

U.S. Embassy American Center Republic of the Union of Burma, Rangoon

US Department of State: Bureau of Overseas Building Operations



Specifications

Demolition Package - 100% Construction Documents

August 1, 2014

Republic of the Union of Burma, Rangoon
U.S. Embassy American Center
Project No: XJ-J4-0166

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BUILDING TYPES MATRIX**

SPEC NO.	RANGOON AMERICAN CENTER	MASTER DATE	SITE	RAC	UTL 1	UTL 2	ROB 1
000010	SPECIFICATIONS TABLE OF CONTENTS & BUILDING TYPES MATRIX	Rev'd 2014					
DIV 01 - GENERAL REQUIREMENTS							
0110XX	CONSTRUCTION EXECUTION AND COORDINATION						<i>Provided by OBO</i>
0132XX	PROJECT SCHEDULING						<i>Provided by OBO</i>
0133XX	CONSTRUCTION SUBMITTALS						<i>Provided by OBO</i>
01352X	CONSTRUCTION SAFETY AND OCCUPATIONAL HEALTH						<i>Provided by OBO</i>
01355X	CONSTRUCTION SECURITY						<i>Provided by OBO</i>
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0150XX	TEMPORARY FACILITIES AND CONTROLS						<i>Provided by OBO</i>
0150YY	TEMPORARY SECURITY FACILITIES AND CONTROLS						<i>Provided by OBO</i>
0177XX	CLOSEOUT PROCEDURES						<i>Provided by OBO</i>
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024115	SELECTIVE DEMOLITION	Add'd 2014	X			X	X
024116	STRUCTURE DEMOLITION	Rev'd 2014	X				
DIV 03 - CONCRETE							
033000	CAST-IN-PLACE CONCRETE	Jan 2012	<i>Not provided in this package</i>				
033810	UNBONDED POST-TENSIONED CONCRETE	Jan- 2012					
034100	PLANT PRECAST STRUCTURAL CONCRETE	Jan- 2012			X	X	
DIV 04 - MASONRY							
044200	EXTERIOR STONE CLADDING	Jan 2012	<i>Not provided in this package</i>				

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DIV 05 - METALS							
054005	BLAST RESISTANT STEEL STUD FRAMING	Jan-2012		X			
054000	COLD FORMED METAL FRAMING	Jan 2012	<i>Not provided in this package</i>				
055000	METAL FABRICATIONS	Jan 2012	<i>Not provided in this package</i>				
055100	METAL STAIRS	Jan-2012					
055133	METAL LADDERS	Jan 2012	<i>Not provided in this package</i>				
055213	PIPE AND TUBE RAILINGS	Jan 2012	<i>Not provided in this package</i>				
055300	METAL GRATINGS	Jan-2012	X				
057305	ORNAMENTAL HANDRAILS AND RAILINGS	Jan 2012	<i>Not provided in this package</i>				
DIV 06 - WOOD, PLASTICS, AND COMPOSITES							
061000	ROUGH CARPENTRY	Jan 2012	<i>Not provided in this package</i>				
061600	SHEATHING	Jan 2012	<i>Not provided in this package</i>				
062005	FINISH CARPENTRY	Jan 2012	<i>Not provided in this package</i>				
064023	INTERIOR ARCHITECTURAL WOODWORK	Jan 2012	<i>Not provided in this package</i>				
064033	CUSTOM MEDICAL CASEWORK	Jan-2012					

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DIV 07 - THERMAL AND MOISTURE PROTECTION							
071113	BITUMINOUS DAMPPROOFING	Jan 2012	<i>Not provided in this package</i>				
071326	SELF ADHERING SHEET WATERPROOFING	Jan 2012			X	X	
071353	ELASTOMERIC SHEET WATERPROOFING	Jan 2012					
071413	HOT FLUID APPLIED RUBBERIZED ASPHALT WATERPROOFING	Jan 2012					
072100	THERMAL INSULATION	Jan 2012	<i>Not provided in this package</i>				
074113	METAL ROOF PANELS	Jan 2012	<i>Not provided in this package</i>				
074213.13	FORMED METAL WALL PANELS	Add'd 2014	<i>Not provided in this package</i>				
075213	APP-MODIFIED BITUMINOUS MEMBRANE ROOFING	Jan 2012	<i>Not provided in this package</i>				
075216	SBS MODIFIED BITUMINOUS MEMBRANE ROOFING	Jan 2012		X			
076200	SHEET METAL AND FLASHING TRIM	Jan 2012	<i>Not provided in this package</i>				
077100	ROOF SPECIALTIES	Jan 2012					
077200	ROOF ACCESSORIES	Jan 2012	<i>Not provided in this package</i>				
077275	FORCED ENTRY (FE)/BALLISTIC RESISTANT (BR) ROOF HATCHES	Jan 2012	<i>Not provided in this package</i>				
078413	PENETRATION FIRESTOPPING	Jan 2012	<i>Not provided in this package</i>				
078446	FIRE RESISTIVE JOINT SYSTEMS	Jan 2012					
079200	JOINT SEALANTS	Jan 2012	<i>Not provided in this package</i>				
079500	EXPANSION CONTROLS	Jan 2012	<i>Not provided in this package</i>				

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DIV 08 - OPENINGS							
080105	GPE WINDOW AND DOOR REQUIREMENTS	Jan 2012	<i>Not provided in this package</i>				
081115	HOLLOW METAL DOORS AND FRAMES	Jan 2012	<i>Not provided in this package</i>				
081416	FLUSH WOOD DOORS	Jan 2012	<i>Not provided in this package</i>				
083113	ACCESS DOORS AND FRAMES	Jan 2012	<i>Not provided in this package</i>				
083185	FORCED ENTRY (FE)/BALLISTIC RESISTANT (BR) DOOR ASSEMBLIES	Jan 2012	<i>Not provided in this package</i>				
083324	OVERHEAD COILING DOORS, GRILLES, AND SHUTTERS	Jan 2012					
083459	VAULT DOORS AND ACCESSORIES	Jan 2012					
083473	SOUND CONTROL DOOR ASSEMBLIES	Jan 2012					
084313	ALUMINUM NON-SECURITY WINDOW AND DOOR SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
085845	BLAST RESISTANT STRUCTURAL MUNTIN WINDOW SYSTEMS	Jan 2012					
086300	METAL-FRAMED SKYLIGHTS	Jan 2012					
086615	EXTERIOR SECURITY WINDOWS	Jan 2012		X			
086625	ALUMINUM SECURITY WINDOWS	Jan 2012	<i>Not provided in this package</i>				
086675	INTERIOR AND EXTERIOR SECURITY AND TELLER WINDOWS	Jan 2012		X			
086685	INTERIOR AND EXTERIOR ALUMINUM SECURITY AND TELLER WINDOWS	Jan 2012	<i>Not provided in this package</i>				
087135	NON-SECURITY DOOR HARDWARE	Jan 2012	<i>Not provided in this package</i>				
087145	SECURITY DOOR HARDWARE	Jan 2012	<i>Not provided in this package</i>				
088000	GLAZING	Jan 2012	<i>Not provided in this package</i>				
088855	SECURITY GLAZING	Jan 2012	<i>Not provided in this package</i>				
089000	LOUVERS AND VENTS	Jan 2012	<i>Not provided in this package</i>				
089005	SECURITY LOUVERS	Jan 2012					

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DIV 09 - FINISHES							
092116	GYPSUM BOARD SHAFT WALL ASSEMBLIES	Jan-2012					
092205	FURRING AND LATHING	Jan 2012	<i>Not provided in this package</i>				
092405	PORTLAND CEMENT PLASTERING	Jan 2012	<i>Not provided in this package</i>				
092905	GYPSUM BOARD ASSEMBLIES	Jan 2012	<i>Not provided in this package</i>				
093000	TILING	Jan 2012	<i>Not provided in this package</i>				
095113	ACOUSTICAL PANEL CEILINGS	Jan-2012	<i>Not provided in this package</i>				
096340	STONE FLOORING	Jan 2012	<i>Not provided in this package</i>				
096513	RESILIENT WALL BASE AND ACCESSORIES	Jan 2012	<i>Not provided in this package</i>				
096517	LINOLEUM FLOOR COVERINGS	Jan-2012		X			
096536	STATIC-CONTROL RESILIENT FLOOR COVERINGS	Jan 2012	<i>Not provided in this package</i>				
096566	RESILIENT ATHLETIC FLOORING	Jan-2012					
096576	ANTI-FATIGUE FLOORING	Jan 2012	<i>Not provided in this package</i>				
096813	TILE CARPETING	Jan 2012	<i>Not provided in this package</i>				
096816	SHEET CARPETING	Jan-2012					
097505	INTERIOR STONE FACING	Jan-2012					
098433	SOUND-ABSORBING WALL PANELS	Jan 2012	<i>Not provided in this package</i>				
099112	PAINTING	Jan 2012	<i>Not provided in this package</i>				
099600	HIGH-PERFORMANCE COATINGS	Jan 2012	<i>Not provided in this package</i>				

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DIV 10 - SPECIALTIES							
101100	VISUAL DISPLAY SURFACES	Jan 2012	<i>Not provided in this package</i>				
101200	DISPLAY CASES	Jan 2012	<i>Not provided in this package</i>				
101410	EXTERIOR SIGNAGE AND GRAPHICS	Jan 2012	<i>Not provided in this package</i>				
101415	MONUMENT SIGNS	Jan 2012					
101420	NON-ILLUMINATED INTERIOR SIGN MESSAGE PANELS	Jan 2012					
101465	AUTOMATED QUEUING SYSTEM	Jan 2012					
102113	TOILET COMPARTMENTS	Jan 2012	<i>Not provided in this package</i>				
102124	HEALTH UNIT SHOWER CURTAIN	Jan 2012					
102213	WIRE MESH PARTITIONS	Jan 2012					
102226	OPERABLE ACOUSTICAL PARTITION	Jan 2012	<i>Not provided in this package</i>				
102605	WALL AND CORNER PROTECTION	Jan 2012	<i>Not provided in this package</i>				
102800	TOILET, BATH, AND LAUNDRY ACCESSORIES	Jan 2012	<i>Not provided in this package</i>				
102805	PREFABRICATED SHOWER RECEPTOR AND DOOR	Jan 2012					X
104415	FIRE-PROTECTION SPECIALTIES	Jan 2012	<i>Not provided in this package</i>				
105115	LOCKERS	Jan 2012	<i>Not provided in this package</i>				
105500	POSTAL SPECIALTIES	Jan 2012					
105613	METAL STORAGE SHELVING	Jan 2012			X	X	
105626	MOBILE STORAGE SHELVING	Jan 2012					
105640	SAFETY STORAGE CABINETS	Jan 2012					
107500	FLAGPOLES	Jan 2012					

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DIV 11 - EQUIPMENT							
111300	LOADING DOCK EQUIPMENT	Jan-2012					
112425	WINDOW WASHING AND FALL PROTECTION ACCESSORIES	Jan 2012	<i>Not provided in this package</i>				
113105	RESIDENTIAL APPLIANCES	Jan 2012	<i>Not provided in this package</i>				
114005	FOODSERVICE EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
115213	PROJECTION SCREENS	Jan 2012	<i>Not provided in this package</i>				
115217	TV AND PROJECTOR BRACKETS	Jan 2012	<i>Not provided in this package</i>				
115355	CLASS I BIOLOGICAL SAFETY CABINET	Jan-2012					
117005	MEDICAL EQUIPMENT	Jan-2012					
DIV 12 - FURNISHINGS							
122115	HORIZONTAL LOUVER BLINDS	Jan 2012	<i>Not provided in this package</i>				
122415	ROLLER WINDOW SHADES	Jan 2012	<i>Not provided in this package</i>				
123200	MANUFACTURED WOOD CASEWORK	Jan-2012					
123214	MANUFACTURED PHARMACEUTICAL CASEWORK	Jan-2012					
124600	FURNISHING ACCESSORIES	Jan-2012					
124816	ENTRANCE FLOOR GRILLES	Jan 2012	<i>Not provided in this package</i>				
124844	SWITCHBOARD MATS	Jan-2012			X	X	
125705	WORK BENCHES	Jan-2012					
125905	GFE FURNITURE INSTALLATION	Jan-2012					
129305	SITE FURNISHINGS	Jan 2012	<i>Not provided in this package</i>				

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DIV 13 - SPECIAL CONSTRUCTION							
131100	SWIMMING POOLS	Jan-2012	X				
133420	PRE-ENGINEERED BUILDING SYSTEMS	Jan-2012			X	X	
133424	PREFABRICATED CONTROL BOOTHS	Jan-2012	X				
133435	MAIL SCREENING FACILITIES	Jan-2012					
DIV 14 - CONVEYING EQUIPMENT							
142105	ELECTRIC TRACTION ELEVATORS	Jan-2012	<i>Not provided in this package</i>				
144500	VEHICLE LIFTS	Jan-2012					
DIV 21 - FIRE SUPPRESSION							
210513	COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT	Jan-2012	X		X	X	
210533	HEAT TRACING FOR FIRE SUPPRESSION PIPING	Jan-2012			X	X	
210553	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT	Jan-2012		X	X		X
211305	FIRE SPRINKLER SYSTEMS	Jan-2012	<i>Not provided in this package</i>				
213115	FIRE PUMP ASSEMBLIES	Jan-2012	<i>Not provided in this package</i>				

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DIV 22 - PLUMBING							
220513	COMMON MOTORS REQUIREMENTS FOR PLUMBING EQUIPMENT	Jan 2012	X				
220516	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING	Jan 2012	X				
220519	METERS AND GAGES FOR PLUMBING PIPING	Jan 2012	X				
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING	Jan 2012	X				
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT	Jan 2012	X				
220533	HEAT TRACING FOR PLUMBING PIPING	Jan 2012			X	X	
220548	VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
220716	PLUMBING EQUIPMENT INSULATION	Jan 2012			X	X	
220719	PLUMBING PIPING INSULATION	Jan 2012	<i>Not provided in this package</i>				
221005	PLUMBING SPECIALTIES	Jan 2012	X				
221116	DOMESTIC WATER PIPING	Jan 2012	X				
221124	DOMESTIC-WATER PACKAGED BOOSTER PUMPS	Jan 2012	X				
221316	SANITARY WASTE AND VENT PIPING	Jan 2012	<i>Not provided in this package</i>				
221329	SANITARY SEWERAGE PUMPS	Jan 2012			X	X	
221413	BUILDING STORM DRAINAGE PIPING	Jan 2012	<i>Not provided in this package</i>				
221429	SUMP PUMPS	Jan 2012			X	X	
223230	POTABLE WATER TREATMENT	Jan 2012	X				
223300	ELECTRIC, DOMESTIC WATER HEATERS	Jan 2012	<i>Not provided in this package</i>				
224105	RESIDENTIAL PLUMBING FIXTURES	Jan 2012		X			X
224215	COMMERCIAL PLUMBING FIXTURES	Jan 2012	<i>Not provided in this package</i>				
224500	EMERGENCY PLUMBING FIXTURES	Jan 2012	<i>Not provided in this package</i>				
224700	DRINKING FOUNTAINS AND WATER COOLERS	Jan 2012	<i>Not provided in this package</i>				

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DIV 23 - HEATING VENTILATING AND AIR CONDITIONING							
230505	COMMON WORK RESULTS FOR FIRE SUPPRESSION, PLUMBING, AND HVAC	Jan 2012	<i>Not provided in this package</i>				
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING	Jan-2012			X	X	
230519	METERS AND GAGES FOR HVAC PIPING	Jan-2012		X			
230523	GENERAL DUTY VALVES FOR HVAC PIPING	Jan-2012			X	X	
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
230533	HEAT TRACING FOR HVAC PIPING	Jan-2012			X	X	
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
230553	IDENTIFICATION FOR HVAC SYSTEM	Jan 2012	<i>Not provided in this package</i>				
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC	Jan 2012	<i>Not provided in this package</i>				
230713	DUCT INSULATION	Jan 2012	<i>Not provided in this package</i>				
230716	HVAC EQUIPMENT INSULATION	Jan 2012	<i>Not provided in this package</i>				
230719	HVAC PIPING INSULATION	Jan 2012	<i>Not provided in this package</i>				
230905	INSTRUMENTATION AND CONTROLS FOR HVAC	Jan-2012		X	X		X
231113	BUILDING FUEL OIL PIPING	Jan 2012	<i>Not provided in this package</i>				
231123	BUILDING NATURAL GAS PIPING	Jan-2012			X	X	
232113	HYDRONIC PIPING	Jan-2012			X	X	
232123	HYDRONIC PUMPS	Jan-2012			X	X	
232300	REFRIGERANT PIPING	Jan 2012	<i>Not provided in this package</i>				
232500	HVAC WATER TREATMENT	Jan-2012			X	X	
233113	METAL DUCTS	Jan 2012	<i>Not provided in this package</i>				
233300	AIR DUCT ACCESSORIES	Jan 2012	<i>Not provided in this package</i>				
233423	HVAC POWER VENTILATORS	Jan 2012	<i>Not provided in this package</i>				
233600	AIR TERMINAL UNITS	Jan 2012	<i>Not provided in this package</i>				

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233713	DIFFUSERS, REGISTERS, AND GRILLES	Jan 2012	<i>Not provided in this package</i>				
234105	AIR FILTRATION	Jan 2012	<i>Not provided in this package</i>				
235105	BREECHINGS, CHIMNEYS, AND STACKS	Jan-2012			X	X	
235216	CONDENSING BOILERS	Jan-2012			X	X	
235233	WATER TUBE BOILERS	Jan-2012			X	X	
235239	FIRE TUBE BOILERS	Jan-2012			X	X	
235700	HEAT EXCHANGERS FOR HVAC	Jan-2012			X	X	
236201	VARIABLE REFRIGERANT FLOW VOLUME SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
236422	DEDICATED HEAT RECOVERY CHILLERS	Jan-2012			X	X	
236423	SCROLL AIR COOLED WATER CHILLERS	Jan-2012			X	X	
236424	MODULAR SCROLL AIR COOLED WATER CHILLERS	Jan-2012			X	X	
236426	ROTARY SCREW AIR COOLED WATER CHILLERS	Jan-2012			X	X	
236435	REFRIGERANT MONITORING AND SAFETY EQUIPMENT	Jan-2012			X	X	
237315	CENTRAL-STATION AIR-HANDLING UNITS	Jan 2012	<i>Not provided in this package</i>				
238123	COMPUTER ROOM AIR CONDITIONERS	Jan-2012					
238126	SPLIT SYSTEM AIR CONDITIONERS	Jan-2012		X			
238219	FAN COIL UNITS	Jan-2012			X	X	
238233	CONVECTORS	Jan-2012			X	X	
238239	UNIT HEATERS	Jan-2012			X	X	
238413	HUMIDIFIERS	Jan-2012			X	X	

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DIV 26 - ELECTRICAL							
260501	ELECTRICAL DEMOLITION	Add'd 2014	X				
260126	FIELD TESTING AND INSPECTION OF ELECTRICAL SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
260505	COMMON WORK RESULTS FOR ELECTRICAL, COMMUNICATIONS, & ELECTRONIC SAFETY	Jan 2012	X				
260513	MEDIUM-VOLTAGE CABLES	Jan-2012	X		X	X	
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	Jan 2012	X				
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	Jan 2012	X				
260534	RACEWAYS AND BOXES	Jan 2012	X				
260535	SURFACE MOUNTED RACEWAYS FOR ELECTRICAL SYSTEMS	Jan-2012		X			
260537	CABLE TRAYS	Jan-2012			X	X	
260548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY	Jan 2012	<i>Not provided in this package</i>				
260913	ELECTRICAL POWER MONITORING AND CONTROL	Jan-2012	X		X	X	
260923	LIGHTING CONTROL DEVICES	Jan 2012	<i>Not provided in this package</i>				
260935	DIMMING CONTROLS	Jan 2012	<i>Not provided in this package</i>				
261116	SECONDARY UNIT SUBSTATIONS	Jan-2012	X		X	X	
261200	MEDIUM-VOLTAGE TRANSFORMERS	Jan-2012	X		X	X	
261300	MEDIUM VOLTAGE SWITCHGEAR	Jan-2012	X		X	X	
262200	LOW VOLTAGE TRANSFORMERS	Jan-2012			X	X	
262300	LOW VOLTAGE SWITCHGEAR	Jan-2012			X	X	
262313	PARALLELING LOW VOLTAGE SWITCHGEAR	Jan-2012			X	X	
262315	DOUBLE ENDED LOW VOLTAGE SWITCHGEAR	Jan-2012			X	X	
262413	SWITCHBOARDS	Jan 2012	<i>Not provided in this package</i>				
262416	PANELBOARDS	Jan 2012	X				

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262419	MOTOR CONTROL CENTERS	Jan-2012			X	X	
262500	ENCLOSED BUS ASSEMBLIES	Jan-2012			X	X	
262726	WIRING DEVICES	Jan-2012	<i>Not provided in this package</i>				
262813	FUSES	Jan-2012	<i>Not provided in this package</i>				
262815	FUSED POWER CIRCUIT DEVICES	Jan-2012			X	X	
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	Jan-2012		X		X	
262913	ENCLOSED CONTROLLERS	Jan-2012			X	X	
262923	VARIABLE FREQUENCY MOTOR CONTROLLERS	Jan-2012			X	X	
263105	SOLAR PHOTOVOLTAIC SYSTEMS	Jan-2012	X		X	X	
263214	ENGINE GENERATORS	Jan-2012	<i>Not provided in this package</i>				
263234	DOCKING STATION	Add'd 2014	X				
263354	JOINT USER COMPUTER ROOM (JUCR) UNINTERRUPTIBLE POWER-SUPPLY (UPS)	Jan-2012		X			
263533	POWER FACTOR CORRECTION EQUIPMENT	Jan-2012			X	X	
263535	RESISTIVE LOAD BANK	Jan-2012			X	X	
263551	TSS VOLTAGE REGULATORS	Jan-2012	<i>Not provided in this package</i>				
263552	LOW VOLTAGE AUTOMATIC VOLTAGE REGULATORS	Jan-2012		X			
263553	MEDIUM VOLTAGE AUTOMATIC VOLTAGE REGULATORS	Jan-2012	X		X	X	
263600	TRANSFER SWITCHES	Jan-2012	X				
264113	LIGHTNING PROTECTION	Jan-2012	X		X	X	
264315	SURGE PROTECTIVE DEVICES	Jan-2012	<i>Not provided in this package</i>				
265100	INTERIOR LIGHTING	Jan-2012	<i>Not provided in this package</i>				
265600	EXTERIOR LIGHTING	Jan-2012	<i>Not provided in this package</i>				
265615	UNDERCARRIAGE VEHICLE INSPECTION LIGHTING	Jan-2012					

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DIV 27 - COMMUNICATIONS								
270526	GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS	Jan 2012	<i>Not provided in this package</i>					
270528	SURFACE-MOUNTED RACEWAY FOR COMMUNICATIONS SYSTEMS	Jan 2012	<i>Not provided in this package</i>					
270553	IDENTIFICATION FOR COMMUNICATION SYSTEMS	Jan 2012	<i>Not provided in this package</i>					
271113	COMMUNICATIONS ENTRANCE PROTECTION	Jan 2012	<i>Not provided in this package</i>					
271116	COMMUNICATIONS CABINETS, RACKS, FRAMES & ENCLOSURES	Jan 2012	<i>Not provided in this package</i>					
271119	COMMUNICATIONS TERMINATION BLOCKS & PATCH PANELS	Jan 2012	<i>Not provided in this package</i>					
271123	COMMUNICATIONS CABLE MANAGEMENT & LADDER RACK	Jan 2012	<i>Not provided in this package</i>					
271305	COMMUNICATIONS BACKBONE CABLING	Jan 2012	<i>Not provided in this package</i>					
271505	COMMUNICATIONS HORIZONTAL CABLING	Jan 2012	<i>Not provided in this package</i>					
271543	COMMUNICATIONS FACEPLATES AND CONNECTORS	Jan 2012	<i>Not provided in this package</i>					
272129	DATA COMMUNICATION SWITCHES AND POWER SUPPLIES	Jan 2012	<i>Not provided in this package</i>					
275115	MASS NOTIFICATION SYSTEMS	Jan 2012	<i>Not provided in this package</i>					
275121	TSS INTERCOMMUNICATIONS SYSTEMS	Jan 2012	<i>Not provided in this package</i>					
275122	INTERCOMMUNICATIONS SYSTEM FOR CONSULAR WAITING AREA	Jan 2012	<i>Not provided in this package</i>					
275124	NON-CONSULAR TELLER INTERCOMMUNICATIONS SYSTEMS	Jan 2012	<i>Not provided in this package</i>					

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SPEC NO.	RANGOON AMERICAN CENTER	MASTER DATE	SITE	RAC	UTL 1	UTL 2	ROB 1
DIV 28 - ELECTRONIC SAFETY AND SECURITY							
280560	COMMON WORK RESULTS FOR TECHNICAL SECURITY SYSTEMS (TSS)	Jan 2012	<i>Not provided in this package</i>				
280570	SECURITY MANAGEMENT SYSTEM ENTERPRISE (SMSE)	Jan 2012	<i>Not provided in this package</i>				
281305	TECHNICAL SECURITY ACCESS SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
281354	TECHNICAL SECURITY ACCESS EQUIPMENT	Jan 2012	<i>Not provided in this package</i>				
281605	TECHNICAL SECURITY INTRUSION DETECTION SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
282305	TECHNICAL SECURITY CCTV SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
282605	TECHNICAL SECURITY DURESS SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
283115	ADDRESSABLE FIRE ALARM SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
285105	TECHNICAL SECURITY CHEMICAL DISPENSING SYSTEMS	Jan 2012	<i>Not provided in this package</i>				
DIV 31 - EARTHWORK							
311000	SITE CLEARING	Add'd 2014	X				
312000	EARTH MOVING	Jan 2012	X				
313116	TERMITE CONTROL	Jan 2012	<i>Not provided in this package</i>				
316213	CONCRETE PILES	Jan-2012					
316216	STEEL PILES	Jan-2012					
316219	TIMBER PILES	Jan-2012					
316223	COMPOSITE PILES	Jan-2012					
316329	DRILLED CONCRETE PIERS AND SHAFTS	Jan-2012					

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SPEC NO.	RANGOON AMERICAN CENTER	MASTER DATE	SITE	RAC	UTL 1	UTL 2	ROB 1
DIV 32 - EXTERIOR IMPROVEMENTS							
321216	ASPHALT PAVING	Jan-2012	X				
321313	CONCRETE PAVING	Jan-2012	<i>Not provided in this package</i>				
321373	CONCRETE PAVING JOINT SEALANTS	Jan-2012	<i>Not provided in this package</i>				
321400	UNIT PAVING	Jan-2012	<i>Not provided in this package</i>				
323113	CHAIN LINK FENCES AND GATES	Add'd 2014	X				
323120	DECORATIVE METAL FENCES AND GATES	Jan-2012	<i>Not provided in this package</i>				
324005	ANTI-CLIMB GATE SYSTEMS	Jan-2012	<i>Not provided in this package</i>				
324006	ANTI-RAM GATE SYSTEMS	Jan-2012	X				
324007	ACTIVE ROADWAY BARRIER SYSTEMS	Jan-2012	X				
324008	HYDRAULIC BOLLARD BARRICADE SYSTEMS	Jan-2012	X				
324009	CRASH-RATED DROP ARM SYSTEMS	Jan-2012	X				
328400	PLANTING-IRRIGATION	Jan-2012	X				
329115	SOIL PREPARATION	Jan-2012	<i>Not provided in this package</i>				
329305	PLANTING	Jan-2012	<i>Not provided in this package</i>				

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SPEC NO.	RANGOON AMERICAN CENTER	MASTE R DATE	SITE	RAC	UTL 1	UTL 2	ROB 1
DIV 33 - UTILITIES							
330505	COMMON WORK RESULTS FOR PIPED UTILITIES	Jan 2012	X				
331116	SITE WATER DISTRIBUTION PIPING	Jan 2012	X				
331119	SITE FIRE-SUPPRESSION WATER-SERVICE PIPING	Jan 2012	<i>Not provided in this package</i>				
331616	UNDERGROUND WATER STORAGE TANKS	Jan 2012	<i>Not provided in this package</i>				
331617	WATER STORAGE TANKS	Add'd 2014	X				
332100	WATER SUPPLY WELLS	Jan 2012	<i>Not provided in this package</i>				
333150	SITE SANITARY SEWERAGE PIPING AND STRUCTURES	Jan 2012	<i>Not provided in this package</i>				
333700	WASTEWATER TREATMENT PLANT	Jan 2012	<i>Not provided in this package</i>				
334100	SITE STORM UTILITY DRAINAGE PIPING	Jan 2012	<i>Not provided in this package</i>				
335217	MOTOR VEHICLE FUEL DISPENSING	Jan 2012					
335617	UNDERGROUND FUEL STORAGE TANKS AND DISTRIBUTION	Jan 2012	<i>Not provided in this package</i>				
337119	UNDERGROUND DUCTS AND RACEWAYS	Jan 2012	<i>Not provided in this package</i>				

SECTION 024115 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Selective demolition at buildings and structures.
2. Concrete slabs on grade and elevated slabs.
3. Walls and partitions.
4. Signage, equipment, furnishings, fixtures and other equipment as indicated.

B. Disconnecting, capping or sealing, abandoning in place, or removing services. Remove existing elements where indicated and where removal is necessary to accommodate the new design. These elements include, but are not limited to:

1. Plumbing piping, fixtures and equipment.
2. Mechanical piping, ductwork, plenums, and equipment.
3. Electrical, telecommunications, security and access control panels, conduit, raceway, fixtures and outlets.

C. Related Sections include the following:

1. Division 01 Section "Structure Demolition".

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.

1. Remove and Salvage: Detach items from existing construction and deliver them to OBO. Coordinate location of salvaged material storage with Project Director.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.3 SUBMITTALS

A. Proposed Environmental Protection, Erosion Control, Dust-Control, and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. The methods proposed shall comply with the local agencies and regulations. At a minimum erosion control, dust-control, and noise-control measures shall be provided to prevent disturbance to adjacent properties including (but not limited to) sediment dispersal through run-off or air-borne.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of temporary protection and means of egress, including for other tenants affected by building demolition operations.
 - a. Coordinate with Project Director to ensure that access is not disturbed to these facilities during construction or an alternate egress path is provided.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Health Hazards:
 - a. Whenever construction operations could result in worker contact with hazardous materials, follow recommendations of an American Board of Industrial Hygiene Certified Industrial Hygienist (CIH) employed by Contractor.
 - b. Existing Asbestos and Asbestos-Containing Materials: Comply with 29 CFR 1926.1101; complete removal is required.
 - c. Existing Lead-Based Paint: Comply with 29 CFR 1926.62; either removal or recoating is acceptable.

1.5 PROJECT CONDITIONS

- A. Buildings to be partially demolished may be occupied. Contractor to coordinate schedule with Project Director prior to demolition.
 1. OBO assumes no responsibility for buildings and structures to be demolished.
- B. Storage or sale of removed items or materials on-site is not permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building demolition required.

- B. Review Project Record Documents of existing construction provided by OBO. OBO does not guarantee that existing conditions are the same as those at the time of construction.
- C. Inventory and record the condition of items to be removed and salvaged. Walk the site with the OBO Project Director to identify items to be salvaged prior to construction.
- D. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations. Notify Project Director of areas of concern for further direction.
- F. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Remove and store refrigerant according to 40 CFR 82.
- B. Existing Services: Locate, identify, disconnect, and seal or cap off indicated services.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- D. Removed and Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - a. Store items in a secure area until delivery to OBO.
 - b. Transport items to OBO's storage area designated by OBO.
 - 3. Protect items from damage during transport and storage.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during demolition operations.
 - 1. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by OBO, items may be removed to a suitable, protected storage location during demolition and reinstalled in their original locations after demolition operations are complete.

2. Existing items to remain damaged during construction shall be removed and replaced in kind as approved by the Project Director.
- B. Existing Services: Maintain services indicated to remain and protect them against damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by OBO and authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to OBO and to authorities having jurisdiction.
 3. Provide at least 72 hours' notice to OBO if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways and as indicated.
1. Protect existing site improvements, appurtenances, and landscaping to remain. Items indicated to remain and damaged during construction shall be restored to their existing condition or better.
 2. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

3.4 DEMOLITION

- A. Demolish indicated building elements and site improvements as required to accommodate the proposed improvements. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 2. Maintain adequate ventilation when using cutting torches.
 3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from OBO and authorities having jurisdiction. Provide

- alternate routes around closed or obstructed traffic ways if required by the Project Director.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- E. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.
- F. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.
- G. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.
- H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
1. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by OBO.
 2. Transport steel trusses and joists as whole units without dismantling them further.
- I. Carpet: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.
- J. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- K. Below-Grade Construction: Demolish foundation walls and other below-grade construction completely within the project limits and as indicated to accommodate new construction.
- L. Existing Utilities: Demolish completely existing utilities and below-grade utility structures that are within the project limits. Verify that the utilities to be removed do not serve adjacent properties to remain prior to demolition. If adjacent properties are served, provide a new utility service in coordination with the local utility provider prior to demolition of the existing utility lines.
1. Piping: Cap the utilities at the property line in accordance with the local standards.

3.5 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.6 REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by building demolition operations.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain OBO's property, remove demolished materials from Project site and legally dispose of them.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off OBO's property and legally dispose of them.
 - 1. Recycling is preferred over other methods of disposal.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024115

SECTION 024116 - STRUCTURE DEMOLITION

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of buildings and structures.
2. Demolition and removal of site improvements adjacent to a building or structure to be demolished.
3. Removing below-grade construction.
4. Water well decommissioning.

B. Disconnecting, capping or sealing, and removing site utilities. Remove existing elements as indicated on Drawings, if removal is necessary to accommodate the new design, or as identified elsewhere in project requirement documents. These elements include, but are not limited to:

1. Foundation walls and footings.
2. Concrete slabs on grade.
3. Pavements and curbs. Manholes and covers.
4. Curb inlets and catch basins.
5. Underground storage tanks.
6. Underground petroleum products piping.
7. Fences and gates.
8. Utility meters and other equipment and exposed piping.
9. Creosote-treated wood utility poles.
10. All abandoned pipes, ducts, and conduits, whether above or below ground.
11. Relocate existing construction and utilities designated to remain as required for the design.
12. Water well components and connections to water piping and service connections serving adjacent USG properties. (the piping to, and service connections on, adjacent properties shall remain to maintain service).

C. Phasing Narrative – Phase 1 shall be defined as the initial demolition necessary to prepare the site for construction activities to begin. Phase 2 shall be defined as the construction phase, including utilities and buildings.

1. Phase 1 Initial Demolition

- a. Maintain perimeter walls and gates for securing the site.
- b. Install tree protection and ESC measures.
- c. Identify, maintain, and protect utilities that serve adjacent properties.
- d. Demolish and remove structures as indicated (protect structures and utilities as noted).
- e. Decommission on-site well and salvage water service piping and tanks as directed.

2. Phase 2 Building Phase

- a. Maintain perimeter security and construction access points throughout construction.

- b. Construct building and utilities.
- c. Maintain well on #138 in service until new well and water supply system is operational.
- d. The Building Contractor is responsible for maintaining and preserving the property boundary location and all monuments through demolition and construction. Contractor is responsible for ensuring that all new construction, controlled by the property boundary, conforms to the location of the original exterior face of wall.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.
 - 1. Remove and Salvage: Detach items from existing construction and deliver them to Project Director/COR.
- B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged.

1.3 SUBMITTALS

- A. Proposed Dust-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- B. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of temporary protection and means of egress, including for other tenants affected by building demolition operations.
 - a. Coordination of the Government's continuing occupancy of adjacent buildings and partial use of premises.
- C. Provide records of the entire decommissioning process, including depths sealed, quantity of sealing materials, and changes made to the existing well casing.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Health Hazards:

- a. Whenever construction operations could result in worker contact with hazardous materials, follow recommendations of an American Board of Industrial Hygiene Certified Industrial Hygienist (CIH) employed by Contractor.
 - b. Existing Asbestos and Asbestos-Containing Materials: Comply with 29 CFR 1926.1101; complete removal is required.
 - c. Existing Lead-Based Paint: Comply with 29 CFR 1926.62; either removal or recoating is acceptable.
2. Pollution Control:
- a. Underground Storage Tank Removal: Comply with 40 CFR 280.70 and applicable state and local regulations, including all responsibilities of the OBO, including emptying, closure, and removal of tank, and removal of contaminated soil found, as directed by the Project Director/COR.
 - 1) Surplus tank contents, including petroleum products and toxic liquids, shall become the property of the Contractor and may not be disposed of on site.
 - 2) The Contractor shall be responsible for draining all tanks, removing surplus tank contents from the site, and disposing of contents in accordance with US and local laws and regulations.
3. Well decommissioning:
- a. Well decommissioning shall be performed by a qualified water supply well contractor. Work shall be performed in compliance with EPA 570/9-75-001 and ASTM D5299, and AWWA A100-06: American Water Works Association "Water Wells" for decommissioning existing wells to be removed.

1.5 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
 1. The Government assumes no responsibility for buildings and structures to be demolished.
- B. Storage or sale of removed items or materials on-site is not permitted.

PART 2 - PRODUCTS

2.1 CEMENT GROUT FOR WELL DECOMMISSIONING

- A. Cement grout used to seal a well shall be composed of a uniformly mixed slurry of Portland cement or High Early Strength Type III Portland cement and potable water, or High-alumina cement and potable water, mixed in the following proportions (Type of Cement -- liters of Water Per Sack of Dry Cement, respectively):
 1. Portland Cement -- 17 to 22.7;
 2. High Early Strength Type III Portland cement -- 20.8 to 24.6;
 3. High-alumina Cement -- 17 to 22.7.

- B. Additives to increase fluidity, reduce shrinkage, or control time of set may be used in a cement grout mixture. Expanding agents such as aluminum powder may be used at a rate not exceeding 4.9 cm³ (one level teaspoonful) per sack of dry cement. The powder shall not contain polishing agents. The addition of bentonite clay to a cement grout mixture is acceptable but shall not in any case exceed five percent (5%) by weight of dry cement. Calcium chloride may be added to a Portland cement grout to accelerate the set but shall not exceed two pounds per sack of dry cement. High-alumina cement and Portland cement of any type shall not be mixed together for use in a well.
- C. Cement types other than those set forth herein shall not be used as a sealing material in a well except upon written approval of Project Director/COR.
- D. In no case shall sand or aggregate be added to cement grout seal mixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building demolition required.
- B. Inventory and record the condition of items to be removed and salvaged.
- C. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Remove and store refrigerant according to 40 CFR 82.
- B. Existing Utilities: Locate, identify, disconnect, and remove existing utilities within the limits of all proposed building footprint and proposed paved areas.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. For existing utilities to be abandoned in place, cut off pipe or conduit a minimum of 610 mm below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

4. Coordinate existing utilities to be removed/abandoned in place with, and at the final direction of, the Project Director/COR.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.
- D. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items of dirt and demolition debris.
 2. Pack or crate items after cleaning. Identify contents of containers.
 - a. Store items in a secure area until delivery to Project Director/COR.
 - b. Transport items to Government's storage area designated by Project Director/COR.
 3. Protect items from damage during transport and storage.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.
1. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Project Director/COR, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.
- B. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Project Director/COR and local authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to OBO and to authorities having jurisdiction.
 3. Provide at least 72 hours' notice to Project Director if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways and as indicated.
1. Protect existing site improvements, appurtenances, and landscaping to remain.
 2. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.

5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
6. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise from occupied portions of adjacent buildings.

3.4 DEMOLITION

- A. Demolish indicated existing buildings and structures and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 2. Maintain adequate ventilation when using cutting torches.
 3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Project Director/COR and local authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- E. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.
- F. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.
- G. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.

- H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
 - 1. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by Project Director/COR.
 - 2. Transport steel trusses and joists as whole units without dismantling them further.
- I. Carpet and Pad: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.
- J. Building Components: Remove metal gratings, metal ladders, doors, windows, door hardware, cabinets, mirrors, chalkboards and marker boards, tackboards, toilet accessories, plumbing fixtures, and light fixtures.
- K. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- L. Below-Grade Construction: Demolish and remove foundation walls and other below-grade construction.
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
 - 2. Fill demolition excavations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."
- M. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures. Identify utilities serving, or sharing service with, adjacent occupied properties and coordinate with the Project Director/COR the exact scope of utility protection/removal prior to demolition.
 - 1. Fill utility demolition excavations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."
- N. Explosives: Use of explosives is not permitted.

3.5 WELL DECOMMISSIONING

- A. Decommission in accordance with AWWA 100, EPA 570/9-75-001 and ASTM D5299 and as indicted below.
 - 1. Cased Wells: Remove the top 1.5m of the casing. The remaining casing may remain in place but the liners shall be ripped or perforated to all the grout to migrate outside the casing and to prevent the vertical movement of water. The annular spacing between the casing or liner and drillhole shall be filled with cement grout under pressure.
 - 2. Uncased Wells: Completely fill with cement grout.
 - 3. All obstructions or debris that may interfere with the effective abandonment of the well shall be removed prior to the well decommissioning. Foreign material that may cause contamination of the groundwater or aquifer shall be removed prior to sealing the wells.

4. Cement grout used for decommissioning shall be placed at the bottom of the well and placed progressively upward using a grout pipe or dump bailer. Avoid segregation or dilution of sealing materials.

- B. Prior to sealing, the depth of the well shall be measured and recorded in writing to the Project Director/COR.

3.6 SITE RESTORATION

- A. Below-Grade Areas: Fill below-grade areas with satisfactory soil materials according to backfill requirements in Division 31 section "Earth Moving" to leave a uniform, rough graded site for new construction.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by building demolition operations.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Government's property, remove demolished materials from Project site and legally dispose of them.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off the Government's property and legally dispose of them.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

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SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes basic requirements for factory-installed and field-installed motors.
- B. Related Sections include the following:
 - 1. Division 26 Section, “Variable Frequency Motor Controllers” for motors which are to used with variable speed controllers.

1.2 DEFINITIONS

- A. **Factory-Installed Motor:** A motor installed by motorized-equipment manufacturer as a component of equipment.

1.3 SUBMITTALS

- A. **Product Data:** Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
- B. **Factory Test Reports:** For specified test.
- C. **Field Test Reports:** Indicate and interpret test results for compliance with performance requirements.
- D. **Coordination Drawings:** Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

1.4 QUALITY ASSURANCE

- A. **Testing Agency Qualifications:** An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

- B. Comply with the OBO Electrical Code (NFPA 70, “National Electrical Code” as amended by OBO).
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Article 100 of NFPA 70, by a testing agency acceptable to Project Director/COR, and marked for intended use.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

- A. Motors 1 HP and Larger: Three phase.
- B. Motors Smaller Than 1 HP: Single phase.
- C. Frequency Rating: Compatibility with the host country voltage and frequency.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

- F. Duty: Continuous duty at ambient temperature of 40 degrees C and at same altitude as where the installation is to occur.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open Dripproof

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor, unless otherwise indicated.
- B. Efficiency: Premium for motors of 3.7 kW or larger, as defined in NEMA MG 1.
- C. Motors of 3.7 kW or larger shall employ power factor correction devices. The power factor correction shall provide for an overall power factor, measured at the point of connection of the equipment, of not less than 0.85 and not more than unity (1.0). Motors shall be provided with a low current, soft start capability to reduce the costs of gensets, switchgear and other power distribution equipment.
- D. Stator: Copper windings, unless otherwise indicated.
 - 1. Multi-speed motors shall have separate winding for each speed.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Designed with critical vibration frequencies outside operating range of controller output.
 - 2. Temperature Rise: Matched to rating for Class B insulation.
 - 3. Insulation: Class H.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
- D. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.
 - 5. Alignment.

2.5 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.
- E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

- A. Prepare for acceptance tests.
 - 1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
 - 2. Verify bearing lubrication.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control and safety features for proper operation.
 - 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform electrical tests and visual and mechanical inspections stated in NETA ATS. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.2 FIELD-INSTALLED MOTOR DEMONSTRATION

- A. Train government maintenance personnel to adjust, operate, and maintain field-installed motors.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 220513

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SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe expansion fittings and loops for mechanical piping systems, and the following:
 - 1. Metal-bellows expansion joints.
 - 2. Expansion compensators.
 - 3. Rubber expansion joints.
 - 4. Flexible-hose expansion joints.
 - 5. Pipe bends and loops.
 - 6. Guides and anchors.

- B. Related Sections include the following:
 - 1. Division 23 Section “Expansion Fittings and Loops for HVAC Piping.”

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of expansion fitting indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
- C. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
- D. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
- E. Alignment Guide Details: Detail field assembly and anchorage.
- F. Welding Certificates: Copies of certificate for welding procedures and personnel.
- G. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for expansion fittings and loops by a qualified professional engineer.
 - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of expansion fittings and loops that are similar to those indicated for this Project in material, design, and extent.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 - 1. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple -ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
 - 2. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
 - 3. Minimum Pressure Rating: 175 psig (1200 kPa), unless otherwise indicated.

4. Configuration: -bellows type with base, unless otherwise indicated.
- B. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.
1. Minimum Pressure Rating: 150 psig (1035 kPa), unless otherwise indicated.
 2. Configuration for Copper Piping: Two-ply phosphor-bronze or stainless-steel bellows and bronze or stainless-steel shroud.
 3. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
 4. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Threaded.
 5. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 6. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
- C. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
1. Spherical Type: Single spheres.
 - a. Minimum Pressure and Temperature Ratings: 1200 kPa At 116 deg C minimum.
 2. Material: BR.
 3. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
1. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.
 - a. NPS 2 (DN 50) and Smaller: Bronze hoses and single-braid bronze sheaths with 3100 kPa at 21 deg C (450 psig at 70 deg F) and 2340 kPa at 232 deg C (340 psig at 450 deg F) ratings.
 - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Stainless-steel hoses and single-braid, stainless-steel sheaths with 2070 kPa at 21 deg C (300 psig at 70 deg F) and 1550 kPa at 232 deg C (225 psig at 450 deg F) ratings.
 - c. NPS 2 (DN 50) and Smaller: Bronze hoses and double-braid bronze sheaths with 4830 kPa at 21 deg C (700 psig at 70 deg F) and 3450 kPa at 232 deg C (500 psig at 450 deg F) ratings.
 - d. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Stainless-steel hoses and double-braid, stainless-steel sheaths with 2890 kPa at 21 deg C (420 psig at 70 deg F) and 2170 kPa at 232 deg C (315 psig at 450 deg F) ratings.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 20.7 MPa minimum. Refer to Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.
 - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 3. Design Mix: 34.5-MPa, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION FITTING INSTALLATION

- A. Install expansion fittings according to manufacturer's written instructions.
- B. Install expansion fittings in sizes matching pipe size in which they are installed.
- C. Align expansion fittings to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

3.4 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.5 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05 mm.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220516

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SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes meters and gages for mechanical systems and water meters installed outside the building.
- B. Related Sections include the following:
 - 1. Plumbing equipment Sections that specify meters and gages as part of factory-fabricated equipment.
- C. Utility-Furnished Products: Water meters will be furnished to site, ready for installation.

1.2 SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Schedule for gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracy under specified operating conditions and compliance with specified requirements.
- D. Maintenance Data: For meters and gages to include in maintenance manuals. Include data for the following:
 - 1. Flow-measuring systems.
 - 2. Flowmeters.
 - 3. Water meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

2.2 PRESSURE-GAGE FITTINGS

- A. Valves: DN8 brass or stainless-steel needle type.

2.3 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in DN15 fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 3450 kPa minimum.
- D. Core Material for Water: Minus 7 to plus 93 deg C, chlorosulfonated polyethylene synthetic rubber.
- E. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
 - 1. Pressure Gage Ranges: Approximately two times the system's operating conditions.

2.4 WATER METERS

- A. Flow Measuring System General Requirements
 - 1. System includes calibrated flow element, flow processor, valves, fittings wiring, electronics, memory, software, and interface to BAS.
 - a. Range of flow-measuring element and meter covers operating range of system where used
 - 2. Data Management: Meters shall be capable of flow totalization for the purpose of consumption measurement.
 - a. Period of totalization shall be adjustable.
 - b. The metering system shall have non-volatile memory capable of storing one year of hourly data.
 - c. Totalization, memory storage, and calculation may be accomplished through the BAS.

- d. All programming, wiring, calibration, coordination, and interface with existing systems shall be the responsibility of the contractor providing the meter.

B. Turbine-Type Water Meters:

1. Description:

- a. Standard: AWWA C701.
- b. Registration: Flow in cubic meters.

C. Compound-Type Water Meters:

1. Description:

- a. Standard: AWWA C702.
- b. Registration: Flow in cubic meters.

2.5 SIGHT FLOW INDICATORS

A. Description: Instrument for visual verification of flow; made for installation in piping systems.

1. Construction: Bronze or stainless-steel body, with sight glass and plastic pelton-wheel indicator.
2. Pressure Rating: 860 kPa.
3. Temperature Rating: 93 deg C.

PART 3 - EXECUTION

3.1 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.2 INSTALLATIONS

- A. General: Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Install pressure gauges on all inlets and outlets of all water tanks.
- C. Install gauge cocks for all pressure gauge installations.
- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

- E. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- F. Install test plugs in tees in piping.
- G. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- I. Install flowmeter elements in accessible positions in piping systems.
- J. Provide shutoff valves on flowmeter inlets and outlets and valved bypass around meters.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings for attachment to portable indicators in accessible locations.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install meters and gages adjacent to equipment to allow service and maintenance.
 - 2. Connect flow-measuring-system elements to meters.
 - 3. Connect flowmeter transmitters to meters.
- B. Make electrical connections to power supply and electrically operated meters and devices.
- C. Ground electrically operated meters.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Install electrical connections for power and devices.
- E. Electrical power, wiring, and connections are specified in Division 26 Sections.

3.4 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hangers and supports for plumbing system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Powder-actuated fastener systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
 - 1. Professional Engineer Qualifications: A professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.6 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped; for equipment that will not have field-applied finish.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner; on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.2 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 MISCELLANEOUS MATERIALS

- A. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 3. Design Mix: 30 MPa, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, DN15 to DN750.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, DN15 to DN600, if little or no insulation is required.
 - 3. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, DN15 to DN50.
 - 4. U-Bolts (MSS Type 24): For support of heavy pipe, DN15 to DN750.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, DN20 to DN500.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, DN20 to DN500, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 49 to 232 deg C piping installations.
 2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05 mm (2.0 mils).

END OF SECTION 220529

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SECTION 221005 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following plumbing specialties:
1. Water regulators.
 2. Backflow preventers.
 3. Strainers.
 4. Drain valves.
 5. Miscellaneous piping specialties.
- B. Related Sections include the following:
1. Division 22 Section "Meters and Gages for Plumbing Piping" for water meters, thermometers, and pressure gages.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
1. Domestic Water Piping: 560 kPa.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
1. Water regulators.
 2. Backflow preventers.
 3. Strainers.
 4. Hose bibbs, hydrants.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field test reports.
- D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
1. Water regulators.

2. Backflow preventers.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated.
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Project Director/COR, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
 1. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 WATER REGULATOR

- A. Available Manufactures:
 1. Watts Industries, Inc.: Water Products Div. Series 233 or N223B.
 2. Armstrong-Yoshitake, Inc.
 3. Zurn Industries, Inc. Wilkins Div.
- B. General: ASSE 1003, water regulators, rated for initial working pressure of 1035 kPa minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
 1. Dn 50 and Smaller: Bronze body with threaded ends.
 - a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
 - b. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.
 2. Dn 65 and Larger: Bronze or cast-iron body with flange ends. Include AWWA C550- or FDA-approved, interior epoxy coating for regulators with cast-iron body.
 - a. Type: Single-seated, direct operated.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

2.2 BACKFLOW PREVENTERS

- A. General: ASSE standard, backflow preventers.
1. DN 50 and Smaller: Bronze body with threaded ends.
 2. DN 65 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
 5. Strainer: On inlet, if indicated.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- D. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.
- E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
1. Pressure Loss: 83 kPa maximum, through middle 1/3 of flow range.
- F. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
1. Pressure Loss: 35 kPa maximum, through middle 1/3 of flow range.
- G. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 0.19-L/s flow and applications with up to 30-kPa back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.
- H. Back-Siphonage Backflow Vacuum Breakers: ASSE 1056, suitable for continuous pressure and backflow applications. Include shutoff valves, check valve, test cocks, and vacuum vent.

2.3 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 1.2-mm round perforations, unless otherwise indicated.
1. Pressure Rating: 860-kPa minimum steam working pressure, unless otherwise indicated.
 2. DN 50 and Smaller: Bronze body, with female threaded ends.
 3. DN 65 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
 4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - a. Drain: Factory- or field-installed, hose-end drain valve.
 5. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
 6. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
 - a. Drain: Factory- or field-installed, hose-end drain valve.
- B. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
1. Basket: Bronze or stainless steel with 3.2- or 4.8-mm- diameter holes and lift-out handle.
 2. Female threaded ends for DN 50 and smaller, and flanged ends for DN 65 and larger.

2.4 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, DN 20 ball valve, rated for 2760-kPa minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
1. Inlet: Threaded or solder joint.
 2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.
- B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 1380-kPa minimum; ASTM B 62 bronze body, with DN 6 side drain outlet and cap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 22 Sections.

D. Ground equipment.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Connect plumbing specialties and devices that require power according to Division 26 Sections.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Test each backflow prevention device and submit test report

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water regulators.

3.5 PROTECTION

- A. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221005

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes domestic (potable) water piping from locations indicated to fixtures and equipment inside the building.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, fittings, and for water meters inside buildings.
 - 2. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.
 - 3. Division 33 Section "Site Water Distribution Piping" for water meters and water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 SUBMITTALS

- A. Product Data: for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates. Cut sheets for all water consuming fixtures shall highlight specific water flow rates.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Service Piping: 1100 kPa.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products and installation.
- C. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. The distribution system shall be designed in accordance with the requirements of the OBO Plumbing Code.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 STEEL PIPING

- A. Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 - 6. Steel-Piping, Expansion Joints: Compound, galvanized, steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.3 COPPER TUBING

- A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

- B. Hard Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types B and C), water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.4 VALVES

- A. Refer to Division 22 Section "General-Duty Valves for Plumbing Pipes" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 22 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Underground Domestic Water Service Piping: Protect piping from exterior corrosion in accordance with AWWA Manual 27. Use the following piping materials for each size range:
 - 1. DN 50 and Smaller: Soft copper tube, Type A; copper pressure fittings; and soldered joints. Underground installation of soft copper tubing is to be installed in building interior only.
 - 2. DN 65 to DN 90: Soft copper tube, Type A; copper pressure fittings. Underground installation of soft copper tubing is to be installed in building interior only.
- D. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. DN 40 and Smaller: Hard copper tube, Type B; copper pressure fittings; and soldered joints.
 - 2. DN 50: Hard copper tube, Type B; copper pressure fittings; and soldered joints.

3. DN 65 to DN 90: Hard copper tube, Type B; copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use bronze ball valves for piping DN 50 and smaller. Use cast-iron butterfly valves with flanged ends for piping DN 65 and larger.
 2. Throttling Duty: Use bronze ball or globe valves for piping DN 50 and smaller. Use cast-iron butterfly valves with flanged ends for piping DN 65 and larger.
 3. Drain Duty: Hose-end drain valves with end cap and chain.

3.4 PIPING INSTALLATION

- A. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Plumbing Specialties."
- B. Install domestic water piping level and plumb.
- C. If water treatment is to be done remotely on-site outside the building, extend domestic water service piping to exterior water distribution piping connecting building domestic water service with remote water treatment in sizes and locations indicated.
- D. Install underground ductile-iron piping according to AWWA C600 and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- E. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- F. Perform the following steps before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

- G. Check plumbing specialties and verify proper settings, adjustments, and operation.
 - 1. Water-Pressure Regulators: Set outlet pressure at 550 kPa maximum, unless otherwise indicated.
- H. Energize pumps and verify proper operation.

3.5 JOINT CONSTRUCTION

- A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping DN 50 and smaller. Use butterfly valves for piping DN 65 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping DN 50 and smaller. Use butterfly valves for piping DN 65 and larger.
- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 30 m and Less: MSS Type 1, adjustable, steel clevis hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 10 mm.

- E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. DN 100 and DN 125: 3.7 m with 16-mm rod.
 - 2. DN 150: 3.7 m with 19-mm rod.
 - 3. DN 200 to DN 300: 3.7 m with 22-mm rod.
- F. Install supports for vertical copper tubing every 3 m.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:
 - 1. Booster Systems: Cold-water suction and discharge piping.

3.9 FIELD QUALITY CONTROL

- A. Test domestic water piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested. Tests are to be witnessed by the Government.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Cap and subject piping to static water pressure of 345 kPa above operating pressure, without exceeding pressure rating of piping system materials. This test pressure is to be maintained for a period of at least 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

B. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by Project Director/COR or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 mg/L of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 mg/L of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to Project Director/COR. Repeat procedures if biological examination shows contamination.

B. When non-potable domestic water piping is required, clean as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by Project Director/COR or; if methods are not prescribed, follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to Project Director/COR. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221124 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged booster pumps to maintain pressure in the building potable-water distribution systems.
- B. Related Sections include the following:
 - 1. Division 22 Section "Common Motor Requirements for Plumbing Equipment" for general motor requirements.

1.2 SUBMITTALS

- A. Product Data: For each packaged booster pump specified. Include certified performance curves with operating points and surge line for VFD-controlled pumps plotted on curves; include rated capacities of selected models, electrical characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For packaged booster pumps and accessories. Include plans, elevations, sections, details, and attachments to other work. Shop Drawings shall be signed and sealed by a qualified professional engineer.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
 - 4. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 5. Wiring Diagrams: Detail power, signal, and control wiring, clearly indicating what is provided as factory wiring, and what is required for field wiring
 - 6. Indicate manufacturer recommended clearances for maintenance and Code required electrical access.
- C. Manufacturer Potable Water Qualification Certification: Submit certification that packaged booster pumps, accessories, and components all meet requirements of NSF 61.

- D. Operation and Maintenance Data: For each packaged booster pump to include in emergency, operation, and maintenance manuals.
 - 1. Provide copy of all operating setpoints.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of packaged booster pumps through one source from a single manufacturer.
- B. Basis of Design: Drawings indicate size, profiles, connections, and dimensional requirements of packaged booster pumps and are based on specific manufacturer types and models indicated. Other manufacturers' pumps with equal performance characteristics may be used.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Project Director/COR.
- D. Pumps, valves and all other skid components in contact with potable water supply rated according to NSF61.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings, control panel, and couplings against damage.
- C. Comply with pump manufacturer's rigging instructions for handling.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate hardware and software requirements with Division 23 Section "Instrumentation and Controls for HVAC" for monitor and display of specified alarms.

PART 2 - PRODUCTS

2.1 CONSTANT-SPEED, MULTIPLEX BOOSTER PUMPS

- A. Description: Factory-assembled and -tested, packaged booster pump with multiple pumps, piping, valves, sensors, and controls on skids or base.
- B. System Working-Pressure Rating: 1035 kPa (150 psig) minimum.

- C. Pump Arrangement: Duplex with two equal-size pumps.
- D. Motors: Single speed high-efficiency type, NEMA efficiency greater than 0.90, and oil-lubricated bearings, unless otherwise indicated. Select motor that will not overload through full range of pump performance curve. Comply with Division 22 Section "Common Motor Requirements for Plumbing Equipment."
- E. Control Valves: Adjustable, automatic, direct-acting pressure regulator on each pump discharge. (delete bold)
- F. Relief Valves: Adjustable, pressure relief type on pump discharge.
- G. Piping: ASME B31.9 and NSF 61 for piping materials and installation.
 - 1. NPS 4 (DN 100) and Smaller: ASTM B 88, Type L (ASTM B 88M, Type B), drawn copper water tube; with copper solder-joint pressure fittings, and brazed joints. (also, delete red / aqua font colors here and throughout the document)
 - 2. NPS 5 (DN 125) and Larger: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded cast-iron fittings and threaded joints.
 - 3. Header End Connections:
 - a. NPS 2 (DN 50) and Smaller: Threaded.
 - b. NPS 2-1/2 (DN 65) and Larger: Flanged.
 - 4. Piping Option: Piping, including valves and other components, may have galvanized Victaulic or approved equal grooved end with gaskets compatible with potable water systems
 - 5. Include NSF 61 rated strainer to protect pumps, with blow-off ball valve and cap.
- H. Valves: Include shutoff valve at each pump suction, and shutoff valve and check valve at each pump discharge.
 - 1. Shutoff Valves, NPS 2 (DN 50) and Smaller: MSS SP-110, 600-psig (4135-kPa) minimum CWP, bronze ball valve with ends matching piping.
 - 2. Shutoff Valves, NPS 2-1/2 (DN 65) and Larger: MSS SP-67, Type I for tight shutoff, 175-psig (1200-kPa) CWP, single-flanged, cast-iron butterfly valve.
 - 3. Check Valves, NPS 2 (DN 50) and Smaller: MSS SP-80, Class 125, bronze, spring-loaded check valve.
 - 4. Check Valves, NPS 2-1/2 (DN 65) and Larger: Spring- or lever-loaded, MSS SP-71, Class 125, bronze-trim, cast-iron, swing check valve.
- I. Sensors: Pressure and flow switches.
- J. Dielectric Fittings: With insulating material isolating joined dissimilar metals to prevent galvanic action and to stop corrosion.
 - 1. NPS 2 (DN 50) and Smaller: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

2. NPS 2-1/2 (DN 65) and Larger: Factory-fabricated, companion-flange assembly; for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- K. Control Panel: Factory installed and connected as an integral part of unit complying with NEMA ICS 2 and UL 508; automatic for multiple-pump, constant-speed operation, with load control and protection functions.
1. Enclosure: NEMA 250, Type 12.
 2. Motor Controller: Full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.
 - a. Control Voltage: Using integral control power transformer, the voltage shall be compatible with host country voltage and frequency.
 3. Motor Overload Protection: Overload relay in each phase.
 4. Duplex Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control. Alternating Starter: Switches lead pump to lag main pump and to two-pump operation
 5. Instrumentation: suction and discharge pressure gages for each pump.
 6. Lights: Running light for each pump.
 7. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 8. High-suction pressure cutout.
 9. High-discharge pressure cutout.
 10. Remote signal contacts.
- L. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and pump nozzles.

2.2 FLEXIBLE CONNECTORS

- A. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 175-psig (1200-kPa) minimum working-pressure rating and ends according to the following:
1. NPS 2 (DN 50) and Smaller: Provide flanged ends for flanged pump connections, otherwise provide threaded ends for DN50 and smaller.
 2. NPS 2-1/2 (DN 65) and Larger: Flanged.

2.3 BUILDING-AUTOMATION-SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
1. On-off status of each pump.
 2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water distribution piping to verify actual locations of connections before packaged booster pump installation.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for packaged booster pumps. Refer to Division 23 Section "Common Work Results for Fire-Suppression, Plumbing and HVAC."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm (18-inch) centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 - 4. Install anchor bolts to elevation required for proper attachment to supported equipment.

3.3 BOOSTER PUMP INSTALLATION

- A. Install packaged booster pumps level on concrete bases with access for periodic maintenance including removal of pumps, motors, impellers, couplings, and accessories.
 - 1. Do not dismantle packaged booster pumps or remove individual components.
- B. Vibration Isolation: Install on spring isolators with minimum specified deflection. Vibration isolation and seismic devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- C. Support connected domestic water piping so weight of piping is not supported by packaged booster pumps.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to packaged booster pumps. Install suction and discharge pipe equal to or greater than size of unit suction and discharge piping.
 - 1. Install full-size flexible connectors as connections to pump suction and discharge ends.

2. Install shutoff valves on both suction and discharge piping connections to each booster pump. Install full-port ball, butterfly, or gate valves same size as suction and discharge. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform the following startup service:
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers.
 4. Verify that pump controls are adjusted correctly for required application.
- B. Perform the following startup checks for each pump of packaged booster pump unit before starting:
 1. Verify bearing lubrication.
 2. Prime pumps by opening suction valves and closing discharge valves, and prepare pumps for operation.
 3. Start motors.
 4. Open discharge valves slowly.
 5. Adjust control settings.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting packaged booster pumps to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- D. Identify all operating setpoints for inclusion in O&M manuals for future reference by Government maintenance staff.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's maintenance personnel to adjust, operate, and maintain units as specified below:
 1. Train Government's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 2. Review data in maintenance manuals.

END OF SECTION 221124

SECTION 223230– POTABLE WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes equipment, piping, and specialties, along with water testing and monitoring to provide transitional potable water system during construction.
- B. Related Sections include the following:
 - 1. Refer to Division 23 Section "Common Work Results for Fire Suppression, Plumbing and HVAC" for dielectric fittings.
 - 2. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
 - 3. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 4. Install electrical connections for power, controls, and devices. Electrical power wiring, devices, and connections are specified in Division 26 Sections.

1.2 SYSTEM DESCRIPTION

- A. Provide multi-barrier potable water system capable of providing the design volume and flow rate of water with minimum of operations and maintenance. System shall be able to automatically produce potable water with one unit of each process out of service. System shall include the following:
 - 1. Pretreatment.
 - 2. Potable water treatment.
 - 3. Process pressure FRP tanks.
 - 4. Controls.
 - 5. System accessories
 - 6. Testing and monitoring equipment.
- B. Water treatment shall conform to requirements in Chapter 6 of the OBO Plumbing Code.
- C. Water treatment system shall be tailored to specific source water quality. However, in no case shall source water be conveyed directly to Department of State facilities served by system without written approval from Project Director/COR based on input from OBO/PDCS/DE mechanical engineer. Systems shall be passive and self-correcting, with chemical feeds systems minimized to the extent practicable.
- D. Provide automatic treatment capable of complying with National Primary and Secondary Drinking Water Regulations 40 CFR Parts 141 – 143, and Safe Drinking Water Act (PL 93-523, PL 104-182, and other applicable Public laws).

1.3 SUBMITTALS

- A. Product Data: Include system design flow, component rated capacities; water-pressure drops; shipping, installed, and operating weights; and furnished products listed below:
1. Pumps
 2. Chemical solution tanks
 3. Chemical mixers
 4. Process monitoring equipment
 5. Control equipment and devices
 6. Testing and monitoring equipment.
 7. Filters media
 8. Chemical feeders
 9. Water Testing Kits
- B. Shop Drawings: Detail equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: Detail power and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- D. Test Data, Calculations and Analysis of supply water source(s) as required in Chapter 6 of the OBO Plumbing Code. Submit six final copies of report and analyses to Project Director/COR for distribution to the following: OBO/CFSM/CM (for their records), Commissioning Agent, OBO/CFSM/FAC, OBO/OPS/SHEM, Post Facility Manager, and OBO/PDCS/DE mechanical engineer. Indicate and interpret test results for compliance with performance requirements. At a minimum, the testing shall include the following constituents, as defined by the EPA:
1. Turbidity
 2. Bacteriological quality
 3. Radioactive chemicals
 4. Volatile organic chemicals (VOCs)
 5. Synthetic organic chemical (SOCs)
 6. Inorganic chemicals
 7. Corrosivity
- E. Narratives and Calculations describing the potable water treatment system. Provide narrative and calculations, including design flows and pressures, life-cycle costing with estimates of equipment life and labor for treatment system process and equipment selection. Additionally, provide calculations demonstrating the adequacy of the disinfection system including locations of feed points.
- F. Operations and maintenance manuals for supplied equipment including information on normal operating parameters, when to change consumable parts, and troubleshooting guide.
- G. Complete list of required chemicals including meter reagents. Include local NSF 60 source and/or shipping restriction.

- H. Compliance Monitoring Plan: Provide recommendation testing schedule for process control and treatment compliance.

1.4 QUALITY ASSURANCE

- A. Process Monitoring: At a minimum, the parameters listed below shall be monitored. Monitoring equipment shall be designed for use in potable water applications.
 - 1. Flow rate, instantaneous
 - 2. Flow rate, total
 - 3. Operating pressure
 - 4. Pressure differential (across all filters)
 - 5. Turbidity (raw and finished water)
 - 6. Chlorine Residual
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Project Director/COR, and marked for intended use.
- D. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
 - 3. Comply with NSF 60 "Drinking Water Treatment Chemicals - health effects"
- E. Document any applicable local codes or authorities and ensure that all relevant work is in compliance.
- F. Implement applicable provisions of the Quality Control program as established in Division 01 Section "Contractor's Quality Control."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ship and store water treatment components in accordance with manufacturer's recommendations.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving other occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Project Director/COR not less than two weeks in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Project Director/COR's written permission.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

1.8 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water softeners/ion exchangers that fail in materials or workmanship within specified warranty period. Include coverage for the following:
 1. Attrition loss of resin not to exceed 3 percent per year.
 2. Resin not to be washed out of system during service run or backwashing period.
 3. Effluent turbidity not to be greater and color not to be darker than incoming water.
 4. Underdrain system, gravel, and resin not to become fouled, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.
- C. Warranty Period: Not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Provide minimum of one year of water treatment chemicals and other consumables that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 WATER TREATMENT SYSTEM

- A. Pretreatment
 1. Pre-storage filtration- provide membrane, cartridge, or media filtration sufficient to remove particles greater than or equal to five (5) microns with one filtration unit out of service.

2. Disinfection: Disinfect raw water, UV, sodium hypochlorite, or ozone, and maintain a free chlorine residual of 0.2 – 0.5 ppm.

B. Potable Water Treatment

1. Membrane, cartridge, or media filtration.
2. Ion exchange modules
3. Granulated activated carbon.
4. Disinfection: UV, Liquid or tablet chlorination, or on-site generation, such that the system maintains a free chlorine residual in all parts of the system between 0.2 – 0.5 ppm. Where sodium hypochlorite is selected, equipment shall be able to provide adequate disinfection using between 4 and 12.5 percent solution.

C. Process Pressure FRP Tanks

1. Construction: Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
2. Pressure Rating: 690 kPa minimum.
3. Wetted Components: Suitable for water temperatures from 5 to at least 49 deg C.
4. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
5. Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.

D. Controls: Fully automatic; factory mounted on unit and factory wired.

1. Push-button start and complete manual or automatic operation.
2. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration or backwash at any hour of day and any day of week or at fixed time and flow intervals.
3. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.
4. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
 - a. Slow opening and closing, non-slam operation.
 - b. Diaphragm guiding on full perimeter from fully open to fully closed.
 - c. Isolated dissimilar metals within valve.

1)

5. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.
6. Battery Backup: Provide UPS for electronic control systems such that power flashes and losses will not interrupt equipment operation.

E. Factory-Installed Accessories

1. Piping, valves, tubing, and drains.
2. Sampling cocks.
3. Main-operating-valve position indicators.

4. Water Meters

2.2 TESTING AND MONITERING EQUIPMENT

- A. A. Provide complete filter equipment and incubator at location in facility identified by Project Director/COR based on input from Post.
 - 1. Basis of Design: Colilert or MILLIPORE™ filter equipment.
- B. Water-Hardness Testing Set: Manufacturer's standard testing apparatus and chemicals with testing procedure instructions and metal container suitable for wall mounting.
- C. Additional equipment as necessary to fulfill the requirements of the monitoring plan prepared above.

PART 3 - EXECUTION

3.1 WATER TREATMENT EQUIPMENT INSTALLATION

- A. Install water treatment equipment on concrete bases, level and plumb, according to manufacturer's written instructions, layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing servicing are accessible.
- B. In accordance with requirements in Chapter 16 of the OBO Building Code, install seismic restraints for tanks and floor-mounting accessories and anchor to substrate.
- C. Install pressure gages on all process inlet and outlets.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Install drains as indirect wastes to spill into open drains or over floor drains.
- C. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Make piping connections to dissimilar-metal water piping with dielectric fittings. Refer to Division 23 Section "Common Work Results for Fire Suppression, Plumbing and HVAC" for dielectric fittings.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field assembly of components and installation of water treatment equipment, including piping and electrical connections. Report results in writing.
 - 1. Leak Tests: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Clean and disinfect Water-Storage Facilities and Water Treatment Plants as follows:
 - 1. Disinfection of water storage tank(s) are required before putting into service per AWWA Standard 652-02.
 - 2. Disinfection of Water Treatment Plants is required before putting into service per AWWA C653-03.

- C. Sample water treatment plant effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's maintenance personnel to adjust, operate, and maintain units.
 - 1. Train Government's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 - 2. Review data in maintenance manuals.

END OF SECTION 223230

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Ferrous-alloy ball valves.
 - 3. Ferrous-alloy butterfly valves.
 - 4. Bronze check valves.
 - 5. Ferrous-alloy wafer check valves.

- B. Related Sections include the following:
 - 1. Division 33 Section “Site Water Distribution Piping” for general-duty and specialty valves for site construction piping.

1.2 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. PTFE: Polytetrafluoroethylene plastic.

1.3 SUBMITTALS

- A. Product data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

- B. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY CONTROL

- A. Install devices in accordance with manufacturer’s recommendations.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain valves from single source which assumes responsibility for compatibility with plumbing systems.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.
- D. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: DN 50 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: DN 65 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Gear Drive: For quarter-turn valves DN 200 and larger.

2. Handwheel: For valves other than quarter-turn types.
3. Lever Handle: For quarter-turn valves DN 150 and smaller, except plug valves.

G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

H. Threaded: With threads according to ASME B1.20.1.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

A. Copper-Alloy Ball Valves, General: MSS SP-110.

B. Two-Piece, Copper-Alloy Ball Valves: Bronze body with regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 4140-kPa minimum CWP rating and blowout-proof stem.

2.3 FERROUS-ALLOY BALL VALVES

A. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

B. Ferrous-Alloy Ball Valves: Class 150, full port.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

B. Flangeless, 1035-kPa CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with two-piece stem.

2.5 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.6 FERROUS-ALLOY WAFER CHECK VALVES

A. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

B. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or plug valves.
 - 2. Throttling Service: Ball, butterfly, plug, or valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
 - 1. Ball Valves, DN 50 and Smaller: Two-piece, 2760-kPa CWP rating, copper alloy.
 - 2. Ball Valves, DN 65 and Larger: Class 150, ferrous alloy.
 - 3. Butterfly Valves, DN 65 and Larger: Flangeless, 1035-kPa CWP rating, ferrous alloy, with EPDM liner.
 - 4. Swing Check Valves, DN 50 and Smaller: Type 4, Class 125, bronze.
 - 5. Swing Check Valves, DN 65 and Larger: Type II, Class 125, gray iron.
 - 6. Wafer Check Valves, DN 65 and Larger: Single-plate, wafer, Class 125 or 150, ferrous alloy.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, DN 50 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water and heating hot water services.
 - 2. For Copper Tubing, DN 65 to DN 100: Flanged ends.

3. For Copper Tubing, DN 125 and Larger: Flanged ends.
4. For Steel Piping, DN 50 and Smaller: Threaded ends.
5. For Steel Piping, DN 65 to DN 100: Flanged ends.
6. For Steel Piping, DN 125 and Larger: Flanged ends.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.

3.4 JOINT CONSTRUCTION

- A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

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SECTION 260501 – ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Materials and Equipment

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with the OBO Electrical Code (NFPA 70 "National Electrical Code" as amended by OBO).
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NFPA 70, Article 100 by testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.

1.4 COORDINATION

- A. Coordinate arrangement, mounting and support, layout and installation of electrical equipment with demolition work.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.

- B. Determine the exact location of existing utilities and equipment before commencing work, compensate the Owner for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.
- D. Demolition drawings are based on casual field observation.
 - 1. Verify the accuracy of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the work.
 - 2. Verify location and number of electrical outlets in the field.
- E. Report discrepancies to Owner before disturbing existing installation.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. Beginning of demolition means installer accepts existing conditions without exception.

3.2 PREPARATION

- A. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, and access to different areas. The Owner will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- B. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- C. Coordinate utility service outages with utility company.
- D. Interruption of services (power, telephone, fire alarm, communication systems) to existing facilities: not permitted without express permission in each instance from the Owner.
 - 1. Requests for service outages: state specific dates, hours and the maximum duration.
 - 2. Written permission: obtain from Owner for interruption of power, lighting or signal circuits and systems.
 - 3. Organize the work to minimize duration of service interruptions.
 - 4. Provide temporary wiring and connections to maintain existing systems in service during construction.
- E. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- F. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
 - 1. Obtain permission from Owner at least 24 working days before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

- G. Overtime and shift work: provide as required to maintain continuity of services during normal working hours of the occupied building.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Reroute wiring clear of demolition which serve existing outlets that remain and reconnect back to source.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- K. Furred out walls/columns: extend circuiting and outlets.
- L. Extend existing installations using materials and methods compatible with existing electrical installations, as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires to remain: Remove luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps ballasts and broken electrical parts.

3.5 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner.
- B. Salvage the following equipment not being reused and sell/give to electrical salvage company:
 - 1. Luminaires
 - 2. Panelboards
 - 3. Breakers
 - 4. Transformers
- C. Electrical equipment that cannot be salvaged for reuse sell/give to recycling company. Recycle the following excess, removed, or demolished electrical material:
 - 1. Copper or aluminum conductors, buses, motor/transformer windings, and the like.
 - 2. Steel and aluminum from raceways, boxes, enclosures, housings and the like.
 - 3. Acrylic and glass from luminaire lenses/refractors.
- D. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

END OF SECTION 260501

SECTION 260505 – COMMON WORK RESULTS FOR ELECTRICAL, COMMUNICATIONS AND ELECTRONIC SAFETY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Safety considerations for outdoor substations.
 2. Supporting devices for electrical components.
 3. Electrical identification.
 4. Sleeves and sleeve seals
 5. Lock-out/tag-out devices.
 6. Safety accessories.
 7. Concrete equipment bases.
 8. Touchup painting.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, including lock-out/tag-out devices and safety accessories.
- B. Lock-Out/Tag-Out (LOTO) Schedule: Identify which LOTO model is intended to be used for each applicable electrical equipment.

1.3 QUALITY ASSURANCE

- A. Comply with the OBO Electrical Code (NFPA 70 “National Electrical Code” as amended by OBO).
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NFPA 70, Article 100 by testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.

1.4 COORDINATION

- A. Coordinate arrangement, mounting and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations

3. To allow right of way for piping and conduit installed at required slope
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment
- B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate electrical service connections to components furnished by utility companies.
1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- H. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to Project Director/COR.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 14-mm-diameter slotted holes at a maximum of 50 mm o.c., in webs.

- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Refer to Division 26 Section "Identification for Electrical Systems."

2.3 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 1.3- or 3.5-mm (0.05- or 0.14-inch) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 LOCK-OUT/TAG-OUT (LOTO) DEVICES

- A. Provide lockout tag-out devices to securely de-energize equipment in the Sections identified below. A set of LOTO devices shall be selected by the Contractor to positively lock-out all of the models of equipment in these Sections. Provide five of each model of LOTO device for each model of LOTO device in the set.
1. Division 26 Section "Transfer Switches."
 2. Division 26 Section "Panelboards."

2.6 SAFETY ACCESSORIES

- A. Supply safety accessories identified below to assist in safely de-energizing AVR and transformer. Provide prior to system and testing and commissioning.
1. Two live-line tools conforming to ASTM F711; one 1200 mm (4 foot) and one 1800 mm (6 foot) in length.
 2. Non-contact voltage proximity detector. Detector shall have both audio and visual alerts and warning indicators. Detector shall be instrument rated for AVR and transformer voltages. Detector shall be compatible with live-line tool.
 3. Two pair voltage-rated (VR) gloves and leather protectors conforming to ASTM D120 Class 2 (voltage rating of 17,000 AC and 25,500 DC); one pair glove size 8.5, and one pair glove size 9.5. Provide canvas bags for glove storage.
 4. Two sets VR rubber sleeves similar voltage rating as VR gloves, with canvas storage bags.
 5. Two arc flash protection suits, conforming to ASTM F1506, and rated for NFPA 70E hazard class 4 (40 cal); one sized large and one sized medium.
 6. Two sets safety grounds capacity rated for application conforming to ASTM F855. Ground cluster connectors shall acceptably secure clamp onto phase conductor and ground conductor.
 7. Retrieval stick conforming to ASTM F711; 1800 mm (6 foot) in length.

2.7 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 03 Section "Cast-in-Place Concrete."
- B. Concrete: As required for footings/foundations in Division 03 Section "Cast-in-Place Concrete."

2.8 TOUCH-UP PAINT

- A. Equipment Not Exposed to Harsh Environment: Equipment manufacturer's paint.
- B. Equipment Enclosures Not Exposed to Harsh Environment: Manufacturer's standard finish for indoor installations in non-harsh environments.

- C. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.
- D. Paints for Applications Exposed to Harsh Environments: For all outdoor applications and for indoor applications in harsh environment refer to Division 09 Section “High Performance Coatings.” Metallic materials shall be protected against corrosion.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.
- F. Electrical equipment shall be designed and rated to operate in project-specific unusual environmental conditions such as wind-blown sand, salt atmosphere, flooding, ultraviolet rays due to altitude, high winds such as hurricanes and tornadoes, etc. Where standard ratings are not available to match environmental conditions, equipment shall be derated as required to compensate for factors such as high altitude and ambient temperature. Equipment installed in conditioned spaces shall be designed and rated for the conditioned ambient.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations, Outdoors, and Area’s Exposed to the Environment: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 90-kg design load.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 6-mm diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 40-mm and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 600 mm from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. New Concrete: Concrete inserts with machine screws and bolts.
 - 3. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 4. Steel: Welded threaded studs or spring-tension clamps on steel.

5. Field Welding: Comply with AWS D1.1.
6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
7. Light Steel: Sheet-metal screws.
8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 100 mm (4 inches) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 1. Supporting devices for electrical components.
 2. Concrete bases.
 3. Touchup painting.
 4. Sleeves and Seals
- B. Test the Government's electricity-metering installation for proper operation, accuracy, and usability of output data.
 1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
 5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.7 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 09 painting sections.
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 DEMONSTRATION

- A. Demonstrate, to Project Director/COR and appropriate post electrical staff, the operation of each Lock-out/tag-out (LOTO) model and safety accessories. Identify which LOTO model is used for each applicable electrical equipment, referencing LOTO Schedule. Coordinate with training in Division 26 Section "Overcurrent Protective Device Coordination Study." Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260505

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 27 Sections for communications cables.

1.2 SUBMITTALS

- A. Product Data - General: For each type of product indicated.
- B. Product Data - Products Manufactured to International Standards: Identify variations from U.S. standards.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association (NETA), or is nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE.
- B. Comply with the OBO Electrical Code (NFPA 70 “National Electrical Code” as amended by OBO).
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NFPA 70, Article 100 by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.
- C. Products Manufactured to International Standards: Variations from U.S. standards require evaluation and approval by Project Director/COR with input from OBO/PDCS/DE/EE.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductor Material: Copper only complying with NEMA WC 70; solid conductor for 6.0 mm² and smaller, stranded for 10.0 mm² and larger. Copper shall be 98 percent conductivity and hard drawn.
- B. Conductor Insulation Types: Type THHN-THWN, XHHW, SO, or XHHW-2 complying with NEMA WC 70
 - 1. International Type Conductors and Cables: If requests are approved for international type conductors and cables, conductor and cable ampacities for applications of 600-VAC or less shall not exceed ampacities listed in National Electrical Code Table 310.16.

2.2 AERIAL CABLES

- A. Conductor Material: Conductor XHHW-2, copper stranded, insulated with cross-linked polyethylene. 600 volt, ICEA S-95-658NEMA NC-70.
- B. Messenger: 30 percent EHS copperweld, 8 mm² for up to size 50 mm², 12 mm² for up to 150 mm² cable.
- C. Binding: Flat bare copper strap.
- D. Maximum Span: 45 meters with maximum 765 mm sag.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- C. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.

- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- F. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- G. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- H. Class 3 Control Circuits: Type THHN-THWN, in raceway.
- I. Control wiring shall be minimum of 4 mm² (#12 AWG) stranded copper and shall be rated for 600-volt service.
- J. Neutral Conductor: Where a secondary distribution system requires a neutral conductor, a full-sized neutral conductor shall be used throughout the system, such that neutral conductor is not shared with any other branch circuit or feeder.
- K. Ground Conductor: Insulated equipment grounding conductors run with branch circuits shall be installed such that that conductor is not shared with any other branch circuit.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Common Work Results for Electrical, Communications and Electronic Safety."
- F. Seal around cables penetrating fire-rated elements according to Division 07 Section "Penetration Firestopping."
- G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification (ATS), Section 7.3. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 33 Section "Underground Ducts and Raceways" for ground test wells.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: Include the following in operation and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.3 QUALITY ASSURANCE

- A. Grounding. The system shall meet the requirements as listed on the plan drawings.

- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to Project Director based upon input from OBO/PDCS/DE/EE.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- C. Comply with UL 467.
- D. Comply with the OBO Electrical Code (NFPA 70, “National Electrical Code” as amended by OBO).
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.
- E. For overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- F. Comply with NFPA 780 “Standard for the Installation of Lightning Protection Systems.”
- G. Comply with UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated copper conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Equipment Grounding Conductors: Insulated with green-colored insulation.
- C. Grounding Electrode Conductors: Stranded copper cable.
- D. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- E. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 95 mm² copper conductor.
 - 2. Bonding Conductor: 25 mm² or 16 mm², stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 42 mm wide and 1.5 mm thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 42 mm wide and 1.5 mm thick.

2.2 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
- B. Ground Rods
 1. Size: 20 mm diameter by 3000 mm long.

PART 3 - EXECUTION

3.1 APPLICATION

- A. In raceways, use insulated equipment-grounding conductors.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- D. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with Article 250 of the Electrical Code of Overseas Buildings Operations for types, sizes, and quantities of equipment grounding conductors, unless more restrictive specific types, larger sizes, or more conductors are indicated on Drawings.
- B. Install equipment grounding conductors in all feeders and circuits.

- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for communications cables.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 300 mm below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.4 3.5 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surface indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For 10 mm² and larger, use pressure-type grounding lugs. 10 mm² and smaller grounding conductors may be terminated with winged pressure-type connectors.

- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
- B. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each building electric service entrance, electric/telecom rooms, generator system, buildings and lightning protection system where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Tests at each ground rod before any conductors are connected are not required if a clamp-on ground tester is used. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Maximum value of acceptable system ground resistance is 10 ohms.

END OF SECTION 260526

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SECTION 260534 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Common Work Results for Electrical, Communications and Electronic Safety" for supports, anchors, and identification products.
 - 2. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
 - 3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. RMC: Rigid metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

1.3 PERFORMANCE

- A. Install raceway and conduit in manner that maintains required performances and ratings of walls.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 QUALITY ASSURANCE

- A. Comply with the OBO Electrical Code (NFPA 70, “National Electrical Code” as amended by OBO).
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- C. IMC: ANSI/NEMA C80.6.
- D. EMT: ANSI C80.3.
- E. EMT Fittings: ANSI/NEMA FB 1
 - 1. Fittings: Compression type. Set screw type not permitted.
 - 2. Connectors: Threaded / locknut type. Snap in type not permitted.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- B. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

- A. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 250, Type 1.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system.
- D. Wireway Covers: Hinged type or as indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS (NEMA 3R)

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- C. Pull Boxes and Junction Boxes – General (NEMA 3R):
 - 1. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
 - 2. Provide pull boxes and junction boxes with blank cover plates.

2.6 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors - General:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors - General:

1. Exposed: EMT Conduits may be exposed in utility spaces such as electrical and mechanical rooms.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
6. Lighting fixtures “whips”: FMC; MC cable may be used instead of FMC subject to approval by Project Director/COR.

C. Minimum Raceway Size: 21mm DN 21. Exception: 12mm as noted for specialized control conduits and for FMC lighting fixture “whips.”

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

E. PROTECTION

F. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.2 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 260534

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
 - 3. Transient voltage surge suppressor panelboards.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RCCB: Residual current circuit breaker.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. SPD: Surge protective device.
- H. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

- A. Product Data - General: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

- a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports including the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- 1.4 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Comply with NEMA PB 1.
- C. Comply with requirements of the OBO Electrical Code (NFPA 70, "National Electrical Code" as amended by OBO).
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 40 degrees C.
 - 2. Altitude: Not exceeding 2000 m.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 2000 m.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Post or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Project Director/COR no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Project Director/COR's written permission.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

- A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 FABRICATION AND FEATURES

- A. Enclosures: Flush or surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 3. Separate neutral and grounding buses for all panelboards.
 - 4. Five 12 mm holes in bottom of cabinet to allow for acquired natural condensation to drain.

- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with door-in-door hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Bus Bars of Power Distribution and Branch Circuit Panelboards: Provide hard drawn copper. The neutral bus shall be isolated from both the ground bus and the cabinet, except at the service entrance or at the output of separately derived systems and shall be grounded in accordance with the NEC.
- H. Main and Neutral Lugs: Compression or mechanical type suitable for use with conductor material.
- I. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- J. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- K. Feed-through Lugs: Compression or mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- L. Provide 10 percent spare circuit breakers, 20 percent spaces for future breakers, and 20 percent overall spare current carrying capacity for future expansion.

2.2 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Circuit Panelboards: Branch protective devices in panelboards shall be of the bolt-on type circuit breakers unless fuses are required because of available fault currents. Locate panelboards at the utility area nearest the center of the load. Panelboards shall have main circuit breakers. Where multiple section panelboards are required, each section shall have a main breaker. Size panels as noted above.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- C. Doors: Door-in-door style front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISTRIBUTION PANELBOARDS

- A. Power Distribution Panelboards: Panelboards serving three-phase motors and other power equipment shall be of circuit breaker type. Size the panel bus, lugs, and circuit breakers to match the transformer kVA and system fault level.
- B. Doors: Door-in-door front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- C. Main Overcurrent Protective Devices: Circuit breaker.
- D. Branch overcurrent protective devices shall be one of the following:
 - 1. For All Circuit-Breaker Frame: Bolt-on circuit breakers.

2.5 SURGE SUPPRESSION

- A. Transient voltage disturbances from commercial power systems associated with lightning storms and switching surges externally, as well as harmonics generated by adjustable speed drives and SCR power supplies associated with UPS equipment internally may cause stress and damage to electrical equipment. Therefore, transient voltage surge protection is required at the service entrance to all buildings, at all main distribution panels and all secondary power panels. The surge protection shall be provided in accordance with Division 26 Section “ Surge Protective Devices”.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Residual Current Circuit Breakers: Single- and two-pole configurations with 4-mA to 6 mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical or Compression style, suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Shunt Trip: 220 or 240 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.7 CONTROLLERS

- A. Motor Controllers: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:
1. Individual control-power transformers.
 2. Fuses for control-power transformers.
 3. Bimetallic-element overload relay.
 4. Indicating lights.
 5. Seal-in contact.
 6. Four convertible auxiliary contacts.
 7. Push buttons.
- B. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:
1. Individual control-power transformers.
 2. Fuses for control-power transformers.
 3. Indicating lights.
 4. Seal-in contact.
 5. One convertible auxiliary contacts.
 6. Push buttons.
 7. Selector switches.
- C. Controller Disconnect Switches: Adjustable instantaneous-trip circuit breaker, integrally mounted and interlocked with controller.
1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.

- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.
 - 1. Control-Power Source: 220 V branch circuit.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mounting Heights: Top of trim 2,100 mm above finished floor, unless otherwise indicated.
- D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub four 27 mm GRC empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 27 mm GRC empty conduits into raised floor space or below slab not on grade.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical, Communications and Electronic Safety."

- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. eBalancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and online data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

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SECTION 263234 – DOCKING STATION

PART 1 - GENERAL

1.1 SCOPE:

- A. This section includes Generator Docking Station and related equipment.
- B. Contractor shall furnish, deliver, install and test the docking station as specified herein and in accordance with the drawings.

1.2 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- B. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Comply with requirements of the OBO Electrical Code (NFPA 70, "National Electrical Code" as amended by OBO).
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE, and marked for intended use.

1.3 SUBMITTALS:

- A. Product Data - General: Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings – Generator Docking Station and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

- C. Operation and Maintenance Data: For the docking station and components to include in emergency, operation, and maintenance manuals.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 40 degrees C.
 - 2. Altitude: Not exceeding 2000 m.
- B. Service Conditions: Usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 2000 m.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Post or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Project Director/COR no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Project Director/COR's written permission.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment shall be new and meet all environmental conditions at installed location.
- B. Generator Docking Station manufacturer must have produced and sold generator docking stations as a standard product for a minimum of two years.
- C. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.
- D. Generator tap boxes shall be TempTap Inlet Boxes as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

2.2 GENERATOR DOCKING STATION

- A. Generator docking station shall consist of cam-style male connectors and grounding terminals, all housed within a padlockable enclosure.

- B. Generator docking station enclosure shall be Type 4X, constructed of continuous seam-welded, powder coated steel. The main access shall be through a hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via cable entry openings in the bottom of the enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. On bottom of enclosure, install three 10mm holes near the center to allow for condensation to escape. Bottom panel of enclosure shall be sloped from perimeter walls towards the weep holes for positive drainage. Enclosure shall be powder coated after fabrication; color shall be light gray RAL 7038.
- C. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. None of the cam-style male connectors shall be accessible unless the main access door is open.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prior to installation of generator docking station, Contractor shall examine the areas and conditions under which the generator tap box is to be installed and notify the Project Director/COR in writing if unsatisfactory conditions exist.
- B. Generator docking station shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".
- C. Conduit entry into the manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the generator docking station. The hub size shall match the conduit size for conductors and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 4X integrity of the generator docking station.
- D. Contractor shall terminate conductors and ground per the manufacturer's instructions. Use copper wire only for all conductors and grounds. All field wiring terminations in the generator tap box shall be torqued as required per the instructions on the generator docking station.
- E. Mount top of generator docking station enclosure 1828mm above concrete housekeeping pad. Utilize corrosion resistant structural electrical channel to support enclosure.
- F. Mounting: Plumb and rigid without distortion of box.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- H. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.2 FIELD TESTING

- A. Prior to energizing generator tap box, the Contractor shall perform the following checks and tests as a minimum:
 - 1. Verify mounting and connections are complete and secure.
 - 2. Verify internal components and wiring are secure.
 - 3. Perform continuity check of all circuits.
 - 4. Perform 1,000 VDC megger test on phase and ground cables.
 - 5. Verify deadfront is secure.
 - 6. Confirm operation of the generator tap box ground receptacle by attaching a plug to the generator tap box ground receptacle and then verify that the plug is grounded to the facility ground.

END OF SECTION 263234

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switch.
 - 2. Automatic closed-transition transfer switch.
- B. Related Sections include the following:
 - 1. Division 21 Section "Fire Pump Assemblies" for automatic transfer switches for fire pumps.
 - 2. Division 26 Section "Common Work Results for Electrical, Communications, and Electronic Safety," including electrical safety accessories.
 - 3. Division 26 Section "Field Testing and Inspection of Electrical Systems."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For manufacturer and testing agency.
- E. Field quality-control test reports: Indicate and interpret test and inspection results for compliance with.
- F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
 3. Include safety Standard Operating Procedures (SOP), including de-energization and isolation procedures.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing emergency maintenance and repairs at Project site with an eight-hour maximum response time.
- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies (Level 3 or higher), to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switch, bypass/isolation switch, nonautomatic transfer switch, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.
- D. Comply with NEMA ICS 1.
- E. Comply with requirements of the OBO Electrical Code (NFPA 70, "National Electrical Code" as amended by OBO).
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100 of NFPA 70 for emergency service under UL 1008, by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE/EE.
- F. Comply with NFPA 99.
- G. Comply with NFPA 110.

- H. Comply with UL 1008, unless requirements of these Specifications are stricter.

1.4 EXTRA MATERIALS

- A. Furnish extra parts at Substantial Completion. Extra parts shall be packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is the same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communications Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
 - 1. Fully automatic make-before-break operation.
 - 2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
 - 3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
 - a. Initiation occurs without active control of generator set.
 - b. Controls ensure closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees, maximum and plus or minus 5 percent maximum voltage difference.
 - 4. Failure of the power source serving the load initiates automatic break-before-make transfer.

- H. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

2.2 AUTOMATIC TRANSFER-SWITCH FEATURES

- A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent. Provide over/under voltage and frequency sensing for all generator transfer switches to initiate generator start and transfer of power.
- B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
- C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
- D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
- E. Test Switch: Simulates normal-source failure.
- F. Switch-Position Pilot Lights: Indicate source to which load is connected.
- G. Source-Available Indicating Lights: Supervise sources via transfer-switch, normal- and emergency-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
- H. Unassigned Auxiliary Contacts: Two normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
- I. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- J. Engine Starting Contacts: One isolated, normally closed and one isolated, normally open, rated 10 A at 32-V dc minimum.

- K. Engine Shutdown Contacts: Instantaneous. Initiates shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
- L. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes; factory set for five minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.
- M. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - 1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - 2. Push-button programming control with digital display of settings.
 - 3. Integral battery operation of time switch when normal control power is not available.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. General Purpose Automatic Transfer Switch: 4-pole and have a continuous current rating equal to or greater than the prime current rating of the genset. Switch configuration shall be "break" before "make" arranged such that all four poles open and close simultaneously, and shall be mechanically interlocked to prevent simultaneous closing of normal and emergency contacts. The main switch contacts shall be long life, high pressure, silver alloy, and have separate arcing contact areas. There shall be two sets of form "C" auxiliary contacts (one for each source) rated at 10 amps continuous and [250 V]. The three leads from each set of contacts shall be wired to six terminals on the consumers terminal strip (see subpara. below on "Terminals (ATS)"). The ATS components shall be in a NEMA 1 enclosure arranged for wall mounting.
 - 1. Sequence of operation (ATS):
 - a. When the voltage on any phase of the normal source (commercial power) is reduced to 80 percent of rated voltage (adjustable from 75 percent to 98 percent of pickup voltage) for more than 10 seconds (adjustable 0 to 15), the starting contacts shall close.
 - b. When the genset has started and obtained 90 percent of rated voltage (adjustable 85- 100 percent) on all phases and rated frequency, the load shall be transferred to the genset after 30 seconds (adjustable 2 to 120).
 - c. When the normal source has been restored and the voltage of all phases has been within 90 percent of rated voltage (adjustable 85-100 percent) for 15 minutes (adjustable 0 - 30), the load shall transfer to normal power.
 - d. The genset shall continue to run for 10 (adjustable 1 to 10) minutes before it automatically stops. The system shall now be ready for another failure cycle.

2. Neutral bus (ATS): The neutral bus shall be electrically isolated from the ATS enclosure and shall be rated at full capacity of the switch. There shall be sufficient terminals to accommodate the load neutral, the normal source neutral, the emergency source neutral, ground electrode conductor, and an equipment bonding jumper.
3. Equipment Ground Bus (ATS): The equipment ground bus shall be electrically bonded to the ATS enclosure. It shall have one terminal sized to accommodate the equipment bonding jumper, and a second terminal sized to accommodate the equipment grounding conductor.
4. Lugs (ATS): All cable terminations for genset (source two), load and normal (source one) power shall have tinned copper lugs sized to accept a conductor one size larger than required for the current rating.
5. Manual Operation (ATS): The ATS shall have a permanently mounted handle capable of operating the switch mechanism to accomplish both a transfer and retransfer of rated load.
6. Controls (ATS): There shall be a three position, key operated switch labeled "TEST", "NORMAL" and "RETRANSFER" located on the enclosure door.
 - a. Test position (ATS): In the "TEST" position the genset shall automatically start come up to rated speed and rated voltage, but the ATS shall not transfer the load to the genset
 - b. Normal position (ATS): In the "NORMAL" position the ATS functions in the completely automatic mode.
 - c. Retransfer position (ATS): In the "RETRANSFER" position the ATS immediately transfers the load to commercial source bypassing any preset transfer delays.
7. Indicators (ATS): There shall be four indicator lights, properly labeled as to function mounted on the enclosure door. Two of the indicator lights are to be labeled to show the position of the main switch. The other two indicating lights are to be labeled to show the status of the two sources.
8. Terminals (ATS): A terminal strip(s) for customer use, located inside the ATS enclosure, shall be provided to facilitate the interconnection between the transfer switch and the genset. There shall be a minimum of twenty terminal points available for customer use. Three of these terminals shall be wired to each of the two sets of form C contacts from the main switch auxiliary relays; one terminal shall be wired to accept the genset battery B+; one terminal shall be wired to accept the genset battery (B-); and one terminal shall be wired to serve as the remote start signal source for the genset. The remaining terminals will be unused spares.
9. ATS shall match the final approved construction drawings.
 - a. ATS 4-pole: The 4-pole ATS shall have four poles and shall meet all preceding requirements for GP-ATS.
 - b. ATS 3-pole with programmed transition: The ATS shall meet all preceding requirements for GP-ATS, and have programmed transition (time delay in neutral position for 30 seconds, adjustable from 1 to 60 seconds).
 - c. ATS 4-pole with programmed transition: The ATS 4-pole shall meet all preceding requirements for GP-ATS, and have programmed transition (time delay in neutral position for 30 seconds, adjustable from 1 to 60 seconds).

- d. ATS 4-pole with "make" before "break" (overlapping) neutral contacts: The ATS 4-pole shall meet all preceding requirements for GP-ATS, and have overlapping contacts.
- e. ATS mounted battery charger where required: There shall be a static battery charger mounted inside the ATS enclosure. This battery charger shall be the temperature compensated constant voltage type rated to match the battery voltage of the genset, with over-current control to limit the output current to 10 amps even when connected to a dead battery. The charger output shall be pre wired to the B+ and B- terminals of the customer terminal strip.

2.4 FINISHES

- A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.5 SOURCE QUALITY CONTROL

- A. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Four-Pole Switches: Where four-pole switches are indicated, install neutral switching.

3.2 INSTALLATION

- A. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, pretest, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
 - C. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.22.3. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
 - b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Remove and replace malfunctioning units and retest as specified above.

3.5 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.6 CONDENSATION DRAIN

- A. Install five 12 mm holes in bottom of cabinet to allow naturally acquired condensation to drain.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.
- B. Coordinate with Project Director/COR and post Facility Manger to identify staff, including locally employed staff (LES) maintenance personnel, who may access transfer switches.
- C. Coordinate this training with that for generator equipment.
- D. Train Government maintenance personnel in the following:
 1. Coordinate training on safety precautions and use of medium-voltage safety accessories with requirements in Division 26 Sections “Common Work Results for Electrical, Communications, and Electronic Safety” and “Overcurrent Protective Device Coordination Study.”
 - a. De-energizing procedures to safely de-energize, isolate and lock-out the transfer switches prior to any maintenance or repair work. Standard Operating Procedures described in O&M Data Manual.

2. Features and construction of project equipment.
3. Routine testing and monitoring operations.
4. Interpretation of readings of indicating and alarm devices.
5. Routine inspection procedures.
6. Access control panel to maintain an operations log in accordance with procedures of OBO/CFSM/FAC.
7. Remove and replace control panel or components.
8. Clean connections and conductors on basis identified by OBO/CFSM/FAC considering input from manufacturer.
9. Review data in maintenance manuals, including written Standard Operating Procedures to (SOP) accomplish the above tasks. .

E. Schedule training with Project Director/COR with at least seven days' advance notice.

END OF SECTION 263600

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Erosion and sediment control.
 - 6. Tree protection.
- B. Selective demolition of three existing site buildings to remain shall be performed in accordance with the Construction Documents and the specification Division 02 Section 024115 Selective Demolition and Section 024116 Structure Demolition.

1.3 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property, removed from the site, and disposed of properly.
- B. Historic items, relics, and other items of interest or value to the Owner encountered during site clearing shall remain the Owner's property. Carefully remove and salvage in a manner to prevent damage and deliver promptly to Owner.
- C. Hazardous material shall be removed off-site if encountered. Contractor shall coordinate hazardous material removal and disposal with Project Director/COR prior to construction.

1.4 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Notify utility providers for Project area at least 72 hours prior to site clearing, to coordinate utility shut down and verify line locations.

1.5 SUBMITTALS

- A. Provide submittals for erosion- and sediment-control measures:
 - 1. Drawings and requirements of authorities having jurisdiction.
 - 2. Sediment fence and all other erosion- and sedimentation-control measures used.
- B. Provide submittals for tree-protection products used.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: As specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.
- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating .
 - 1. Use coating with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Topsoil – Natural or cultivated surface-soil layer containing organic matter, sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 50mm in diameter; and free of weeds, roots, and other deleterious materials.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 1500 mm above the ground.
- B. Protect existing buildings and foundations to remain.
 - 1. Restore damaged building and foundations to their original condition, as acceptable to Owner.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

- D. Protect and maintain bench marks and survey control points from disturbance during construction.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 UTILITIES

- A. Contractor shall arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the written permission of the Project Director/COR.
- E. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Completely remove stumps, roots larger than 75mm diameter, obstructions, and debris extending to a depth of 450 mm below exposed subgrade.
 3. Use only hand methods for grubbing within protection zones.
 4. Dispose of removed tree branches off-site using locally practiced methods.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
1. Place and compact fill material per Division 31 Earth Moving.
 2. Under proposed buildings and pavement areas, fill depressions per Division 31 Earth Moving.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to the depth that will prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 50 mm in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
1. Do not stockpile topsoil within protection zones.
 2. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity required to be reused.
 3. Stockpile topsoil to allow for respreading deeper topsoil.
 4. Install silt fence around stock piled surplus topsoil. Silt fence is to remain erect until topsoil is re-spread.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 TREE PROTECTION:

- A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection." Special Provisions for local arborist oversight and direction of all clearing, grading and drainage work related to the preservation of the historic "hanging tree" shall be observed pursuant to CSS CMPD drawings incorporated per section J.3.2 of the Contract Documents.
- B. Preserve and protect groups of trees, planting, or other landscape features, such as walls, steps or walkways identified to remain.
 - 1. Fence: Erect 1.8 m high chain link fence, with posts 3 m apart around the selected vegetation/trees to remain. Place the fence at location indicated on Tree Protection Drawings. Where fence alignment has not been indicated, place fencing at the dripline of the trees and around shrub masses. Include one gate per enclosure.
 - 2. Signs: Post signs identifying tree protection areas for selected features on fence 7 m apart. Print "Entry Prohibited" or similar warning in English and local language.
 - 3. No construction activities including utility trenching or material storage shall be allowed in the tree preservation areas. Also prohibited are any stored vehicles, parked vehicles, or other uses that will compact the ground. Contractor shall erect tree protection fence, maintain trees and vegetation during construction, monitor the tree protection areas, remove fence at the conclusion of construction and restore the area as indicated on the landscape tree preservation plans.
 - 4. Any plants or shrubs within the approved final Tree Preservation areas that are damaged, removed, or altered shall be replaced with three trees of similar species sized per minimum OBO standards and as approved by the Project Director/COR.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

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SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for foundations, slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs
4. Subbase and base course for pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling for utility trenches.
7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt/concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use backfill, common fill or structural fill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Project Director/COR. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 3 m in width and more than 9 m in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Project Director/COR. Unauthorized

excavation, as well as remedial work directed by Project Director/COR, shall be without additional compensation.

- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 0.75 m³ for bulk excavation or 0.60 m³ for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 157 kW (210 hp) flywheel power and developing a minimum of 216 kN (48,500 lbf) breakout force with a general-purpose bare bucket; measured according to SAE J-732.
 2. Excavation of Foundations, Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 1100 mm wide, maximum, short-tip-radius rock bucket; rated at not less than 100 kW (138 hp) flywheel power with bucket-curling force of not less than 125 kN (28,000 lbf) and stick-crowd force of not less than 83 kN (18650 lbf) ; measured according to SAE J-1179.
- I. Structures: Buildings, footings, foundations, retaining walls, perimeter walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage course, fill, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- M. Gravel: crushed rock material to be used for fill and adjacent to walls as noted.
- N. Filter Material: course of graded mixture of natural or crushed gravel, or crushed stone and natural sand placed as part of subdrainage systems.
- O. Common Fill: course placed to be backfill excavations in non-structural areas or to regrade landscaping.
- P. Structural Fill: course of naturally or artificially graded mixture of natural or crushed gravel places over excavated subgrade, under pavements, foundations, slabs, and behind retaining walls.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.
4. Retaining wall.

B. Samples: 300-mm by 300-mm sample of subdrainage and separation geotextile.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.
3. Laboratory test results for corrosion potential of soils to include:
 - a. redox potential per American Water Works Association (AWWA) Qualitative Test C105;
 - b. soil resistivity per American Association of State Highways Officials (AASHTO) T288;
 - c. sulfide content per AWWA C105;
 - d. water-soluble chloride ion content per AASHTO T291; and
 - e. water-soluble sulfate content (Method A Gravimetric) per AASHTO T290.

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.4 QUALITY ASSURANCE

A. Conform to grading, excavation, and other earth moving requirements of the OBO Zoning Code.

B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

C. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section, "Contractor's Quality Control."

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted in writing by Project Director/COR and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Project Director/COR not less than three days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Project Director/COR's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground structures and utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- C. A Subsurface Soil Investigation dated December 2010 is available from the Project Director/COR. This is provided for information only.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 75 mm in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Satisfactory soils should be tested to demonstrate a low corrosion potential for buried metal and reinforced concrete structures.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and Pt according to ASTM D 2487, or a combination of these groups, or other properties that do not meet the criteria for satisfactory soils.
1. Unsatisfactory Soils also include satisfactory soils not maintained within 2 percent of optimum moisture content corresponding to the maximum dry density at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 40 mm (1-1/2 inch) sieve and not more than 12 percent passing a 0.075 mm (No. 200) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 40 mm (1-1/2 inch) sieve and not more than 8 percent passing a 0.75 mm (No. 200) sieve.
- F. Common Fill: Clean, naturally or artificially graded mixture of debris-free Satisfactory Soils not meeting the criteria for Structural Fill.
- G. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 40 mm (1-1/2 inch) sieve and not more than 12 percent passing a 0.075 mm (No. 200) sieve. Structural fill

shall be free of deleterious matter such as organics, building rubble or rock greater than 100mm in the largest dimension.

- H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 25-mm (1-inch) sieve and not more than 8 percent passing a 0.075 mm (No. 200) sieve.
- I. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 40 mm (1-1/2 inch) sieve and 0 to 5 percent passing a 2.4 mm (No. 8) sieve.
- J. Filter Material: Graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm (1-inch) sieve and 0 to 5 percent passing a 4.8 mm (No. 4) sieve.
- K. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile (Filter Fabric): Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 700 N ; ASTM D 4632.
 - 3. Sewn Seam Strength: 630 N ; ASTM D 4632.
 - 4. Tear Strength: 250 N ; ASTM D 4533.
 - 5. Puncture Strength: 250 N ; ASTM D 4833.
 - 6. Apparent Opening Size: [0.42-mm (No. 40)] [0.25-mm (No. 60)] [0.21-mm (No. 70)] sieve, maximum; ASTM D 4751.
 - 7. Permittivity: [0.5] [0.2] [0.1] per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 1100 N ; ASTM D 4632.
 - 3. Sewn Seam Strength: 1000 N ; ASTM D 4632.
 - 4. Tear Strength: 400 N ; ASTM D 4533.
 - 5. Puncture Strength: 400 N ; ASTM D 4833.
 - 6. Apparent Opening Size: 0.250 mm (No. 60) sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
1. Portland Cement: ASTM C 150, Type II.
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33, 20 mm nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869.
 5. Water: ASTM C 94/C 94M.
 6. Air-Entraining Admixture: ASTM C 260.
- B. Produce low-density, controlled low-strength material with the following physical properties:
1. As-Cast Unit Weight: 480 to 580 kg/m³ at point of placement, when tested according to ASTM C 138/C 138M.
 2. Compressive Strength: 1000 kPa, when tested according to ASTM C 495.
- C. Produce conventional-weight, controlled low-strength material with 1000 kPa compressive strength when tested according to ASTM C 495.

2.4 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 150 mm wide and 0.1 mm (4 mils) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 750 mm deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems/Stormwater systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 600 mm outside of concrete forms other than at footings.
 - b. 300 mm outside of concrete forms at footings.
 - c. 150 mm outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 150 mm beneath bottom of concrete slabs on grade.
 - f. 150 mm beneath pipe in trenches, and the greater of 600 mm wider than pipe or 1100 mm wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 150 mm to 300 mm above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 25 mm. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
1. See Drawings for duct bank earthwork requirements.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 300 mm higher than top of pipe or conduit, unless otherwise indicated.
1. Clearance: 300 mm each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
1. For pipes and conduit less than 150 mm in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 150 mm or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 3. Excavate trenches 150 mm deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Project Director/COR when excavations have reached required subgrade.
- B. If Project Director/COR or Geotechnical Testing Agency determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction with a minimum of two passes. Limit vehicle speed to 5 km/h (3 mph).
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 14 tonnes.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Project Director/COR, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Project Director/COR, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 10 MPa, may be used when approved by Project Director/COR.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Project Director/COR.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated Satisfactory Soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud and standing water.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud and standing water.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 450 mm of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- D. Provide 100 mm thick, concrete-base slab support for piping or conduit less than 750 mm below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 100 mm of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of Satisfactory Soil, free of particles larger than 25 mm in any dimension, to a height of 300 mm over the utility pipe or conduit.
1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 300 mm over the utility pipe or conduit.
- G. Backfill voids with Satisfactory Soil while installing and removing shoring and bracing.
- H. Place and compact final backfill of Structural Fill or Common Fill to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, 300 mm below finished grade, except 150 mm below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use Satisfactory Soil or Common Fill
 - 2. Under walks, use Satisfactory Soil or Common Fill.
 - 3. Under pavements, steps and ramps, use Structural Fill.
 - 4. Under building slabs, use Structural Fill. Under footings and foundations, use Structural Fill.
- C. Place soil fill on subgrades free of mud and standing water.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 200 mm in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 300 mm of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 150 mm below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 150 mm below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 25 mm.
 2. Walks: Plus or minus 25 mm.
 3. Pavements: Plus or minus 12 mm.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 12 mm when tested with a 3.00 m straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 32 Section, "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 150 mm course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 300 mm of filter material, placed in compacted layers 150 mm thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 150 mm.
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 300 mm of final subgrade, in compacted layers 150 mm thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 150 mm
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 2. Place and compact impervious fill over drainage backfill in 150 mm thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, and standing water.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile, where indicated on Plans, on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 4. Place subbase and base course 150 mm or less in compacted thickness in a single layer.
 5. Place subbase and base course that exceeds 150 mm in compacted thickness in layers of equal thickness, with no compacted layer more than 150 mm thick or less than 75 mm thick.
- C. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 RETAINING WALL

- A. Construct retaining wall per the manufacturer's instructions.
- B. Tolerances for the wall shall be as follows:
1. Vertical alignment: 40mm over 3m distance
 2. Wall Batter: within 2 degrees of design batter
 3. Horizontal Alignment: 40mm over 3m distance. Corners and bends are 300mm from design.
 4. Maximum horizontal gap between units: 13mm

3.20 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 150 mm or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 150 mm in compacted thickness in layers of equal thickness, with no compacted layer more than 150 mm thick or less than 75 mm thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum shall be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Project Director/COR.
- D. Testing agency shall test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests shall be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 200 m² or less of paved area or building slab, but in no case fewer than 3 tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 30.00 m or less of wall length, but no fewer than 2 tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 50 m or less of trench length, but no fewer than 2 tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Project Director/COR; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government's property.

END OF SECTION 312000

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SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Temporary site fencing, including the following:

1. Chain-link fences.
2. Swing gates.
3. Privacy slats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Privacy slats and Barbed tape.
 - d. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

1.3 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.

2. Steel Wire for Fabric: Wire diameter of 2.87 mm.
 - a. Mesh Size: 50 mm maximum.
 - b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 366 g/m² with zinc coating applied [before] [after] weaving.
 - c. Zn-5-Al-MM Aluminum-Mischmetal-Coated Fabric: ASTM F 1345, Type III, Class 1, 183 g/m².
3. Aluminum Wire Fabric: ASTM F 1183, with mill finish, and wire diameter of 3.76 mm.
 - a. Mesh Size: 50 mm minimum.
4. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:
 1. Fence Height: As indicated on Drawings.
 2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
 - a. Line Post: 60 mm in diameter.
 - b. End, Corner, and Pull Posts: 102 mm in diameter.
 3. Horizontal Framework Members: Intermediate, top and bottom rails according to ASTM F 1043.
 - a. Top Rail: 42 mm in diameter.
 4. Metallic Coating for Steel Framework: One of the following:
 - a. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.27 kg/sq. m of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.0076-mm-thick, zinc-pigmented coating.
 - b. Type C: Zn-5-Al-MM alloy, consisting of not less than 0.55-kg/sq. m coating.

2.3 SWING GATES

- A. General: ASTM F 900 for gate posts and single and double swing gate types.
 1. Gate Leaf Width: As indicated.
 2. Framework Member Sizes and Strength: Same as for fencing.
- B. Pipe and Tubing: Same as for fencing.
- C. Frame Corner Construction: Welded or assembled with corner fittings.

- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend 300 mm above top of chain-link fabric at both ends of gate frame to attach barbed tape assemblies.
- E. Hardware:
 - 1. Hinges: 360-degree inward and outward swing.
 - 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

2.4 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
 - 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 152 mm long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 50 mm shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Barbed Tape Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed tape, and means for attaching to posts or integral with post cap, for each post unless otherwise indicated, and as follows:
 - 1. Provide line posts with arms that accommodate top rail or tension wire.
 - 2. Provide corner arms at fence corner posts unless extended posts are indicated.
 - 3. Single-Arm Type: Type II, vertical arm.
- H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 3.76-mm-diameter wire galvanized coating thickness matching coating thickness of chain-link fence fabric.
- I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 366 g/sq. m of zinc.
2. Aluminum: Mill finish.

2.5 PRIVACY SLATS

A. Provide one of the following for privacy slats:

1. Fiber-Glass-Reinforced Plastic Slats: UV-light-stabilized fiber-glass-reinforced plastic, not less than 1.5 mm thick, sized to fit mesh specified for direction indicated.
2. Tubular Polyethylene Slats: Minimum 0.58-mm-thick tubular polyethylene, manufactured for chain-link fences from virgin polyethylene with UV inhibitor, sized to fit mesh specified for direction indicated.
3. Aluminum Slats: Minimum 0.25-mm-thick aluminum, sized to fit mesh specified for direction indicated.

B. Color: Green.

2.6 BARBED TAPE

A. Wire-Reinforced Tape: ASTM F 1910; continuous coils with four-point, needle-sharp barbs permanently cold clenched around a core wire.

1. Core Wire: High-tensile-strength, zinc-coated steel or stainless steel].
2. Configuration: Single coil.
3. Style: Helical or Concertina pattern.
4. Coil Diameter: 457-mm.
5. Coil Loop Spacing(s): 300 mm.
6. Barb Length Classification: 10.2-mm barb.
7. Barb Spacing: 102 mm o.c.
8. Barb Set: Straight or Offset.

B. Clips: Stainless steel, 1.7 mm thick by 9.5 mm wide, capable of withstanding a minimum 667-N pull load to limit extension of coil, resulting in a concertina pattern when deployed.

C. Tie Wires: Stainless steel, 1.7 mm in diameter.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 150 m or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 - 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 50 mm above grade; shape and smooth to shed water.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more. For runs exceeding 150 m, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 3 m o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 1830 mm or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 25-mm bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 380 mm o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 1. Maximum Spacing: Tie fabric to line posts at 300 mm o.c. and to braces at 610 mm o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Privacy Slats: Install slats in direction indicated, securely locked in place.
 1. Diagonally for privacy factor of 80 to 85.
- N. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113

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SECTION 330505 - COMMON WORK RESULTS FOR PIPED UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Piped utility demolition.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Metal supports and anchorages.

1.2 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Product Data: For the following:
1. Dielectric fittings.
 2. Identification devices.

B. Shop Drawings:

1. Ballistic protection of piping penetrating hardlines.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Piped Utility Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- E. Document any applicable local codes or authorities and ensure that all relevant work is in compliance.
- F. Implement applicable provisions of the Quality Control program as established in Section 01 Section "Contractor's Quality Control."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Divisions 21, 22, 23 and 33 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Divisions 21, 22, 23, and 33 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 3.2-mm maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 3.2 mm thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping DN 40 (NPS 1-1/2) and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping DN 50 (NPS 2) and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 1725-kPa minimum working pressure at 82 deg C.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 1035- or 2070-kPa minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 1035- or 2070-kPa minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 2070-kPa minimum working pressure at 107 deg C.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 2070-kPa minimum working pressure at 107 deg C.

2.5 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Division 23 Section "Common Work Results for Fire Suppression, Plumbing and HVAC."
- B. Galvanized-Steel Sheet: 0.6-mm minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

2.6 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other Divisions 21, 22, 32, and 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 30 mm for ducts, and 20 mm for access door signs and similar operational instructions.
 - 1. Material: Fiberboard.
 - 2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive vinyl type with permanent adhesive.
- F. Pipes with OD, Including Insulation, Less Than 150 mm: Full-band pipe markers, extending 360 degrees around pipe at each location.

- G. Pipes with OD, Including Insulation, 150 mm and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
- H. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- I. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cold-air supply.
 2. Yellow: Hot-air supply.
 3. Blue: Exhaust, outside, return, and mixed air.
 4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.
 5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin; duct destination; and design flow.
- J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 0.08 mm thick.
1. Width: 40 mm on pipes with OD, including insulation, less than 150 mm; 65 mm for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- K. Valve Tags: Stamped or engraved with 6.4-mm letters for piping system abbreviation and 13-mm sequenced numbers. Include 4-mm hole for fastener.
1. Material: Valve manufacturer's standard solid plastic.
 2. Size: 40 mm in diameter, unless otherwise indicated.
 3. Shape: As indicated for each piping system.
- L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 2. Thickness: 1.6 mm, unless otherwise indicated.
 3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.

5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 65 by 100 mm for control devices, dampers, and valves; 115 by 150 mm for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: 85 by 145 mm.
 2. Fasteners: Brass grommets and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 34.5-MPa, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures where applicable.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Post.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Divisions 21, 22, 23, and 33 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by Project Director/COR.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 50 mm above finished floor level.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. PVC Pipe Sleeves: For pipes smaller than DN 150.
 - b. Steel Sheet Sleeves: For pipes DN 150 and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Divisions 21, 22, 23, and 33 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping DN 50 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping DN 65 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 BALLISTIC PROTECTION OF PIPING PENETRATING HARDLINES

- A. Cut, fit, and place ballistic protection of piping accurately in all required locations.
- B. Field Welding: Comply with AWS D1.1.
- C. Provide 6 mm thick steel plate ($F_y = 250$ mega Pascal) at all pipes penetrating non-steel plate hardline walls. Extend steel plate a minimum of 25 mm beyond the penetration opening (in all directions) in the hardline wall. The maximum permissible gap between the pipe penetration and the ballistic plate is 6 mm. Fasten plate to wall with minimum 10 mm diameter expansion anchors (minimum 4 per penetration). Tack weld heads of expansion anchors to plate to prevent tampering. The steel plate may be two 'c' shaped sections fitted around the pipe. No gap between sections is permitted. Provide ballistic protection according to the following:

1. Horizontal 15 minute hardline wall penetrations: Provide single plate on attack side of penetration.
2. Vertical 15 minute hardline wall penetrations: Provide plates on attack and protected sides of penetration.
3. Horizontal and vertical 60 minute hardline penetrations: Provide plates on attack and protected sides of penetration.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting sections.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Stenciled Markers: According to ASME A13.1.
 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 3. Locate pipe markers on exposed piping according to the following:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 - d. At manholes and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.

- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 - 1. Lettering Size: Minimum 6.4 mm high for name of unit if viewing distance is less than 610 mm, 13 mm high for distances up to 1800 mm, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 - 2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 100 mm larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 20.7-MPa, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.11 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330505

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SECTION 331116 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for dedicated water service.

1.2 SUMMARY

- A. Related Sections include the following:
 - 1. Division 31 Section “Earth Moving.”
 - 2. Division 33 Section “Common Work Results for Piped Utilities.”

1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - a. Wiring Diagrams: Power, signal, and control wiring for alarms.
 - 2. Provide shop drawing for revised utility routing. Include relationship to concrete utility support system.

- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Local Regulatory Requirements: In addition to conforming with requirements of the OBO Codes, conform to the following:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with the OBO Plumbing Code and standards of local authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Project Director/COR based upon input from OBO/PDCS/DE, and marked for intended use.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.

- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Project Director/COR no fewer than 72 hours in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Project Director/COR's written permission.

1.8 COORDINATION

- A. Coordinate connection to water main with utility company.
- B. Coordinate point of connection 1.5m outside the building with plumbing plans prior to construction. These specifications are applicable to within 1.5m of the building, unless otherwise noted.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88M, Type B, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper, Pressure-Seal Fittings:
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Viega; Plumbing & Heating Systems.
 - b. DN 50 (NPS 2) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - c. DN 65 to DN 100 (NPS 2-1/2 to NPS 4): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

B. Hard Copper Tube: ASTM B 88M, Type B, water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper, Pressure-Seal Fittings:
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Viega; Plumbing & Heating Systems.
 - b. DN 50 (NPS 2) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - c. DN 65 to DN 100 (NPS 2-1/2 to NPS 4): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International, Inc.
 - 2) Victaulic Company of America.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PVC PIPE AND FITTINGS

- A. PVC, Schedule 80 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 - 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- B. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. EBAA Iron, Inc.
 - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - c. Star Pipe Products.
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 1700 kPa (250 psig) minimum.
 - b. Offset: 300 mm .
 - c. Expansion Required: 200 mm.

B. Ductile-Iron Deflection Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 1700 kPa (250 psig) minimum.

2.5 JOINING MATERIALS

- A. Refer to Division 33 Section "Common Work Results for Piped Utilities" for commonly used joining materials.

- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Flexible Connectors:
 - 1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
 - 2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.
- C. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.
 - 1. Dielectric Unions: Factory-fabricated union assembly, designed for 1700-kPa (250 psig) minimum working pressure at 80 deg C (180 deg F). Include insulating material that isolates dissimilar metals and ends with inside threads according to ASME B1.20.1.
 - 2. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 1000- or 2000-kPa (150- or 300-psig) minimum working pressure to suit system pressures.
 - 3. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 1035- or 2070-kPa (150- or 300-psig) minimum working pressure to suit system pressures.
 - 4. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 2000-kPa (300-psig) minimum working pressure at 105 deg C (225 deg F).
 - 5. Dielectric Nipples: Electroplated steel nipples with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types, and 2000-kPa (300-psig) minimum working pressure at 105 deg C (225 deg F).

2.7 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Encasement for Underground Metal Piping: per Geotechnical recommendations. See Geotech report for further information.
 - 1. Standards: ASTM A 674 or AWWA C105.
 - 2. Form: Sheet or tube.

3. Material: LLDPE film of 0.20-mm (0.008-inch) minimum thickness, or high-density, crosslaminated PE film of 0.10-mm (0.004-inch) minimum thickness.
4. Color: Black.

2.8 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. East Jordan Iron Works, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. McWane, Inc.; M & H Valve Company Div.
 - i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - j. Mueller Co.; Water Products Div.
 - k. NIBCO INC.
 - l. U.S. Pipe and Foundry Company.
2. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 1400 kPa (200 psig).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
3. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 1700 kPa (250 psig).
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

B. UL/FMG, Cast-Iron Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. NIBCO INC.
 - i. U.S. Pipe and Foundry Company.
2. UL/FMG, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 1200 kPa (175 psig).
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
2. Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
- b. East Jordan Iron Works, Inc.
- c. Flowserve.
- d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- e. McWane, Inc.; Kennedy Valve Div.
- f. McWane, Inc.; M & H Valve Company Div.
- g. Mueller Co.; Water Products Div.
- h. U.S. Pipe and Foundry Company.

2. Description: Sleeve and valve compatible with drilling machine.

- a. Standard: MSS SP-60.
- b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
- c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, cover plate with lettering "WATER," for water piping valves and bottom section with base that fits over valve and with a barrel approximately 125 mm (5inches) in diameter. Set box in 1 m x 1 m concrete pad where located in landscaped areas.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.10 CHECK VALVES

- A. AWWA Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American AVK Co.; Valves & Fittings Div.
- b. American Cast Iron Pipe Co.; American Flow Control Div.
- c. APCO Williamette; Valve and Primer Corporation.
- d. Crane Co.; Crane Valve Group; Crane Valves.
- e. Crane Co.; Crane Valve Group; Stockham Div.
- f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- g. McWane, Inc.; Kennedy Valve Div.

- h. McWane, Inc.; M & H Valve Company Div.
 - i. Mueller Co.; Water Products Div.
 - j. NIBCO INC.
 - k. Watts Water Technologies, Inc.
2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
- a. Standard: AWWA C508.
 - b. Pressure Rating: 1207 kPa (175 psig).
- B. UL/FMG, Check Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. Crane Co.; Crane Valve Group; Stockham Div.
 - c. Globe Fire Sprinkler Corporation.
 - d. Kidde Fire Fighting.
 - e. MATCO-NORCA, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. Mueller Co.; Water Products Div.
 - i. NIBCO INC.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products.
 - l. United Brass Works, Inc.
 - m. Victaulic Company of America.
 - n. Viking Corporation.
 - o. Watts Water Technologies, Inc.
2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
- a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 1700 kPa (250 psig).

2.11 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. DeZURIK/Copes-Vulcan; a unit of SPX Corporation.
 - b. Milliken Valve Company.

- c. Mosser Valve; a division of Olson Technologies, Inc.
 - d. Mueller Co.; Water Products Div.
 - e. Pratt, Henry Company.
 - f. Val-Matic Valve & Manufacturing Corp.
 - 2. Description: Rubber seated.
 - a. Standard: AWWA C504.
 - b. Body: Cast or ductile iron.
 - c. Body Type: Mechanical joint or flanged.
 - d. Pressure Rating: 1000 kPa (150 psig).
 - B. UL Butterfly Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Milwaukee Valve Company.
 - c. Mueller Co.; Water Products Div.
 - d. NIBCO INC.
 - e. Pratt, Henry Company.
 - 2. Description: Metal on resilient material seating.
 - a. Standards: UL 1091 and FMG approved.
 - b. Body: Cast or ductile iron.
 - c. Body Type: Mechanical joint or flanged.
 - d. Pressure Rating: 1200 kPa (175 psig).
- 2.12 CORPORATION VALVES AND CURB VALVES
- A. Manufacturers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amcast Industrial Corporation; Lee Brass Co.
 - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - c. Jones, James Company.
 - d. Master Meter, Inc.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Mueller Co.; Water Products Div.
 - g. Red Hed Manufacturing & Supply.
 - B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 75 mm (3 inches) in diameter.
1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.13 WATER METERS

A. General Requirements:

1. Water meter may be furnished by local water company. Contractor to coordinate.
2. System includes calibrated flow element, flow processor, valves, fittings wiring, electronics, memory, software, and interface to BAS.
 - a. Range of flow-measuring element and meter covers operating range of system where used
3. Data Management: Meters shall be capable of flow totalization for purpose of consumption measurement.
 - a. Standard: comply with local utility company standards for meters required to provide data to local utility.
 - b. Period of totalization shall be adjustable.
 - c. Metering system shall have non-volatile memory capable of storing one year of hourly data.
 - d. Totalization, memory storage, and calculation may be accomplished through BAS.
 - e. All programming, wiring, calibration, coordination, and interface with existing systems shall be responsibility of Contractor providing the meter.

B. Manufacturers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMCO Water Metering Systems.
 - b. Badger Meter, Inc.

- c. Carlon Meter.
- d. Hays Fluid Controls; a division of ROMAC Industries Inc.
- e. McCrometer.
- f. Mueller Co.; Hersey Meters.
- g. Neptune Technology Group Inc.
- h. Sensus Metering Systems.

C. Displacement-Type Water Meters:

- 1. Description: With bronze main case.
 - a. Standard: AWWA C700.
 - b. Registration: Flow in liters.

D. Turbine-Type Water Meters:

- 1. Description:
 - a. Standard: AWWA C701.
 - b. Registration: Flow in liters.

E. Compound-Type Water Meters:

- 1. Description:
 - a. Standard: AWWA C702.
 - b. Registration: Flow in liters.

2.14 CONCRETE VAULTS

A. Description: Precast or cast-in-place, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.

- 1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
- 2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: 600-mm (24-inch) minimum diameter, unless otherwise indicated.
- 3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.15 PROTECTIVE ENCLOSURES

A. Weather-Resistant Enclosures:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aqua Shield.
 - b. BF Products, Inc.
 - c. DekoRRa Products.
 - d. Dunco Manufacturing, Inc.
 - e. G&C Enclosures.
 - f. Hot Box, Inc.
 - g. HydroCowl, Inc.
 - h. Watts Water Technologies, Inc.
2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
 - a. Standard: ASSE 1060.
 - b. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.

B. Enclosure Bases:

1. Description: 150-mm- minimum thickness precast concrete, of dimensions required to extend at least 150 mm beyond edges of enclosure housings. Include openings for piping.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping DN 20 to DN 90 (NPS $\frac{3}{4}$ to NPS 3 shall be the following:

1. Soft copper tube, ASTM B 88M, Type B; wrought-copper, solder-joint fittings; and brazed joints. Use flushable flux and lead free solder.
 2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
- F. Underground water-service piping DN 100 to DN 200 (NPS 4 to NPS 8 shall be the following:
1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
 2. DN 200 (NPS 8): PVC, AWWA Class 200 pipe; mechanical-joint, ductile-iron fittings; and gasketed joints.
- G. Water Meter Box Water-Service Piping DN 20 to DN 90 (NPS $\frac{3}{4}$ to NPS 2) > shall be same as underground water-service piping.
- H. Underground Combined Water-Service and Fire-Service-Main Piping DN 150 to DN 300 (NPS 6 to NPS 12) shall be of the kind identified for Underground Fire Service Main Piping.
- I. Combined Water Service and Fire-Service-Main Piping DN 150 to DN 300 (NPS 6 to NPS 12) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- J. Underground Reclaimed Water Service Piping shall be PVC, Purple Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints. PVC pipe for recycled water system applications shall be purple. Fittings and pipe appurtenances installed with PVC mains for recycled water shall be identified with purple-colored coating, purple polyethylene sleeves, and identification labels,

3.3 VALVE APPLICATIONS

- A. General Application: All buildings within a campus design shall have isolation valve at point of connection to main campus loop. Provide at least one sectional valve on campus system loop. Use mechanical-joint-end valves for DN 80 (NPS 3) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for DN 50 (NPS 3) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, DN 80 (NPS 3) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 2. Underground Valves, DN 100 (NPS 4) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, DN 50 (NPS 2) and Smaller: Bronze, nonrising stem.
 - b. Gate Valves, DN 80 (NPS 3) and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
 - c. Check Valves: AWWA C508, swing type.

4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
5. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.
6. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 33 Section "Common Work Results for Piped Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Make connections larger than DN 50 (NPS 2) with tapping machine according to the following:
 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- E. Bury piping with depth of cover over top at 1000mm, and according to the following, or as indicated per plans:
 1. Under Driveways: With at least 1000mm cover over top.
- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Mechanical sleeve seals are specified in Division 23.
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, anchors, tie-rods and clamps, and other supports.
- J. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. See Division 33 Section "Common Work Results for Piped Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 - 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 33 Section "Common Work Results for Piped Utilities" for joining piping of dissimilar metals.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Locking mechanical joints.
 - 2. Set-screw mechanical retainer glands.
 - 3. Bolted flanged joints.

4. Heat-fused joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of the OBO Plumbing Code and local plumbing and health department.
- B. Do not install any backflow device between the water tank supply and the fire pump.

- C. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- D. Do not install bypass piping around backflow preventers.
- E. Support DN 65 (NPS 2-1/2) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.12 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.13 CONNECTIONS

- A. Piping installation requirements are specified in other Divisions 22, 23, and 33 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 33 Section "Common Work Results for Piped Utilities" for piping connections to valves and equipment.
- C. Connect water-distribution piping to utility water main and existing water main.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.14 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests:
 - 1. General Water Lines: Test at not less than one-and-one-half times working pressure for two hours. Increase pressure in 350-kPa (50-psig) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 kPa (0 psig). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 1.9 L (2 quarts) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.
 - 1. Refer to NFPA 24 for fire protection piping testing requirements.

3.15 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 33 Section "Common Work Results for Piped Utilities" for identifying devices.
- C. Pipe markings for PVC pipe for recycled water systems shall include designation "RECLAIMED WATER" in addition to standard labels required.

3.16 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by Project Director/COR based upon input from OBO/PDCS/DE, or, if method is not prescribed, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to Project Director/COR and local authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331116

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SECTION 331617 - WATER STORAGE TANKS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section addresses double wall fiberglass water storage tanks for office compounds.
 - 1. Remove and relocate existing aboveground water storage tanks for use in transitional water treatment system.

1.2 DESIGN REQUIREMENTS

- A. Water Tank Design Requirements: Conform to requirements of Chapter 6 of the OBO Plumbing Code.

1.3 QUALITY ASSURANCE

- A. NFPA Certification: If tanks are used as part of the potable water system, all products shall be NSF 61 certified for use with potable water.

1.4 DELIVERY AND HANDLING

- A. The storage tank manufacturer's installation manual shall strictly govern all movement and temporary placement of the storage tank from the point of distribution to the point of installation. Do not damage storage tank in transit.

PART 2 - PRODUCTS

2.1 TANK ACCESSORIES

- A. Tank Lifting Lugs: Lifting lugs shall be provided on all tanks. Lugs shall be capable of withstanding weight of tanks with a safety factor of 3.
- B. Anchor Hold Down Straps:
 - 1. Fiberglass reinforced plastic (FRP) anchor hold down straps shall be provided for each tank. Number and location of straps shall be as required by the Tank Manufacturer. Each strap shall be capable of withstanding the buoyancy load for the tank diameter as shown:
 - a. 1.22 m diameter (1,905 kg).
 - b. 1.83 m diameter (8,165 kg).

- c. 2.44 m diameter (11,340 kg).
- 2. Straps shall be standard as supplied by the Tank Manufacturer.
- C. Provide 20 mesh bronze insect screens to protect against contamination from insects, birds, and other animals.
- D. Provide goosenecks and vandal-proof vent caps to protect from precipitation.

2.2 LIQUID LEVEL AND LEAK MONITORING

- A. General:
 - 1. Provide tank system that is capable of both tank level monitoring and tank leak monitoring. This system shall consist of an electronic control panel, tank liquid level transmitter assembly for each tank, tank leak sensor for each tank capable of detecting a break in the inner and outer tank and a turbine enclosure leak sensor for each tank turbine enclosure capable of detecting a leak in the enclosure.
 - 2. Install wiring in conduit with long radius bends at all changes in direction. Comply with Division 26 requirements for conduit.

PART 3 - EXECUTION

3.1 TANKS

- A. Installation:
 - 1. Tank(s) shall be installed according to the current installation instructions provided with the tank by the manufacturer.
 - 2. Set storage tank shall on concrete pad and anchor in accordance with NFPA 30.
 - a. Consider tank weight, weight of earth above tank, weight of concrete and tank buoyancy in computation for sizing concrete hold down pad.
 - b. Provide thickness and construction of reinforced concrete pad and concrete ballast pad under storage tank(s) sufficient to keep empty tanks from floating.

3.2 FIELD QUALITY CONTROL

- A. The storage tank system installation shall be inspected and approved by the storage tank system supplier or its certified contractor. The system supplier shall complete a comprehensive checklist of quality and safety items critical to the system and verify that the installation has been done in accordance with the customary standards as well as local applicable fire and environmental codes.

- B. Pressure testing shall be as required by the Piping Manufacturer. During testing, care shall be taken to avoid sudden pressure surges or "water hammer" since pressures produced can exceed, many times over, the rating of the pipe and fittings.

3.3 DISINFECTION

- A. Cleaning and disinfection of water storage tanks is required before putting into service per AWWA Standard 652-02.
- B. The residual chlorine disinfection level in the distribution storage tank shall not fall below 0.1 mg/L at any time.

3.4 DEMONSTRATION

- A. Train Government maintenance personnel to adjust, operate, and maintain water storage tank monitoring and controls.
 - 1. Train Government maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Schedule training with Project Director/COR with at least seven days advance notice.

END OF SECTION 331616

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