
CHECK SCALE AND ADJUST ACCORDINGLY.

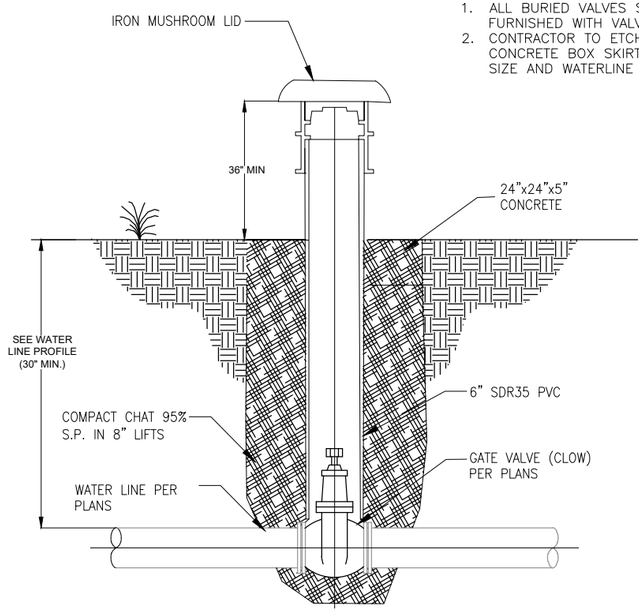
SEQ. 07/09
SHEET C–4

NOTES:
1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL EXCESS EXCAVATED MATERIAL AS REQUIRED BY OWNER.
2. BEDDING MATERIAL SHALL BE VULCAN CHAT OR APPROVED EQUAL.
3. ALL ASPHALT AND BASE REPAIR SHALL BE PAID FOR SEPARATELY BY THE LINEAR FOOT, REGARDLESS OF TRENCH WIDTH.



TRENCH OUTSIDE OF STREET
NOT TO SCALE

NOTE:
1. ALL BURIED VALVES SHALL BE FURNISHED WITH VALVE BOX.
2. CONTRACTOR TO ETCH IN CONCRETE BOX SKIRT: GATE VALVE SIZE AND WATERLINE DIRECTION.



GATE VALVE & BOX
NOT TO SCALE

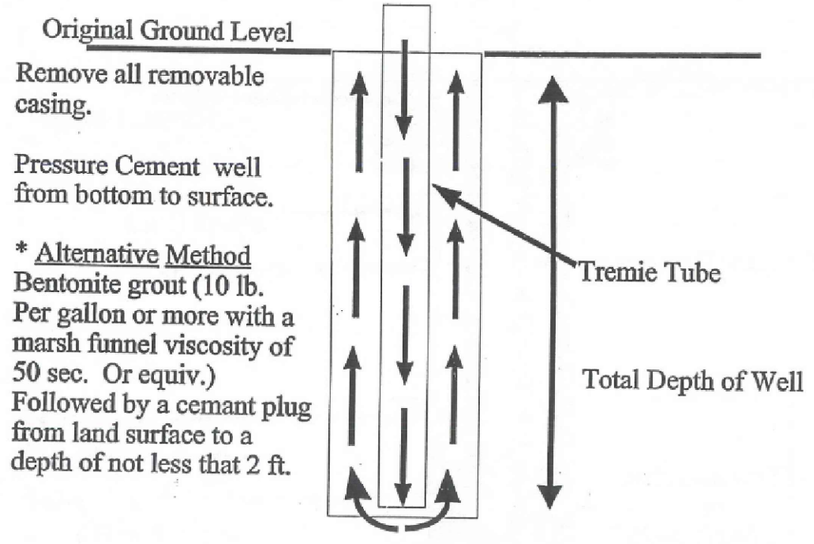
CONTRACTOR TO COMPLY WITH WITH THE FOLLOWING STEPS FOR TCEQ.

1. Construction data on the completed well: [§290.41(c)(3)(A)]
   - 1.1. Final installed pump data including capacity in gallons per minute (gpm), total dynamic head (tdh) in feet, motor horsepower, and setting depth;
   - 1.2. Bore hole diameter(s) (must be 3" larger than casing OD) and total well depth;
   - 1.3. Casing size, length, and material (e.g. 200 lf of 12" PVC ASTM F480 SDR–17);
   - 1.4. Length and material of any screens, blanks, and/or gravel packs utilized;
   - 1.5. Cementing depth and pressure method (one of the methods in latest revision of AWWA Standard A–100, Appendix C, excluding the dump bailer and tremie methods);
   - 1.6. Driller's geologic log of strata penetrated during the drilling of the well;
   - 1.7. Cementing certificate; and
   - 1.8. Copy of the official State of Texas Well Report (some of the preceding data is included on the Well Report).
2. Record of a 36–hour continuous pump test on the well showing stable production at the well's rated capacity. Include the following: [§290.41(c)(3)(G)]
   - 2.1. Test pump capacity in gpm, tdh in feet, and horsepower of the pump motor;
   - 2.2. Test pump setting depth;
   - 2.3. Static water level (in feet); and
   - 2.4. Draw down (in feet).
3. Three bacteriological analysis reports for samples collected on three successive days showing raw well water to be free of coliform organisms. Reports must be for samples of raw (untreated) water from the disinfected well and submitted to a laboratory accredited by TCEQ, accredited to perform these test; and [§290.41(c)(3)(F)(i)]
4. Chemical analysis reports for well water samples showing the water to be of acceptable quality for the most problematic contaminants listed below. Reports must come from a laboratory accredited by TCEQ; accredited to perform these tests. Maximum contaminant level (MCL) and secondary constituent level (SCL) units are in milligrams per liter (except arsenic which is in micrograms per liter). [§290.41(c)(3)(G) and§290.104 and §290.105]

Plugging of Drilled Wells

Chapter 76.104

NOTE:
1. CONTRACTORS SHALL COMPLY WITH ALL TDLR REGULATIONS.



STATE OF TEXAS
JAMES A. PHILLIPS
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PROFESSIONAL ENGINEER
06/24/24

ISSUED FOR REVIEW

JACOB MARTIN
TBPE FIRM # 2448 | TBAE FIRM # BR 2261 | TBPELS FIRM # 10194493

ACKERLY, TEXAS
NEW PWS WELL

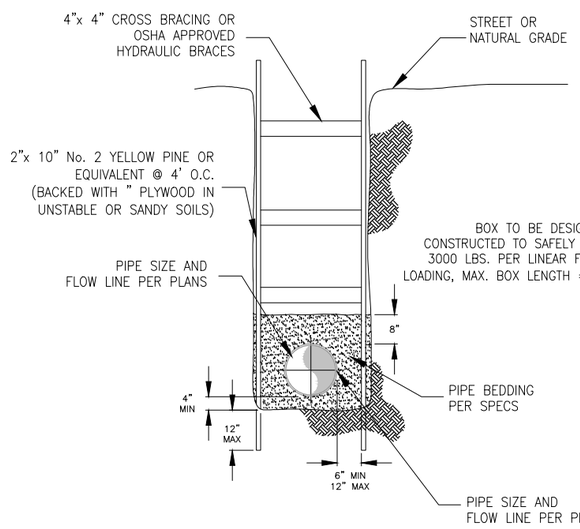
MISCELLANEOUS DETAILS 1

NO.	REVISION	DATE
1	ADDENDUM #1	09/19/2024

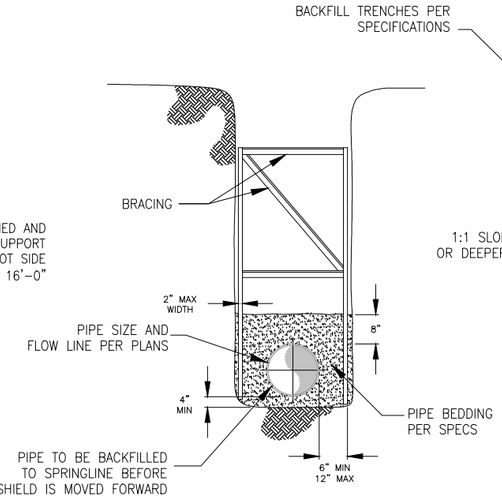
BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263 | SCALE NTS

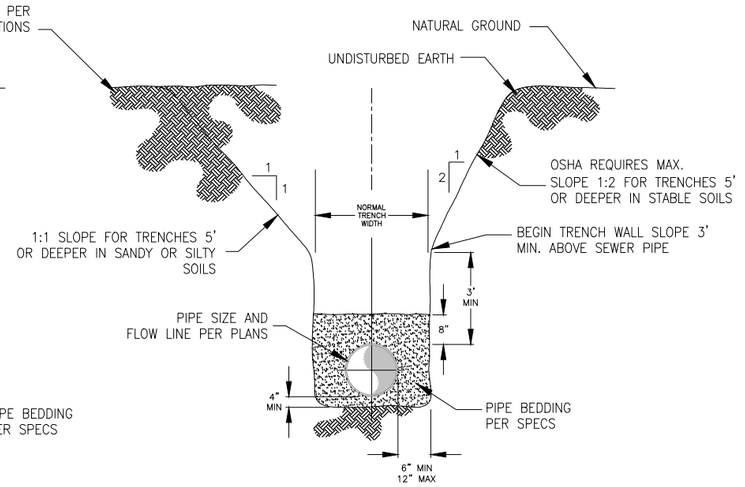
SEQ. 08/09 | SHEET C–5



WALL BRACING DETAIL



MOVABLE SHIELD



TRENCH WALL SLOPING

TRENCH WALL PROTECTION
NTS

TRENCH SAFETY NOTE:

EXCAVATIONS DEEPER THAN 5.0' SHALL MEET O.S.H.A. TRENCH SAFETY STANDARDS PER REQUIREMENTS OF PART 1926, SUBPART "P", SECTIONS 1926.650 THROUGH 1926.653 INCLUSIVE ("EXCAVATION, TRENCHING & SHORING") OF THE O.S.H.A. STANDARDS.

DIMENSIONS FOR CONCRETE THRUST BLOCKS			
Pipe Dia. Size (inches)	Minimum Soil Bearing Area Required (Square Feet)	Typical Dimensions Of Bearing Area In Inches (A x B)	Typical Volume Of Conc. Required (Cubic Feet) *
2	2.0	12" x 24"	3.0
2 1/2	2.5	12" x 30"	4.0
3	3.0	14" x 30"	4.5
4	4.0	18" x 32"	6.0
6	6.0	24" x 36"	9.0
8	8.0	29" x 40"	12.0
10	10.0	30" x 48"	15.0
12 & 14	12.0	36" x 48"	18.0

* VARIES CONSIDERABLY W/DISTANCE BETWEEN PIPE AND BEARING POINT

NOTES:

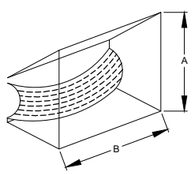
BLOCKING REQ'D. ON ALL BENDS 2" & LARGER. ALL REQ'D. BENDS & FITTINGS ARE NOT LABELED ON THE PLANS. PIPE MAY BE CURVED UP TO 75% OF MFG. RECOMMENDED MAX. CURVATURE WITHOUT A BEND AS APPROVED BY OWNER & ENGINEER.

BORE & ENCASEMENT LENGTH SPECIFIED ON PLANS SHALL NOT BE INCREASED W/O PRIOR PERMISSION FROM ENGINEER.

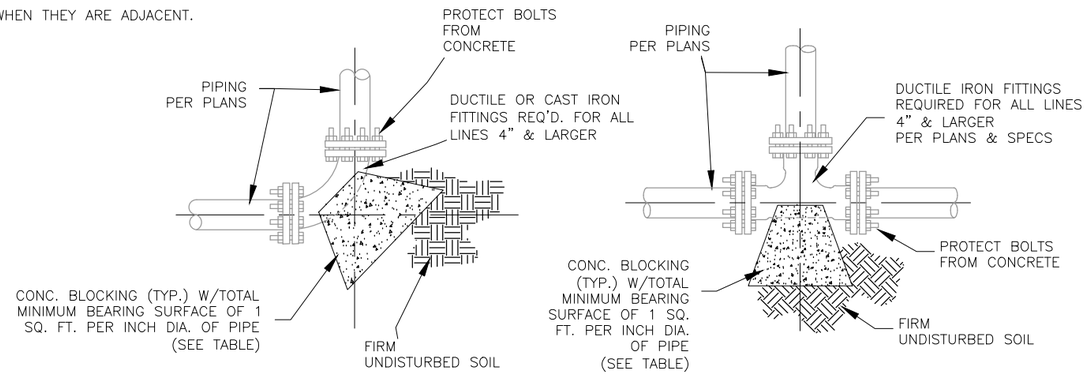
ALL IRON FITTINGS & VALVES SHALL BE ENCAPSULATED IN 8 MIL POLYETHYLENE PER SPECS.

CONTRACTOR SHALL USE MEGA LUG RESTRAINTS FOR ALL FITTINGS AND VALVES.

USE FOSTER ADAPTORS BETWEEN VALVES AND FITTINGS WHEN THEY ARE ADJACENT.



TYPICAL BLOCKING DIMENSIONS
NTS



TYPICAL BLOCKING DETAILS
NTS

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06/24/24

ISSUED FOR REVIEW

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TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

MISCELLANEOUS DETAILS 2

NO.	REVISION	DATE

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263 | SCALE NTS

SEQ. 09/09 | SHEET C-6

Plotted by: sarah davis Plot Date: 9/19/2024 4:24 PM
Saved By: jbaker Save Time: 6/24/2024 3:03 PM
X:\CI_Ackerly\24263 - New PWS Well - City of Ackerly\Drafting_Plans_C_Civil\08- Misc. Details 2.dwg

(3) – #10 AWG PHASE CONDUCTORS, (1) – #10 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 3/4" CONDUIT FROM THE PUMP CONTROL PANEL TO NEW WELL PUMP. CONTRACTOR IS TO VERIFY BREAKER SIZE WITH CONTROL PANEL MANUFACTURER AND ADJUST WIRING, CONDUIT, AND PANEL "MDP" BREAKER PER NEC CODE.

(3) – #4 AWG PHASE CONDUCTORS, (1) – #4 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 1–1/4" CONDUIT FROM THE STEP–DOWN TRANSFORMER TO PANEL "A".

(3) – #10 AWG PHASE CONDUCTORS, (1) – #10 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 3/4" CONDUIT FROM PANEL "MDP" TO THE STEP–DOWN TRANSFORMER.

(3) – #4 AWG PHASE CONDUCTORS, (1) – #4 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 1–1/4" CONDUIT FROM THE DTSS TO PANEL "MDP"

NEW 480V, 3Ø, 7.5 HP WELL PUMP PROVIDED AND INSTALLED BY THE CONTRACTOR.

NEW STAND MOUNTED LIGHT. REFERENCE LIGHTING SCHEDULE SHEET 12 AND ELECTRICAL STAND DETAIL SHEET 13 FOR MORE INFORMATION.

EXISTING SCADA PANEL AND ANTENNA IS TO BE MOUNTED ON THE NEW ELECTRICAL STAND BY OTHERS. CONTRACTOR IS TO LEAVE ROOM ON THE ELECTRICAL STAND FOR MOUNTING OF THE SCADA PANEL.

NEW CONDUIT AND WIRING FROM PANEL "A" TO THE EXISTING SCADA PANEL PROVIDED AND INSTALLED BY OTHERS.

NEW 480V, 3Ø, 7.5 HP WELL PUMP CONTROL PANEL PROVIDED AND INSTALLED BY THE CONTRACTOR.

NEW 208/120V, 3Ø, 60A PANEL "A" IN A 200A FRAME. PANEL IS TO BE IN A NEMA 3R ENCLOSURE.

NEW 480:208/120V, 3Ø, 15 KVA STEP–DOWN TRANSFORMER.

NEW 480V, 3Ø, 60A PANEL "MDP" IN A 200A FRAME AND NEMA 3R ENCLOSURE.

NEW 480V, 3Ø, 60A DTSS WITH GENERATOR DOCKING STATION. DTSS IS TO BE IN A NEMA 3R ENCLOSURE WITH AIC RATING >21 KA.CONTRACTOR IS TO VERIFY THE GENERATOR DOCKING STATION WITH OWNER PRIOR TO ORDERING TO ENSURE COMPATIBILITY.

NEW ELECTRICAL STAND PROVIDED AND INSTALLED BY THE CONTRACTOR. REFERENCE SHEET 13 FOR MORE DETAILS ON THE ELECTRICAL STAND.

(3) – #10 AWG PHASE CONDUCTORS, (1) – #10 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 3/4" CONDUIT FROM THE PUMP CONTROL PANEL TO NEW WELL PUMP. CONTRACTOR IS TO VERIFY BREAKER SIZE WITH CONTROL PANEL MANUFACTURER AND ADJUST WIRING, CONDUIT, AND PANEL "MDP" BREAKER PER NEC CODE AND MANUFACTURER'S REQUIREMENTS. CONTRACTOR IS TO VERIFY CONDUIT ROUTE AND ADJUST AS NECESSARY.

(3) – #4 AWG PHASE CONDUCTORS, (1) – #4 AWG NEUTRAL CONDUCTOR, (1) – #10 AWG GROUND IN 1–1/4" CONDUIT FROM THE SERVICE RATED DISCONNECT TO THE STAND MOUNTED DTSS. CONTRACTOR IS TO VERIFY THE CONDUIT ROUTE AND ADJUST AS NECESSARY.

APPROXIMATELY 90'

EXISTING SCADA PANEL AND ANTENNA IS TO BE REMOVED BY THE CONTRACTOR AND RETURNED TO THE OWNER.

EXISTING WIRING AND CONDUIT FROM CONTROL PANEL TO SCADA PANEL IS TO BE DEMOLISHED.

EXISTING 480V, 3Ø, 5 HP WELL PUMP CONTROL PANEL IS TO BE DEMOLISHED BY THE CONTRACTOR.

EXISTING 480V, 3Ø, 5 HP WELL PUMP AND ASSOCIATED WIRING AND CONDUIT IS TO BE DEMOLISHED.

EXISTING ELECTRICAL STAND IS TO BE DEMOLISHED BY THE CONTRACTOR.

EXISTING ABOVE GROUND WIRING AND CONDUIT FROM POLE MOUNTED DISCONNECT TO EXISTING WELL PUMP CONTROL PANEL IS TO BE DEMOLISHED BY THE CONTRACTOR. UNDERGROUND CONDUIT IS TO BE ABANDONED IN PLACE. UNDERGROUND WIRING IS TO BE REMOVED IF POSSIBLE.

EXISTING 480V, 3Ø, 60A FUSED SERVICE RATED POLE MOUNTED DISCONNECT IS TO REMAIN. CONTRACTOR IS TO PROVIDE AND INSTALL A NEW NEUTRAL AND GROUND BAR AS NECESSARY.

EXISTING ONCOR PRIMARY DEADEND POLE WITH (2) TRANSFORMER BANK FOR EXISTING 480V, 3Ø ELECTRICAL SERVICE IS TO REMAIN.

EXISTING WIRING AND CONDUIT BETWEEN METER AND SERVICE RATED DISCONNECT IS TO REMAIN.

EXISTING ONCOR POLE MOUNTED ELECTRICAL METER #141641007, WEATHERHEAD, AND MAST IS TO REMAIN.

EXISTING ONCOR ELECTRICAL PRIMARY IS TO REMAIN.

NORTH

GRAPHIC SCALE 1"=10'
5 0 5 10

ELECTRICAL SITE PLAN NOTES:

1. EXISTING EQUIPMENT IS SHOWN FOR REFERENCE ONLY AND SHOULD BE VERIFIED BY THE CONTRACTOR. FOR CLARITY, NOT ALL EXISTING UTILITIES ARE SHOWN ON THIS PLAN. CONTRACTOR SHALL FIELD VERIFY LOCATIONS OF EXISTING UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR IS RESPONSIBLE TO REPAIR ANY DAMAGE TO UTILITIES OR STRUCTURES, WHETHER SHOWN ON THESE PLANS OR NOT.
2. REFERENCE SHEET 11 FOR ELECTRICAL RISER DIAGRAM OF THE NEW WELL.
3. CONTRACTOR TO MAINTAIN 3' WORKING SPACE IN FRONT OF ELECTRICAL EQUIPMENT PER NEC CODE.
4. CONTRACTOR TO VERIFY WELL PUMP CONTROL PANEL BREAKER SIZES WITH THE PANEL MANUFACTURER AND ADJUST BREAKERS IN PANEL "MDP", WIRING, AND CONDUIT AS NECESSARY PER NEC CODE.

ELECTRICAL LEGEND

- (A) NEW LED STAND LIGHT PER SCHEDULE
- OE EXISTING OVERHEAD ELECTRICAL
- UE NEW UNDERGROUND ELECTRICAL
- EXISTING POWER POLE
- PANEL — X–5,7 — BREAKER # / HOMERUN

NOTE: X DENOTES FIXTURES SCHEDULE DESIGNATION

GENERAL ELECTRICAL NOTES

1. ALL ELECTRICAL COMPONENTS OF THIS PROJECT SHALL COMPLY WITH: NFPA 70 – NATIONAL ELECTRICAL CODE: MOST RECENT EDITION ADOPTED BY AUTHORITY HAVING JURISDICTION, INCLUDING ALL APPLICABLE AMENDMENTS AND SUPPLEMENTS.
2. ALL CIRCUITS SHALL BE A MINIMUM SIZE OF 12 GAUGE AND A MINIMUM 3/4" CONDUIT.
3. ALL CIRCUITS SHALL CONTAIN A GROUND WIRE.
4. EACH CIRCUIT SHALL CONTAIN ITS OWN NEUTRAL WIRE. NO NEUTRAL SHARING SHALL BE ALLOWED.
5. ALL CONDUCTORS SHALL BE COPPER UNLESS OTHERWISE SHOWN ON PLAN. USE THHW, THW, THWN, OR XHHW.
6. ALL NEW INTERIOR CIRCUITS SHALL BE RAN IN EMT CONDUIT EXPOSED. HOLD CIRCUITS TIGHT TO CEILINGS AND WALLS. DO NOT SUPPORT OFF PIPING OR DUCTWORK. CONDUIT SHALL BE RAN PARALLEL TO BUILDING ELEMENTS AND SHALL BE WELL SUPPORTED.
7. CLEAR, READABLE PANEL DIRECTORIES ARE REQUIRED FOR ALL PANELS.
8. LABEL ALL NEW PANELS, TRANSFORMERS, & DISCONNECT SWITCHES WITH ENGRAVED PLASTIC SIGNS, RED BACKGROUND WITH WHITE LETTERS. USE MINIMUM SIZE OF 4"X2". SCREW OR RIVET TO PANEL. SIGN NEEDS TO GIVE PANEL NAME, AMPERAGE, VOLTAGE, & PHASE.
9. COORDINATE THE LOCATIONS OF ALL ELECTRICAL EQUIPMENT, DEVICES, FIXED EQUIPMENT, ETC. WITH WITH OWNER PRIOR TO ROUGH–IN–WORK. DO NOT SCALE ELECTRICAL DRAWINGS.
10. ELECTRICAL DESIGN PROVIDES A NUMBER OF BRANCH CIRCUITS, PHASES, AMPACITY AND OVERCURRENT PROTECTION CONFORMING TO MANUFACTURER'S SPECIFICATIONS AVAILABLE AT TIME OF DESIGN. IF REQUIREMENTS OF EQUIPMENT ACTUALLY PROVIDED UNDER CONTRACT FOR CONSTRUCTION ARE DIFFERENT, CONTRACTOR SHALL MAKE ALL CHANGES REQUIRED. SUCH CHANGES MAY INCLUDE, BUT ARE NOT LIMITED TO: SIZE OF WIRES, SIZE OF CONDUIT, NUMBER, TYPE AND SIZE OF CIRCUIT BREAKERS, FUSE PROTECTION AND ADDITIONAL DISCONNECT SWITCHES.
11. JUNCTION/PULL BOXES LOCATED AT CEILING SHALL BE INSTALLED FACING DOWN AND SHALL BE ACCESSIBLE AFTER INSTALLATION. COORDINATE WITH OTHER TRADES AND STRUCTURES.
12. EXISTING UTILITIES, ELECTRICAL EQUIPMENT, AND UNDERGROUND OR CONCEALED ITEMS ARE SHOWN FOR REFERENCE ONLY. ADDITIONAL ITEMS NOT SHOWN MAY BE PRESENT AND LOCATIONS MAY DIFFER FROM THAT SHOWN. CONTRACTOR SHALL PERFORM WORK AS TO AVOID DAMAGE TO EXISTING ITEMS, SHALL NOTIFY OWNER AND ENGINEER AT ONCE OF ALL DAMAGE AND SHALL REPAIR DAMAGE TO ORIGINAL CONDITION TO THE SATISFACTION OF OWNER AND ENGINEER.
13. ELECTRICAL CONTRACTOR SHALL VERIFY EQUIPMENT AND CONDUCTOR SIZE PRIOR TO ORDERING AND INSTALLATION OF ANY EQUIPMENT OR CONDUCTORS. REPORT ALL DISCREPANCIES TO THE ENGINEER.
14. CONTRACTOR SHALL PROVIDE SUITABLE MATERIALS AND CONSTRUCTION METHODS TO PREVENT DAMAGE TO CONDUIT SWEEPS RESULTING FROM INSTALLATION OF LARGE CONDUCTORS.
15. PROVIDE GRAY SWITCHES AND OUTLETS WITH STAINLESS STEEL COVERS IN METAL ELECTRICAL BOXES.
16. ALL OUTLETS TO BE RATED AT A MINIMUM OF 20 AMPS.
17. THE CONTRACTOR WILL LABEL THE SERVICE DISCONNECT WITH FOLLOWING " THE MAXIMUM AVAILABLE FAULT CURRENT IS_____ AMPS AND THE CLEARING TIME OF THE FUSED DISCONNECT IS _____ CALCULATED_____, 2025" NOTE: CALCULATED"#" AND DATE TO BE SUPPLIED BY JACOB MARTIN. THE LABEL MUST BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AS STATED IN THE NEC PARAGRAPH 110.24.
18. CONTRACTOR WILL REMOVE ALL CABLE SPLICERS AND TWIST ON WIRE CONNECTORS. THEY ARE TO BE REPLACED WITH CIRCUIT CABLES CONNECTED TO BREAKERS OR FUSES FOR OVERCURRENT PROTECTION AS REQUIRED BY THE NEC.

STATE OF TEXAS
EDWARD R WELLS
66579
LICENSED
PROFESSIONAL ENGINEER
09/19/24

ISSUED FOR BID

JACOB MARTIN
TBPELS FIRM # 10194493
TBAE FIRM # BR 2261
TBPE FIRM # 2448

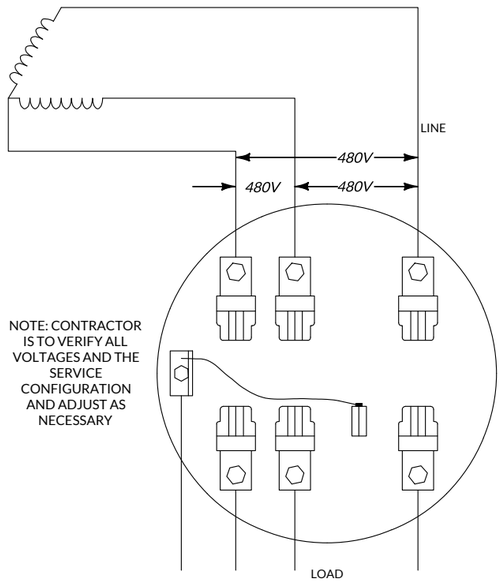
ACKERLY, TEXAS
NEW PWS WELL

ELECTRICAL SITE PLAN

NO.	REVISION	DATE

PROJECT #24263 SCALE 1"=10'
BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

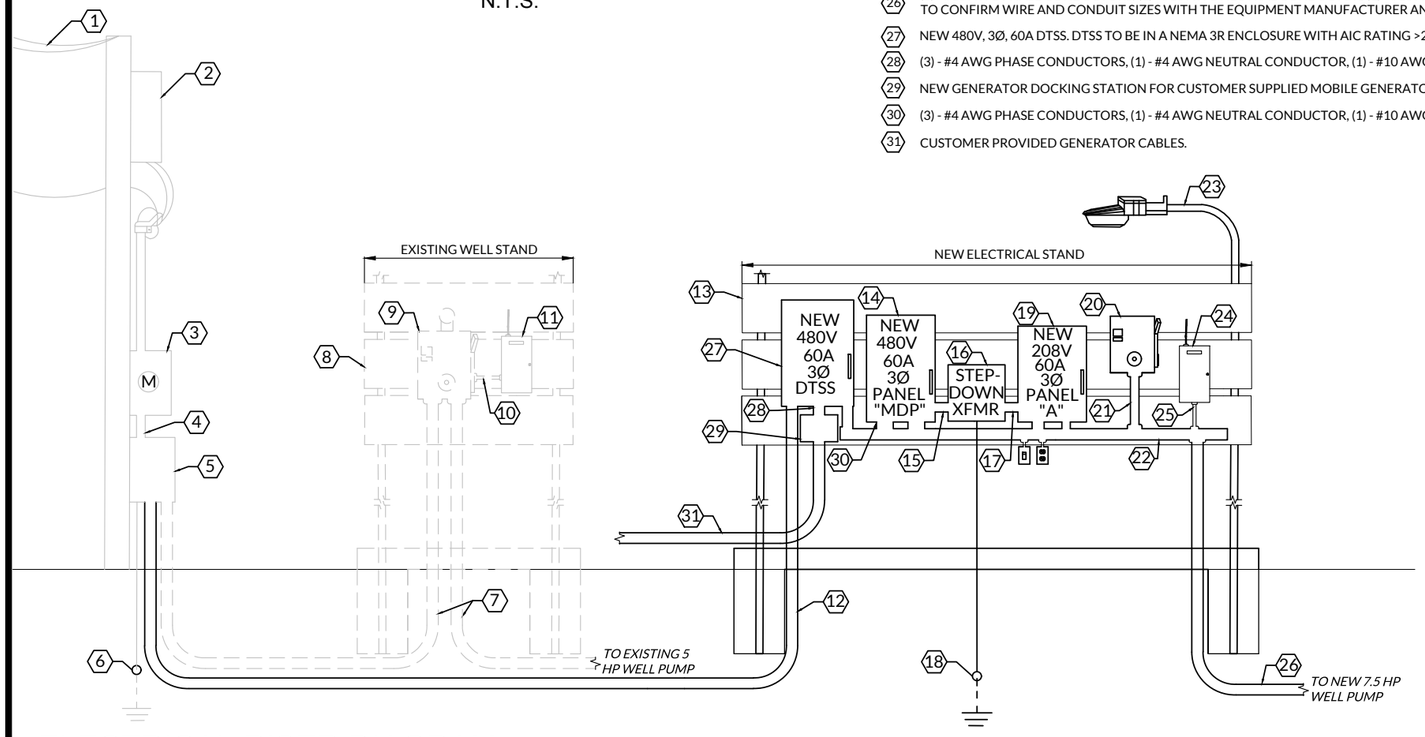
SEQ. 10/13 SHEET E–1



3 WIRE 480V OPEN DELTA SERVICE

EXISTING ONCOR ELECTRICAL SERVICE DETAIL

N.T.S.



ELECTRICAL RISER DIAGRAM

N.T.S.

ELECTRICAL RISER DIAGRAM NOTES BY REFERENCE (#)

1. EXISTING ONCOR OVERHEAD ELECTRICAL PRIMARY IS TO REMAIN.
2. EXISTING ONCOR PRIMARY DEADEND POLE WITH (2) TRANSFORMER BANK FOR EXISTING 480V, 3Ø ELECTRICAL SERVICE IS TO REMAIN.
3. EXISTING ONCOR POLE MOUNTED METER #141641007, WEATHERHEAD, AND MAST IS TO REMAIN.
4. EXISTING WIRING AND CONDUIT BETWEEN METER AND POLE MOUNTED DISCONNECT IS TO REMAIN.
5. EXISTING 480V, 3Ø, 60A FUSED SERVICE RATED POLE MOUNTED DISCONNECT IS TO REMAIN. CONTRACTOR IS TO PROVIDE AND INSTALL A NEUTRAL AND GROUND BAR AS NECESSARY.
6. EXISTING GROUND ROD IS TO REMAIN.
7. EXISTING ABOVE GROUND CONDUIT AND WIRING FROM POLE MOUNTED DISCONNECT TO EXISTING WELL PUMP CONTROL PANEL AND CONTROL PANEL TO WELL PUMP IS TO BE DEMOLISHED BY THE CONTRACTOR. UNDERGROUND CONDUIT IS TO BE ABANDONED IN PLACE. UNDERGROUND WIRING IS TO BE REMOVED IF POSSIBLE.
8. EXISTING WELL ELECTRICAL STAND IS TO BE DEMOLISHED BY THE CONTRACTOR.
9. EXISTING 480V, 3Ø, 5 HP WELL PUMP CONTROL PANEL IS TO BE DEMOLISHED BY THE CONTRACTOR.
10. EXISTING WIRING AND CONDUIT FROM CONTROL PANEL TO SCADA PANEL AND ALL OTHER ASSOCIATED WIRING AND CONDUIT IS TO BE DEMOLISHED BY THE CONTRACTOR.
11. EXISTING SCADA PANEL AND ANTENNA IS TO BE REMOVED BY THE CONTRACTOR AND RETURNED TO THE OWNER.
12. (3) - #4 AWG PHASE CONDUCTORS, (1) - #4 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 1-1/4" CONDUIT FROM DISCONNECT TO NEW DTSS. CONTRACTOR IS TO VERIFY THE CONDUIT ROUTE AND ADJUST AS NECESSARY.
13. NEW ELECTRICAL STAND PROVIDED AND INSTALLED BY THE CONTRACTOR. CONTRACTOR IS TO VERIFY THE WIDTH OF THE ELECTRICAL STAND AND ADJUST AS NECESSARY. REFERENCE SHEET 13 FOR MORE DETAILS ON THE ELECTRICAL STAND AND STAND MOUNTED EQUIPMENT.
14. NEW 480V, 3Ø, 60A PANEL "MDP" IN A 200A FRAME. PANEL IS TO BE IN A NEMA 3R ENCLOSURE .
15. (3) - #10 AWG PHASE CONDUCTORS, (1) - #10 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 3/4" CONDUIT FROM PANEL "MDP" TO NEW STEP-DOWN TRANSFORMER.
16. NEW 480:208/120V, 3Ø, 15 KVA STEP-DOWN TRANSFORMER. BOND NEUTRAL TO GROUND IN THIS PANEL.
17. (3) - #4 AWG PHASE CONDUCTORS, (1) - #4 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 1-1/4" CONDUIT FROM STEP-DOWN TRANSFORMER TO THE NEW PANEL "A".
18. (1) - #8 AWG GROUND IN 1/2" PVC CONDUIT. CADWELD TO 5/8" X 10'-0" COPPER CLAD STEEL GROUND ROD.
19. NEW 208/120V, 3Ø, 60A PANEL "A" IN A 200A FRAME. PANEL IS TO BE IN A NEMA 3R ENCLOSURE.
20. NEW 480V, 3Ø, 7.5 HP WELL PUMP CONTROL PANEL PROVIDED AND INSTALLED BY THE CONTRACTOR.
21. (3) - #10 AWG PHASE CONDUCTORS, (1) - #10 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 3/4" CONDUIT FROM PANEL "MDP" TO THE WELL PUMP CONTROL PANEL. CONTRACTOR IS TO VERIFY THE PANEL SIZE WITH THE PANEL MANUFACTURER AND ADJUST BREAKER, WIRE, AND CONDUIT SIZES AS REQUIRED PER NEC CODE.
22. NEW ELECTRICAL RACEWAY TO BE UTILIZED FOR NEW WIRING.
23. NEW STAND MOUNTED LIGHT PER LIGHTING SCHEDULE. REFERENCE LIGHTING SCHEDULE SHEET 12 AND ELECTRICAL STAND DETAIL SHEET 13 FOR MORE INFORMATION.
24. EXISTING SCADA PANEL IS TO BE MOVED TO THIS STAND BY OTHERS. CONTRACTOR IS TO LEAVE SUFFICIENT ROOM ON THE STAND FOR INSTALLATION OF THE EXISTING SCADA PANEL.
25. NEW CONDUIT AND WIRING FROM PANEL "A" TO THE SCADA PANEL IS TO BE PROVIDED AND INSTALLED BY OTHERS.
26. (3) - #10 AWG PHASE CONDUCTORS, (1) - #10 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 3/4" CONDUIT FROM THE WELL PUMP CONTROL PANEL TO THE NEW 7.5 HP WELL PUMP. CONTRACTOR IS TO CONFIRM WIRE AND CONDUIT SIZES WITH THE EQUIPMENT MANUFACTURER AND ADJUST THE WIRING AND CONDUIT AS NECESSARY TO ENSURE ADEQUATE PUMP OPERATION.
27. NEW 480V, 3Ø, 60A DTSS. DTSS TO BE IN A NEMA 3R ENCLOSURE WITH AIC RATING >21 KA.
28. (3) - #4 AWG PHASE CONDUCTORS, (1) - #4 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 1-1/4" CONDUIT FROM DTSS TO GENERATOR DOCKING STATION.
29. NEW GENERATOR DOCKING STATION FOR CUSTOMER SUPPLIED MOBILE GENERATOR. CONTRACTOR IS TO VERIFY DOCKING STATION WITH OWNER PRIOR TO ORDERING TO ENSURE COMPATIBILITY.
30. (3) - #4 AWG PHASE CONDUCTORS, (1) - #4 AWG NEUTRAL CONDUCTOR, (1) - #10 AWG GROUND IN 1-1/4" CONDUIT FROM DTSS TO PANEL "MDP"
31. CUSTOMER PROVIDED GENERATOR CABLES.

STATE OF TEXAS
EDWARD R. WELLS
66579
LICENSED PROFESSIONAL ENGINEER
09/19/24

ISSUED FOR BID

JACOB MARTIN
TBPELS FIRM # 10194493
TBAE FIRM # BR 2261
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

ELECTRICAL RISER DIAGRAM AND DETAIL

NO.	REVISION	DATE
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PROJECT # 24263 | SCALE NTS

BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

SEQ. 11 | SHEET 13

E-2

City of Ackerly New PWS Well
New Panel "MDP" Schedule

Main Breaker Rating: 60 AMPS
M.L.O. Bus Rating: 200 AMPS
Sym. Inter. Cap.: > 21k AMPS

3 Phase 3 Wire
480V Open Delta

Surface Mount.: X
Flush Mount.:

NEMA 1:
NEMA 3R: X

Conductor Color Code

Phase 1	BROWN
Phase 2	ORANGE
Phase 3	YELLOW
Neutral	WHITE or GRAY
Ground	GREEN

Load	
Phase 1 Load:	29
Phase 2 Load:	29
Phase 3 Load:	29

Contractor is to provide and install a Surge Protective Device (SPD) with this panel.

POLE	SERVICE	W	LOAD PHASE 1	LOAD PHASE 2	LOAD PHASE 3	BREAKER POLES	POLE	1	2	3	POLE	SERVICE	W	LOAD PHASE 1	LOAD PHASE 2	LOAD PHASE 3	BREAKER POLES	POLE
1	New Well Control Panel	9134	11			25 / 3	1	X			2	New 480:240/120V, 3Ø, 15 KVA	15000	18			25 / 3	2
3	for 7.5 HP Well Pump (Note 1)			11			3		X		4	Step-Down Transformer			18			4
5	"				11		5			X	6	"				18		6
7							7	X			8							8
9							9		X		10							10
11							11			X	12							12
13							13	X			14							14
15							15		X		16							16
17							17			X	18							18
19							19	X			20	SPD		X				20
21							21		X		22	SPD			X			22
23							23			X	24	SPD				X		24

Notes:
1. Contractor is to verify the Well Pump Control Panel breaker size with the panel manufacturer and adjust the breaker size in this panel, wiring, and conduit as necessary per NEC code.

City of Ackerly New PWS Well
New Panel "A" Schedule

Main Breaker Rating: 60 AMPS
M.L.O. Bus Rating: 200 AMPS
Sym. Inter. Cap.: AMPS

3 Phase 4 Wire
208/120 VAC

Surface Mount.: X
Flush Mount.:

NEMA 1:
NEMA 3R: X

Conductor Color Code

Phase 1	BLACK
Phase 2	RED
Phase 3	BLUE
Neutral	WHITE or GRAY
Ground	GREEN

Load	
Phase 1 Load:	6
Phase 2 Load:	4
Phase 3 Load:	4

POLE	SERVICE	W	LOAD PHASE 1	LOAD PHASE 2	LOAD PHASE 3	BREAKER POLES	POLE	1	2	3	POLE	SERVICE	W	LOAD PHASE 1	LOAD PHASE 2	LOAD PHASE 3	BREAKER POLES	POLE
1	SCADA Panel (Installed by others) (Note 1)	600	5			20 / 1	1	X			2	Stand mounted light	60	1			20 / 1	2
3	Future Heat Tape (Note 1)	180		2		20 / 1	3		X		4	Stand mounted convenience receptacle	180		2		20 / 1	4
5	Future Heat Tape (Note 1)	180			2	20 / 1	5			X	6	Future Heat Tape (Note 1)	180			2	20 / 1	6
7							7	X			8							8
9							9		X		10							10
11							11			X	12							12
13							13	X			14							14
15							15		X		16							16
17							17			X	18							18

Notes:
1. Contractor is to provide and install the breaker only for these loads. No wiring or conduit is to be installed as part of this contract.

LIGHTING FIXTURE SCHEDULE

FIXTURE MARK	MANUFACTURER & CATALOG NUMBER	TYPE	LAMPS BULBS	VOLTAGE	SUPPORT	NOTES
A	COOPER MODEL #: ALP90LSFUNVDGY	EXTERIOR AREA LIGHT	LED	UNV	STAND MOUNTED	CONTRACTOR IS TO PROVIDE AND INSTALL COOPER CURVED MOUNT MODEL #: EA24 AS REQUIRED FOR MOUNTING. CONTRACTOR IS TO PROVIDE AND INSTALL A SHORTING CAP FOR PHOTOCELL TO OPERATE VIA SINGLE POLE SWITCH.

STATE OF TEXAS
EDWARD R. WELLS
66579
LICENSED PROFESSIONAL ENGINEER
09/19/24

ISSUED FOR BID

JACOB MARTIN
TBPELS FIRM # 10194493
TBAE FIRM # BR 2261
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL
ELECTRICAL SCHEDULES

NO.	REVISION	DATE
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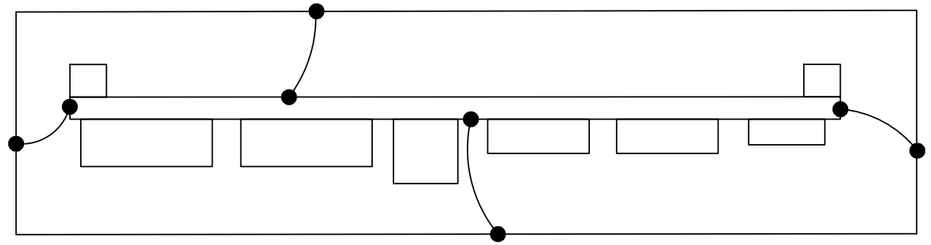
BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING.
CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263
SCALE NTS
SEQ. 12
SHEET 13
E-3

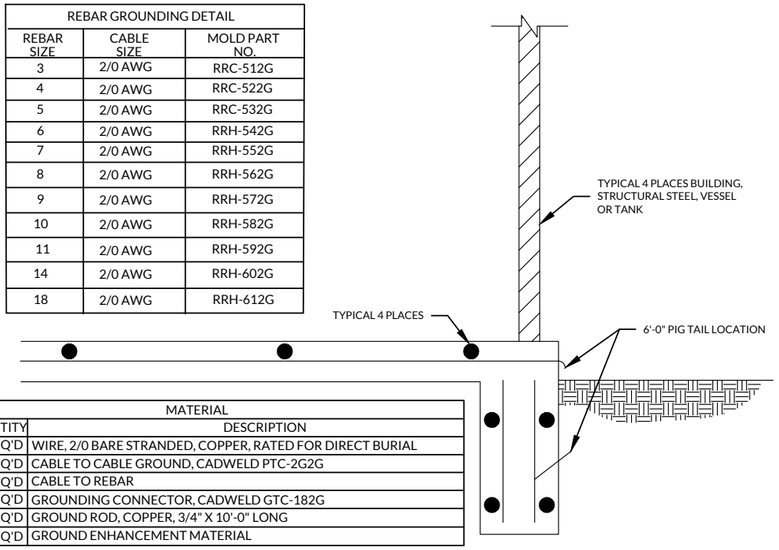


ELECTRICAL WELL STAND GROUNDING PLAN
N.T.S.

L E G E N D

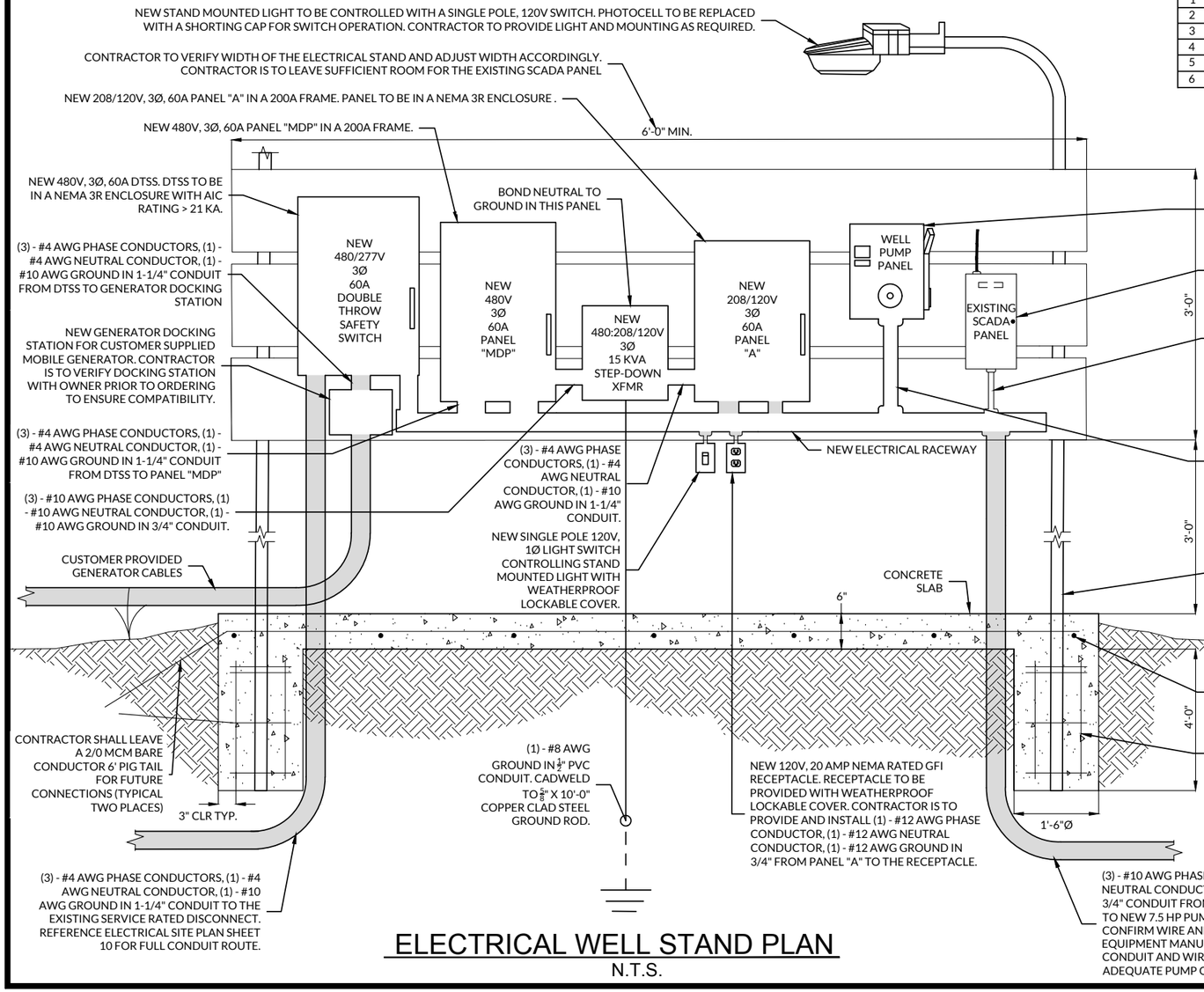
- GROUND CONNECTION
- 4/0 MCM BARE COPPER GROUNDING CONDUCTOR
- 2/0 MCM BARE COPPER GROUNDING CONDUCTOR

REBAR GROUNDING DETAIL		
REBAR SIZE	CABLE SIZE	MOLD PART NO.
3	2/0 AWG	RRC-512G
4	2/0 AWG	RRC-522G
5	2/0 AWG	RRC-532G
6	2/0 AWG	RRH-542G
7	2/0 AWG	RRH-552G
8	2/0 AWG	RRH-562G
9	2/0 AWG	RRH-572G
10	2/0 AWG	RRH-582G
11	2/0 AWG	RRH-592G
14	2/0 AWG	RRH-602G
18	2/0 AWG	RRH-612G

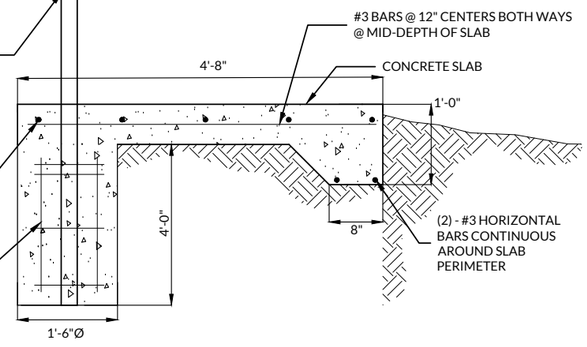


MATERIAL		
ITEM	QUANTITY	DESCRIPTION
1	AS REQ'D	WIRE, 2/0 BARE STRANDED, COPPER, RATED FOR DIRECT BURIAL
2	AS REQ'D	CABLE TO CABLE GROUND, CADWELD PTC-2G2G
3	AS REQ'D	CABLE TO REBAR
4	AS REQ'D	GROUNDING CONNECTOR, CADWELD GTC-182G
5	AS REQ'D	GROUND ROD, COPPER, 3/4" X 10'-0" LONG
6	AS REQ'D	GROUND ENHANCEMENT MATERIAL

GROUND LOOP DETAIL
N.T.S.



ELECTRICAL WELL STAND PLAN
N.T.S.



ELECTRICAL WELL STAND PLAN (SIDE VIEW)
N.T.S.

STATE OF TEXAS
EDWARD R. WELLS
66579
LICENSED PROFESSIONAL ENGINEER
09/19/24

ISSUED FOR BID

JACOB MARTIN
TBPELS FIRM # 10194493
TBAE FIRM # BR 2261
TBPE FIRM # 2448

ACKERLY, TEXAS
NEW PWS WELL

ELECTRICAL STAND DETAILS

NO.	REVISION	DATE
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BAR IS ONE INCH IN LENGTH ON ORIGINAL DRAWING. CHECK SCALE AND ADJUST ACCORDINGLY.

PROJECT # 24263 | SCALE NTS

SEQ. 13 / 13 | SHEET E-4

SECTION 01 03 01 - MEASUREMENT AND PAYMENT

PART 1 PAYMENT ITEMS

1.1 LUMP SUM PAYMENT ITEMS

A. Payment items for the work of this contract for which contract lump sum payments will be made are listed in the BIDDING SCHEDULE and described below. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

1.2 REFERENCE STANDARDS

1.3 DRILL AND COMPLETE NEW WATER WELL

A. PAYMENT
Payment shall be made for costs asssociated with operations necessary to furnish and install drilling, casing, gravel pack, cement seal, well development, test pumping, chemical water sampling, etc. CONTRACTOR shall prepare all TCEQ required completion data furnish it to the engineer for submission to TCEQ.

B. Unit of measure: LUMP SUM

1.4 MOBILIZATION

A. PAYMENT
The measurement and Payment item shall be measured and paid for according to the lump sum in the bid proposal. Payment shall constitute full reimbursment for all mobilization to the site. Bonds and Insurance shall be included.

B. Unit of measure: LUMP SUM

1.5 SUBMERSIBLE PUMP

A. PAYMENT
Payment shall be made for cost associated with operations necessary to furnish and install permanent 80 gpm submersible pumping unit set at 175' with pipe, wire, control panel, well disinfection and bacteriological testing.

B. Unit of measurement: LUMP SUM

1.6 WELL HEAD

A. PAYMENT
Payment shall be made for cost associated with operations necessary to furnish and install concrete well slab and wellhead improvements (valves, flow meter, piping, ect.) as specified and shown in the plans.

B. Unit of measure: LUMP SUM

1.7 ELECTRICAL

A. PAYMENT
Payment shall be made for cost associated with operations necessary to furnish and install new electrical conduit and conductors from the existing service pole as well as connecting to the existing disconnect, new electrical stand, panels, generator plug in, startup, and all other eledctrical compnents at the well site.

B. Unit of measure: LUMP SUM

1.8 PLUGGING EXISTING WELL

A. PAYMENT
Payment shall be made for cost associated with operations necessary to abandon and plug the existing well as well as submit the state plugging report.

B. Unit of measure: LUMP SUM

1.9 UNIT PRICE PAYMENT ITEMS

A. Payment items for the work of this contract on which the contract unit price payments will be made are listed in the BIDDING SCHEDULE and described below. The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items.

1.10 WATER LINE

A. PAYMENT
Payment will be made for costs associated with operations necessary to furnish and install water line as specified and shown on the Plans. Water pipelines shall be measured and paid for at the unit prices for each size and class of water pipeline, which payment shall include trenching, laying, bedding, jointing, backfilling, connection to or plugging of existing water lines and furnishing water pipelines, fittings, couplings and accessories as specified, including labor, equipment, testing, sterilization, cleanup and supervision necessary to complete the water pipeline and place the water system in operation in accordance with these Specifications and may be directed by the ENGINEER.
No extra payment shall be made for special backfill in public ROW or gravel repair and asphalt repair. These shall be considered subsidiary to the pipeline installation and reimbursement for these items shall be included in the price bid for furnishing and installing the water line.
* Asphat repair shall be paid under the item "Asphalt Repair".

B. Unit of measure: LINEAR FOOT

1.11 GATE VALVES

A. PAYMENT
Payment will be made for costs associated with operations necessary to furnish and install gate valves as specified and shown on the Plans. Gate valves, tapping valves, and sleeves with Valve Boxes shall be measured and paid for at the unit price bid for each size valve, and incidentals furnished and installed.

B. Unit of measure: EACH

1.12 WATER LINE CONNECTIONS

A. PAYMENT
Payment will be made for costs associated with operations necessary to furnish and install water line connections as specified and shown on the Plans. Water line connections including piping, fittings, and coupling shall be measured and paid for at the unit price bid for each size and type of water line connection and incidentals furnished and installed.

B. Unit of measure: EACH

PART 2 NOT USED

PART 3 NOT USED

-- END OF SECTION --

THE FOLLOWING SECTIONS WERE PREPARED BY EDWARD R. WELLS, P.E. WITH JACOB|MARTIN

DIVISION 26 - ELECTRICAL

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September 19, 2024

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Underground feeder and branch-circuit cable.
D. Service entrance cable.
E. Armored cable.
F. Metal-clad cable.
G. Power and control tray cable.
H. Variable-frequency drive cable.
I. Manufactured wiring systems.
J. Wiring connectors.
K. Electrical tape.
L. Heat shrink tubing.
M. Oxide inhibiting compound.
N. Wire pulling lubricant.
O. Cable ties.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2015).
F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2016.
G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
I. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.
J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
K. NECA 104 - Liquefied Petroleum Gas Code; 2014, with 2015 Amendments.
L. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
M. NECA 121 - Energy-Efficient Design of Low-Rise Residential Buildings; 2007, Including All Addenda.

N. NEMA WC 70 - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
O. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
P. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
Q. UL 4 - Armored Cable; Current Edition, Including All Revisions.
R. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
S. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
T. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
U. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
V. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
W. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
X. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
Y. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
Z. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.
AA. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
BB. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.
CC. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
B. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
C. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
H. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.
   1. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
      b. Use power and control tray cable or metal-clad cable for installation in cable tray.
C. Nonmetallic-sheathed cable is not permitted.
D. Underground feeder and branch-circuit cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For damp, wet, or corrosive locations as a substitute for NFPA 70, Type NMC nonmetallic-sheathed cable, when nonmetallic-sheathed cable is permitted.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view.
      b. Where exposed to damage.
E. Service entrance cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For overhead service drop, installed in raceway to service head.
      b. For underground service entrance, installed in raceway.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to damage.
F. Armored cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:

a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
1) Maximum Length: 6 feet.
b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
c. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
2. In addition to other applicable restrictions, may not be used:
a. Unless approved by OWNER.
b. Where not approved for use by the authority having jurisdiction.
c. Where exposed to damage.
d. For damp, wet, or corrosive locations.
e. For isolated ground circuits.

G. Metal-clad cable is permitted only as follows:
1. Where not otherwise restricted, may be used:
a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
1) Maximum Length: 6 feet.
b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
2. In addition to other applicable restrictions, may not be used:
a. Unless approved by OWNER.
b. Where not approved for use by the authority having jurisdiction.
c. Where exposed to damage.
d. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
e. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.
f. For patient care areas of health care facilities requiring redundant grounding.

H. Manufactured wiring systems are permitted only as follows:
1. Where not otherwise restricted, may be used:
a. For branch circuits where concealed under raised floors, where concealed above accessible ceilings for lighting, and in open ceiling areas for lighting.
1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
b. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
2. In addition to other applicable restrictions, may not be used:
a. Unless approved by OWNER.
b. Where not approved for use by the authority having jurisdiction.
c. Where exposed to view.
d. Where exposed to damage.
e. For damp, wet, or corrosive locations.
f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.
B. Provide products listed, classified, and labeled as suitable for the purpose intended.
C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
E. Comply with NEMA WC 70.
F. Comply with FS A-A-59544 where applicable.
G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
I. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
J. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
K. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
L. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
M. Conductor Material:
    1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
    2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
    3. Tinned Copper Conductors: Comply with ASTM B33.
N. Minimum Conductor Size:
    1. Branch Circuits: 12 AWG.
        a. Exceptions:
            1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
            2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
            3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
    2. Control Circuits: 14 AWG.
O. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
P. Conductor Color Coding:
    1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
    2. Color Coding Method: Integrally colored insulation.
        a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
    3. Color Code:
        a. 480Y/277 V, 3 Phase, 4 Wire System:
            1) Phase A: Brown.
            2) Phase B: Orange.
            3) Phase C: Yellow.
            4) Neutral/Grounded: Gray.
        b. 208Y/120 V, 3 Phase, 4 Wire System:
            1) Phase A: Black.
            2) Phase B: Red.
            3) Phase C: Blue.
            4) Neutral/Grounded: White.
        c. Equipment Ground, All Systems: Green.
        d. Isolated Ground, All Systems: Green with yellow stripe.
        e. Travelers for 3-Way and 4-Way Switching: Pink.
        f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

g. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. General Cable Technologies Corporation: www.generalcable.com/#sle.
      d. Southwire Company: www.southwire.com/#sle.
      e. Substitutions: Submit Manufacture's Data Sheet for Approval.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
      a. Encore Wire Corporation: www.encorewire.com/#sle.
      b. Southwire Company: www.southwire.com/#sle.
      c. Stabiloy, a brand of General Cable Technologies Corporation; _____: www.stabiloy.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Description: Single conductor insulated wire.
C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.
D. Insulation Voltage Rating: 600 V.
E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.4 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.
C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.
D. Insulation Voltage Rating: 600 V.

2.5 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
C. Provide equipment grounding conductor unless otherwise indicated.
D. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.

2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.6 SERVICE ENTRANCE CABLE

A. Manufacturers:
   1. Copper Service Entrance Cable:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Service Entrance Cable for Above-Ground Use: NFPA 70, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.

C. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

2.7 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
   1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.8 METAL-CLAD CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Provide dedicated neutral conductor for each phase conductor where indicated or required.

H. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

I. Armor: Steel, interlocked tape.
J. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.9 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
   1. Encore Wire Corporation: www.encorewire.com/#sle.
   2. General Cable Technologies Corporation: www.generalcable.com/#sle.
   3. Okonite: www.okonite.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.
C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.
D. Conductor Stranding: Stranded.
E. Insulation Voltage Rating: 600 V.
F. Insulation: Type XHHW or XHHW-2.
G. Grounding: Full-size integral equipment grounding conductor.
H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.10 MANUFACTURED WIRING SYSTEMS

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. D&P Custom Lights & Wiring Systems, Inc: www.dandpcustomlights.com/#sle.
   3. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
   4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   5. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.
C. Provide components necessary to transition between manufactured wiring system and other wiring methods.
D. Branch Circuit Cables:
   1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
   2. Insulation Voltage Rating: 600 V.
   3. Insulation: Type THHN.
   4. Provide dedicated neutral conductor for each phase conductor where indicated or required.
   5. Grounding: Full-size integral equipment grounding conductor.
      a. Provide additional isolated/insulated grounding conductor where indicated or required.
      b. Provide redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities<> where indicated or required.
   6. Armor: Steel, interlocked tape.
E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.
F. Fixture Leads: Type TFN insulation.
G. Product(s):
   1. Substitutions: Submit Manufacture's Data Sheet for Approval.

2.11 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
C. Wiring Connectors for Splices and Taps:
    1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
    2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
D. Wiring Connectors for Terminations:
    1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
    2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
    3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
    4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
    5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
    6. Aluminum Conductors: Use compression connectors for all connections.
    7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
    8. Conductors for Control Circuits: Use crimped terminals for all connections.
E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
    1. Manufacturers:
        a. 3M: www.3m.com/#sle.
        b. Ideal Industries, Inc: www.idealindustries.com/#sle.
        c. NSI Industries LLC: www.nsiindustries.com/#sle.
        d. Substitutions: Submit Manufacture's Data Sheet for Approval.
H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
    1. Manufacturers:
        a. Ideal Industries, Inc: www.idealindustries.com/#sle.
        b. NSI Industries LLC: www.nsiindustries.com/#sle.
        c. Wago Corporation: www.wago.us/#sle.
        d. Substitutions: Submit Manufacture's Data Sheet for Approval.
I. Mechanical Connectors: Provide bolted type or set-screw type.
    1. Manufacturers:
        a. Burndy LLC: www.burndy.com.
        b. Ilsco: www.ilsco.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: Submit Manufacture's Data Sheet for Approval.
J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
    1. Manufacturers:
        a. Burndy LLC: www.burndy.com.
        b. Ilsco: www.ilsco.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: Submit Manufacture's Data Sheet for Approval.
K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
    1. Manufacturers:
        a. Burndy LLC: www.burndy.com.

b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: Submit Manufacture's Data Sheet for Approval.

2.12 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
c. Substitutions: Submit Manufacture's Data Sheet for Approval.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
a. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Burndy LLC: www.burndy.com.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: Submit Manufacture's Data Sheet for Approval.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC: www.burndy.com.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.
d. Substitutions: Submit Manufacture's Data Sheet for Approval.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. American Polywater Corporation: www.polywater.com/#sle.
c. Ideal Industries, Inc: www.idealindustries.com/#sle.
d. Substitutions: Submit Manufacture's Data Sheet for Approval.

E. Cable Ties: Material and tensile strength rating suitable for application.

1. Manufacturers:
   a. Burndy LLC: www.burndy.com.
   b. Substitutions: Submit Manufacture's Data Sheet for Approval.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.
B. Verify that work likely to damage wire and cable has been completed.
C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
D. Verify that field measurements are as indicated.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
B. Install products in accordance with manufacturer's instructions.
C. Perform work in accordance with NECA 1 (general workmanship).
D. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.
E. Install armored cable (Type AC) in accordance with NECA 120.
F. Install metal-clad cable (Type MC) in accordance with NECA 120.
G. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
H. Exposed Cable Installation (only where specifically permitted):
   1. Route cables parallel or perpendicular to building structural members and surfaces.
   2. Protect cables from physical damage.
I. Direct Burial Cable Installation:
   1. Install cable with minimum cover of 24 inches unless otherwise indicated or required.
   2. Protect cables from damage in accordance with NFPA 70.
   3. Provide underground warning tape in accordance with Section 26 05 53 along entire cable length.

J. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
K. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
    1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
    2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
L. Terminate cables using suitable fittings.
    1. Armored Cable (Type AC):
        a. Use listed fittings and anti-short, insulating bushings.
        b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
    2. Metal-Clad Cable (Type MC):
        a. Use listed fittings.
        b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
M. Install conductors with a minimum of 12 inches of slack at each outlet.
N. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
O. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
P. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
Q. Make wiring connections using specified wiring connectors.
    1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
    2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
    3. Do not remove conductor strands to facilitate insertion into connector.
    4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
    5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
    6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
R. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
    1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
        b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
    2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.

b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

S. Insulate ends of spare conductors using vinyl insulating electrical tape.

T. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

U. Identify conductors and cables in accordance with Section 26 05 53.

V. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.
F. Chemically-enhanced ground electrodes.
G. Ground enhancement material.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
F. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2017.
G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
C. Field quality control test reports.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
D. Grounding System Resistance:
    1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
    2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
    3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
E. Grounding Electrode System:
    1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    2. Metal Underground Water Pipe(s):
        a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
        b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
        c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
    3. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
F. Service-Supplied System Grounding:
    1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
    2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
G. Bonding and Equipment Grounding:
    1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
    2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
    3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
    4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
    5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
8. Provide bonding for metal building frame.
9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

H. Lightning Protection Systems, in Addition to Requirements of Section 26 41 13:
   1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
   2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).
   2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: 5/8" diameter X 10' long copper clad ground rod unless otherwise indicated or required.
   3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 5/8 inch diameter by 10 feet length, unless otherwise indicated.
   4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.

F. Chemically-Enhanced Ground Electrodes:
   1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
   2. Length: 10 feet.
   3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
   4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.

5. Manufacturers:
   a. Advanced Lightning Technology (ALT): www.altfab.com.
   b. Erico International Corporation: www.erico.com.
   c. Harger Lightning & Grounding: www.harger.com.
   d. thermOweld®, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

G. Ground Enhancement Material:
   1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
   2. Resistivity: Not more than 20 ohm-cm in final installed form.
   3. Manufacturers:
      a. Erico International Corporation: www.erico.com.
      b. Harger Lightning & Grounding: www.harger.com.
      c. thermOweld®, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.
B. Verify that field measurements are as indicated.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
E. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect and test in accordance with NETA ATS except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
B. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
C. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
D. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
E. Section 26 51 33 - Luminaires and Drivers - Lutron: Additional support and attachment requirements for luminaires.
F. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
D. MFMA-4 - Metal Framing Standards Publication; 2004.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
F. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete

and masonry anchors.

C. Installer's Qualifications: Include evidence of compliance with specified requirements.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
      c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
      d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
      e. Outlet Boxes: 1/4 inch diameter.
      f. Luminaires: 1/4 inch diameter.

F. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Plastic and lead anchors are not permitted.
   3. Hammer-driven anchors and fasteners are not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
H. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
I. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
J. Conduit Support and Attachment: Also comply with Section 26 05 33.13.
K. Box Support and Attachment: Also comply with Section 26 05 33.16.
L. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
M. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.
N. Secure fasteners according to manufacturer's recommended torque settings.
O. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect support and attachment components for damage and defects.
C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Intermediate metal conduit (IMC).
C. Flexible metal conduit (FMC).
D. Liquidtight flexible metal conduit (LFMC).
E. Electrical metallic tubing (EMT).
F. Rigid polyvinyl chloride (PVC) conduit.
G. Electrical nonmetallic tubing (ENT).
H. Reinforced thermosetting resin conduit (RTRC).
I. Conduit fittings.
J. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
    1. Includes additional requirements for fittings for grounding and bonding.
D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
E. Section 26 05 33.16 - Boxes for Electrical Systems.
F. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
G. Section 26 05 33.16 - Boxes for Electrical Systems.
H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
I. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
J. Section 31 23 16 - Excavation.
K. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
L. Section 31 23 23 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2015.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
H. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
I. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014.
J. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
K. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
N. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
S. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
T. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
U. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use rigid PVC conduit.

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use rigid PVC conduit.
2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Hollow Stud Walls: Use FMC or Nonmetallic sheathed cable. Where nonmetallic sheathed cables pass through factory or field punched holes in metal studs the cable shall be protedted with listed grobushings or grommets cover all metal edges and securley fastened in the opening..

F. Concealed Above Accessible Ceilings: Use FMC (Flexible Metal Conduit).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
1. Locations subject to physical damage include, but are not limited to:
a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

L. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit, aluminum rigid metal conduit, or reinforced thermosetting resin conduit (RTRC).

M. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.

N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.

O. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
a. Transformers.
b. Motors.

c. HVAC.

P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.2 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 26 21 00.

C. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.

D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

E. Provide products listed, classified, and labeled as suitable for the purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 1/2 inch (16 mm) trade size.
2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
3. Control Circuits: 1/2 inch (16 mm) trade size.
4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
5. Underground, Interior: 3/4 inch (21 mm) trade size.
6. Underground, Exterior: 1 inch (27 mm) trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com/#sle.
4. Substitutions: Submit Manufacture's Data Sheet for Approval..

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: Submit Manufacture's Data Sheet for Approval..
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com/#sle.
4. Substitutions: Submit Manufacture's Data Sheet for Approval..

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:

a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: Not permitted.
e. Substitutions: Not permitted.

2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval..
B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval..
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval..
B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval..
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.

2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval..
B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval..
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
   6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle: www.jmeagle.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval..
B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
B. Supports: Per manufacturer's recommendations.
C. Fittings: Same type and manufacturer as conduit to be connected.

2.10 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
   1. Substitutions: See Section 01 60 00 - Product Requirements.
B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
   1. Substitutions: Submit Manufacture's Data Sheet for Approval..
C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
    1. Substitutions: Submit Manufacture's Data Sheet for Approval..

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive conduits.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
G. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.
H. Conduit Routing:
    1. Unless dimensioned, conduit routing indicated is diagrammatic.
    2. When conduit destination is indicated without specific routing, determine exact routing required.
    3. Conceal all conduits unless specifically indicated to be exposed.
    4. Conduits in the following areas may be exposed, unless otherwise indicated:
        a. Electrical rooms.
        b. Mechanical equipment rooms.
        c. Within joists in areas with no ceiling.
    5. Unless otherwise approved, do not route conduits exposed:
        a. Across floors.
        b. Across roofs.
        c. Across top of parapet walls.
        d. Across building exterior surfaces.
    6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
    7. Arrange conduit to maintain adequate headroom, clearances, and access.
    8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
    9. Arrange conduit to provide no more than 150 feet between pull points.
    10. Route conduits above water and drain piping where possible.
    11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
    12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
    13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
        a. Heaters.
        b. Hot water piping.
    14. Group parallel conduits in the same area together on a common rack.
I. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use of spring steel conduit clips for support of conduits is not permitted.
9. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

L. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
   3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
   4. Where conduits are subject to earth movement by settlement or frost.

N. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

O. Provide grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

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SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
C. Boxes for hazardous (classified) locations.
D. Floor boxes.
E. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.
B. Section 07 84 00 - Firestopping.
C. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
F. Section 26 05 33.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
G. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
   1. Accessory boxes designed specifically for surface raceway systems.
   2. Lay-in wireways and wiring troughs with removable covers.
H. Section 26 05 39 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.
I. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
J. Section 26 27 26 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Poke-through assemblies.
   4. Access floor boxes.
   5. Additional requirements for locating boxes for wiring devices.
K. Section 26 28 13 - Fuses: Spare fuse cabinets.
L. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.
M. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
G. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
M. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. All boxes and cabinets shall be steel. Do not use plastic boxes.
C. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use suitable concrete type boxes where flush-mounted in concrete.
   6. Use suitable masonry type boxes where flush-mounted in masonry walls.
   7. Use raised covers suitable for the type of wall construction and device configuration where required.
   8. Use shallow boxes where required by the type of wall construction.
   9. Do not use "through-wall" boxes designed for access from both sides of wall.
   10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
   14. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
      b. Communications Systems Outlets: Comply with Section 27 10 00.
      c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
   15. Wall Plates: Comply with Section 26 27 26.
   16. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
      b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
      c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
      d. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      e. Thomas & Betts Corporation: www.tnb.com.
      f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
      a. Indoor Clean, Dry Locations: Type 1, painted steel.
      b. Outdoor Locations: Type 3R, painted steel.
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
      a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
      b. Back Panels: Painted steel, removable.
      c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
   5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
   6. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
      b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com.

c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com.
d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
a. Appleton, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com.
d. Substitutions: See Section 01 60 00 - Product Requirements.

E. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

F. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
a. Manufacturers:
1) Highline Products, a subsidiary of MacLean Power Systems: www.highlineproducts.com.
2) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
3) Oldcastle Precast, Inc: www.oldcastleprecast.com.
4) Substitutions: See Section 01 60 00 - Product Requirements.
b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
c. Product(s):
1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive boxes.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide separate boxes for emergency power and normal power systems.
E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
H. Box Locations:
    1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
    2. Unless dimensioned, box locations indicated are approximate.
    3. Locate boxes as required for devices installed under other sections or by others.
        a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
        b. Communications Systems Outlets: Comply with Section 27 10 00.
    4. Locate boxes so that wall plates do not span different building finishes.
    5. Locate boxes so that wall plates do not cross masonry joints.
    6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
    7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
    8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
    9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
        a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
        b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
    10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
    11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
        a. Concealed above accessible suspended ceilings.
        b. Within joists in areas with no ceiling.
        c. Electrical rooms.
        d. Mechanical equipment rooms.
I. Box Supports:
    1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
    2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
    3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

P. Underground Boxes/Enclosures:
   1. Install enclosure on gravel base, minimum 6 inches deep.
   2. Flush-mount enclosures located in concrete or paved areas.
   3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
   4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
   5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

S. Close unused box openings.

T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

U. Provide grounding and bonding in accordance with Section 26 05 26.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
B. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

1.3 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
C. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
    1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
    2. Do not install identification products until final surface finishes and painting are complete.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.6 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
    1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
        a. Panelboards:
            1) Identify ampere rating.
            2) Identify voltage and phase.
            3) Identify power source and circuit number. Include location when not within sight of equipment.
            4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
            5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

c. Time Switches:
1) Identify load(s) served and associated circuits controlled. Include location.

d. Enclosed Contactors:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
4) Identify coil voltage.
5) Identify load(s) and associated circuits controlled. Include location.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. Emergency System Equipment:
a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

4. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
a. Service equipment.
b. Industrial control panels.
c. Motor control centers.
d. Elevator control panels.
e. Industrial machinery.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
a. At each source and load connection.
b. Within boxes when more than one circuit is present.
c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.

D. Identification for Devices:

1. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Manufacturers:
      a. Brimar Industries, Inc: www.brimar.com/#sle.
      b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
      c. Seton Identification Products: www.seton.com.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval.
   2. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
      a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
   4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
   5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
   6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com.
      b. Brother International Corporation: www.brother-usa.com/#sle.
      c. Panduit Corp: www.panduit.com/#sle.
      d. Substitutions: Submit Manufacture's Data Sheet for Approval.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.3 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. HellermannTyton: www.hellermanntyton.com.
   3. Panduit Corp: www.panduit.com/#sle.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
   1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Minimum Size:
   1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
C. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
D. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
   1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
E. Legend: Type of service, continuously repeated over full length of tape.
F. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: Submit Manufacture's Data Sheet for Approval.
B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.
D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
      a. Do not use labels designed to be completed using handwritten text.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Conductors and Cables: Legible from the point of access.
   9. Devices: Outside face of cover.
C. Install identification products centered, level, and parallel with lines of item being identified.
D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
G. Secure rigid signs using stainless steel screws.
H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

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SECTION 26 05 73 - POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Short-circuit study.
B. Protective device coordination study.
C. Arc flash and shock risk assessment.
D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 RELATED REQUIREMENTS

A. Section 26 24 16 - Panelboards.
B. Section 26 28 16.13 - Enclosed Circuit Breakers.
C. Section 26 28 16.16 - Enclosed Switches.

1.3 REFERENCE STANDARDS

A. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaff 1999).
B. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata, 2003.
C. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
D. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
E. NEMA MG 1 - Motors and Generators; 2021.
F. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
G. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
    2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
    3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Study reports, stamped or sealed and signed by study preparer.

1.6 POWER SYSTEM STUDIES

A. Scope of Studies:
    1. Perform analysis of new electrical distribution system as indicated on drawings.
    2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
    3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
        a. Known Operating Modes:
            1) Utility as source.
            2) Generator as source.
B. General Study Requirements:
    1. Comply with NFPA 70.

2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
   a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      1) Obtain up-to-date information from Utility Company.
      2) Utility Company: As indicated on drawings.
   b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
   c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
   d. Protective Devices:
      1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
   e. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
   f. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
   a. Maximum utility fault currents.
   b. Maximum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.
   b. Maximum and minimum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
a. Identify date of study and study preparer.
b. Identify study methodology and software product(s) used.
c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
d. Identify base used for per unit values.
e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
f. Include conclusions and recommendations.
2. Short-Circuit Study:
a. For each scenario, identify at each bus location:
1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
2) Fault point X/R ratio.
3) Associated equipment short circuit current ratings.
b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
b. For each graph include (where applicable):
1) Partial single-line diagram identifying the portion of the system illustrated.
2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
3) Conductors: Damage curves.
4) Transformers: Inrush points and damage curves.
5) Motors: Full load current, starting curves, and damage curves.
c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
2) Include ground fault pickup and delay.
3) Include fuse ratings.
4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
a. For the worst case for each scenario, identify at each bus location:
1) Calculated incident energy and associated working distance.
2) Calculated arc flash boundary.
3) Bolted fault current.
4) Arcing fault current.
5) Clearing time.
6) Arc gap distance.
b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.7 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum three years experience in the preparation of studies of similar type and complexity using specified computer software.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

END OF SECTION

SECTION 26 05 83 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
B. Section 26 05 33.13 - Conduit for Electrical Systems.
C. Section 26 05 33.16 - Boxes for Electrical Systems.
D. Section 26 27 26 - Wiring Devices.
E. Section 26 28 16.16 - Enclosed Switches.
F. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).
B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
C. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.
B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.
C. Wiring Devices: As specified in Section 26 27 26.
D. Flexible Conduit: As specified in Section 26 05 33.13.
E. Wire and Cable: As specified in Section 26 05 19.
F. Boxes: As specified in Section 26 05 33.16.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.
B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
D. Provide receptacle outlet to accommodate connection with attachment plug.
E. Provide cord and cap where field-supplied attachment plug is required.
F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
H. Install terminal block jumpers to complete equipment wiring requirements.
I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.
B. Lighting and appliance panelboards.
C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 26 43 00 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Revision E with Supplement 1, 2013.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
G. NEMA PB 1 - Panelboards; 2011.
H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
J. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
M. UL 67 - Panelboards; Current Edition, Including All Revisions.
N. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
P. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
Q. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
R. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
S. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
B. Field Quality Control Test Reports.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
   2. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.
B. General Electric Company: www.geindustrial.com.
C. Schneider Electric; Square D Products: www.schneider-electric.us.
D. Siemens Industry, Inc: www.usa.siemens.com.
E. Substitutions: Submit Manufacture's Data Sheet for Approval.
F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained

from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.
B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
      b. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
H. Conductor Terminations: Suitable for use with the conductors to be installed.
I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.
J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.
L. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
   1. Ampere Rating: Not less than ampere rating of panelboard bus.
   2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
   3. Coil Voltage: As required for connection to control system indicated.
M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
    a. Use zero sequence ground fault detection method unless otherwise indicated.
    b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

N. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Mechanical.
C. Bussing:
1. Phase and Neutral Bus Material: Copper.
2. Ground Bus Material: Copper.
D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
2. Provide thermal magnetic circuit breakers unless otherwise indicated.
3. Provide electronic trip circuit breakers where indicated.
E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Mechanical.
C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Copper.
3. Ground Bus Material: Copper.
D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.
F. Provide column-width panelboards with accessory column-width cable trough and pullbox where indicated.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.

2. Fuse Clips: As required to accept indicated fuses.
   a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
4. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Provide compression lugs where indicated.
   c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 14,000 rms symmetrical amperes at 480 VAC.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Provide compression lugs where indicated.
   c. Lug Material: Copper, suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
      5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
11. Provide the following features and accessories where indicated or where required to complete installation:

a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.6 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive panelboards.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
E. Provide required supports in accordance with Section 26 05 29.
F. Install panelboards plumb.
G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
I. Provide grounding and bonding in accordance with Section 26 05 26.
    1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
    2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
J. Install all field-installed branch devices, components, and accessories.
K. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
L. Set field-adjustable circuit breaker tripping function settings as indicated.
M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
N. Provide filler plates to cover unused spaces in panelboards.
O. Identify panelboards in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.
D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
E. Test GFCI circuit breakers to verify proper operation.
F. Test AFCI circuit breakers to verify proper operation.
G. Test shunt trips to verify proper operation.
H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.
C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.
B. Wall dimmers.
C. Receptacles.
D. Wall plates.
E. Access floor boxes.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
C. Section 26 0535 - Surface Raceways: Surface raceway systems, including multioutlet assemblies.
D. Section 26 05 33.16 - Boxes for Electrical Systems.
E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
F. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.

1.3 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Revision H, 2014.
B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Revision G, 2014.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R2015).
F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
G. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
    2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
    3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
    4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
    5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.

6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
E. Provide GFCI protection for receptacles installed in kitchens.
F. Provide GFCI protection for receptacles serving electric drinking fountains.
G. Unless noted otherwise, do not use combination switch/receptacle devices.

2.2 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.
B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
F. Isolated Ground Convenience Receptacles: Orange.
G. Surge Protection Receptacles: Blue.
H. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
I. Clock Hanger Receptacles: Brown with stainless steel wall plate.
J. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.
K. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.
L. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.
M. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.3 WALL SWITCHES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
4. Substitutions: Submit Manufacture's Data Sheet for Approval.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.4 RECEPTACLES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
5. Substitutions: Submit Manufacture's Data Sheet for Approval.
6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
3. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.5 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com.

2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Lutron Electronics Company, Inc: www.lutron.com/sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
5. Substitutions: Submit Manufacture's Data Sheet for Approval.
6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.
   4. Provide screwless wallplates with concealed mounting hardware where indicated.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

F. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that openings in access floor are in proper locations.

I. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches above finished floor.
      b. Wall Dimmers: 48 inches above finished floor.
      c. Receptacles: 18 inches above finished floor or 6 inches above counter.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.
D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
K. Install wiring devices plumb and level with mounting yoke held rigidly in place.
L. Install wall switches with OFF position down.
M. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
N. Do not share neutral conductor on branch circuits utilizing wall dimmers.
O. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
P. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
Q. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
R. Identify wiring devices in accordance with Section 26 05 53.
S. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect each wiring device for damage and defects.
C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
D. Test each receptacle to verify operation and proper polarity.
E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
F. Inspect each surge protection receptacle to verify surge protection is active.
G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect/Engineer.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 16.13 - ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed circuit breakers.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Revision E with Supplement 1, 2013.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted enclosed circuit breakers where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.
B. General Electric Company: www.geindustrial.com.
C. Schneider Electric; Square D Products: www.schneider-electric.us.
D. Siemens Industry, Inc: www.usa.siemens.com.
E. Substitutions: Submit Manufacture's Data Sheet for Approval.
F. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
B. Provide products listed, classified, and labeled as suitable for the purpose intended.
C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
    1. Altitude: Less than 6,600 feet.
    2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
D. Short Circuit Current Rating:
    1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
F. Conductor Terminations: Suitable for use with the conductors to be installed.
G. Provide thermal magnetic circuit breakers unless otherwise indicated.
H. Provide electronic trip circuit breakers where indicated.
I. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
    1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
        a. Indoor Clean, Dry Locations: Type 1.
        b. Outdoor Locations: Type 3R.
    2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
    3. Provide surface-mounted enclosures unless otherwise indicated.
K. Provide externally operable handle with means for locking in the OFF position.
L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
B. Interrupting Capacity:
    1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
        a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.

b. 14,000 rms symmetrical amperes at 480 VAC.
2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:
1. Provide mechanical lugs unless otherwise indicated.
2. Provide compression lugs where indicated.
3. Lug Material: Copper, suitable for terminating copper conductors only.

D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide required supports in accordance with Section 26 05 29.
E. Install enclosed circuit breakers plumb.
F. Install flush-mounted enclosed circuit breakers so that trims fit completely flush to wall with no gaps and rough opening completely covered.
G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
H. Provide grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance. Tests listed as optional are not required.
D. Test GFCI circuit breakers to verify proper operation.
E. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.
B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.
D. Siemens Industry, Inc: www.usa.siemens.com.
E. Substitutions: Submit Manufacture's Data Sheet for Approval.
F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy or general duty as indicated; ratings, configurations, and features as indicated on the drawings.
B. Provide products listed, classified, and labeled as suitable for the purpose intended.
C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
    1. Ambient Temperature: Between -22 degrees F and 104 degrees F.
D. Horsepower Rating: Suitable for connected load.
E. Voltage Rating: Suitable for circuit voltage.
F. Short Circuit Current Rating:
    1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
    2. Minimum Ratings:
        a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
H. Provide with switch blade contact position that is visible when the cover is open.
I. Conductor Terminations: Suitable for use with the conductors to be installed.
J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
    1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
        a. Indoor Clean, Dry Locations: Type 1.
        b. Outdoor Locations: Type 3R.
    2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
N. Heavy Duty Switches:
    1. Comply with NEMA KS 1.
    2. Conductor Terminations:
        a. Provide mechanical lugs unless otherwise indicated.
        b. Provide compression lugs where indicated.
        c. Lug Material: Copper, suitable for terminating copper conductors only.
    3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
        a. Provide means for locking handle in the ON position where indicated.
O. General Duty Switches:
    1. Conductor Terminations:
        a. Provide mechanical lugs.

b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

2. Provide externally operable handle with means for locking in the OFF position, capable of accepting two padlocks.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive enclosed safety switches.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide required supports in accordance with Section 26 05 29.
E. Install enclosed switches plumb.
F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
G. Provide grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic transfer switches.
   2. Manual transfer switches.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 32 13 - Engine Generators: For interface with transfer switches.
   1. Includes code requirements applicable to work of this section.
   2. Includes additional testing requirements.
   3. Includes related demonstration and training requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2005.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
F. NFPA 110 - Standard for Emergency and Standby Power Systems; 2016.
G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
      a. Engine Generators: See Section 26 32 13.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Where work of this section involves interruption of existing electrical service, arrange service interruption with OWNER.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system

interconnection schematic diagrams showing all factory and field connections.

D. Evidence of qualifications for installer.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
F. Manufacturer's certification that products meet or exceed specified requirements.
G. Source quality control test reports.
H. Manufacturer’s detailed field testing procedures.
I. Field quality control test reports.
J. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
    1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
K. Executed Warranty: Submit documentation of final executed warranty completed in OWNER's name and registered with manufacturer.
L. Maintenance contracts.
M. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
N. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.
    2. Bypass/Isolation Transfer Switches: Provide accessories (ramps, dollies, etc.) necessary for removal of drawout components.

1.6 QUALITY ASSURANCE

A. Comply with the following:
    1. NFPA 70 (National Electrical Code).
    2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section 26 32 13.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
    1. Authorized service facilities located within 200 miles of project site.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.
B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Substitutions: Not permitted.
B. Source Limitations: Furnish transfer switches and accessories produced by a single manufacturer or obtained from a single supplier.

2.2 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
B. Provide products listed, classified, and labeled as suitable for the purpose intended.
C. Applications:
   1. Utilize open transition transfer unless otherwise indicated or required.
D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
E. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).
F. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
G. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
H. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
   2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
I. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
   1. Altitude: 1760 feet.
J. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
      b. Outdoor Locations: Type 3R or Type 4.
   2. Finish: Manufacturer's standard unless otherwise indicated.
K. Manual Transfer Switches:
   1. Description: Transfer switches with manually initiated transfer between sources; mechanically operated and mechanically held.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
C. Verify that rough-ins for field connections are in the proper locations.
D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Arrange equipment to provide minimum clearances and required maintenance access.
D. Provide required support and attachment in accordance with Section 26 05 29.
E. Install transfer switches plumb and level.
F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
G. Provide grounding and bonding in accordance with Section 26 05 26.
H. Identify transfer switches and associated system wiring in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
C. Prepare and start system in accordance with manufacturer's instructions.
D. Automatic Transfer Switches:
    1. Inspect and test in accordance with NETA ATS, except Section 4.
    2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The control wiring insulation-resistance tests listed as optional are not required.
E. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
C. Demonstration: Demonstrate proper operation of transfer switches to OWNER, and correct deficiencies or make adjustments as directed.
D. Training: Train OWNER's personnel on operation, adjustment, and maintenance of transfer switches.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Location: At project site.
E. Coordinate with related generator demonstration and training as specified in Section 26 32 13.

3.6 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices for service entrance locations.
B. Surge protective devices for distribution locations.
C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 24 16 - Panelboards.

1.3 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
B. SPD: Surge Protective Device.

1.4 REFERENCE STANDARDS

A. MIL-STD-220 - Method of Insertion Loss Measurement; Revision C, 2009.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
E. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
F. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
G. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to ordering equipment.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Factory-installed, Internally Mounted Surge Protective Devices:
   1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

B. Substitutions: Submit Manufacture's Data Sheet for Approval.
C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
B. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.
   2. Delta Systems: L-G, L-L.
   3. Single Split Phase Systems: L-N, L-G, N-G, L-L.
   4. High Leg Delta Systems: L-N, L-G, N-G, L-L.
C. UL 1449 Voltage Protection Ratings (VPRs):
   1. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
D. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
E. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
F. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
G. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
   1. Panelboards: See Section 26 24 16.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
E. UL 1449 Nominal Discharge Current (I-n): 20 kA.
F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
G. Diagnostics:
   1. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
   2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

2.4 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
B. List and label as complying with UL 1449, Type 1 or Type 2.
C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
E. UL 1449 Nominal Discharge Current (I-n): 20 kA.
F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
G. Diagnostics:
    1. Protection Status Monitoring: Provide indicator lights to report the protection status.
    2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
D. Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
E. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
F. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

3.4 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 33.16 - Boxes for Electrical Systems.
C. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.

1.3 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2012.
B. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
C. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
D. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
F. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
G. NFPA 70 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange; 1997f; R 2012.
H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
    1. Provide photometric calculations where luminaires are proposed for substitution upon request.
C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
    1. LED Luminaires:
        a. Include estimated useful life, calculated based on IES LM-80 test data.
    2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
    3. Lamps: Include rated life and initial and mean lumen output.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

A. Manufacturers:
   1. Acuity Brands, Inc: www.acuitybrands.com.
   2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com.
   3. Electro-Matic Visual, Inc; www.empvisual.com.
   4. Hubbell Lighting, Inc: www.hubbelllighting.com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.
B. Provide products that comply with requirements of NFPA 70.
C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
D. Provide products listed, classified, and labeled as suitable for the purpose intended.
E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install products in accordance with manufacturer's instructions.
D. Install luminaires in accordance with NECA/IESNA 501.
E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
F. Install accessories furnished with each luminaire.
G. Bond products and metal accessories to branch circuit equipment grounding conductor.
H. Install lamps in each luminaire.

3.2 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect each product for damage and defects.
C. Operate each luminaire after installation and connection to verify proper operation.
D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.3 ADJUSTING

A. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.4 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

END OF SECTION

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 26, 2024

Allen Phillips, P.E.
Jacob and Martin, LLC
4920 South Loop 289
Lubbock, TX 79404

Re: City of Ackerly - Public Water System ID No. 0580011
Proposed Well No. 5
Engineer Contact Telephone: (806) 368-6375
Plan Review Log No. P-06252024-156
Dawson County, Texas

CN600623128 RN101174985

Dear Mr. Phillips:

On June 25, 2024, the Texas Commission on Environmental Quality (TCEQ) received planning material with your letter dated June 21, 2024 for the proposed Well No. 5 to replace the existing Well No. 4 that has been collapsed. Based on our review of the information submitted, the project generally meets the minimum requirements of Title 30 Texas Administrative Code (TAC) Chapter 290 – Rules and Regulations for Public Water Systems and is **conditionally approved for construction** if the project plans and specifications meet the following requirements:

1. Your submittal indicated that the proposed well is located by to the existing Well No. 4 which has been collapsed and will be plugged. Well No. 4 is considered as an improperly constructed well which is located within 150-feet of the proposed well. Pursuant to 30 TAC §290.46(u), abandoned public water supply wells owned by the system must be plugged with cement according to 16 TAC Chapter 76 (relating to Water Well Drillers and Water Well Pump Installers). A copy of State of Texas Well Plugging Report **must be provided** with submittal of well completion data for Well No. 5.

2. In accordance with TCEQ online guidance, a bentonite plug may be used in a water saturated zone to seal the annular space above the packer. The plug may not exceed ten feet in height and the entire plug shall be below the water table at all times. The placement of the plug and the grout seal shall be a continuous operation to minimize the possibility of voids in the seal.

3. With well completion submittal, please provide setting depth, motor horsepower, design capacity, total dynamic head and pump curve for the well pump.

4. Corrosive indices will be used to calculate corrosivity of the water from new source(s). Corrosive or aggressive water could result in aesthetic problems, increased levels of toxic metals, and deterioration of household plumbing and fixtures. **If the water appears to be corrosive**, the system will be required to conduct a study and submit an engineering report that addresses corrosivity issues or may choose to install corrosion control treatment **before use may be granted**. All changes in treatment require submittal of plans and specifications for approval by TCEQ.

Texas Water Code Section 36.0015 allows for the creation of groundwater conservation districts (GCDs) as the preferred method of groundwater management. GCDs manage groundwater in many counties and are authorized to regulate production and spacing of water wells. **Public water systems drilling wells within an existing GCD are responsible for meeting the GCD's requirements.** The authorization provided in this letter does not affect GCD authority to manage groundwater or issue permits.

The TCEQ does not approve this well for use as a public water supply at this time. We have enclosed a copy of the "Public Well Completion Data Checklist for Approval to Use (Step 2)". We provide this checklist to help you in obtaining approval to use this well.

The submittal consisted of 11 sheets of engineering drawings, technical specifications and an engineering report. The proposed project consists of:

- One (1) public water supply well drilled to 180 feet with 110 linear feet (lf) of 8.625-inch outside diameter (od) ASTM F480 PVC casing and pressure-cemented 110 lf with a 3-lf bentonite plug; 60 lf of 8.625-inch od PVC slot screen, 20 lf of 8.625-inch od blank PVC liner, with 67 lf gravel pack. The well is rated for 80 gallons per minute (gpm) yield. The pump setting depth, motor horsepower, design capacity and total dynamic head for the well pump to be determined;

- Wellhead including concrete sealing block, raw water sample tap, flow meter and casing vent with 16-mesh or finer PVC screen facing downward; and

- Associated yard pipe and appurtenances.

This approval is for the construction of the above listed items only. Any wastewater components contained in this design were not considered. The authorization provided in this letter does not relieve a Public Water System from the need to comply with other applicable state and federal regulations.

This project may have approved the construction of facilities that may require either the creation of or update to an Emergency Preparedness Plan (EPP). Information on EPPs is available at the following website:

https://www.tceq.texas.gov/drinkingwater/homeland_security/disasterprep/epp

If you have additional questions about EPPs, please contact the Emergency Preparedness and Response Section at 512-239-4691 or PDWEPP@tceq.texas.gov.

The City of Ackerly public water supply system provides water treatment.

The project is located approximately 2,750 feet northeast intersection of 87 and 34 Highway in Dawson County, Texas.

An appointed engineer must notify the TCEQ's Region 7 Office in Midland by email at R7PWS@TCEQ.Texas.gov when construction will start. Please keep in mind that upon completion of the water works project, the engineer or owner will notify the commission's Water Supply Division, in writing, as to its completion and attest to the fact that the completed work is substantially in accordance with the plans and change orders on file with the commission as required in 30 TAC §290.39(h)(3). This notification may be sent to PTRS@tceq.texas.gov.

Please refer to the Plan Review Team's Log No. **P-06252024-156** in all correspondence for this project.

Please complete a copy of the most current Public Water System Plan Review Submittal form for any future submittals to TCEQ. Every blank on the form must be completed to minimize any delays in the review of your project. The document is available on TCEQ's website at the address shown below. You can also download the most current plan submittal checklists and forms from the same address.

https://www.tceq.texas.gov/drinkingwater/udpubs.html

For future reference, you can review part of the Plan Review Team's database to see if we have received your project. This is available on TCEQ's website at the following address:

https://www.tceq.texas.gov/drinkingwater/planrev.html/#status

You can download the latest revision of 30 TAC Chapter 290 – Rules and Regulations for Public Water Systems from this site.

If you have any questions concerning this letter or need further assistance, please contact Jonathan Pi, P.E. at (512) 239-6968 or by email at Jonathan.Pi@Tceq.Texas.Gov or by correspondence at the following address:

Plan Review Team, MC-159
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Sincerely,

Jonathan Pi, P.E.
Plan Review Team
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

Craig A. Stowell, P.E., Team Leader
Plan Review Team
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

CAS/JP/av

Enclosure: "Public Well Completion Data Checklist for Approval to Use (Step 2)"

cc: City of Ackerly, Attn: Scott Ragle, Mayor, PO Box 37, Ackerly, TX 79713-0037

bcc: TCEQ Central Records PWS File 0580011 (P-06252024-156/City of Ackerly)
TCEQ Region No. 7 Office - Midland
TCEQ PWSINVEN, MC-155

Public Well Completion Data Checklist for Approval to Use (Step 2)

Texas Commission on Environmental Quality
Water Supply Division
Plan Review Team MC-159
P.O. Box 13087, Austin, Texas 78711-3087

Public Water System I.D. No._____
TCEQ Log No. P-_____

The following list is a brief outline of the "Rules for Public Water Systems", 30 TAC Chapter 290 regarding proposed Water Supply Well Completion. Failure to submit the following items may delay project approval. Copies of the rules may be obtained from Texas Register, 1019 Brazos St, Austin, TX, 78701-2413, Phone: (512) 463-5561 or downloaded from the website: http://www.tceq.texas.gov/rules/indxpdf.html

Any well proposed as a source of water for a public water supply must have plans approved for construction by TCEQ. Please include the well construction approval letter with your submittal of well completion data listed below for TCEQ evaluation. Based on review of this submitted data, approval may be given for use of the well.

1. ☐ Site map(s) at appropriate scales showing the following: [§290.41(c)(3)(A)]
   - ☐ (i) Final location of the well with coordinates;
   - ☐ (ii) Named roadways;
   - ☐ (iii) All property boundaries within 150 feet of the final well location and the property owners' names;
   - ☐ (iv) Concentric circles with the final well location as the center point with radii of 10 feet, 50 feet, 150 feet, and ¼ mile;
   - ☐ (v) Any site improvements and existing buildings;
   - ☐ (vi) Any existing or potential pollution hazards; and
   - ☐ (vii) Map must be scalable with a north arrow.
2. ☐ A copy of the recorded deed of the property on which the well is located showing the Public Water System (PWS) as the landowner, and/or any of the following: [§290.41(c)(1)(F)(iv)]
   - ☐ (i) Sanitary control easements (filed at the county courthouse and bearing the county clerk's stamp) covering all land within 150 feet of the well not owned by the PWS (for a sample easement see TCEQ Form 20698);
   - ☐ (ii) For a political subdivision, a copy of an ordinance or land use restriction adopted and enforced by the political subdivision which provides an equivalent or higher level of sanitary protection to the well as a sanitary control easement; and/or
   - ☐ (iii) A copy of a letter granting an exception to the sanitary control easement rule issued by TCEQ's Technical Review and Oversight Team.
3. ☐ Construction data on the completed well: [§290.41(c)(3)(A)]
   - ☐ (i) Final installed pump data including capacity in gallons per minute (gpm), total dynamic head (tdh) in feet, motor horsepower, and setting depth;
   - ☐ (ii) Bore hole diameter(s) (must be 3" larger than casing OD) and total well depth;
   - ☐ (iii) Casing size, length, and material (e.g. 200 lf of 12" PVC ASTM F480 SDR-17);
   - ☐ (iv) Length and material of any screens, blanks, and/or gravel packs utilized;
   - ☐ (v) Cementing depth and pressure method (one of the methods in latest revision of AWWA Standard A-100, Appendix C, excluding the dump bailer and tremie methods);
   - ☐ (vi) Driller's geologic log of strata penetrated during the drilling of the well;
   - ☐ (vii) Cementing certificate; and

Public Well Completion Data Checklist for Approval to Use (Step 2)

- ☐ (viii) Copy of the official State of Texas Well Report (some of the preceding data is included on the Well Report).

4. ☐ A U.S. Geological Survey 7.5-minute topographic quadrangle map (include quadrangle name and number) or a legible copy showing the location of the completed well; [§290.41(c)(3)(A)]
5. ☐ Record of a 36-hour continuous pump test on the well showing stable production at the well's rated capacity. Include the following: [§290.41(c)(3)(G)]
   - ☐ (i) Test pump capacity in gpm, tdh in feet, and horsepower of the pump motor;
   - ☐ (ii) Test pump setting depth;
   - ☐ (iii) Static water level (in feet); and
   - ☐ (iv) Draw down (in feet).
6. ☐ Three bacteriological analysis reports for samples collected on three successive days showing raw well water to be free of coliform organisms. Reports must be for samples of raw (untreated) water from the disinfected well and submitted to a laboratory accredited by TCEQ, accredited to perform these test; and [§290.41(c)(3)(F)(i)]
7. ☐ Chemical analysis reports for well water samples showing the water to be of acceptable quality for the most problematic contaminants listed below. Reports must come from a laboratory accredited by TCEQ; accredited to perform these tests. Maximum contaminant level (MCL) and secondary constituent level (SCL) units are in milligrams per liter (except arsenic which is in micrograms per liter). [§290.41(c)(3)(G) and§290.104 and §290.105]

Table 1: Primary Constituents with Maximum Contaminant Level (MCL)

PRIMARY	MCL
Nitrate	10 (as N)
Nitrite	1 (as N)
Arsenic	10
Fluoride	4.0

Table 2: Secondary Constituents with Secondary Contaminant Level (SCL)

SECONDARY	SCL
Aluminum	0.2
Copper	1.0
Iron	0.3
Manganese	0.05
Zinc	5.0
Total Dissolved Solids	1,000
Fluoride	2.0
Sulfate	300
Chloride	300
pH	> 7.0

Public Well Completion Data Checklist for Approval to Use (Step 2)

Table 3: Water Quality Parameters

PARAMETER	UNITS
Alkalinity as CaCO3	mg/L
Calcium as CaCO3	mg/L
Sodium	mg/L
Free Ammonia*	mg/L
Lead**	mg/L

*Systems that use free chlorine as their disinfectant and have raw water free ammonia readings above 0.1 mg/l may lose disinfectant residuals or may be using excessive amounts of chlorine due to unintended formation of chloramines. When naturally occurring ammonia is present, the system may consider using chloramine as the disinfectant instead of chlorine. Free available ammonia (referred to as 'free ammonia') is a field test conducted by the Indophenol Method and is not to be confused with Total Ammonia, which also includes the portion that exists as ammonium (NH4). There is no available accredited method for free ammonia and it is not listed as an "approved Drinking Water or approved Public Water System Lab" analyte on the agency's Drinking Water Lab Approval Form: https://www.tceq.texas.gov/downloads/drinking-water/form-10450-drinking-water-lab-approval.pdf. Therefore, please note the following requirements for analyzing raw water free ammonia:

- Required test accuracy is plus or minus 0.1 mg/L.
- Free ammonia must be analyzed in the field.
- Ammonia is measured as free available ammonia as nitrogen.
- Check the range of your kit. The most common one pegs out at 0.55 mg/L. Samples over that level should be diluted and reanalyzed.
- Follow all instructions provided by the field test kit manufacturer.

If you find raw water free ammonia readings above 0.1 mg/l in a well proposed as a source of water for a public water supply, please ensure your submittal addresses the type of disinfectant to be used. The most common methods to address naturally occurring ammonia are to breakpoint chlorinate or create chloramines as the disinfectant. For systems choosing to create chloramines, please be aware that you may need to install ammonia injection to have a reliable level of ammonia. If you would like to discuss any questions about this topic before finalizing and sending in your submittal, please send an email to PTRS@tceq.texas.gov and a staff member will assist you.

**Lead is regulated by the lead and copper rule. This analyte is to document the amount of lead in the source water. The level shall be less than 0.010 mg/L for approval to use.

List of Counties Where Radionuclide Testing is Required

Please be aware that we have added the requirement for analysis for radionuclides for high-risk counties. For elevated levels of any contaminants found in a test well, treatment or blending may be required. All systems located in a high-risk county (see page 4) shall submit radiological analysis reports for water samples showing the water to be of acceptable quality for the contaminants listed below. Reports must come from a TCEQ accredited laboratory for approval to use of the well.

Public Well Completion Data Checklist for Approval to Use (Step 2)

Table 4: Radionuclides with Maximum Contaminant Level (MCL)

CONTAMINANT	MCL
Gross alpha	15 pCi/L
Radium-226/228	5 pCi/L
Beta particle	50 pCi/L
Uranium	30 µg/L

WHERE: pCi/L = pico curies per liter, µg/L = micrograms per liter

Please be aware when you review your radiological data that if the report has gross alpha over 15 pCi/L and individual uranium isotopes are not reported, you will have to resample or reanalyze and resubmit radionuclide results. If you see gross alpha plus radium-228 over 5 pCi/L, and don't have radium-226, you will have to resample or reanalyze and resubmit complete results.

Table 5: List of Counties where Radionuclide Testing is required

COUNTY				
Atascosa	Bandera	Bexar	Bosque	Brazoria
Brewster	Burnet	Concho	Culberson	Dallam
Dawson	Erath	Fort Bend	Frio	Garza
Gillespie	Gray	Grayson	Harris	Hudspeth
Irion	Jeff Davis	Jim Wells	Kendall	Kent
Kerr	Kleberg	Liberty	Llano	Lubbock
McCulloch	Mason	Matagorda	Medina	Midland
Montgomery	Moore	Parker	Pecos	Polk
Presidio	Refugio	San Jacinto	San Saba	Tarrant
Travis	Tyler	Upton	Val Verde	Victoria
Walker	Washington	Wichita	Williamson	Zavala