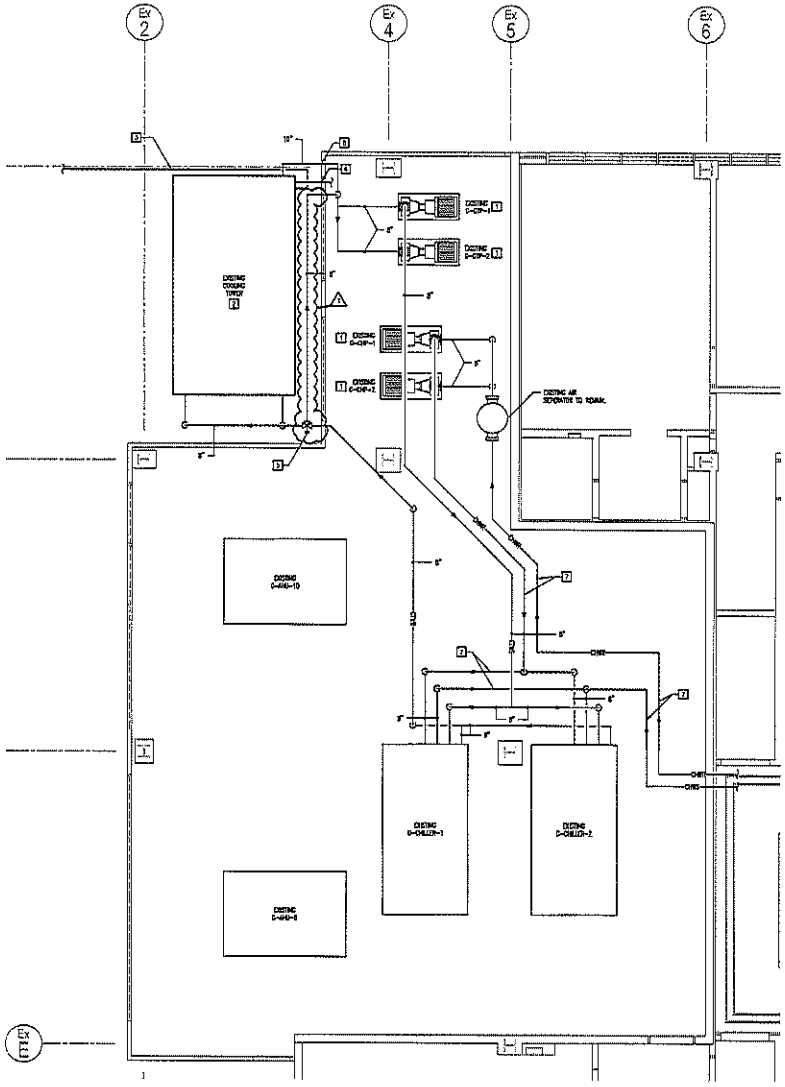
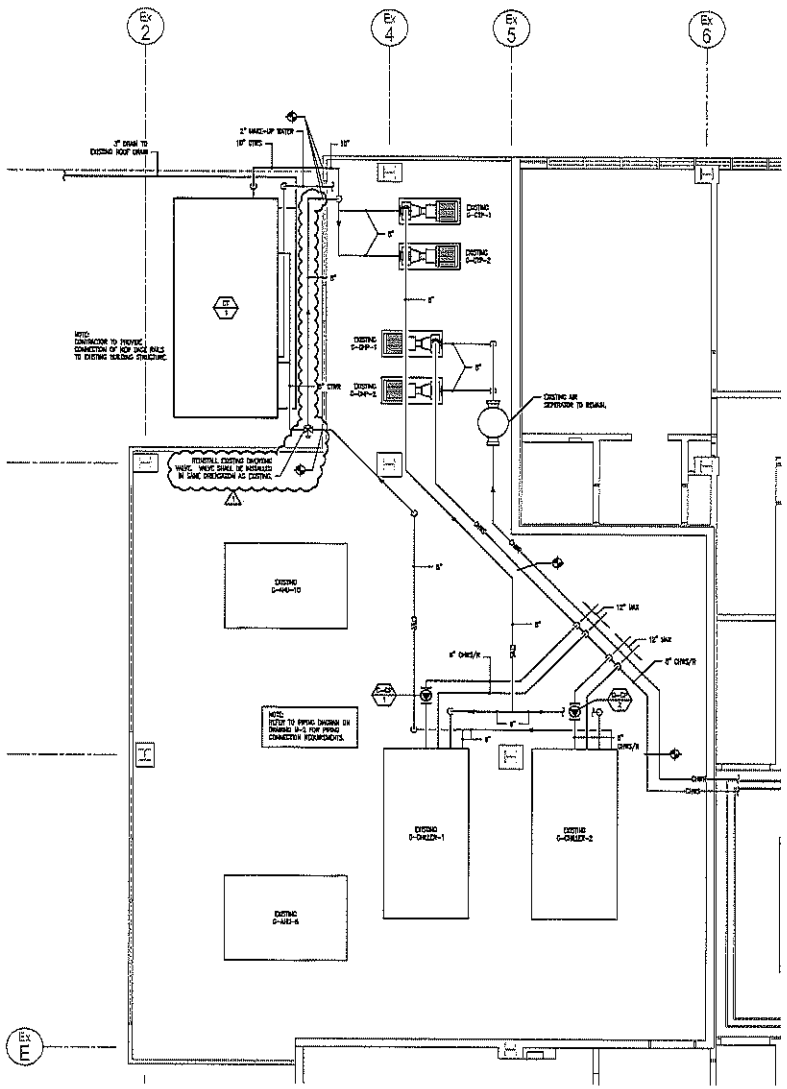


DEMOLITION FLOOR PLAN - MECHANICAL

SCALE: 1/4" = 1'-0"



NEW WORK FLOOR PLAN - MECHANICAL

SCALE: 1/4" = 1'-0"

MECHANICAL KEY NOTES:

1. EXISTING PUMPS TO REMAIN. ALL ASSOCIATED VALVES, VFD, CONTROLS, ELECTRICAL CONNECTIONS, AND OTHER APPURTENANCES TO REMAIN.
2. EXISTING COOLING TOWER TO BE REMOVED IN ITS ENTIRETY. REMOVE ASSOCIATED PIPING AS INDICATED. REMOVE ASSOCIATED VALVES, ELECTRICAL CONNECTIONS, AND ALL OTHER APPURTENANCES.
3. REMOVE EXISTING DRAIN PIPING IN ITS ENTIRETY.
4. REMOVE EXISTING MAKE UP WATER CONNECTION TO COOLING TOWER. CAP AT EXTERIOR WALL FOR CONNECTION UNDER NEW WORK.
5. REMOVE COOLING TOWER WATER RETURN AND BYPASS PIPING BACK TO EXTERIOR WALL AS INDICATED AND CAP FOR CONNECTION UNDER NEW WORK. THREE-WAY VALVE TO BE REMOVED AND REUSED UNDER NEW WORK. PRIOR TO REMOVING VALVE, NOTE ORIENTATION OF VALVE FOR REINSTALLATION IN SAME ORIENTATION.
6. REMOVE COOLING TOWER WATER SUPPLY PIPING BACK TO EXTERIOR WALL AND CAP FOR CONNECTION UNDER NEW WORK.
7. REMOVE CHILLED WATER PIPING AS INDICATED AND CAP FOR CONNECTION UNDER NEW WORK. REMOVED CHILLED WATER CONNECTIONS TO EXISTING CHILLERS.

HVAC/ELECTRICAL PLUMBING FIRE PROTECTION

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Project: COGENERATION TOWER AND PUMP REPLACEMENT AT THE ROGER WILLIAMS UNIVERSITY JUDICIAL COMPLEX

ONE DORRANCE PLAZA
PROVIDENCE, RI 02903

Revisions

No.	Description	Date
1	PRELIMINARY CONSTRUCTION	12/23/14

Sheet Title: 6TH FLOOR MECHANICAL ROOM PLANS

Project No: 20140132

Drawn by: KLJ

Checked by: RCN

Scale: AS NOTED

Date: 11-20-14

Drawing No: M-1

CEC # 20140132

COOLING TOWER SCHEDULE

TAG NO.	LOCATION	CHILLER SERVED	NET CAPACITY (TONS)	GPM	EWT (°F)	LWT (°F)	AIR EWB (°F)	FAN NO. FANS	FAN CFM (EA)	FAN HP (EA)	HTR DATA NO. HTRS	HTR DATA KW (EA)	ELECTRICAL DATA HP	V	PH	HZ	WTGHT (LBS)	MANUFACTURER MODEL NUMBER	REMARKS
1	ROOF	EXIST	500	1,200	95.5	85	78	2	95,200	15	1	0	(2)15	460	3	60	13,130	BAC / FTC-0809A-3L2	1,2,3,4

REMARKS:
1. NEW VARIABLE FREQUENCY DRIVE. REFER TO ELECTRICAL DRAWINGS.
2. PROVIDE VIBRATION ISOLATION BASE RAILS.
3. PROVIDE FULL STAINLESS STEEL CONSTRUCTION.
4. PROVIDE ONE POWER CONNECTION FOR EACH TOWER CELL.

PUMP SCHEDULE

TAG NO.	LOCATION	SYSTEM SERVED	TYPE	GPM	HEAD (FT.)	ELYCOL	FLUID TEMP °F	RPM	ELECTRICAL DATA MOTOR HP	V	PH	HZ	MANUFACTURER MODEL NUMBER	REMARKS
1	CHILLER ROOM	C-CHILLER-1	INLINE	300	35	0	54	1160	7.5	460	3	60	TACO KV5011	-
2	CHILLER ROOM	C-CHILLER-2	INLINE	300	35	0	54	1160	7.5	460	3	60	TACO KV5011	-

MECHANICAL SYMBOL LEGEND

ALL ITEMS SHOWN ARE NOT NECESSARILY USED ON THIS PROJECT

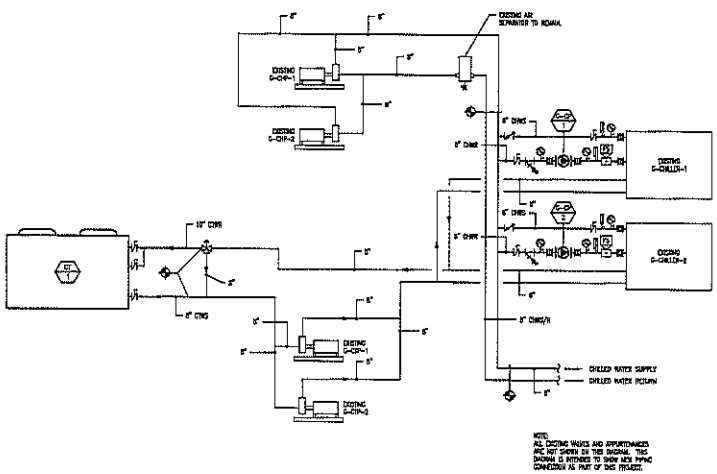
PIPING

- CHWS — CHILLED WATER SUPPLY
- CHWR — CHILLED WATER RETURN
- CD — CONDENSATE DRAIN
- CTWS — COOLING TOWER WATER SUPPLY
- CTWR — COOLING TOWER WATER RETURN
- NEW / EXISTING — POINT TO CONNECT NEW TO EXISTING. VERIFY SIZE AND LOCATION IN FIELD PRIOR TO INSTALLATION
- PIPE TURNING DOWN
- PIPE TURNING UP
- TEE OFF TOP
- TEE OFF BOTTOM
- DROP AND RUN
- DROP AND TURN
- TEE UP
- TEE DOWN
- UNION (DIELECTRIC TYPE ON DISSIMILAR METALS)
- BALL VALVE
- GATE VALVE
- BUTTERFLY VALVE
- 3-WAY VALVE
- 4-WAY VALVE
- CHECK VALVE (SWING TYPE)
- CIRCUIT SETTER w/ GAGE PORT
- MULTI PURPOSE VALVE
- AUTOMATIC BALANCING VALVE
- PUMP
- STRAINER w/ BLOW DOWN (MUNI)
- EPDM FLEXIBLE CONNECTION
- FLOW SWITCH
- THERMOMETER w/ SNSP
- PRESSURE GAGE w/ STOP

ABBREVIATIONS

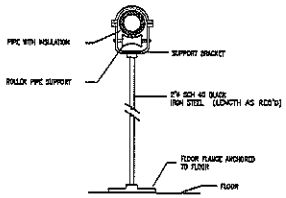
ALL ABBREVIATIONS SHOWN ARE NOT NECESSARILY USED ON THIS PROJECT

AD	ACCESS DOOR
BTU	BRITISH THERMAL UNITS
BTUH	BTU PER HOUR
CFM	CUBIC FEET PER MINUTE
CH	CHILLER
CT	COOLING TOWER
CTWP	COOLING TOWER WATER PUMP
CHWP	CHILLED WATER PUMP
CP	CHILLED PUMP
E	EXISTING
EFF	EFFICIENCY
EWT	ENTERING WET BULB
EWT	ENTERING WATER TEMPERATURE
HT	HEIGHT FRAMEWORK
FLA	FULL LOAD AMPS
FLEX	FLEXIBLE
FMS	FLOW MONITORING STATION
FT	FEET
GAL	GALLONS
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
HP	HORSEPOWER
HVAC	HEATING, VENTILATION, & AIR CONDITIONING
LWT	LEAVING WATER TEMPERATURE
MBH	THOUSANDS OF BTU'S PER HOUR
MCA	MINIMUM CIRCUIT AMPS
MECH	MECHANICAL
MOCP	MAXIMUM OVER CURRENT PROTECTION
P	PUMP
PD	PRESSURE DROP
PSI	POUNDS PER SQUARE INCH GAL
R	RETURN
RLA	RATED LOAD AMPS
RPM	REVOLUTIONS PER MINUTE
S	SUPPLY
SF	SQUARE FEET
SP	STATIC PRESSURE
TYP.	TYPICAL

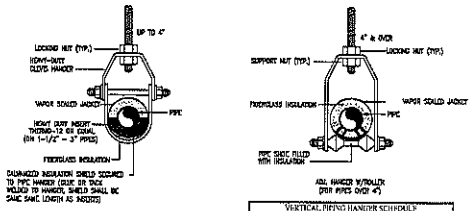


NOTE:
ALL EXISTING VALVES AND APPURTENANCES ARE NOT SHOWN ON THIS DIAGRAM. THIS DIAGRAM IS INTENDED TO SHOW NEW HVAC CONNECTIONS AS PART OF THIS PROJECT.

COOLING TOWER / CHILLER PIPING DIAGRAM
SCALE: NONE



DETAIL FLOOR PIPE SUPPORT
NTS



HANGER & SUPPORT SCHEDULE			
PIPE SIZE	ROD SIZE	MAXIMUM SPACING COPPER	MAXIMUM SPACING STEEL
3/4"	3/8"	5'-0"	7'-0"
1"	3/8"	6'-0"	7'-0"
1-1/4"	3/8"	7'-0"	7'-0"
1-1/2"	3/8"	8'-0"	7'-0"
2"	3/8"	8'-0"	10'-0"
2-1/2"	1/2"	9'-0"	11'-0"
3"	1/2"	10'-0"	12'-0"
4" - 5"	5/8"	12'-0"	14'-0"
6" - 8"	3/4"	14'-0"	17'-0"

VERTICAL PIPING HANGER SCHEDULE	
PIPE MATERIAL	MAX. VERTICAL SPACING
CAST IRON	15'-0"
COPPER	10'-0"
GALVANIZED STEEL	15'-0"
PVC	4'-0"
CPVC	3'-0"

INSULATION INSERTS	
PIPE SIZES	LENGTH
1 1/2" TO 3 1/2"	10"
3" TO 8"	12"
8" TO 10"	18"
12" AND OVER	22"

PIPING SUPPORT DETAL
NTS

HIGH-ELECTRICAL ENGINEERING CO.
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Project: COOLING TOWER AND FLUSH REPLACEMENT AT THE APPELLATE COURT JUDICIAL COMPLEX
ONE DORRANCE PLAZA, PROVIDENCE, RI 02903

Status:

No.	Date	Description

Sheet Title: MECHANICAL DETAILS & SCHEDULES

Project No: 20140132
Drawn By: KLJ
Checked By: RGH
Scale: AS NOTED
Date: 11-07-14

Drawing No: M-2

CEC # 20140132

MECHANICAL SPECIFICATIONS

PART 1 – GENERAL PROVISIONS FOR MECHANICAL WORK

1.01 GENERAL REQUIREMENTS:

A. SCOPE OF WORK SHALL INCLUDE ALL LABOR, MATERIALS, TOOLS, EQUIPMENT, TRANSPORTATION, HOISTING, RIGGING, INSURANCE, ETC., TO PERFORM THE WORK AS INDICATED ON THE DRAWINGS AND HEREIN SPECIFIED FOR A COMPLETE INSTALLATION. ALL WORK SHALL BE IN ACCORDANCE WITH NATIONAL, STATE AND LOCAL CODES AND ORDINANCES HAVING JURISDICTION, AS INTERPRETED BY THE ENGINEER.

B. APPLY AND PAY FOR ALL NECESSARY INSPECTION FEES, LICENSES AND PERMITS REQUIRED BY THE PROPER AUTHORITIES HAVING JURISDICTION.

C. THE BUILDING WILL BE OCCUPIED DURING ALL OF THE CONSTRUCTION PROCESS. THE CONSTRUCTION SCHEDULE SHALL BE DEVELOPED WITH THE UNDERSTANDING THAT THE BUILDING IS OCCUPIED AND THAT IT CAN NEITHER BE CLOSED NOR CAN THE OWNER'S OPERATIONS STOP.

D. NO EXITS SHALL BE CLOSED WITHOUT THE WRITTEN PERMISSION OF THE OWNER AND LOCAL AUTHORITIES HAVING JURISDICTION.

E. ANY UTILITY OUTAGES OR SYSTEM SHUTDOWNS FOR CONSTRUCTION SHALL BE SCHEDULED WITH THE OWNER PRIOR TO COMMENCING OF WORK.

F. SUBMIT SHOP DRAWINGS OF ALL HVAC EQUIPMENT AND RECORD DRAWINGS FOR ALL WORK PROVIDED UNDER THIS CONTRACT TO THE ENGINEER/OWNER FOR HIS USE PRIOR TO ORDERING, FABRICATING OR INSTALLING SAME.

G. ALL MATERIALS SHALL BE NEW. ALL EQUIPMENT SHALL BEAR THE U.L. LABEL.

H. RECORD DRAWINGS: THE CONTRACTOR SHALL KEEP DAILY UPDATED ACCURATE RECORDS OF ALL DEVIATIONS IN WORK AS ACTUALLY INSTALLED FROM WORK INDICATED ON THE CONTRACT DRAWINGS. THE RECORD DRAWINGS SHALL BE KEPT AT THE JOB SITE, AVAILABLE TO THE OWNER AT ALL TIMES AND LABELED AS "PROJECT RECORD INFORMATION -- JOB SET". WHEN WORK IS COMPLETED THIS CONTRACTOR SHALL PROVIDE TO THE OWNER ONE COMPLETE SET OF MARKED-UP ORIGINAL PRINTS, UPDATED CAD DRAWINGS AND A CD WITH CAD FILES.

1.02 GUARANTEE:

A. ALL WORK, MATERIALS AND EQUIPMENT SHALL BE GUARANTEED AGAINST DEFECTS RESULTING FROM THE USE OF INFERIOR MATERIALS, EQUIPMENT, OR WORKMANSHIP FOR ONE YEAR FROM THE DATE OF FINAL COMPLETION OF THE CONTRACT, OR FROM FULL ACCEPTANCE BY THE OWNER, WHICHEVER IS EARLIER. ALL DEFECTIVE MATERIAL OR WORKMANSHIP AS WELL AS DAMAGES TO THE WORK OF ALL TRADES RESULTING FROM SAME SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

B. THE GUARANTEE PERIOD SHALL BE FOR ONE (1) YEAR FROM THE DATE OF ACCEPTANCE, WHICH SHALL BE THE DATE OF FINAL PAYMENT OR THE DATE OF FORMAL NOTICE OF ACCEPTANCE, WHICHEVER IS EARLIER.

C. CERTIFICATION SHALL BE SUBMITTED BY THE CONTRACTOR ATTESTING TO THE FACT THAT SPECIFIED PERFORMANCE CRITERIA ARE MET BY ALL EQUIPMENT.

D. IF, WITHIN ANY GUARANTEE PERIOD, REPAIRS OR CHANGES TO GUARANTEED WORK ARE REQUIRED AS A RESULT OF THE USE OF DEFECTIVE MATERIALS OR EQUIPMENT, INFERIOR WORKMANSHIP OR WORK THAT IS NOT IN ACCORDANCE WITH THE TERMS OF THE CONTRACT, AND UPON RECEIPT OF NOTICE FROM THE OWNER, THE FOLLOWING SHALL BE DONE WITHOUT EXPENSE TO THE OWNER:

1. REPAIR ALL DAMAGE TO THE BUILDING OR SITE/EQUIPMENT OR CONTENTS THEREOF WHICH IS THE RESULT OF THE USE OF DEFECTIVE MATERIALS OR EQUIPMENT OR INFERIOR WORKMANSHIP, OR OF WORK NOT IN ACCORDANCE WITH THE TERMS OF THE CONTRACT.

2. MAKE GOOD ANY WORK OR MATERIALS, OR THE EQUIPMENT AND CONTENTS OF SAID BUILDING OR SITE DISTURBED IN FULFILLING ANY SUCH GUARANTEE.

3. IN FULFILLING THE REQUIREMENTS OF THE CONTRACT OR OF ANY GUARANTEE EMBRACED IN OR REQUIRED THEREBY, ANY WORK GUARANTEED UNDER ANOTHER CONTRACT IS DISTURBED, RESTORE SUCH DISTURBED WORK TO ORIGINAL CONDITION AND GUARANTEE SUCH RESTORED WORK TO THE SAME EXTENT AS IT WAS GUARANTEED UNDER SUCH OTHER CONTRACT.

4. IF UPON FAILURE TO PROCEED PROMPTLY AFTER NOTICE TO COMPLY WITH THE TERMS OF THE GUARANTEE, THE OWNER MAY HAVE THE DEFECTS CORRECTED AND CONTRACTOR AND HIS SURETY SHALL BE LIABLE FOR ALL EXPENSES INCURRED.

1.03 CONTRACTORS RESPONSIBILITIES:

A. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY INJURIES TO PEOPLE, EMPLOYEES OR DAMAGE DONE TO BUILDING PREMISES OR ADJOINING AREAS OR TO OTHER WORK RESULTING FROM EXECUTION ON HIS PART OF WORK, IN ANY MANNER WHATSOEVER.

B. CONTRACTOR SHALL BE RESPONSIBLE FOR PROPER PROTECTION OF HIS WORK, MATERIALS, PEOPLE OR EMPLOYEES FROM INJURY OR LOSS DONE BY OTHERS AND SHALL MAKE GOOD SUCH INJURY AT HIS OWN EXPENSE.

C. DRAWINGS DO NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY.

D. ENGINEER SHALL NOT BE RESPONSIBLE FOR THE SAFETY OF CONTRACTOR' EMPLOYEES, MATERIALS OR EQUIPMENT.

1.04 COORDINATION AND INTERPRETATION OF DRAWINGS:

A. THIS CONTRACTOR, PRIOR TO SUBMITTING BID SHALL VISIT THE PROJECT SITE TO BECOME FAMILIAR WITH ALL EXISTING CONDITIONS AND TO INSPECT THAT ALL PROVISIONS HAVE BEEN MADE FOR ALL ASPECTS OF THIS PROJECT.

B. IF DISCREPANCIES EXIST BETWEEN DRAWINGS AND/OR SITE CONDITIONS, THE HVAC CONTRACTOR SHALL NOTIFY THE ENGINEER AND THE OWNER PRIOR TO SIGNING OF CONTRACT. REQUESTS FOR COMPENSATION FOR EXTRA WORK, WHICH WOULD HAVE BEEN EVIDENT BY COMPLIANCE WITH THE PREVIOUS STATEMENT, WILL NOT BE CONSIDERED.

C. MECHANICAL EQUIPMENT AND SUCH OTHER APPARATUS AS MAY REQUIRE MAINTENANCE AND OPERATION FROM TIME TO TIME SHALL BE MADE EASILY ACCESSIBLE. ALTHOUGH THE EQUIPMENT MAY BE SHOWN ON THE DRAWINGS IN CERTAIN LOCATIONS, THE CONSTRUCTION MAY DISCLOSE THAT SUCH LOCATIONS DO NOT MAKE ITS POSITION READILY ACCESSIBLE. IN SUCH CASES, THE OWNER OR HIS REPRESENTATIVE SHALL BE NOTIFIED BEFORE ADVANCING THE CONSTRUCTION TO A STAGE WHERE A CHANGE WILL REFLECT ADDITIONAL EXPENSE.

D. IT SHALL BE THE RESPONSIBILITY OF THE HVAC CONTRACTOR TO STUDY ALL DRAWINGS AND DETAILS SO THAT THE INSTALLATION OF ALL NEW WORK CAN BE FULLY COORDINATED. COORDINATE WITH ALL TRADES TO AVOID INTERFERENCE OF EQUIPMENT.

E. HVAC WORK IS INDICATED DIAGRAMMATICALLY. EXACT LOCATION OF ALL COMPONENTS ARE TO BE DETERMINED IN THE FIELD AND BY THE ACTUAL BUILDING CONDITIONS. EQUIPMENT, DUCTS OR PIPES INTERFERING WITH OTHER INSTALLATIONS SHALL BE RELOCATED AS REQUIRED AT NO ADDITIONAL COST TO THE OWNER.

F. HVAC CONTRACTOR SHALL COORDINATE ALL WALL, CEILING, FLOOR, ROOF AND BEAM PENETRATIONS WITH ARCHITECT AND STRUCTURAL ENGINEER.

1.05 DEMOLITION:

A. ALL DEMOLITION OF INACTIVE HVAC SYSTEMS WITHIN THE CONTRACT LIMITS SHALL BE BY THE GENERAL CONTRACTOR. EACH BIDDER FOR WORK UNDER THIS SECTION OF THE SPECIFICATION SHALL INCLUDE IN HIS BID ALL COSTS INVOLVED IN DISCONNECTING ALL PIPING, DUCTWORK AND UNUSED CONTROL WIRING SERVING EXISTING HVAC EQUIPMENT THAT IS TO BE REMOVED. COORDINATE ALL SHUTDOWN OF EXISTING SYSTEMS AS REQUIRED, WITH THE ARCHITECT/OWNER, THROUGH THE GENERAL CONTRACTOR.

B. CONTRACTOR SHALL VISIT SITE AND IDENTIFY EXISTING CONDITIONS AND DIFFICULTIES THAT WILL AFFECT WORK OF THIS SECTION. DEMOLITION WORK WILL REQUIRE CAREFUL SITE EXAMINATION PRIOR TO BIDDING.

C. PRIOR TO COMMENCING DEMOLITION, CONTRACTOR SHALL IDENTIFY WITH OWNER ANY EQUIPMENT TO BE RETURNED TO THE OWNER AFTER DEMOLITION. ALL OTHER DEBRIS SHALL BE DISPOSED OF BY THIS CONTRACTOR IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS.

D. THE MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISCONNECTION AND REMOVAL OF THE EXISTING MECHANICAL EQUIPMENT, DUCTWORK, PIPING, VALVES, ETC., IN DESIGNATED AREAS. CUT & CAP PIPING & DUCTWORK BACK TO MAINS. PATCH ALL ROOF AND WALL PENETRATIONS TO MATCH EXISTING.

E. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF EXISTING SUPPORT STEEL. PATCH ROOF TO MATCH EXISTING. COORDINATE WITH ROOF MANUFACTURER AS TO MAINTAIN ANY ROOF WARRANTIES. (1)

F. THIS CONTRACTOR SHALL PROTECT WORK AGAINST INJURY OR DAMAGE; AND CAREFULLY STORE MATERIAL AND EQUIPMENT TO BE RELOCATED. OPEN ENDS OF WORK SHALL BE CLOSED WITH TEMPORARY COVERS OR PLUGS DURING STORAGE AND CONSTRUCTION TO PREVENT ENTRY OF OBSTRUCTING MATERIAL.

1.06 EQUIPMENT:

A. PRODUCTS REQUIRED BY CONSTRUCTION BUT NOT SPECIFICALLY DESCRIBED HEREIN SHALL BE AS SELECTED BY THE CONTRACTOR SUBJECT TO THE APPROVAL OF THE ENGINEER.

B. PROVIDE ALL MATERIALS, LABOR, AND ACCESSORIES FOR A COMPLETE AND OPERABLE SYSTEMS AND AS REQUIRED BY THE EQUIPMENT MANUFACTURER'S INSTALLATION INSTRUCTIONS.

C. PROVIDE ALL HANGERS AND SUPPORTS AS REQUIRED TO SUPPORT ALL NEW PIPING AND EQUIPMENT.

D. MOTORS: ALL MOTORS SHALL BE RATED AT 85% POWER FACTOR AT FULL RATED LOAD. MOTORS LESS THAN 85% POWER FACTOR SHALL BE CORRECTED TO 85% POWER FACTOR AT THE FACTORY. ALL MOTORS SHALL BE RATED PREMIUM EFFICIENCY. MOTORS USED WITH VARIABLE FREQUENCY DRIVES SHALL BE RATED FOR INVERTER DUTY.

E. STARTERS: STARTERS SHALL BE CUTLER HAMMER OR EQUAL, WITH PUSH BUTTONS, HOA SWITCHES, AUXILIARY CONTACTS, ETC. FURNISH STARTERS FOR MOTORS ½ HP AND OVER AND AS REQUIRED BY SEQUENCE OF OPERATION. STARTERS FOR MOTORS 200 V/3 PHASE AND OVER, USE PRODUCTS WITH BUILT-IN, 120-VOLT CONTROL CIRCUIT TRANSFORMER. THIS CONTRACTOR SHALL SUPPLY ALL STARTERS UNLESS SPECIFICALLY SHOWN OR SPECIFIED ELSEWHERE. ELECTRICAL CONTRACTOR SHALL INSTALL STARTERS.

F. DISCONNECTS PROVIDED BY THIS CONTRACTOR WILL BE INSTALLED BY ELECTRICAL CONTRACTOR, WITH THE EXCEPTION OF FACTORY MOUNTED DISCONNECTS.

G. PROVIDE VIBRATION ISOLATION ON MOTOR DRIVEN EQUIPMENT, PLUS CONNECTED PIPING. COMPLY WITH MINIMUM STATIC DEFLECTIONS AS RECOMMENDED BY ASHRAE FOR SELECTION AND APPLICATION OF VIBRATION ISOLATION MATERIALS AND UNITS.

1.07 EXECUTION:

A. ALL ROUGH CUTTING, CORE DRILLING AND PATCHING REQUIRED FOR INSTALLATION OF THE MECHANICAL SYSTEM SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR. ALL FINISH PATCHING RELATING TO THIS CONTRACTOR'S WORK SHALL BE THE RESPONSIBILITY OF OTHER TRADES IN ACCORDANCE WITH OTHER SECTIONS OF THIS SPECIFICATION. COORDINATE ALL WORK FOR A COMPLETE AND FINISHED INSTALLATION.

B. INSTALL ALL MATERIALS, ACCESSORIES AND EQUIPMENT ACCORDING TO MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR A COMPLETE AND OPERABLE SYSTEMS AS INDICATED ON THE DRAWINGS MANUFACTURERS INSTRUCTIONS.

C. INSTALLATION OF THE HVAC SYSTEM SHALL PERMIT ACCESSIBILITY FOR SERVICE AND/OR REPLACEMENT OF NEW AND EXISTING EQUIPMENT.

D. ALL MISCELLANEOUS STRUCTURAL SUPPORTS REQUIRED FOR HVAC EQUIPMENT INSTALLATION SHALL BE PROVIDED BY MECHANICAL CONTRACTOR. THIS INCLUDES STRUCTURAL SUPPORT FOR THE NEW COOLING TOWER. (1)

E. CONTRACTOR SHALL FLASH & SEAL ALL ROOF PENETRATIONS PER ROOFING MANUFACTURER'S REQUIREMENTS IN ORDER TO MAINTAIN INTEGRITY OF EXISTING WARRANTY. COORDINATE THESE REQUIREMENTS WITH ROOFING MANUFACTURER, OWNER, ENGINEER AND ACTUAL FIELD CONDITIONS PRIOR TO SUBMITTING A BID. NO PENETRATIONS WILL BE ALLOWED UNTIL FINAL WRITTEN APPROVAL OF METHODS AND MATERIALS IS RECEIVED FROM THE ROOFING MANUFACTURER.

F. CONTRACTOR TO DRAIN, FLUSH, FILL AND BALANCE ALL SYSTEMS AS REQUIRED TO COMPLETE THE WORK.

1.08 EQUIPMENT, VALVE, AND PIPE IDENTIFICATION:

A. AVAILABLE MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PRODUCTS ARE LIMITED TO SETON, BRADY OR BRIMAR WHOM HAVE A MINIMUM OF 5 YEARS EXPERIENCE IN THE MANUFACTURING OF MECHANICAL IDENTIFICATION PRODUCTS.

B. PLASTIC PIPE MARKERS

1. SNAP-ON TYPE: PROVIDE MANUFACTURER'S STANDARD PRE-PRINTED, SEMI-RIGID SNAP-ON, COLOR-CODED PIPE MARKERS, COMPLYING WITH ANSI A13.1.

2. FOR EXTERNAL DIAMETERS LESS THAN 6" (INCLUDING INSULATION IF ANY), PROVIDE FULL-BAND PIPE MARKERS, EXTENDING 360 DEGREES AROUND PIPE AT EACH LOCATION, FASTENED BY SNAP-ON APPLICATION OF PRE-TENSIONED SEMI-RIGID PLASTIC PIPE MARKER.

3. THE FOLLOWING DESCRIPTION AND COLORS SHALL BE USED FOR PIPING IDENTIFICATION WITH FLOW ARROWS UNLESS NOTED OTHERWISE:

LEGEND	SERVICE	COLOR
CHWS	CHILLED WATER SUPPLY	GREEN
CHWR	CHILLED WATER RETURN	GREEN
CTWS	COOLING TOWER WATER SUPPLY	GREEN
CTWR	COOLING TOWER WATER RETURN	GREEN

COLOR BANDING SHALL MEET LATEST EDITION OF NSI AND OSHA REQUIREMENTS.

C. WHERE HYDRONIC SYSTEMS HAVE BEEN BALANCED, THE CONTRACTOR SHALL PERMANENTLY MARK, ON THE DEVICE, THE CORRECT BALANCING SETTING OF EACH VALVE OR SIMILAR DEVICE.

D. VALVE NUMBERING AND VALVE CHART:

1. USE BLACK LAMINATED PHENOLIC TAGS 2" IN DIAMETER WITH INCISED LETTERS 3/8" HIGH.

2. USE BRASS "S" HOOKS AND/OR BRASS CHAIN TO ATTACH TO VALVE.

3. USE PRINTING 1/8" HIGH FOR CHARTS.

4. PLACE CHARTS IN METAL FRAME WITH NON-GLARE GLASS.

E. EQUIPMENT IDENTIFICATION:

1. USE BLACK LAMINATED PHENOLIC NAMEPLATES 6" LONG X 3" HIGH WITH WHITE INCISED LETTERING ¾" HIGH. ATTACH TO EQUIPMENT WITH STAINLESS STEEL OR BRASS SCREWS, OR RIVETS.

PART 2 – EQUIPMENT

2.01 PIPING:

A. HEATING/COOLING:

1. PIPING 2-1/2" AND SMALLER SHALL BE SCHEDULE 40 BLACK STEEL WITH SCREWED FITTING OR TYPE L HARD COPPER SEAMLESS TUBE AS MANUFACTURED BY ANACONDA, REVERE OR CHASE, WITH WROUGHT COPPER FITTINGS, SOLDERED WITH LEAD-FREE SOLDER. UNIONS OR FLANGES SHALL BE INSTALLED AT ALL CONNECTIONS TO ALL EQUIPMENT.

2. PIPING 3" AND LARGER SHALL BE SCHEDULE 40 BLACK STEEL WITH WELDED FITTINGS AND 150 LB. FLANGES.

B. UNIONS: USE DIELECTRIC UNIONS, FLANGES OR WATERWAYS TO CONNECT DISSIMILAR METAL PARTS.

C. PIPE SLEEVES: THROUGH OUTSIDE MASONRY WALLS AND BELOW GRADE MASONRY WALLS, USE SCHEDULE 40 DUCTILE IRON, CAULKED WATERTIGHT. THROUGH MASONRY FLOORS OR INTERIOR MASONRY WALLS AND FIRE RATED ASSEMBLIES, USE SCHEDULE 40 GALVANIZED STEEL PIPE. THROUGH INTERIOR NON-FIRE RATED STUD PARTITIONS, USE 22-GAUGE GALVANIZED SHEET METAL.

D. ESCUTCHEONS: ESCUTCHEONS FOR PIPES PASSING THROUGH OUTSIDE WALLS SHALL BE SOLID CAST BRASS, FLAT TYPE, SECURED TO PIPE WITH A SET SCREW. ESCUTCHEONS FOR PIPES PASSING THROUGH FLOORS SHALL BE SPLIT HINGED, CAST BRASS TYPE DESIGNED TO FIT PIPE ON ONE END AND COVER SLEEVE PROJECTION THROUGH FLOOR ON OTHER END. ESCUTCHEONS FOR PIPES PASSING THROUGH INTERIOR WALLS, PARTITIONS AND CEILINGS SHALL BE SPLIT-HINGED, CAST BRASS, CHROMIUM PLATED TYPE. RITTER PATTERN, CASTING CO., J3A, BEATON & CORBIN AND/OR CALDWELL PRODUCTS WILL BE ACCEPTABLE.

2.02 PIPE HANGERS AND SUPPORTS:

A. USE INSULATION PROTECTION SADDLES OR SHIELDS FOR ALL INSULATED CHILLED WATER PIPING AND WHERE HANGER IS OUTSIDE THE INSULATION. SECURE ALL SADDLES AND SHIELDS TO THE INSULATION TO PREVENT SLIPPAGE OR SHIFTING THAT MAY CAUSE THE SHIELD TO FALL TO THE GROUND. SADDLES SHALL BE SPOT WELDED TO HANGERS.

B. CLEVIS TYPE HANGERS, GRINNELL FIG. 260, SHALL BE USED EXCEPT AS OTHERWISE REQUIRED FOR VIBRATION ISOLATION AND SEISMIC RESTRAINT. SUPPORT PIPES FOUR INCHES AND OVER WITH GRINNELL FIGURE 181 OR 171 ADJ. PIPE ROLL WITH PIPE COVERING PROTECTION SADDLE.

C. PERFORATED BAND IRON, WIRE, CHAIN OR OTHER PIPING SHALL NOT BE USED AS SUPPORTS NOR SHALL HANGER RODS PIERCE DUCTWORK.

D. VERTICAL PIPING SUPPORTS SHALL BE PROVIDED WHERE REQUIRED, EQUAL TO GRINNELL STEEL EXTENSION PIPE CLAMPS, FIGURE 261, OR SOMERVILLE MANUFACTURER.

E. ON PIPING CONVEYING FLUID AT TEMPERATURES BELOW 60°F, SUPPORT SHALL BE OUTSIDE THE PIPE INSULATION. USE INSULATION PROTECTION SADDLES FOR EACH SUPPORT. SIZE SHALL BE AS PER MANUFACTURER'S RECOMMENDATION FOR EACH SIZE AND SERVICE OF PIPE.

F. ALL HANGERS AND SUPPORTS LOCATED EXTERIOR TO THE BUILDING SHALL BE STAINLESS STEEL.

2.03 PIPING INSULATION:

A. FIBERGLASS PIPE INSULATION SHALL BE BY OWENS CORNING TYPE SSL-II OR APPROVED EQUAL BY JOHNS MANVILLE OR CERTAINTEED. INSULATION SHALL HAVE FACTORY APPLIED ALL-SERVICE JACKET (ASJ) AND TWO-COMPONENT ADHESIVE CLOSURE SYSTEM, RATED FOR A MAXIMUM SERVICE TEMPERATURE OF 850°F. FOR LARGE PIPE SIZES WHERE SSL-II IS NOT AVAILABLE THE SINGLE ADHESIVE SSL CLOSURE MAY BE SUBSTITUTED. CIRCUMFERENTIAL JOINTS SHALL BE SEALED BY BUTT STRIPS HAVING A TWO-COMPONENT SEALING SYSTEM.

1. PIPING 1-1/2" AND SMALLER SHALL HAVE A MINIMUM INSULATION THICKNESS OF 1-1/2".

2. PIPING LARGER THAN 1-1/2" SHALL HAVE A MINIMUM INSULATION THICKNESS OF 2".

3. INSULATION THICKNESS IS BASED ON A "K" VALUE NOT EXCEEDING 0.27 BTU PER INCH/HR/SQ.FT./°F.

B. FITTINGS AND VALVES SHALL BE INSULATED WITH PRE-FORMED FIBERGLASS FITTINGS. THICKNESS SHALL BE EQUAL TO ADJACENT PIPE INSULATION. FINISH SHALL BE WITH PRE-FORMED PVC FITTING COVERS.

C. FLANGES, COUPLINGS AND VALVE BONNETS SHALL BE COVERED WITH AN OVERSIZED PIPE INSULATION SECTION SIZED TO PROVIDE THE SAME INSULATION THICKNESS AS ON THE MAIN PIPE SECTION. AN OVERSIZED INSULATION SECTION SHALL BE USED TO FORM A COLLAR BETWEEN THE TWO INSULATION SECTIONS WITH LOW-DENSITY BLANKET INSULATION BEING USED TO FILL GAPS. JACKETING SHALL MATCH THAT USED ON STRAIGHT PIPE SECTIONS. WHERE FITTINGS ARE TO BE LEFT EXPOSED, INSULATION ENDS SHOULD BE BEVELED AWAY FROM BOLTS FOR EASY ACCESS.

2.04 PIPING INSULATION EXPOSED TO WEATHER

A. FIBERGLASS PIPE INSULATION SHALL BE BY OWENS CORNING OR APPROVED EQUAL WITH FACTORY APPLIED ALL-SERVICE JACKET (ASJ) AND TWO-COMPONENT ADHESIVE CLOSURE SYSTEM. FOR LARGE PIPE SIZES WHERE SSL-II IS NOT AVAILABLE, THE SINGLE ADHESIVE SSL CLOSURE MAY BE SUBSTITUTED. CIRCUMFERENTIAL JOINTS SHALL BE SEALED BY BUTT STRIPS HAVING A TWO-COMPONENT SEALING SYSTEM.

B. FITTINGS AND VALVES SHALL BE INSULATED WITH PRE-FORMED FIBERGLASS FITTINGS. THICKNESS SHALL BE EQUAL TO ADJACENT PIPE INSULATION. FINISH SHALL BE WITH PRE-FORMED PVC FITTING COVERS.

C. FLANGES, COUPLINGS AND VALVE BONNETS SHALL BE COVERED WITH AN OVERSIZED PIPE INSULATION SECTION SIZED TO PROVIDE THE SAME INSULATION THICKNESS AS ON THE MAIN PIPE SECTION. AN OVERSIZED INSULATION SECTION SHALL BE USED TO FORM A COLLAR BETWEEN THE TWO INSULATION SECTIONS WITH LOW-DENSITY BLANKET INSULATION BEING USED TO FILL GAPS. JACKETING SHALL MATCH THAT USED ON STRAIGHT PIPE SECTIONS. WHERE FITTINGS ARE TO BE LEFT EXPOSED, INSULATION ENDS SHOULD BE BEVELED AWAY FROM BOLTS FOR EASY ACCESS.

D. PIPING SHALL BE INSULATED WITH A MINIMUM THICKNESS OF 2" REGARDLESS OF PIPE SIZE. THICKER INSULATION USE DETERMINED ACCORDING TO THE WORST WEATHER EXTREMES EXPECTED.

E. EXPOSED PIPE INSULATION SHALL BE PROTECTED WITH ONE OF THE FOLLOWING WEATHERPROOF FINISHES:

1. METAL JACKETING SHALL BE 0.016" (0.4 MM) MINIMUM ALUMINUM OR STAINLESS STEEL WITH MOISTURE BARRIER, SECURED IN ACCORDANCE WITH THE JACKET MANUFACTURER'S RECOMMENDATIONS. JOINTS SHALL BE APPLIED SO THEY WILL SHED WATER AND SHALL BE SEALED COMPLETELY.

2. UV RESISTANT PVC JACKETING MAY BE APPLIED IN LIEU OF METAL JACKETING PROVIDED JACKETING MANUFACTURER'S LIMITATIONS WITH REGARD TO PIPE SIZE, SURFACE TEMPERATURE, AND THERMAL EXPANSION AND CONTRACTION ARE FOLLOWED.

3. FITTINGS SHALL BE INSULATED AS PRESCRIBED ABOVE, JACKETED WITH PREFORMED FITTING COVERS MATCHING OUTER JACKETING USED ON STRAIGHT PIPE SECTIONS, WITH ALL JOINTS WEATHER SEALED.

2.05 VALVES AND SPECIALTIES:

A. PROVIDE WHERE SHOWN ON THE DRAWINGS AND AT ALL HIGH POINTS IN THE PIPING AND AT ALL AIR HANDLING UNIT COILS, A SPIROTOP AUTOMATIC AIR VENT WITH SHUT-OFF. FURNISH TO THE GENERAL CONTRACTOR ACCESS PANELS AS MANUFACTURED BY MILCOR FOR EACH CONCEALED AIR VENT.

B. PROVIDE ALL REQUIRED VALVES FOR THE EQUIPMENT AS SHOWN ON THE PLANS AND AS REQUIRED FOR PROPER OPERATION OF THE EQUIPMENT. PROVIDE THROTTLING VALVES WHERE REGULATION OF FLOW IS NECESSARY OR DESIRABLE. CHECK VALVES WHERE REVERSE FLOW IS LIABLE UNDER ANY CONDITIONS AND SHUT-OFF VALVES ON ALL LINES CONNECTING TO ANY PIECE OF EQUIPMENT, INCLUDING HEATING AND VENTILATING UNITS, COILS, UNIT HEATERS AND FIN TUBE RADIATION. ALL VALVES SHALL BE 125-LB. STANDARD CONSTRUCTION. VALVES SHALL BE BRONZE OR BRASS. VALVES 3" AND LARGER SHALL BE FLANGED ENDS. ALL VALVES SHALL HAVE THE NAME OR TRADEMARK OF THE MANUFACTURER AND GUARANTEED WORKING PRESSURE CAST ON THE BODY OF THE VALVE. ALL EQUIPMENT SHALL HAVE ISOLATION VALVES. ALL VALVES SHALL HAVE EXTENSIONS SUFFICIENT TO CLEAR INSTALLATION.

C. PROVIDE ALL VALVES OF THE SAME MANUFACTURER (JENKINS, FAIRBANKS, CRANE OR LUNKENHEIMER) OF TOP LINE, FIRST QUALITY.

D. CHECK VALVES SHALL BE OF THE HORIZONTAL SWING TYPE WITH HINGED CHECK, GROUND SEAT AND APPROVED TYPE DISCS.

E. GLOBE AND ANGLE VALVES USED FOR THROTTLING SERVICES SHALL BE OF THE PLUG TYPE WITH RENEWABLE SEATS AND DISCS. SEATS AND DISCS FOR PLUG TYPE VALVES SHALL BE OF APPROVED TYPE METAL ALLOY.

2.06 VERTICAL INLINE PUMPS

A. FURNISH AND INSTALL CENTRIFUGAL IN-LINE SINGLE STAGE PUMPS WITH CAPACITIES AND CHARACTERISTICS AS SHOWN ON THE PLANS. THE DESIGN MUST PERMIT EASY REPLACEMENT OF THE MECHANICAL SHAFT SEAL WITHOUT REMOVAL OF THE MOTOR. PUMPS SHALL BE TACO MODEL KV OR APPROVED EQUAL.

B. PUMP VOLUTE OR CASINGS SHALL BE CONSTRUCTED OF CLASS 30 CAST IRON. THE PUMP CASING SHALL HAVE EQUAL SUCTION AND DISCHARGE PORTS. THE PUMP CASING SHALL BE DRILLED AND TAPPED FOR GAUGE PORTS AT BOTH THE SUCTION AND DISCHARGE FLANGES AND FOR DRAIN PORT AT THE BOTTOM OF THE CASING. THE PUMP SHALL BE CAPABLE OF BEING SERVICED WITHOUT DISTURBING SYSTEM PIPING.

C. THE IMPELLER SHALL BE BRONZE AND HYDRAULICALLY BALANCED BY EITHER BACK VANES OR BALANCING HOLES. THE IMPELLER SHALL BE DYNAMICALLY BALANCED TO ANSI GRADE G6.3 AND SHALL BE FITTED TO THE SHAFT WITH A KEY.

D. THE PUMP COVER SHALL BE MACHINED TO PROVIDE A BALANCE CHAMBER FROM THE CLOSE TOLERANCE BETWEEN THE BACK IMPELLER HUB AND THE COVER. THE COVER SHALL BE FITTED WITH A BRONZE THROTTLE BUSHING AS STANDARD. THE COVER SHALL BE DESIGNED TO PROVIDE MAXIMUM FLEXIBILITY OF MECHANICAL SHAFT SEALS AND FLUSH GLANDS.

E. THE PUMP SEAL SHALL BE EPT CERAMIC RATED TO 250°F. THE PUMP SHALL HAVE A FACTORY INSTALLED VENT/FLUSH LINE TO INSURE REMOVAL OF TRAPPED AIR AND MECHANICAL SEAL COOLING. THE VENT/FLUSH LINE SHALL RUN FROM THE SEAL CHAMBER TO THE PUMP DISCHARGE.

F. THE PUMP SHALL BE COUPLED TO A NEMA RATED MOTOR DESIGNED FOR CONTINUOUS OPERATION AND READILY REMOVABLE FOR SERVICING. THE PUMP SHAFT SHALL BE OF STAINLESS STEEL AND INCORPORATE A SUITABLE INTERNAL OR EXTERNAL SEAL. THE PUMP AND MOTOR SHAFT MUST BE CONNECTED WITH CIRCULAR KEYS CAPABLE OF TRANSMITTING AXIAL LOADS TO THE MOTOR BEARINGS. THE MOTOR SHALL BE CONNECTED TO THE PUMP SHAFT THROUGH A HIGH TENSILE ALUMINUM SPLIT STYLE COUPLING.

2.07 COOLING TOWER

A. NEW COOLING TOWER SHALL BE AS MANUFACTURED BY BALTIMORE AIR COIL OR APPROVED EQUALS: EVAPCO OR TOWER TECH. NEW COOLING TOWER MUST FIT IN EXISTING TOWER ENCLOSURE INCLUDING SERVICE CLEARANCES.

B. TOWER SHALL BE CONSTRUCTED OF CORROSION RESISTANT TYPE 304 STAINLESS STEEL CONSTRUCTION; ALL STEEL PANELS AND STRUCTURAL MEMBERS SHALL BE CONSTRUCTED OF TYPE 304 STAINLESS STEEL AND ASSEMBLED WITH TYPE 304 STAINLESS STEEL NUT AND BOLT FASTENERS.

C. COLD WATER BASIN PROTECTED WITH TRIARMOR CORROSION PROTECTION SYSTEM: THE COLD WATER BASIN SHALL BE PROTECTED WITH THE TRIARMOR CORROSION PROTECTION SYSTEM. THE SYSTEM SHALL CONSIST OF G-235 GALVANIZED STEEL ENCAPSULATED WITH A THERMOSETTING HYBRID POLYMER FURTHER PROTECTED BY A POLYURETHANE LINER FACTORY APPLIED TO ALL SUBMERGED SURFACES. THE POLYURETHANE BARRIER SHALL SEAL ALL FACTORY SEAMS IN THE COLD WATER BASIN TO ENSURE A CORROSION RESISTANT AND WATER TIGHT CONSTRUCTION AND SHALL BE WARRANTED AGAINST LEAKS AND CORROSION FOR FIVE (5) YEARS. FIELD APPLIED POLYURETHANE OR POLYURETHANE APPLIED DIRECTLY TO GALVANIZED STEEL IS NOT AN ACCEPTABLE ALTERNATIVE. STANDARD BASIN ACCESSORIES SHALL INCLUDE A CORROSION RESISTANT MAKE-UP VALVE WITH LARGE DIAMETER POLYSTYRENE FILLED PLASTIC FLOAT FOR EASY ADJUSTMENT OF THE OPERATING WATER LEVEL, REMOVABLE ANTI-VORTEXING DEVICE TO PREVENT AIR ENTRAINMENT, AND LARGE AREA LIFT OUT STRAINERS WITH PERFORATED OPENINGS SIZED SMALLER THAN THE WATER DISTRIBUTION SYSTEM NOZZLES. THE STRAINER AND ANTI-VORTEXING DEVICE SHALL BE CONSTRUCTED FROM TYPE 304 STAINLESS STEEL TO PREVENT CORROSION. A WELDED TYPE 316 STAINLESS STEEL BASIN SHALL BE AN ACCEPTABLE ALTERNATIVE, PROVIDED THE BASIN IS WARRANTED AGAINST LEAKS AND CORROSION FOR A PERIOD OF AT LEAST 5 YEARS. A BOLTED TYPE 304 STAINLESS STEEL BASIN SHALL NOT BE AN ACCEPTABLE ALTERNATIVE.

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ELECTRICAL SYMBOL LEGEND

POWER	ABBREVIATIONS
JUNCTION BOX	A — AMPS
UNFUSED DISCONNECT SWITCH	C — CONDUIT
VARIABLE FREQUENCY DRIVE	CB — CIRCUIT BREAKER
MOTOR	CU — COPPER
WIRING RUN TURNING DOWN	EG — EQUIPMENT GROUND
DUPLEX RECEPTACLE MTD 18" A.F.F. TO CENTER.	FLA — FULL LOAD AMPS
GROUND FAULT INTERRUPTING RECEPTACLE MTD 18" A.F.F. TO CENTER.	G — GROUND
	HOA — HAND-OFF-AUTOMATIC SWITCH
	HP — HORSEPOWER
	HVAC — HEATING, VENTILATING, AND AIR CONDITIONING
	KW — KILOWATT
	MTD — MOUNTED
	NA — NOT APPLICABLE
	NF — NOT FUSIBLE
	NTS — NOT TO SCALE
	P — POLE
	PH — PHASE
	TYP — TYPICAL
	V — VOLT
	VFD — VARIABLE FREQUENCY DRIVE
	W — WATT

ELECTRICAL CONNECTION SCHEDULE FOR MECHANICAL EQUIPMENT

DESCRIPTION	EQUIPMENT CHARACTERISTICS VOLTS	PH	AMPS	HP	MR	MCA	MOCP	CTH	PANEL	CIRCUIT	BREAKER SIZE	FEEDER AND CONDUIT	EQUIPMENT LOCATION	DISCONNECT SWITCH SIZE	FUSE	POLES	NEMA	MOTOR CONTROL	NOTES
G-CP-1	480	3	11	7.5					MCC3	1,3,5	3P 25A	(3)#12CU in (1)#3/4 IN 1/2"C	MECHANICAL ROOM 524						7
G-CP-2	480	3	11	7.5					MCC3	1,3,5	3P 25A	(3)#12CU in (1)#3/4 IN 1/2"C	MECHANICAL ROOM 524						7
CT-1A-COOLING TOWER FAN	480	3	21	15					MCC3			(3)#6CU in (1)#40 IN 1"C	ROOF	60	40	3	3R		1,2,4,5,6
CT-1B-COOLING TOWER FAN	480	3	21	15					MCC3			(3)#6CU in (1)#40 IN 1"C	ROOF	60	40	3	3R		1,2,4,5,6
HOW DRAIN HEATER	480	3	8.8		5				MCC3			(3)#10CU in (1)#1/2 IN 1"C	ROOF	30	15	3	3R		2,5,6

NOTES:
1. NEW VFD PROVIDED BY THE ELECTRICAL CONTRACTOR. VFD IS LOCATED FOR DIAGRAMATIC PURPOSES ONLY. FIELD VERIFY EXACT LOCATION IN THE FIELD AS NECESSARY. PROVIDE ALL MOUNTING HARDWARE AND ALL FINAL TERMINATIONS. PROVIDE FLOOR MOUNTED UNISTRUT RACKING AS NECESSARY TO SUPPORT VFD. PROVIDE ALL NECESSARY HARDWARE AND ALL FINAL TERMINATIONS.
2. PROVIDE NEW CONDUIT AND WIRE FROM THE LOAD SIDE OF THE NEW VFD TO THE LINE SIDE OF THE NEW DISCONNECT MOUNTED ON COOLING TOWER. SEE DRAWING E-3 FOR ADDITIONAL INFORMATION.
3. PROVIDE NEW CONDUIT AND WIRE FROM THE LOAD SIDE OF THE NEW DISCONNECT TO THE LINE SIDE OF THE NEW DISCONNECT MOUNTED ON COOLING TOWER. SEE DRAWING E-3 FOR ADDITIONAL INFORMATION.
4. ELECTRICAL CONTRACTOR SHALL PROVIDE AUXILIARY CONTACTS AND PROVIDE (2)#18 in (1)#16G, IN 3/4" CONDUIT, TO PERMANENT RUN CONTACTS ON THE VFD.
5. DISCONNECT SWITCH SHALL BE NEMA 3R RATED.
6. INSTALLATION ON ROOF SHALL BE WEATHERPROOF. PROVIDE RIGID STEEL CONDUIT AND LIQUID TIGHT CONNECTIONS (18" MAXIMUM) TO EQUIPMENT.
7. REFER BY EXISTING MCC. SEE PLAN DRAWINGS FOR ADDITIONAL INFORMATION.

VFD SCHEDULE (SEE VFD SPECIFICATION FOR ADDITIONAL INFORMATION)

LOAD TAG	CIRCUIT	STARTER LOCATION	LOAD HP	FLA	VOLTS	PHASE	STARTER NEMA SIZE	TYPE	OVERCURRENT DEVICE CB	FUSE	MCP	PB	HOA	ACCESSORIES INDICATING LIGHTS R	G	A	AUXILIARY CONTACTS CPT	N.O.	N.C.	DIMENSIONS (IN) H	W	D	PHASE #	DC BUS REACTOR SIZE (CONT. AND SURGE)	AC INPUT LINE REACTOR SIZE	AC LOAD LINE REACTOR SIZE (PART WINDING LOW LOSS)	FLOOR MOUNTED UNISTRUT RACK	PROVIDED WITH CHILLER	REMARKS
CT-1A		MECHANICAL ROOM 524	15	21	480	3	2	VFD	X				X	X	X	X				34.77	20.45	17.60	6		X	X	X		
CT-1B		MECHANICAL ROOM 524	15	21	480	3	2	VFD	X				X	X	X	X				34.77	20.45	17.60	6		X	X	X		

NOTES:
1. PROVIDE INTERNAL OVERLOAD TRIPS FOR ALL STARTERS SIZED TO MATCH LOAD NAMEPLATE AND NEC REQUIREMENTS.
2. PROVIDE CPT SIZED TO ACCOMMODATE INDICATED AUXILIARIES AT 120V UNLESS NOTED OTHERWISE IN THE SPECIFICATIONS.
3. VFD SHALL BE CONTROLLED VIA NEMATIC 4-20 mA OR 0-5V SIGNAL PROVIDED BY THE HVAC BTC CONTRACTOR.
4. PROVIDE NEMA 12 ENCLOSURE.
5. PROVIDE LOCKABLE HANDLE MANUAL CIRCUIT BREAKER.

KEY:
FVNR = FULL VOLTAGE NON-REVERSING
FVR = FULL VOLTAGE REVERSING
2S1W = TWO SPEED SINGLE WINDING
2S2W = TWO SPEED TWO WINDING
RVAT = REDUCED VOLTAGE AUTOTRANSFORMER
RVPW = REDUCED VOLTAGE PART WINDING
RVYDT = REDUCED VOLTAGE WYE DELTA OPEN TRANSITION
RVYDCT = REDUCED VOLTAGE WYE DELTA CLOSED TRANSITION
MVS = MANUAL MOTOR STARTER
CB = CIRCUIT BREAKER
MCP = MOTOR CIRCUIT PROTECTION
PB = START AND STOP PUSH BUTTON
HOA = HAND-OFF-AUTOMATIC SELECTOR SWITCH
CPT = CONTROL POWER TRANSFORMER
VFD = VARIABLE FREQUENCY DRIVE

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Project: COOLING TOWER AND PUMP REPLACEMENT AT THE RIDEPRO WEST FIELD LEGACY COMPLEX
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Status:

No.	Revision/Issue	Date

Sheet Title: SCHEDULES AND SYMBOL LEGEND

Project No: 20140132
Drawn By: WHS
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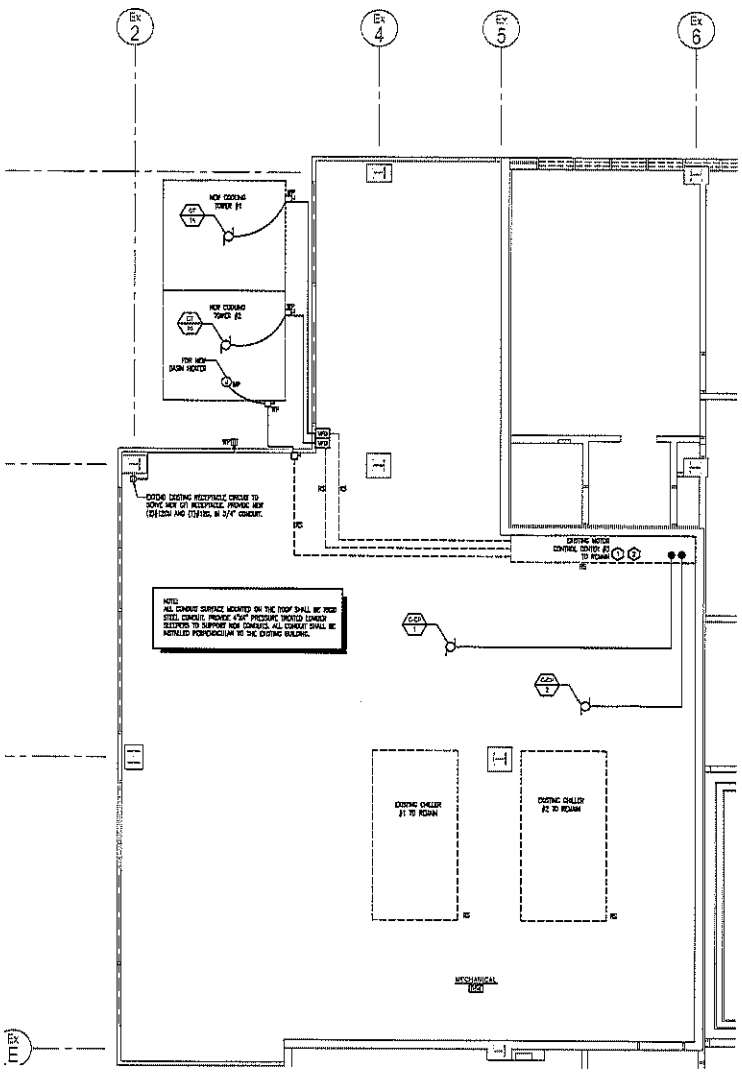
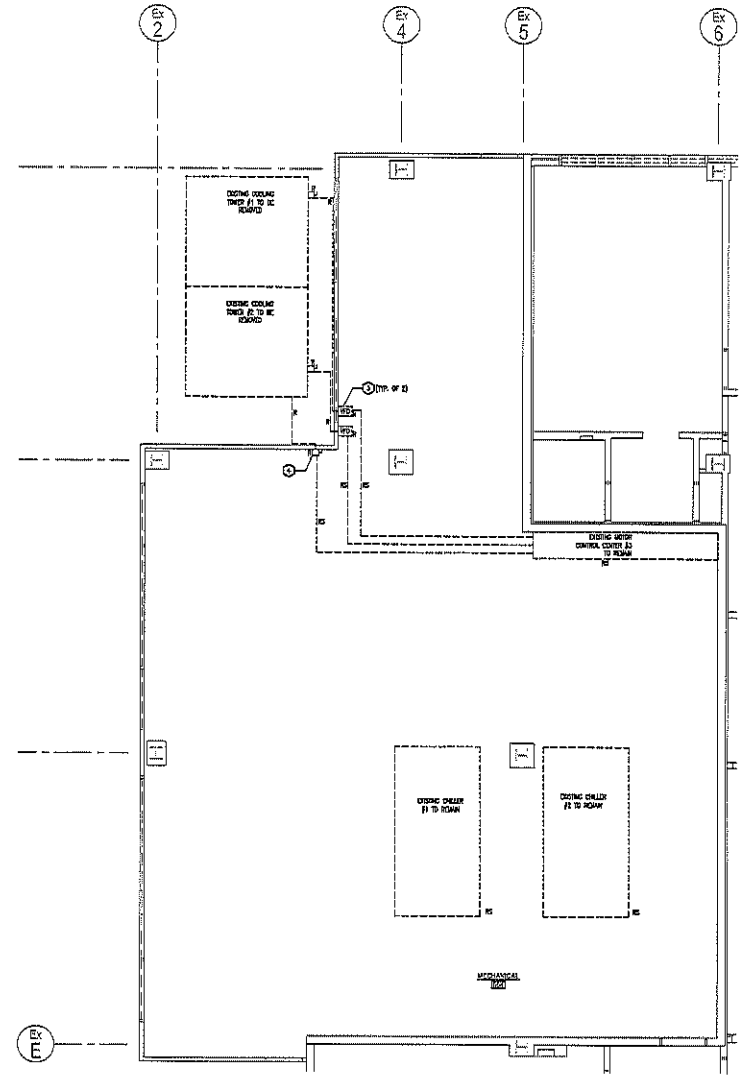


MECHANICAL ROOM (6TH FLOOR) PART PLAN - NEW ELECTRICAL WORK

SCALE: 1/4" = 1'-0"



MECHANICAL ROOM (6TH FLOOR) PART PLAN - EXISTING ELECTRICAL WORK

SCALE: 1/4" = 1'-0"

EXISTING ITEMS NOTES:

1. ALL ITEMS SHOWN DASHED ARE EXISTING AS NOTED.
   - R — REMAIN
   - RS — TO REMAIN
   - RR — REMOVE AND RELOCATE
   - RN — SHOWN IN NEW REQUESTED POSITION
2. SEE SPECIFICATION SECTION "REMOVALS AND RELOCATIONS".

SHEET NOTE:

1. PROVIDE TWO NEW 3 POLE 25 AMP CIRCUIT BREAKERS TO SERVE EACH NEW PUMP. MC WIRING SHALL MATCH EXISTING. PROVIDE ALL NECESSARY HARDWARE AND ALL FINAL TERMINATIONS. PROVIDE PHOTOCELL ON NEW PUMPS AND ASSOCIATED MCC CIRCUITS.
2. REMOVE EXISTING (3) 60 AMP FUSES IN EACH OF TWO FUSED DISCONNECTS SERVING EXISTING COOLING TOWERS #1 AND #2 RESPECTIVELY. PROVIDE NEW (3) 40 AMP FUSES IN EACH OF TWO EXISTING FUSED DISCONNECT SWITCHES. PROVIDE ALL NECESSARY HARDWARE AND ALL FINAL TERMINATIONS.
3. REMOVE EXISTING (3)#4Cu & (1)#8Gr. PRESENTLY TERMINATED ON BOTH THE LINE AND LOAD SIDES OF THE EXISTING VFD. REMOVE THE EXISTING 1" CONDUIT AND WIRE EXTENDING TO THE EXISTING DISCONNECT MOUNTED ON THE EXISTING COOLING TOWER. REMOVE EXISTING VFD AND REPLACE WITH NEW. REFEED EXISTING LINE SIDE CONDUIT AND WIRE AS NECESSARY, AND TERMINATE TO THE LINE SIDE OF THE NEW VFD.
4. REMOVE EXISTING (3)#8Cu & (1)#10Gr. PRESENTLY TERMINATED ON BOTH THE LINE AND LOAD SIDES OF THE EXISTING DISCONNECT. REMOVE THE EXISTING 1" CONDUIT AND WIRE EXTENDING TO THE EXISTING DASH HEATER IN THE EXISTING COOLING TOWER. REMOVE EXISTING DISCONNECT AND REPLACE WITH NEW. REFEED EXISTING LINE SIDE CONDUIT AND WIRE AS NECESSARY AND TERMINATE TO THE LINE SIDE OF THE NEW VFD.

HVAC/ELECTRICAL INSTALLATIONS
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Project:
COOLING TOWER AND HEAT REPLACEMENT AT THE
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Revisions:

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ELECTRICAL PLAN

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2. INDICATE METHOD OF PROVIDING TEMPORARY ELECTRICAL SERVICE.
3. DO NOT PROCEED WITH INTERRUPTION OF ELECTRICAL SYSTEMS WITHOUT CONSTRUCTION MANAGER'S AND OWNER'S WRITTEN PERMISSION.
4. COMPLY WITH NFPA 70E.

C. PRODUCT SELECTION FOR RESTRICTED SPACE: DRAWINGS INDICATE MAXIMUM DIMENSIONS FOR VFDS, INCLUDING CLEARANCES BETWEEN VFDS, AND ADJACENT SURFACES AND OTHER ITEMS.

1.9 COORDINATION

A. COORDINATE FEATURES OF MOTORS, LOAD CHARACTERISTICS, INSTALLED UNITS, AND ACCESSORY DEVICES TO BE COMPATIBLE WITH THE FOLLOWING:
1. TORQUE, SPEED, AND HORSEPOWER REQUIREMENTS OF THE LOAD.
2. RATINGS AND CHARACTERISTICS OF SUPPLY CIRCUIT AND REQUIRED CONTROL SEQUENCE.
3. AMBIENT AND ENVIRONMENTAL CONDITIONS OF INSTALLATION LOCATION.

B. COORDINATE SIZES AND LOCATIONS OF CONCRETE BASES WITH ACTUAL EQUIPMENT PROVIDED. CAST ANCHOR-BOLT INSERTS INTO BASES.

C. COORDINATE SIZES AND LOCATIONS OF ROOF CURBS, EQUIPMENT SUPPORTS, AND ROOF PENETRATIONS WITH ACTUAL EQUIPMENT PROVIDED.

1.10 WARRANTY

A. SPECIAL WARRANTY: MANUFACTURER'S STANDARD FORM IN WHICH MANUFACTURER AGREES TO REPAIR OR REPLACE VFDS THAT FAIL IN MATERIALS OR WORKMANSHIP WITHIN SPECIFIED WARRANTY PERIOD.
1. WARRANTY PERIOD: ONE YEAR FROM DATE OF START-UP, NOT TO EXCEED 5 YEARS FROM DATE OF SHIPMENT. WARRANTY SHALL INCLUDE PARTS, AND LABOR ALLOWANCE FOR REPAIR HOURS.

1.11 EXTRA MATERIALS

A. FURNISH EXTRA MATERIALS DESCRIBED BELOW THAT MATCH PRODUCTS INSTALLED AND THAT ARE PACKAGED WITH PROTECTIVE COVERING FOR STORAGE AND IDENTIFIED WITH LABELS DESCRIBING CONTENTS.
1. POWER FUSES: EQUAL TO 5 PERCENT OF QUANTITY INSTALLED FOR EACH SIZE AND TYPE, BUT NO FEWER THAN THREE OF EACH SIZE AND TYPE.
2. CONTROL POWER FUSES: EQUAL TO 5 PERCENT OF QUANTITY INSTALLED FOR EACH SIZE AND TYPE, BUT NO FEWER THAN TWO OF EACH SIZE AND TYPE.
3. INDICATING LIGHTS: TWO OF EACH TYPE AND COLOR INSTALLED.
4. AUXILIARY CONTACTS: FURNISH ONE SPARE(S) FOR EACH SIZE AND TYPE OF MAGNETIC CONTROLLER INSTALLED.
5. POWER CONTACTS: FURNISH THREE SPARES FOR EACH SIZE AND TYPE OF MAGNETIC CONTACTOR INSTALLED.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY ONE OF THE FOLLOWING:
1. YASKAWA ELECTRIC AMERICA, INC; DRIVES DIVISION.
2. ABB.
3. ROCKWELL AUTOMATION, INC.; ALLEN-BRADLEY BRAND.

B. DESIGN
1. VFD SHALL EMPLOY MICROPROCESSOR BASED INVERTER LOGIC, ISOLATED FORM ALL POWER CIRCUITS.
2. VFD SHALL INCLUDE SURFACE MOUNT TECHNOLOGY WITH PROTECTIVE COATING.
3. VFD SHALL EMPLOY A PWM (PULSE WIDTH MODULATED) POWER ELECTRONIC SYSTEM, CONSISTING OF:
a. INPUT SECTION:
1) VFD INPUT POWER STAGE SHALL CONVERT THREE-PHASE AC LINE POWER INTO A FIXED DC VOLTAGE VIA A SOLID STATE FULL WAVE DIODE RECTIFIER, WITH MOV (METAL OXIDE VARISTOR) SURGE PROTECTION.
2) A MINIMUM OF 3% INPUT LINE REACTOR TO MINIMIZE REFLECTED CURRENT.
3) 6 PULSE VFD SHALL BE UTILIZED UP TO 30 HP @ 480 VAC.
4) 18 PULSE VFD/PHASE SHIFTING TRANSFORMER SHALL BE UTILIZED FORM 40 HP TO 500 HP @ 480 VAC MODELS TO MINIMIZE THD GENERATED BY THE VFD.
b. INTERMEDIATE SECTION:
1) DC BUS AS A SUPPLY TO THE VFD OUTPUT SECTION SHALL MAINTAIN A FIXED VOLTAGE WITH FILTERING AND SHORT CIRCUIT PROTECTION.
2) DC US SHALL BE INTERFACED WITH THE VFD DIAGNOSTIC LOGIC CIRCUIT, FOR CONTINUOUS MONITORING AND PROTECTION OF THE POWER COMPONENTS.
3) PROVIDE 5% DC BUS FILTER FOR 5 HP AND LARGER.
c. OUTPUT SECTION:
1) INSULATED GATE BIPOLAR TRANSISTORS (IGBTS) SHALL CONVERT DC BUS VOLTAGE TO VARIABLE FREQUENCY AND VOLTAGE.
2) THE VFD SHALL EMPLOY PWM SINE CODED OUTPUT TECHNOLOGY TO POWER THE MOTOR.
3) PROVIDE 5% OUTPUT REACTOR WHERE LEAD LENGTHS EXCEED 50 FEET.

C. VFD DESCRIPTION: VARIABLE-FREQUENCY POWER CONVERTER (RECTIFIER, DC BUS, AND IGBT, PWM INVERTER) FACTORY PACKAGED IN AN ENCLOSURE, WITH INTEGRAL DISCONNECTING MEANS AND OVERCURRENT AND OVERLOAD PROTECTION; LISTED AND LABELED BY AN NRTL AS A COMPLETE UNIT; ARRANGED TO PROVIDE SELF-PROTECTION, PROTECTION, AND VARIABLE-SPEED CONTROL OF ONE OR MORE THREE-PHASE INDUCTION MOTORS BY ADJUSTING OUTPUT VOLTAGE AND FREQUENCY.
1. UNITS SUITABLE FOR OPERATION OF NEMA MG 1, DESIGN A AND DESIGN B MOTORS AS DEFINED BY NEMA MG 1, SECTION IV, PART 30, "APPLICATION CONSIDERATIONS FOR CONSTANT SPEED MOTORS USED ON A SINUSOIDAL BUS WITH HARMONIC CONTENT AND GENERAL PURPOSE MOTORS USED WITH ADJUSTABLE-VOLTAGE OR ADJUSTABLE-FREQUENCY CONTROLS OR BOTH."
2. UNITS SUITABLE FOR OPERATION OF INVERTER-DUTY MOTORS AS DEFINED BY NEMA MG 1, SECTION IV, PART 31, "DEFINITE-PURPOSE INVERTER-FED POLYPHASE MOTORS."
3. LISTED AND LABELED FOR INTEGRATED SHORT-CIRCUIT CURRENT (WITHSTAND) RATING BY AN NRTL ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION.

D. DESIGN AND RATING: MATCH LOAD TYPE, SUCH AS FANS, BLOWERS, AND PUMPS; AND TYPE OF CONNECTION USED BETWEEN MOTOR AND LOAD SUCH AS DIRECT OR THROUGH A POWER-TRANSMISSION CONNECTION.

E. OUTPUT RATING: THREE-PHASE; 5 TO 60 HZ, WITH VOLTAGE PROPORTIONAL TO FREQUENCY THROUGHOUT VOLTAGE RANGE; MAXIMUM VOLTAGE EQUALS INPUT VOLTAGE.

F. UNIT OPERATING REQUIREMENTS:
1. INPUT AC VOLTAGE TOLERANCE: PLUS 10 AND MINUS 10 PERCENT OF VFD INPUT VOLTAGE RATING.
2. INPUT AC VOLTAGE UNBALANCE: NOT EXCEEDING 3 PERCENT.
3. INPUT FREQUENCY TOLERANCE: PLUS OR MINUS 3 PERCENT OF VFD FREQUENCY RATING.
4. MINIMUM EFFICIENCY: 97 PERCENT AT 60 HZ, FULL LOAD.
5. MINIMUM DISPLACEMENT PRIMARY-SIDE POWER FACTOR: 98 PERCENT UNDER ANY LOAD OR SPEED CONDITION.
6. MINIMUM SHORT-CIRCUIT CURRENT (WITHSTAND) RATING: 65 KA.
7. AMBIENT TEMPERATURE RATING: NOT LESS THAN 14 DEG F (MINUS 10 DEG C) AND NOT EXCEEDING 104 DEG F (40 DEG C).
8. AMBIENT STORAGE TEMPERATURE RATING: NOT LESS THAN MINUS 4 DEG F (MINUS 20 DEG C) AND NOT EXCEEDING 140 DEG F (60 DEG C).
9. HUMIDITY RATING: LESS THAN 95 PERCENT (NONCONDENSING).
10. ALTITUDE RATING: NOT EXCEEDING 3300 FEET (1000 M).
11. VIBRATION WITHSTAND: COMPLY WITH IEC 60068-2-6.
12. OVERLOAD CAPABILITY: 1.1 TIMES THE BASE LOAD CURRENT FOR 60 SECONDS; MINIMUM OF 1.5 TIMES OF RATED FLA PEAK.
13. STARTING TORQUE: MINIMUM 100 PERCENT OF RATED TORQUE FROM .5 TO 60 HZ.
14. SPEED REGULATION: PLUS OR MINUS 5 PERCENT.
15. OUTPUT CARRIER FREQUENCY: 1 TO 12.5 KHZ.
16. STOP MODES: PROGRAMMABLE; INCLUDES FAST, FREE-WHEEL, AND DC INJECTION BRAKING.

G. INVERTER LOGIC: MICROPROCESSOR BASED, ISOLATED FROM ALL POWER CIRCUITS.

H. ISOLATED CONTROL INTERFACE: ALLOWS VFD TO FOLLOW REMOTE-CONTROL SIGNAL OVER A MINIMUM 40:1 SPEED RANGE.
1. SIGNAL: ELECTRICAL.

I. INTERNAL ADJUSTABILITY CAPABILITIES:
1. MINIMUM SPEED: 5 TO 25 PERCENT OF MAXIMUM RPM.
2. MAXIMUM SPEED: 80 TO 100 PERCENT OF MAXIMUM RPM.
3. CURRENT LIMIT ADJUSTMENT: 30 TO MINIMUM OF 200 PERCENT OF MAXIMUM RATING.

J. SELF-PROTECTION AND RELIABILITY FEATURES:
1. INPUT TRANSIENT PROTECTION BY MEANS OF SURGE SUPPRESSORS TO PROVIDE THREE-PHASE PROTECTION AGAINST DAMAGE FROM SUPPLY VOLTAGE SURGES 10 PERCENT OR MORE ABOVE NOMINAL LINE VOLTAGE.
2. LOSS OF INPUT SIGNAL PROTECTION: SELECTABLE RESPONSE STRATEGY, INCLUDING SPEED DEFAULT TO A PERCENT OF THE MOST RECENT SPEED, A PRESET SPEED, OR STOP; WITH ALARM.
3. UNDER- AND OVERVOLTAGE TRIPS.
4. INVERTER OVERCURRENT TRIPS.
5. VFD AND MOTOR OVERLOAD/OVERTEMPERATURE PROTECTION: MICROPROCESSOR-BASED THERMAL PROTECTION SYSTEM FOR MONITORING VFDS AND MOTOR THERMAL CHARACTERISTICS, AND FOR PROVIDING VFD OVERTEMPERATURE AND MOTOR OVERLOAD ALARM AND TRIP; SETTINGS SELECTABLE VIA THE KEYPAD; NRTL APPROVED.
6. CRITICAL FREQUENCY REJECTION, WITH THREE SELECTABLE, ADJUSTABLE DEADBANDS.
7. INSTANTANEOUS LINE-TO-LINE AND LINE-TO-GROUND OVERCURRENT TRIPS.
8. LOSS-OF-PHASE PROTECTION.
9. REVERSE-PHASE PROTECTION.
10. SHORT-CIRCUIT PROTECTION.
11. MOTOR OVERTEMPERATURE FAULT.

K. AUTOMATIC RESET/RESTART: ATTEMPT THREE RESTARTS AFTER DRIVE FAULT OR ON RETURN OF POWER AFTER AN INTERRUPTION AND BEFORE SHUTTING DOWN FOR MANUAL RESET OR FAULT CORRECTION; ADJUSTABLE DELAY TIME BETWEEN RESTART ATTEMPTS.

L. POWER-INTERRUPTION PROTECTION: TO PREVENT MOTOR FROM RE-ENERGIZING AFTER A POWER INTERRUPTION UNTIL MOTOR HAS STOPPED, UNLESS "BIDIRECTIONAL AUTOSPEED SEARCH" FEATURE IS AVAILABLE AND ENGAGED.

M. BIDIRECTIONAL AUTOSPEED SEARCH: CAPABLE OF STARTING VFD INTO ROTATING LOADS SPINNING IN EITHER DIRECTION AND RETURNING MOTOR TO SET SPEED IN PROPER DIRECTION, WITHOUT CAUSING DAMAGE TO DRIVE, MOTOR, OR LOAD.

N. TORQUE BOOST: AUTOMATICALLY VARIES STARTING AND CONTINUOUS TORQUE TO AT LEAST 1.5 TIMES THE MINIMUM TORQUE TO ENSURE HIGH-STARTING TORQUE AND INCREASED TORQUE AT SLOW SPEEDS.

O. MOTOR TEMPERATURE COMPENSATION AT SLOW SPEEDS: ADJUSTABLE CURRENT FALL-BACK BASED ON OUTPUT FREQUENCY FOR TEMPERATURE PROTECTION OF SELF-COOLED, FAN-VENTILATED MOTORS AT SLOW SPEEDS.

P. INTEGRAL INPUT DISCONNECTING MEANS AND OCPD: NEMA AB 1, THERMAL-MAGNETIC CIRCUIT BREAKER WITH PAD-LOCKABLE, DOOR-MOUNTED HANDLE MECHANISM.
1. DISCONNECT RATING: NOT LESS THAN 115 PERCENT OF VFD INPUT CURRENT RATING.
2. DISCONNECT RATING: NOT LESS THAN 115 PERCENT OF NFPA 70 MOTOR FULL-LOAD CURRENT RATING OR VFD INPUT CURRENT RATING, WHICHEVER IS LARGER.
3. AUXILIARY CONTACTS: NO/NC, ARRANGED TO ACTIVATE BEFORE SWITCH BLADES OPEN.
4. AUXILIARY CONTACTS "A" AND "B" ARRANGED TO ACTIVATE WITH CIRCUIT-BREAKER HANDLE.
5. NC AND NO ALARM CONTACT THAT OPERATES ONLY WHEN CIRCUIT BREAKER HAS TRIPPED.

2.2 CONTROLS AND INDICATION

A. STATUS LIGHTS: DOOR-MOUNTED LED INDICATORS DISPLAYING THE FOLLOWING CONDITIONS:
1. POWER ON.
2. RUN.
3. OVERVOLTAGE.
4. LINE FAULT.
5. OVERCURRENT.
6. EXTERNAL FAULT.

B. PANEL-MOUNTED OPERATOR STATION: MANUFACTURER'S STANDARD FRONT-ACCESSIBLE, SEALED KEYPAD AND PLAIN-ENGLISH LANGUAGE DIGITAL DISPLAY; ALLOWS COMPLETE PROGRAMMING, PROGRAM COPYING, OPERATING, MONITORING, AND DIAGNOSTIC CAPABILITY.
1. KEYPAD: IN ADDITION TO REQUIRED PROGRAMMING AND CONTROL KEYS, INCLUDE KEYS FOR HAND, OFF, AND AUTO MODES.
2. SECURITY ACCESS: PROVIDE ELECTRONIC SECURITY ACCESS TO CONTROLS THROUGH IDENTIFICATION AND PASSWORD WITH AT LEAST THREE LEVELS OF ACCESS: VIEW ONLY; VIEW AND OPERATE; AND VIEW, OPERATE, AND SERVICE.
a. CONTROL AUTHORITY: SUPPORTS AT LEAST FOUR CONDITIONS: OFF, LOCAL MANUAL CONTROL AT VFD, LOCAL AUTOMATIC CONTROL AT VFD, AND AUTOMATIC CONTROL THROUGH A REMOTE SOURCE.

C. HISTORICAL LOGGING INFORMATION AND DISPLAYS:
1. REAL-TIME CLOCK WITH CURRENT TIME AND DATE.
2. RUNNING LOG OF TOTAL POWER VERSUS TIME.
3. TOTAL RUN TIME.
4. FAULT LOG, MAINTAINING LAST FOUR FAULTS WITH TIME AND DATE STAMP FOR EACH.

D. INDICATING DEVICES: DIGITAL DISPLAY AND ADDITIONAL READOUT DEVICES AS REQUIRED, MOUNTED FLUSH IN VFD DOOR AND CONNECTED TO DISPLAY VFD PARAMETERS INCLUDING, BUT NOT LIMITED TO:
1. OUTPUT FREQUENCY (HZ).
2. MOTOR SPEED (RPM).
3. MOTOR STATUS (RUNNING, STOP, FAULT).
4. MOTOR CURRENT (AMPERES).
5. MOTOR TORQUE (PERCENT).
6. FAULT OR ALARMING STATUS (CODE).
7. PID FEEDBACK SIGNAL (PERCENT).

2. VFD SHALL INCLUDE ONE FORM "C" FAULT CONTACT, TWO PROGRAMMABLE MAINTENANCE FORM "A" CONTACTS, AND ONE PROGRAMMABLE FORM "C" CONTACT. THESE OUTPUT RELAY CONTACTS SHALL ALL BE RATED FOR 5A AT 250 VAC AND SHALL BE PROGRAMMED FOR, BUT NOT LIMITED TO:

a. SPEED ABOVE
b. SPEED EXCEED
c. SERVE READY
d. SERVICE RUN
e. UNDERLOAD SELECTION

F. PID CONTROL INTERFACE: PROVIDES CLOSED-LOOP SET POINT, DIFFERENTIAL FEEDBACK CONTROL IN RESPONSE TO DUAL FEEDBACK SIGNALS. ALLOWS FOR CLOSED-LOOP CONTROL OF FANS AND PUMPS FOR PRESSURE, FLOW, OR TEMPERATURE REGULATION.

1. NUMBER OF LOOPS: TWO.

G. BAS INTERFACE: FACTORY-INSTALLED HARDWARE AND SOFTWARE TO ENABLE THE BAS TO MONITOR, CONTROL, AND DISPLAY VFD STATUS AND ALARMS. ALLOWS VFD TO BE USED WITH AN EXTERNAL SYSTEM WITHIN A MAJORITY (AS CONFIGURATION SETTINGS REMAIN WITHIN VFD'S MANUFACTURE MEMORY.

1. NETWORK COMMUNICATIONS PORTS: ETHERNET AND RS-422/485.
2. EMBEDDED BAS PROTOCOLS FOR NETWORK COMMUNICATIONS: ASHRAE 135 BACNET AND JOHNSON METASYS N2 MODBUS/MEMOBUS SEMENS SYSTEM DXR APOGEE PROTOCOLS ACCESSIBLE VIA THE COMMUNICATIONS PORTS. COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT COMMUNICATION PROTOCOL PRIOR TO PROVIDING BIC SUBMITTAL.

2.3 LINE CONDITIONING AND FILTERING

A. INPUT LINE CONDITIONING: BASED ON THE HARMONIC ANALYSIS STUDY AND REPORT, PROVIDE INPUT FILTERING, AS REQUIRED, TO LIMIT THD AND THD(V) AT THE DEFINED POC PER IEEE 519.
B. INPUT LINE CONDITIONING: 3% REACTOR.
C. OUTPUT FILTERING: 3% DC DCS FILTER FOR 30 HP AND LARGER.
D. EMI/RFI FILTERING: CE MARKED; COMPLY COMPLIANCE WITH IEC 61800-3 FOR CATEGORY C2.
E. AC LOAD LINE REACTOR: PROVIDE DC LINE REACTOR WHERE MOTOR LEAD LENGTH EXCEEDS 50 FEET.

2.4 BYPASS SYSTEMS

A. BYPASS OPERATION: SAFELY TRANSFERS MOTOR BETWEEN POWER CONVERTER OUTPUT AND BYPASS CIRCUIT, MANUALLY, AUTOMATICALLY, OR LOCAL. SELECTOR SWITCHES (KEY MODES AND INDICATOR LIGHTS) INDICATE MODE SELECTED. UNIT IS CAPABLE OF STABLE OPERATION (STARTING, STOPPING, AND RUNNING) WITH MOTOR COMPLETELY DISCONNECTED FROM POWER CONVERTER.
B. BYPASS MODES: (MANUAL OPERATION) EACH FEATURES LOCAL OPERATING SELECTION AT VFD. TRANSFER BETWEEN POWER CONVERTER AND BYPASS CONTACTOR AND MOTOR STARTER SHALL THAT BE ALLOWED WITH THE MOTOR AT ZERO SPEED.
C. BYPASS CONTROLLER: THREE-CONTACTOR-STYLE BYPASS ALLOWS MOTOR OPERATION VIA THE POWER CONVERTER OR THE BYPASS CONTROLLER WITH INPUT ISOLATING SWITCH AND BYPASS ARRANGED TO ISOLATE THE POWER CONVERTER INPUT AND OUTPUT AND PERMIT SAFE TESTING AND TROUBLESHOOTING OF THE POWER CONVERTER, BOTH ENERGIZED AND DE-ENERGIZED, WHILE MOTOR IS OPERATING IN BYPASS MODE.

1. BYPASS CONTACTOR: LOAD-RATED, NEMA-RATED CONTACTOR.
2. INPUT AND OUTPUT ISOLATING CONTACTORS: NON-LOAD-BREAK, NEMA-RATED CONTACTORS.
3. ISOLATING SWITCH: NON-LOAD-BREAK SWITCH ARRANGED TO ISOLATE POWER CONVERTER AND PERMIT SAFE TROUBLESHOOTING AND TESTING OF THE POWER CONVERTER, BOTH ENERGIZED AND DE-ENERGIZED. WHILE MOTOR IS OPERATING IN BYPASS MODE. FAD-LOCKABLE, DOOR-MOUNTED HANDLE MECHANISM.

F. BYPASS CONTACTOR CONFIGURATION: REDUCED-VOLTAGE (AUTOTRANSFORMER) TYPE.

1. NORMAL/BYPASS SELECTOR SWITCH.
2. HAND/OFF/AUTO SELECTOR SWITCH.
3. NORMAL/TEST SELECTOR SWITCH: ALLOWS TESTING AND ADJUSTING OF VFD WHILE THE MOTOR IS RUNNING IN THE BYPASS MODE.
4. CONTACTOR COILS: PRESSURE-ENCAPSULATED TYPE WITH COIL TRANSIENT SUPPRESSORS.

a. OPERATING VOLTAGE: DEPENDING ON CONTACTOR NEMA SIZE AND LINE-VOLTAGE RATING. MANUFACTURER'S STANDARD MATCHING CONTROL POWER BY LINE VOLTAGE.
b. POWER CONTACTS: TOTALLY ENCLOSED, DOUBLE BREAK, AND SILVER-CADMIUM OXIDE; ARRANGED TO ALLOW INSPECTION AND REPLACEMENT WITHOUT DISTURBING LINE OR LOAD WIRING.

5. CONTROL CIRCUITS: 120-V AC; DERIVED FROM INTERNAL CPT, WITH PRIMARY AND SECONDARY FUSES, OF SUFFICIENT CAPACITY TO OPERATE ALL INTERNAL DEVICES AND REMOTELY LOCATED PILOT, INDICATING, AND CONTROL DEVICES.

a. CPT SPARE CAPACITY: 200 VA.

6. OVERLOAD RELAYS: NEMA ICS 2.

a. MECHANICAL-ALLOY OVERLOAD RELAYS:

1) INVERSE-TIME-CURRENT CHARACTERISTIC.
2) CLASS 10, 20 OR 30 PROGRAMMABLE TRIPPING CHARACTERISTICS.
3) HEATERS IN EACH PHASE MATCHED TO MANUFACTURE FULL-LOAD CURRENT OF ACTUAL PROTECTED MOTOR AND WITH APPROPRIATE ADJUSTMENT FOR DUTY CYCLE.

b. MANUFACTURED OVERLOAD RELAYS:

1) INVERSE-TIME-CURRENT CHARACTERISTIC.
2) CLASS 10, 20 OR 30 PROGRAMMABLE TRIPPING CHARACTERISTIC.
3) HEATERS IN EACH PHASE MATCHED TO MANUFACTURE FULL-LOAD CURRENT OF ACTUAL PROTECTED MOTOR AND WITH APPROPRIATE ADJUSTMENT FOR DUTY CYCLE.
4) AMBIENT COMPENSATED.
5) AUTOMATIC RESETTING.

c. SOLID-STATE OVERLOAD RELAYS:

1) SWITCH OR DIAL SELECTABLE FOR MOTOR-RUNNING OVERLOAD PROTECTION.
2) SENSORS IN EACH PHASE.
3) CLASS 10, 20 OR 30 PROGRAMMABLE TRIPPING CHARACTERISTIC.
4) CLASS II GROUND-FAULT PROTECTION, WITH START AND RUN DELAYS TO PREVENT NUISANCE TRIP ON STARTING.
5) ANALOG COMMUNICATION MODULE.

d. NO AND NC ISOLATED OVERLOAD ALARM CONTACT.
e. EXTERNAL OVERLOAD RESET PUSH BUTTON.

2.5 OPTIONAL FEATURES

A. REMOTE MONITORING CIRCUIT TERMINALS: MODE SELECTION, CONTROLLER STATUS, AND CONTROLLER FAULT.
B. COMMUNICATION PORT: RS-232 PORT, USB 2.0 PORT, OR EQUIVALENT CONNECTION CAPABLE OF CONNECTING A PRINTER AND A NOTEBOOK COMPUTER.

2.6 ENCLOSURES

A. VFD ENCLOSURES: NEMA 250, TO COMPLY WITH ENVIRONMENTAL CONDITIONS AT INSTALLED LOCATION.

1. OUTDOOR LOCATIONS: TYPE 4X.
2. OTHER WET OR DAMP OR CORROSIVE INDOOR LOCATIONS: TYPE 4X.
3. KITCHENS: TYPE 4X.
4. INDOOR DRY, NON-CORROSIVE LOCATIONS: TYPE 12.

B. FUSEBOX RATING: UL 1995; NRTL CERTIFICATION LABEL ON ENCLOSURE; CLEARLY IDENTIFYING VFD AS "FUSEBOX RATED."

2.7 ACCESSORIES

A. GENERAL REQUIREMENTS FOR CONTROL-CIRCUIT AND PILOT DEVICES: NEMA ICS 5; FACTORY INSTALLED IN VFD ENCLOSURE COVER UNLESS OTHERWISE INDICATED.

1. PUSH BUTTONS, PILOT LIGHTS, AND SELECTOR SWITCHES: HEAVY-DUTY, RUGGED TYPE.

a. PUSH BUTTONS: CONVEXED TYPE.
b. PILOT LIGHTS: LED TYPE; RED FLASHING, GREEN ENERGIZED PUSH TO TEST.
c. STOP AND LOCKOUT PUSH-BUTTON STATIONS: MOMENTARY-BREAK, PUSH-BUTTON STATION WITH A FACTORY-APPLIED HASP ARRANGED SO PADLOCK CAN BE USED TO LOCK PUSH BUTTON IN DEPRESSED POSITION WITH CONTROL CIRCUIT OPEN.

B. REVERSIBLE MOTOR BYPASS CONTACTOR AUXILIARY CONTACTS.
C. CONTROL RELAYS: AUXILIARY AND ADJUSTABLE SOLID-STATE TIME-DELAY RELAYS.
D. PHASE-FAILURE, PHASE-REVERSAL, AND UNDERVOLTAGE AND OVERVOLTAGE RELAYS: SOLID-STATE SENSING CIRCUIT WITH ISOLATED OUTPUT CONTACTS FOR HARD-WIRED CONNECTIONS. PROVIDE ADJUSTABLE UNDERVOLTAGE, OVERVOLTAGE, AND TIME-DELAY SETTINGS.

1. CURRENT TRANSFORMERS: CONTINUOUS CURRENT RATING, BASIC IMPULSE INSULATING LEVEL (BIL) RATING, DURABLE, AND ACCURACY CLASS SUITABLE FOR CONNECTED CIRCUITS. COMPLY WITH IEEE C57.13.

E. SUPPLEMENTAL DIGITAL METERS:

1. STANDARD-TIME METER.
2. KILOWATT METER.
3. KILOWATT-HOUR METER.

F. DEHUMIDIFY AND DRAIN ASSEMBLIES, TO MAINTAIN INTERNAL PRESSURE AND REDUCE CONDENSATION IN NEMA 250, TYPE 4X ENCLOSURES INSTALLED OUTDOORS OR IN UNCONDITIONED INTERIOR SPACES SUBJECT TO HUMIDITY AND TEMPERATURE SWINGS.
G. SPACE HEATERS, WITH NO AUXILIARY CONTACTS, TO MITIGATE CONDENSATION IN NEMA 250, TYPE 4X ENCLOSURES INSTALLED OUTDOORS OR IN UNCONDITIONED INTERIOR SPACES SUBJECT TO HUMIDITY AND TEMPERATURE SWINGS.
H. COOLING FAN AND EXHAUST SYSTEM: FOR NEMA 250, TYPE 12; UL 508 COMPONENT RECOGNIZED; SUPPLY TRAY WITH STAINLESS STEEL MESH; AND EXHAUST GRILLS AND FILTERS; 120-V AC ENERGIZED FROM INTERNAL CPT.
I. SUN SHIELDS INSTALLED ON ROOFS, SIDES, AND TOPS OF ENCLOSURES INSTALLED OUTDOORS AND SUBJECT TO DIRECT AND EXTENDED SUN EXPOSURE.
J. SPARE CONTROL-WIRING TERMINAL BLOCKS: SERIES.

2.8 SOURCE QUALITY CONTROL

A. TESTING: TEST AND INSPECT VFDS ACCORDING TO REQUIREMENTS IN NEMA ICS 61800-2.

1. TEST EACH VFD WHILE CONNECTED TO ITS SPECIFIED MOTOR A MOTOR THAT IS COMPARABLE TO THAT FOR WHICH THE VFD IS RATED.
2. VERIFICATION OF PERFORMANCE: RATE VFDS ACCORDING TO OPERATION OF FUNCTIONS AND FEATURES SPECIFIED.

B. VFDS WILL BE CONSIDERED DEFECTIVE IF THEY DO NOT PASS TESTS AND INSPECTIONS.
C. PROVIDE TEST AND INSPECTION REPORTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. EXAMINE AREAS, SURFACES, AND SUBSTRATES TO RECEIVE VFDS, WITH INSTALLER PRESENT, FOR COMPLIANCE WITH REQUIREMENTS FOR INSTALLATION TOLERANCES, AND OTHER CONDITIONS AFFECTING PERFORMANCE.
B. EXAMINE VFD BEFORE INSTALLATION. REJECT VFDS THAT ARE WET, MOISTURE DAMAGED, OR MOLD DAMAGED.
C. EXAMINE ROUGHING-IN FOR CONDUIT SYSTEM TO VERIFY ACTUAL LOCATIONS OF CONDUIT CONNECTIONS BEFORE VFD INSTALLATION.
D. PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 HARMONIC ANALYSIS STUDY

A. PERFORM A HARMONIC ANALYSIS STUDY TO IDENTIFY THE EFFECTS OF NONLINEAR LOADS AND THEIR ASSOCIATED HARMONIC CONTRIBUTIONS ON THE VOLTAGES AND CURRENTS THROUGHOUT THE ELECTRICAL SYSTEM. ANALYZE POSSIBLE OPERATING DEMANDS, INCLUDING RECOMMENDATIONS FOR VFD INPUT FILTERING TO LIMIT THD AND THD(V) AT EACH VFD AT THE DEFINED POC TO SPECIFIED LIMITS.
B. PREPARE A HARMONIC ANALYSIS STUDY AND REPORT COMPLYING WITH IEEE 519 AND NCPA ACCEPTANCE TESTING SPECIFICATION.

3.3 INSTALLATION

A. COORDINATE LAYOUT AND INSTALLATION OF VFDS WITH OTHER CONSTRUCTION INCLUDING CONDUIT, PIPING, EQUIPMENT, AND ADJACENT SURFACES. MAINTAIN REQUIRED WORKSPACE CLEARANCES AND REQUIRED CLEARANCES FOR EQUIPMENT ACCESS DOORS AND PANELS.

1. WALL-MOUNTING CONTROLLERS ON FLOOR-MOUNTED ENCLOSURE RACK: INSTALL VFDS ON FLOOR-MOUNTED ENCLOSURE WITH TOPS AT UNIFORM HEIGHT AND WITH DISCONNECT OPERATING HANDLES NOT HIGHER THAN 79 INCHES (2000 MM) ABOVE FINISHED FLOOR UNLESS OTHERWISE INDICATED, AND BY SECTIONS SIMILAR TO UNIFORM. INSTALL DUMMY BLOCKS TO CONCEAL CONDUIT ENTRANCE HOLES TO CONCRETE FLOOR. UNLESS OTHERWISE INDICATED, INSTALL DUMMY BLOCKS ON 18-INCH (450-MM) CENTERS AROUND THE FULL PERIMETER OF CONCRETE BASE.
4. FOR SUPPORTED EQUIPMENT, INSTALL EPOXY-COATED ANCHOR BOLTS THAT EXTEND THROUGH CONCRETE BASE AND ANCHOR INTO STRUCTURAL CONCRETE FLOOR.
5. PLACE AND SECURE ANCHORAGE DEVICES. USE SETTING DRAWINGS, TEMPLATES, DIAGRAMS, INSTRUCTIONS, AND DIRECTIONS FURNISHED WITH ITEMS TO BE EMBEDDED.
6. INSTALL ANCHOR BOLTS TO ELEVATIONS REQUIRED FOR PROPER ATTACHMENT TO SUPPORTED EQUIPMENT.

B. SEISMIC ANCHORS: COMPLY WITH RECOMMENDATIONS SPECIFIED IN DIVISION 26 SECTION "VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS."
E. TEMPORARY LIFTING PROVISIONS: REMOVE TEMPORARY LIFTING EYES, CHANNELS, AND BRACKETS AND TEMPORARY BLOCKING OF MOVING PARTS FROM ENCLOSURES AND COMPONENTS.
F. INSTALL FUSES IN EACH FUSEBOX-SWITCH VFD.
G. INSTALL FUSES IN CONTROL CIRCUITS IF NOT FACTORY INSTALLED. COMPLY WITH RECOMMENDATIONS IN DIVISION 26 SECTION "FUSES."
H. INSTALL HEATERS IN THERMAL-OVERLOAD RELAYS. SELECT HEATERS BASED ON ACTUAL NAMEPLATE FULL-LOAD AMPERES AFTER MOTORS HAVE BEEN INSTALLED.
I. INSTALL, CONNECT, AND PLACE THERMAL-PROTECTOR MONITORING RELAYS FURNISHED WITH MOTOR-DRIVEN COMPONENT.
J. COMPLY WITH NEMA 1.

3.4 IDENTIFICATION

A. IDENTIFY VFDS, COMPONENTS, AND CONTROL WIRING. COMPLY WITH REQUIREMENTS FOR IDENTIFICATION SPECIFIED IN DIVISION 26 SECTION "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

1. IDENTIFY FIELD-INSTALLED CONDUCTORS, INTERCONNECTING WIRING, AND COMPONENTS; PROVIDE WARNING SIGNS.
2. LABEL EACH VFD WITH ENGRAVED NAMEPLATE.
3. LABEL EACH ENCLOSURE-MOUNTED CONTROL AND PILOT DEVICE.

B. OPERATING INSTRUCTIONS: FRAME PRINTED OPERATING INSTRUCTIONS FOR VFDS, INCLUDING CONTROL SEQUENCES AND EMERGENCY PROCEDURES. INDICATE FRAME OF FINISHED METAL AND COVER INSTRUCTIONS WITH CLEAR ACRYLIC PLASTIC. MOUNT ON FRONT OF VFD UNITS.

3.5 CONTROL WIRING INSTALLATION

A. INSTALL WIRING BETWEEN VFDS AND REMOTE AUXILIARY CONTACTS WITHIN DISCONNECT SWITCHES.
B. BUNDLE, TRAIN, AND SUPPORT WIRING IN ENCLOSURES.
C. CONNECT SELECTOR SWITCHES AND OTHER AUTOMATIC CONTROL DEVICES WHERE APPROVED.

1. CONNECT SELECTOR SWITCHES TO BYPASS ONLY THOSE MANUAL- AND AUTOMATIC CONTROL DEVICES THAT HAVE NO SAFETY FUNCTIONS WHEN SWITCHES ARE IN MANUAL-CONTROL POSITION.
2. CONNECT SELECTOR SWITCHES WITH CONTROL CIRCUIT IN BOTH MANUAL AND AUTOMATIC POSITIONS FOR SAFETY-TYPE CONTROL DEVICES SUCH AS LOW- AND HIGH-PRESSURE CUTOUTS, HIGH-TEMPERATURE CUTOUTS, AND MOTOR OVERLOAD PROTECTORS.

3.6 FIELD QUALITY CONTROL

A. MANUFACTURER'S FIELD SERVICES: ENGAGE A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO INSPECT, TEST, AND ADJUST COMPONENTS, ASSEMBLIES, AND EQUIPMENT INSTALLATIONS, INCLUDING CONNECTIONS.
B. PERFORM TESTS AND INSPECTIONS.

1. MANUFACTURER'S FIELD SERVICES: ENGAGE A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO INSPECT COMPONENTS, ASSEMBLIES, AND EQUIPMENT INSTALLATIONS, INCLUDING CONNECTIONS, AND TO ASSIST IN TESTING.

C. ACCEPTANCE TESTING PREPARATION:

1. TEST INSULATION RESISTANCE FOR EACH VFD CIRCUIT, BUS, COMPONENT, CONNECTING SUPPLY, FEEDER, AND CONTROL CIRCUIT.
2. TEST CONTINUITY OF EACH CIRCUIT.

D. TESTS AND INSPECTIONS:

1. INSPECT VFD, WIRING, COMPONENTS, CONNECTIONS, AND EQUIPMENT INSTALLATION. TEST AND ADJUST CONTROLLERS, COMPONENTS, AND EQUIPMENT.
2. TEST INSULATION RESISTANCE FOR EACH VFD CIRCUIT, COMPONENT, CONNECTED MOTOR SUPPLY, FEEDER, AND CONTROL CIRCUITS.
3. TEST CONTINUITY OF EACH CIRCUIT.
4. VERIFY THAT VOLTAGES AT VFD LOCATIONS ARE WITHIN 10 PERCENT OF MOTOR NAMEPLATE RATED VOLTAGES. IF OUTSIDE THIS RANGE FOR ANY MOTOR, NOTIFY CONSTRUCTION MANAGER AND MECHANICAL CONTRACTOR BEFORE STARTING THE EQUIPMENT.
5. TEST EACH MOTOR FOR PROPER PHASE ROTATION.
6. PERFORM EACH ELECTRICAL TEST AND VISUAL AND MECHANICAL INSPECTION STATED IN NCPA ACCEPTANCE TESTING SPECIFICATION. VERIFY COMPLIANCE WITH TEST PARAMETERS.
7. CORRECT MALFUNCTIONING UNITS ON-SITE, WHERE POSSIBLE, AND RETEST TO DEMONSTRATE COMPLIANCE; OTHERWISE, REPLACE WITH NEW UNITS AND RETEST.
8. PERFORM THE FOLLOWING INFRARED (THERMOGRAPHIC) SCAN TESTS AND INSPECTIONS AND PREPARE REPORTS:

a. INITIAL INFRARED SCANNING: AFTER SUBSTANTIAL COMPLETION, BUT NOT MORE THAN 60 DAYS AFTER FINAL ACCEPTANCE, PERFORM AN INFRARED SCAN OF EACH VFD. REMOVE FRONT PANELS SO JOINTS AND CONNECTIONS ARE ACCESSIBLE TO PORTABLE SCANNER.
b. FOLLOW-UP INFRARED SCANNING: PERFORM AN ADDITIONAL FOLLOW-UP INFRARED SCAN OF EACH VFD 11 MONTHS AFTER DATE OF SUBSTANTIAL COMPLETION.
c. INSTRUMENTS AND COMPONENTS: USE AN INFRARED SCANNING DEVICE DESIGNED TO measure TEMPERATURE OR TO DETECT SIGNIFICANT DEVIATIONS FROM NORMAL VALUES. PROVIDE CALIBRATION RECORDS FOR DEVICE.

9. TEST AND ADJUST CONTROLS, REMOTE MONITORING, AND SAFETIES. REPLACE DAMAGED AND MALFUNCTIONING CONTROLS AND COMPONENTS.

E. VFDS WILL BE CONSIDERED DEFECTIVE IF THEY DO NOT PASS TESTS AND INSPECTIONS.
F. PROVIDE TEST AND INSPECTION REPORTS, INCLUDING A CERTIFIED REPORT THAT IDENTIFIES THE VFD AND DESCRIBES SCANNING RESULTS. INCLUDE NATURE OF DEFICIENCIES DETECTED, REMEDIAL ACTION TAKEN, AND OBSERVATIONS MADE AFTER REMEDIAL ACTION.

3.7 STARTUP SERVICE

A. ENGAGE A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO PERFORM STARTUP SERVICE.

1. COMPLETE INSTALLATION AND STARTUP CHECKS ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.

3.8 ADJUSTING

A. PROGRAM MICROPROCESSORS FOR REQUIRED OPERational SEQUENCES, STATUS MONITORING, ALARMS, EVENT RECORDING, AND DISPLAY FEATURES. CLEAR EVENTS MEMORY AFTER FINAL ACCEPTANCE TESTING AND PRIOR TO SUBSTANTIAL COMPLETION.
B. SET FIELD-ADJUSTABLE SWITCHES, AUXILIARY RELAYS, TIME-DELAY RELAYS, TIMERS, AND OVERLOAD-RELAY PICKUP AND TRIP RANGES.
C. ADJUST THE TRIP SETTINGS OF MCPS AND THERMAL-MAGNETIC CIRCUIT BREAKERS WITH ADJUSTABLE, INSTANTANEOUS TRIP ELEMENTS. INITIALLY ADJUST TO SIX TIMES THE MOTOR NAMEPLATE FULL-LOAD AMPERES AND TRY TO START MOTORS SEVERAL TIMES, ALLOWING FOR MOTOR COOL-DOWN BETWEEN STARTS. IF TRIPPING OCCURS ON MOTOR INRUSH, ADJUST SETTINGS IN INCREMENTS UNTIL MOTORS START WITHOUT TRIPPING. DO NOT EXCEED EIGHT TIMES THE MOTOR FULL-LOAD AMPERES (SIX TIMES FOR NEMA PREMIUM EFFICIENCY MOTORS IF REQUIRED). WHERE THESE MAXIMUM SETTINGS DO NOT ALLOW STARTING OF A MOTOR, NOTIFY CONSTRUCTION MANAGER AND ENGINEER BEFORE INCREASING SETTINGS.
D. SET THE TAPS ON REDUCED-VOLTAGE, AUTOTRANSFORMER CONTROLLERS.
E. SET FIELD-ADJUSTABLE CIRCUIT-BREAKER TRIP RANGES AS SPECIFIED IN DIVISION 26 SECTION "OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY."
F. SET FIELD-ADJUSTABLE PRESSURE SWITCHES.

3.9 PROTECTION

A. TEMPORARY HEATING: APPLY TEMPORARY HEAT TO MAINTAIN TEMPERATURE ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS UNTIL CONTROLLERS ARE READY TO BE ENERGIZED AND PLACED INTO SERVICE.
B. REPLACE VFDS WHOSE INTERIORS HAVE BEEN EXPOSED TO WATER OR OTHER LIQUIDS PRIOR TO SUBSTANTIAL COMPLETION.

3.10 DEMONSTRATION

A. ENGAGE A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO TRAIN OWNER'S MAINTENANCE PERSONNEL TO ADJUST, OPERATE, INTERROGATE, AND MAINTAIN VFDS.

END OF SECTION 26 2913

END OF SPECIFICATION

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Outline:

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