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## ONE AND THREE LINE DIAGRAM SYMBOLS

- BUS (THICK LINE, WT=5, LC=0, SEE NOTES, TYPICAL).
- BUS DUCT (THICK WEIGHT BUS, WT=3, DUCT WT=1, LC=0).
- POWER CONDUCTOR (MEDIUM LINE, WT=3, LC=0).
- ELECTRICAL CONTROL, METER, OR SIGNAL CIRCUIT (THIN LINE, WT=1).
- MECHANICAL CONTROL, OPERATOR, OR INTERLOCK (1/8" DASHES, THIN, WT=1, LC=3).
- FUTURE (1/16 INCH DASHES, THIN LINE, WT=1, LC=5).
- ENCLOSURE BOUNDARY (THIN LINE, WT=1, LC=4).
- AREA OR JURISDICTION BOUNDARY (MEDIUM LINE, WT=3, LC=6).
- CROSSING OF CONDUCTOR, NOT CONNECTED.
- CONNECTION OF CONDUCTORS (1/8 INCH SPOT).
- CABLE TERMINATION WITH STRESS RELIEF (3/16 INCH EQUILATERAL).
- CONTACT, NORMALLY OPEN (N.O.) (1/4 INCH LINES, TYPICAL).
- CONTACT, NORMALLY CLOSED (N.C.).
- SEPARABLE OR DRAWOUT CONNECTOR (1/8 INCH CHEVRON).
- SWITCH (NO CONTACT CIRCLES, (1/4 INCH OPENING).
  U.A. = UNDER ARM. N/F= NON-FUSIBLE
- FUSED DISCONNECT SWITCH
- MAGNETIC ELEMENT (3/16 INCH QUARTER-WAVE).
- THERMAL OVERLOAD RELAY-1, 2, 3,...ETC INDICATES NEMA SIZE, UL LISTED. (3/16 INCH HALF CIRCLES).
- HEATER OR THERMAL ELEMENT (3/16 INCH). 1, 2, 3,...ETC INDICATES NEMA SIZE, UL LISTED.
- DIODE (1/8 INCH LINE AND EQUILATERAL).
- THYRISTOR (1/8 INCH LINE AND EQUILATERAL).
- IN LINE CONDUCTOR CURRENT LIMITING CABLE PROTECTOR (1/8 INCH LINE AND EQUILATERAL).
- C1 — CAPACITOR (1/4 INCH LINES). C1, 2, 3...=CAPACITOR NUMBER.
- LIGHTNING OR SURGE ARRESTOR (1/8 INCH SPOTS). IDENTIFY EACH ITEM BY TYPE ON THE DIAGRAM.
- PROTECTIVE GAP (1/8 INCH EQUILATERAL TRIANGLES).
- BATTERY (1/4 AND 1/8 INCH LINES).
- INDUCTOR OR REACTOR (1/8 INCH SCALLOPS).
- R1 — RESISTOR (3/16 X 3/8 INCH RECTANGLE). R1, 2, 3...=RESISTOR NUMBER.
- ADJUSTABLE OR VARIABLE FUNCTION.
- FUSIBLE LINK (3/16 X 3/8 INCH HALF WAVE).
- CARTRIDGE FUSE (3/16 X 3/8 INCH RECTANGLE).
  A = ALARM CONTACT.
  CL = CURRENT LIMITING.
  I = INDICATING.
- MOLDED CASE CIRCUIT BREAKER, INCLUDING THERMAL AND MAGNETIC OVERLOAD DEVICES PER SPECIFICATIONS. (3/8 INCH ARC).
  3 POLE UNLESS SHOWN 1P OR 2P.
  N.O. — 600AF 400AT (K)
  AF = AMPERE FRAME RATING.
  AT = AMPERE CONTINUOUS CURRENT RATING OR SETTING OF TRIP ELEMENT.
  E = ELECTRIC OPERATED.
  1P = SINGLE POLE.
  K = KEY INTERLOCKED.
  M = MOTOR OPERATED.
  MCS = MOLDED CASE SWITCH.
  MCP = MOTOR CIRCUIT PROTECTOR.
  N.C. = NORMALLY CLOSED.
  N.O. = NORMALLY OPEN.
  ST = SHUNT TRIP.
  2P = TWO POLE.
- AIR CIRCUIT BREAKER WITH CT.
  SST W LT/ST
  AS = AMP SENSOR.
  GS = GROUND SENSOR.
  LT = LONG TIME.
  SSST = SOLID STATE TRIP.
  ST = SHORT TIME.
  W = WITH.
- POWER CIRCUIT BREAKER WITH FRAME AMPERE RATING AND SHORT CIRCUIT DUTY (3/8 INCH SQUARE).
  52 — 1200 AF 500 MVA (E)
  G = SF6 GAS.
  O = OIL.
  V = VACUUM.
  52 = DEVICE 52 (TYP).
- 300/5 / 3 — PHASE CURRENT INSTRUMENT TRANSFORMER (CT) INDICATING TURNS RATIO AND QUANTITY. BLACK SQUARES INDICATE POLARITY MARKS. MARKS PER ANSI/IEEE STD 242-1986 (1/8 INCH HALF CIRCLES, TYPICAL).
- 50/5 / 1 — GROUND OR ZERO SEQUENCE CURRENT TRANSFORMER (CT) INDICATING TURNS RATIO AND QUANTITY.
- 3A — 8A — INSTRUMENT POTENTIAL TRANSFORMER (PT) (3/16 X 3/8 INCH RECTANGLE).
- 480-120 — GROUND CONNECTION (1/16 INCH SPOT, 1/4, 3/16 & 1/16 INCH LINES).
- MAGNETIC MOTOR STARTER, 1, 2, 3... = STARTER NEMA SIZE
- THERMAL OVERLOAD ELEMENTS
- MAGNETIC CONTACTOR, 1, 2, 3... = CONTACTOR NEMA SIZE
- AS — ADJUSTABLE SPEED DRIVER

## REFERENCE DRAWINGS

| | |
|---|---|
| LA-E-003 | SCHEMATIC & WIRING SYMBOLS |
| LA-E-002 | STANDARD PLAN SYMBOLS |
| LA-E-001 | ABBREVIATIONS & ACRONYMS |

## ONE AND THREE LINE DIAGRAM SYMBOLS

- STEP-UP 1000/1250 KVA OA/FA AT 55°C 13.8 KV-480Y/277 V 3 ø, 4W, 60 HZ, BIL 2 95-30 KV BIL
  POWER TRANSFORMER. DUAL RATING SHOWN TO MATCH COOLING TYPE. TRANSFORMER SHALL BE STEP-DOWN UNIT SUBSTATION TYPE UNLESS IDENTIFIED STEP-UP, AUTO-TRANSFORMER, CONSTANT CURRENT, CONSTANT VOLTAGE, LOAD TAP CHANGING, REGULATING, PHASE SHIFT, FURNACE, RECTIFIER, SCOTT, T-CONNECTED, GROUNDING, POLE-TYPE, PAD-MOUNTED, STATION TYPE, SUBMERSIBLE, SUBWAY, DIRECT BURIED, OR NETWORK TYPE. NEUTRAL CONNECTIONS SHALL BE SHOWN FROM CENTER TAP OF WINDING. ADDATIVE POLARITY UNLESS SHOWN OTHERWISE.

AA = AIR ASPIRATED, (VENTILATED SELF COOLED DRY TYPE).
AFA = VENTILATED FORCED AIR COOLED DRY TYPE
ANV = NONVENTILATED SELF COOLED DRY TYPE.
BIL = BASIC IMPULSE INSULATION LEVEL.
FA = FORCED AIR COOLING.
FFA = FUTURE FORCED AIR COOLING.
FFO = FUTURE FORCED OIL COOLING.
FOA = FORCED OIL COOLING WITH FORCED AIR.
FOW = OIL IMMERSED FORCED WATER COOLED.
GA = SEALED SELF COOLED DRY TYPE.
IG = INERT GAS.
OA = OIL IMMERSED SELF COOLED.
OW = OIL TO WATER COOLING.
OW/A= OIL IMMERSED WATER COOLED BY AIR CONVECTION.
Δ = DELTA CONNECTION.
Y = WYE CONNECTION. STANDARD 30 DEGREE SHIFT SHOWN. PHASE TO PHASE WITH SOLID GROUND.
Y = WYE CONNECTION WITH NEUTRAL RESISTOR.
HZ = HERTZ.
/ = AND (BOTH AVAILABLE WITHOUT RECONNECTION).
- = TO (FROM ONE TO THE OTHER).
X = EITHER AVAILABLE AFTER RECONNECTION.
ø = PHASE.
CPT = CONTROL POWER TRANSFORMER.
= PAD MOUNT TYPE.

- 500 — ROTATING EQUIPMENT (1/2 INCH CIRCLE):
  NUMBER = HORSEPOWER (HP) OF MOTOR.
  2S = 2 SPEED.
  1W = SINGLE WINDING WITH TAPS.
  2W = 2 WINDINGS.
  M = MOTOR.
  G = GENERATOR.
  S = SYNCHRONOUS.
  X'd =DIRECT AXIS TRANSIENT REACTANCE, SATURATED VALUE.
  X"d =DIRECT AXIS SUBTRANSIENT REACTANCE, SATURATED VALUE.
- A — INDICATING LIGHT (1/4 INCH CIRCLE, 1/8 INCH RAYS).
  A = AMBER.
  B = BLUE.
  C = CLEAR.
  G = GREEN = SWITCH OR CONTACT CLOSED.
  O = ORANGE.
  R = RED = SWITCH OR CONTACT OPEN.
  W = WHITE.
- A — METER (3/8 INCH CIRCLE). NUMBER INCICATES QUANTITY.
  A = AMPERE.
  AH = AMPERE-HOUR.
  D = DEMAND ATTACHMENT.
  ET = ELAPSED TIME.
  F = FREQUENCY.
  GD = GROUND DETECTOR.
  K = KILO PREFIX.
  M = MEGA PREFIX.
  O = OHM.
  PF = POWER FACTOR.
  PH = PHASE ANGLE.
  R = RECORDING.
  SY = SYNCHROSCOPE.
  T = TOTALIZING.
  TT = TOTAL TIME.
  V = VOLT.
  VA = VOLT AMPERES.
  VAR = VOLT AMPERES REACTIVE.
  W = WATT.
  WH = WATT HOUR.
- IDENTIFIED EQUIPMENT OR CIRCUIT BREAKER PANEL BOARD. SEE PANEL SCHEDULE.
  RTD = RESISTANCE TEMPERATURE DETECTOR.
  RP, .....ETC = 120 VOLT PANELBOARDS.
  LP, DP....ETC = 277/480 VOLT PANELBOARDS.
  TC= THERMOCOUPLE.
- RECTIFIER (3/8 INCH SQUARE).
- INVERTER (3/8 INCH SQUARE).
- STATIC SWITCH (3/8 INCH SQUARE, 1/8 INCH EQUILATERAL).
- 50G (IX-1) / 51G / 3 — RELAY OR CONTROL DEVICE. DUAL FUNCTION SHOWN. SUBSCRIPT INDICATES QUANTITY. PARENTHESIS INDICATES IDENTIFICATION ON PROCESS DIAGRAM. (1/2 INCH CIRCLE).
- RECEPTACLE, WELDING. (1/4 INCH CIRCLE, TYPICAL).
- RECEPTACLE, SPECIAL PURPOSE.
- PUSH BUTTON STATION.
- AS — DEVICE AND INSTRUMENT OR CONTROL SWITCHES. (1/4 INCH SQUARE).
  AS = AMMETER SWITCH.
  CS = CONTROL SWITCH.
  DE = DIESEL ENGINE.
  GE = GASOLINE ENGINE.
  LPE = LIQUIFIED PROPANE GAS ENGINE.
  LPG = LIQUIFIED PETROLEUM GAS ENGINE.
  RC = REMOTE CONTROL SWITCH.
  PB = PUSH BUTTON.
  SS = SYNCHRONIZING SWITCH.
  SST = SOLID STATE TRIP.
  TC = TEMPERATURE CONTROLLER.
  TS = TEST SWITCH.
  VR = VOLTAGE REGULATOR.
  VS = VOLTMETER SWITCH.
- ANNUNCIATOR OR ALARM (DEVICE 30).

## DEVICE FUNCTION NUMBERS

ADAPTED FROM ANSI C37. 2-1987, USAGE PER IEEE STD. 242-1986

1. MASTER ELEMENT OR INITIATING DEVICE SUCH AS FLOAT SWITCH.
2. TIME DELAY STARTING OR CLOSING RELAY.
3. CHECKING OR INTERLOCKING RELAY. (AND GATE).
4. MASTER CONTACTOR.
5. STOPPING DEVICE.
6. STARTING CIRCUIT BREAKER.
7. ANODE CIRCUIT BREAKER.
8. CONTROL POWER DISCONNECTING DEVICE.
9. REVERSING DEVICE.
10. UNIT SEQUENCE SWITCH.
11. THREE OR MORE FUNCTIONS PER LEGEND.
12. OVER SPEED DEVICE.
13. SYNCHRONOUS SPEED DEVICE.
14. UNDER SPEED DEVICE.
15. SPEED OR FREQUENCY MATCHING DEVICE.
16. RESERVED FOR FUTURE APPLICATION.
17. SHUNTING OR DISCHARGE SWITCH.
18. ACCELERATING OR DECELERATING DEVICE.
19. STARTING TO RUNNING TRANSITION DEVICE.
20. ELECTRICALLY OPERATED VALVE.
21. DISTANCE RELAY. (IMPEDANCE CHANGE DETECTOR).
22. EQUALIZER CIRCUIT BREAKER.
23. TEMPERATURE CONTROL DEVICE. (SPACE HEATER THERMOSTAT).
24. VOLTS PER HERTZ RATIO RELAY.
25. SYNCHRONIZING OR SYNCHRONISM CHECK DEVICE.
26. APPARATUS THERMAL DEVICE. (FIELD OR COOLANT OVERTEMPERATURE).
27. UNDERVOLTAGE RELAY.
28. FLAME DETECTOR.
29. ISOLATING CONTACTOR.
30. ANNUNCIATOR RELAY.
31. SEPARATE EXCITATION DEVICE.
32. DIRECTIONAL POWER RELAY. (ANTI MOTORING).
33. POSITION INDICATOR SWITCH. (CELL SWITCH).
34. MASTER SEQUENCE DEVICE.
35. BRUSH OPERATING OR SLIP RING SHORT CIRCUITING DEVICE.
36. POLARITY OR POLARIZING VOLTAGE DEVICE.
37. UNDERCURRENT OR UNDERPOWER DEVICE (GROUND CONTINUITY MONITOR).
38. BEARING PROTECTIVE DEVICE.
39. MECHANICAL CONDITION (VIBRATION ETC.) MONITOR.
40. FIELD RELAY. (EXCITATION LOSS).
41. FIELD CIRCUIT BREAKER.
42. RUNNING CIRCUIT BREAKER.
43. CONTROL CIRCUIT MANUAL TRANSFER OR SELECTOR DEVICE.
44. UNIT SEQUENCE STARTING RELAY.
45. ATMOSPHERIC CONDITION MONITOR.
46. REVERSE PHASE OR PHASE BALANCE CURRENT RELAY.
47. PHASE SEQUENCE VOLTAGE RELAY.
48. INCOMPLETE SEQUENCE RELAY.
49. MACHINE OR TRANSFORMER (ARMATURE OR LOAD WINDING) THERMAL RELAY.
50. INSTANTANEOUS OVERCURRENT RELAY.
51. AC TIME OVERCURRENT RELAT.
52. AC CIRCUIT BREAKER.
53. EXCITER OR DC GENERATOR RELAY.
54. TURNING GEAR ENGAGING DEVICE.
55. POWER FACTOR RELAY.
56. FIELD APPLICATION RELAY.
57. SHORT CIRCUITING OR GROUNDING DEVICE.
58. RECTIFIER FAILURE RELAY.
59. OVERVOLTAGE RELAY.
60. VOLTAGE BALANCE RELAY.
61. GAS DENSITY SWITCH.
62. TIME DELAY STOPPING OR OPENING RELAY.
63. LIQUID OR GAS SUDDEN PRESSURE RELAY, MANUAL RESET.
64. GROUND PROTECTION RELAY (UNDERVOLTAGE = INSULATION FAILURE).
65. GOVERNOR.
66. NOTCHING OR JOGGING DEVICE.
67. AC DIRECTIONAL OVERCURRENT RELAY.
68. BLOCKING RELAY.
69. PERMISSIVE CONTROL DEVICE.
70. ELECTRICALLY OPERATED RHEOSTAT.
71. LEVEL SWITCH.
72. DC CIRCUIT BREAKER.
73. LOAD RESISTOR CONTACTOR.
74. ALARM RELAY. (ALARMS OTHER THAN ANNUNCIATOR, DEVICE 30).
75. POSITION CHANGING MECHANISM.
76. DC OVERCURRENT RELAY.
77. TELEMETERING DEVICE.
78. PHASE ANGLE MEASURING OR OUT-OF-STEP RELAY.
79. AC RECLOSING RELAY.
80. FLOW SWITCH.
81. FREQUENCY RELAY.
82. DC RECLOSING RELAY.
83. AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY.
84. OPERATING MECHANISM.
85. CARRIER OR PILOT WIRE RECEIVER RELAY.
86. LOCKOUT AUXILIARY RELAY, MANUAL RESET.
87. DIFFERENTIAL PROTECTIVE RELAY.
88. AUXILIARY MOTOR OR MOTOR GENERATOR.
89. LINE SWITCH.
90. REGULATING DEVICE.
91. VOLTAGE DIRECTIONAL RELAY.
92. VOLTAGE AND POWER DIRECTIONAL RELAY.
93. FIELD CHANGING CONTACTOR.
94. TRIPPING OR TRIP FREE RELAY.
95. OPEN FOR SPECIFIC APPLICATIONS.
96. OPEN FOR SPECIFIC APPLICATIONS.
97. OPEN FOR SPECIFIC APPLICATIONS.
98. OPEN FOR SPECIFIC APPLICATIONS.
99. OPEN FOR SPECIFIC APPLICATIONS.

## NOTES:

1. THIS IS A STANDARD DRAWING. ITEMS NOT SHOWN ON DIAGRAMS ARE FOR FUTURE USE. DO NOT EDIT THIS SHEET FOR SPECIFIC APPLICATION. CADD AND MANUAL DRAFTING INSTRUCTIONS SHALL REMAIN FOR FIELD CHANGES AND AS BUILTS. SPECIFICATION DATA SHALL REMAIN FOR QUALITY CONTROL.
2. SYMBOLS ON THIS DRAWING HAVE BEEN ADAPTED FROM ANSI/ASME Y14.15-1966 (R1988) AND ANSI/ASME Y32.2-1975 (IEEE STD. 315-1975 R1989) WITH IEEE STD 315A-1986 AND RESOLUTION OF CONFLICTS AND SHALL BE USED AS BASIC BUILDING BLOCKS TO ASSEMBLE ALL REQUIRED FORMS OF GRAPHIC REPRESENTATION IN BOTH ONE LINE DIAGRAMS AND THREE LINE DIAGRAMS.
3. DRAFTING SHALL INCLUDE LINE THICKNESS PER ANSI/ASME Y 14.2M-1979 (R 1987) AND ANSI/ASME Y14.15-1966 (R 1988) AS FOLLOWS:
   - THIN ——— CENTER, DIMENSION, BREAK, EXISTING, AND BACKGROUND LINES. (0.016, 1/64, INCH, WT=1).
   - MEDIUM — — — — NEW WORK. (0.032, 1/32, INCH, WT=3).
   - THICK ——— MATCH LINE, POWER BUS, OR BATTERY LIMIT. (0.048, 3/64, INCH, WT=5).

   DO NOT USE WT=0, 2 OR 4 FOR LINES.
   CADD WEIGHT SHALL BE AS INDICATED WITH WT=.
   TEXT, EQUIPMENT CALLOUTS, AND LEADER LINES, CADD LV=32.
   SYMBOLS, BUSWAY AND FEATURES, CADD LV=31.
4. LETTERING SHALL BE SLANTED WITHIN DRAWING, 1/8 INCH FOR TEXT, 1/4 INCH FOR HEADINGS AND TITLES, CADD FONT 61. WIDTH RATIO SHALL BE 80 PERCENT. LINE SPACING SHALL BE 1/2 TEXT HEIGHT. 1/8 INCH LETTERS SHALL BE WT=2. 1/4 INCH LETTERS SHALL BE WT=4. LOWER CASE LETTERS SHALL NOT BE USED. FOUR LINE TITTLE BLOCKS SHALL BE 3/16 INCH WT=2.
5. ALL WORK SHALL BE SUITABLE FOR LEGIBLE REPRODUCTION FROM HALF SIZE SECOND GENERATION REPRODUCIBLES.
6. RATINGS SHALL BE SHOWN WHERE ESSENTIAL FOR OVERALL UNDERSTANDING OF THE SYSTEM.
7. DIAGRAMS SHALL BE LAID OUT WITH SOURCES TOWARD THE TOP OF THE SHEET WITH POWER FLOW FROM TOP TO BOTTOM AND FROM LEFT TO RIGHT, PER ANSI Y14.5-15-1966 (R1988).
8. PROVIDE SEPARATE WIRING DIAGRAMS WHERE PHYSICAL ARRANGEMENT OF THE WIRING MUST BE SHOWN FOR CLARITY.
9. DRAWING TITLES AND REFERENCES SHALL BE STANDARDIZED AS ONE OR THREE LINE DIAGRAMS. THE WORDS "SINGLE LINE" SHALL NOT BE USED.
10. STACKED FRACTIONS SHALL NOT BE USED.

## DEVICE SUFFIX DESIGNATIONS:

SPECIFIC USAGE SHALL BE IDENTIFIED IN A LEGEND ON THE DIAGRAM.

A = AIR.
B = BUS
C = CURRENT.
CS = CONTROL SWITCH.
E = ELECTRIC.
F = FREQUENCY.
G = GROUND, CONNECTION ON NEUTRAL OF WYE POWER TRANSFORMER.
GS = GROUND SENSOR, ZERO SEQUENCE WINDOW TYPE CT ENCLOSING ALL PHASE CONDUCTORS AND NO GROUND PATH.
HR = HAND RESET.
J = DIFFERENTIAL.
L = LIQUID, LEVEL, OR LINE.
M = MANUAL.
N = RESIDUAL CURRENT CONNECTION ON WYE OF THREE 1ø CTS.
P = POWER.
PR = PRESSURE RELIEF.
Q = OIL.
S = SYNCHRONIZING.
T = TEMPERATURE OR TRANSFORMER.
-2 = SEQUENTIAL NUMBER OF IDENTICAL UNITS.
V = VOLTAGE.
X = AUXILIARY (ENERGIZING) RELAY.
Y = AUXILIARY (ANTI-PUMPING) RELAY.
Z = AUXILIARY RELAY.

**LIGO-D960997-A-O**

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LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY
SITE NO. 2 - LIVINGSTON, LOUISIANA

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SCALE: NONE
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PROJECT NUMBER: 8094
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