ONE AND THREE LINE DIAGRAM SYMBOLS

BUS

BUS DUCT

POWER CONDUCTOR

ELECTRICAL CONTROL, METER, OR SIGNAL CIRCUIT

MECHANICAL CONTROL, OPERATOR, OR INTERLOCK

FUTURE

ENCLOSURE BOUNDARY

AREA OR JURISDICTION BOUNDARY

CROSSING OF CONDUCTOR, NOT CONNECTED.

CONNECTION OF CONDUCTORS

CABLE TERMINATION WITH STRESS RELIEF

CONTACT, NORMALLY OPEN (N.O.)

CONTACT, NORMALLY CLOSED (N.C.).

SEPARABLE

SWITCH (NO CONTACT CIRCLES, U.A. = UNDER ARM. N/F= NON-FUSIBLE

FUSED DISCONNECT SWITCH

MAGNETIC ELEMENT

THERMAL OVERLOAD RELAY 1, 2, 3....ETC INDICATES NEMA SIZE, UL LISTED.

HEATER OR THERMAL ELEMENT NEMA SIZE, UL LISTED.

DIODE

THYRISTOR

IN LINE CONDUCTOR CURRENT LIMITING CABLE PROTECTOR

C1 — CAPACITOR C1, 2, 3...=CAPACITOR NUMBER.

LIGHTNING OR SURGE ARRESTOR IDENTIFY EACH ITEM BY TYPE ON THE DIAGRAM.

PROTECTIVE GAP

BATTERY

INDUCTOR OR REACTOR

R1 — RESISTOR R1, 2, 3...=RESISTOR NUMBER.

ADJUSTABLE OR VARIABLE FUNCTION.

FUSIBLE LINK

CARTRIDGE FUSE
A = ALARM CONTACT.
CL = CURRENT LIMITING.
I = INDICATING.

MOLDED CASE CIRCUIT BREAKER, INCLUDING THERMAL AND MAGNETIC OVERLOAD DEVICES PER SPECIFICATIONS.. 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.

AJR CIRCUIT BREAKER WITH CT.
SST W LT/ST
AS = AMP SENSOR.
GFS = GROUND FAULT SENSOR.
LT = LONG TIME.
SST = SOLID STATE TRIP.
ST = SHORT TIME.
W = WITH.

POWER CIRCUIT BREAKER WITH FRAME AMPERE RATING AND SHORT CIRCUIT DUTY
52 — 1200 AF 500 MVA — F
G = SF6 GAS.
O = OIL.
V = VACUUM.
52 = DEVICE 52 (TYP).

300/5 — PHASE CURRENT INSTRUMENT TRANSFORMER (CT) INDICATING TURNS RATIO AND QUANTITY. BLACK SQUARES INDICATE POLARITY MARKS. MARKS PER ANSI/IEEE STD 242-1986

50/5 — GROUND OR ZERO SEQUENCE CURRENT TRANSFORMER (CT) INDICATING TURNS RATIO AND QUANTITY.

3A 8A — 480-120 — INSTRUMENT POTENTIAL TRANSFORMER (PT)

GROUND CONNECTION

MAGNETIC MOTOR STARTER, 1, 2, 3... = STARTER NEMA SIZE

THERMAL OVERLOAD ELEMENTS

MAGNETIC CONTACTOR, 1, 2, 3... = CONTACTOR NEMA SIZE

ADJ SPEED DRIVE

CDS CURRENT TRANSFORMER

LA — LIGHTNING ARRESTOR

This document and the design it covers are the property of PARSONS. They are loaned only with the borrower's expressed written agreement that they will not be reproduced, copied, loaned, exhibited, or used in any other way, except by written consent from PARSONS to the borrower.

ONE AND THREE LINE DIAGRAM SYMBOLS

STEP-UP 1000/1250 KVA OA/FA AT 55°C 12.8 KV-480Y/277 V 3 ø, 4W, 60 HZ, BIL 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 CONNECTION.
△ = 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
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.

INDICATING LIGHT
A = AMBER.
B = BLUE.
C = CLEAR.
G = GREEN = SWITCH OR CONTACT CLOSED.
O = ORANGE.
R = RED = SWITCH OR CONTACT OPEN.
W = WHITE.

A / I — METER. NUMBER INDICATES QUANTITY.
A = AMPERE.
AH = AMPERE-HOUR.
D = DEMAND ATTACHMENT.
ET = ELAPSED TIME.
F = FREQUENCY.
GD = GROUND DETECTOR.
K = KILO PREFIX.
M = MEGA PREFIX.
Ω = 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.
HR.....ETC = 120 VOLT PANELBOARDS.
LP, DP....ETC = 277/480 VOLT PANELBOARDS.
TC= THERMOCOUPLE.

RECTIFIER

INVERTER

STATIC SWITCH

SOC (11K-11 SIG) — J — RELAY OR CONTROL DEVICE. DUAL FUNCTION SHOWN. SUBSCRIPT INDICATES QUANTITY. PARENTHESIS INDICATES IDENTIFICATION ON PROCESS DIAGRAM.

RECEPTACLE, WELDING.

RECEPTACLE, SPECIAL PURPOSE.

PUSH BUTTON STATION.

AS — DEVICE AND INSTRUMENT OR CONTROL SWITCHES.
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).

TYPICAL CABLE CALL-OUT
ONE INCH CONDUIT CONTAINING ONE THREE CONDUCTOR NUMBER SIX AWG CABLE WITH ONE NUMBER EIGHT AWG GROUND WIRE

40 — 1"C-3/C #6 W/1 #8 GND

RF FILTER — RADIO FREQUENCY INTERFERENCE FILTER

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 RELAY.
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.

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 CT'S.
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-D960391-01-O

REFERENCES		REVISIONS						
WA-E-001	ABBREVIATIONS & ACRONYMS	NO.	DATE	BY	CHKD	ENGR	PROJ	DESCRIPTION
WA-E-002	STANDARD PLAN SYMBOLS	1	6-15-98	J.G.				ISSUED FOR AS-BUILT
WA-E-003	SCHEMATIC & WIRING SYMBOLS							
DRAWING NO.	DESCRIPTION							

ISSUED FOR CONSTRUCTION

DRAWN	M. M.	6-25-96
CHECKED	J. K.	7-3-96
ENGINEER	K. P.	7-3-96
PROJ	M. D. W.	7-8-96

AS-BUILT DRAWINGS

PARSONS
100 WEST WALNUT STREET
PASADENA, CALIFORNIA

LIGO
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY
SITE NO. 1 - HANFORD, WASHINGTON

TITLE	SIZE	DRAWING NUMBER	REVISION
ELECTRICAL STANDARD ONE & THREE LINE DIAGRAM SYMBOLS	NONE	PP150969	8094
	SHEET NUMBER	WA-E-004	⚠

LIGOWAF.BOR