

PCTS 0000/CONTRACT X-000 or RPQ/ERX00000  
 PUMPING STATION No. 0000 (STD. UPDATE 2021)  
 SUBMERSIBLE PUMPING STATION WITHOUT GEN.  
 PROJECT OFFICIAL ADDRESS  
**ELECTRICAL ONE-LINE DIAGRAM**

DRAWING HISTORY			
NO.	RELEASED FOR	DATE	BY
X	REVIEW 00%	xx/xx/xx	xxxx
	REVIEW 00%		
	PERMIT		
	BID		
	AS-BUILT		
REVISIONS			
NO.	DESCRIPTION	DATE	BY
Δ	xxxxxx xxxxxx	xx/xx/xx	xxxx
APPROVALS			
DESIGNED:	X.X.X.	DRAWN:	X.X.X.
UNIT HEAD:	X.X.X.		
PROJECT MGR.:	X.X.X.		
Xxxx Xxxxx, P.E. Xxxxx Engineer State of Florida—License No.00000 Date: _____			
FILE NAME:	XXXXX03.DWG		
DATE:	XX/XX/20XX	SCALE:	AS NOTED
SHEET <b>E-3</b>		DWG. No. <b>S-00000-D</b>	

CALCULATIONS BASED ON FORMULAS OF NFPA 70E / IEEE 1584, AS FOLLOWS:

**ARCING FAULT CURRENT I<sub>a</sub> CALCULATION**

K	I <sub>bf</sub>	V(kV)	GAP (mm)	log (I <sub>a</sub> )	I <sub>a</sub>
-0.097			25		

$\log(I_a) = K + 0.662 \log(I_{bf}) + 0.096 \times V + 0.000526 \times G + 0.5588 \times V \times \log(I_{bf}) - 0.00304 \times G \times \log(I_{bf})$   
 $K = -0.153$  FOR OPEN CONFIGURATION AND  $-0.097$  FOR BOX CONFIGURATIONS AS IN PANELS AND MCCS  
 $I_{bf}$  = BOLTED FAULT CURRENT FOR 3-PHASE FAULTS AT APPLICABLE ELECTRICAL EQUIPMENT IN kA  
 $V$  = SYSTEM VOLTAGE IN kV  
 $G$  = BUS BAR GAP BETWEEN CONDUCTORS:  
 15kV SWGR: 152mm  
 5kV SWGR: 104mm  
 LV SWGR: 32mm  
 PANEL/MCC: 25mm  
 CABLE: 13mm

**NORMALIZED INCIDENT ENERGY (E<sub>n</sub>) CALCULATION**

K1	K2	I <sub>a</sub>	GAP (mm)	log (E <sub>n</sub> )	E <sub>n</sub>
-0.555	-0.113		25		

$\log E_n = K1 + K2 + 1.081 \log I_a + 0.0011 \times G$   
 $E_n$  = INCIDENT ENERGY IN J/cm<sup>2</sup> NORMALIZED FOR 0.2s ARCING DURATION AND 610mm WORKING DISTANCE  
 $G$  = GAP BETWEEN BUS BAR CONDUCTORS 25mm \*TABLE D.8.2 ASSUMPTION  
 $K1 = -0.792$  FOR OPEN CONFIGURATIONS AND  $-0.555$  FOR BOX CONFIGURATIONS  
 $K2 = 0$  FOR UNGROUNDED AND HIGH RESISTANCE GROUNDED SYSTEMS;  $-0.113$  FOR GROUNDED SYSTEMS  
 $I_a$  = ARCING FAULT CURRENT

**INCIDENT ENERGY (E) CALCULATION**

Cf	E <sub>n</sub>	t	D (mm)	X	E (J/cm <sup>2</sup> )	E (cal/cm <sup>2</sup> )
1.5			455	1.641		

$E = (4.184) (Cf) (E_n) (t/0.2) (610^X/D^X)$   
 $Cf = 1.5$  FOR VOLTAGES AT OR BELOW 1kV AND 1.0 FOR VOLTAGES ABOVE 1kV  
 $t$  = ARCING DURATION IN SECONDS  
 $X$  = DISTANCE EXPONENT, 1.473 FOR SWGR <=1kV, 0.973 FOR SWGR >1kV AND 1.641 FOR PANELS <=1kV  
 $D$  = WORKING DISTANCE 455mm = 18 IN PER NFPA 70E

**FLASH BOUNDARY IN mm AT INCIDENT ENERGY OF 5.0 J/cm<sup>2</sup>**

Cf	E <sub>n</sub>	t	X	E <sub>b</sub>	D <sub>b</sub> (mm)	D <sub>b</sub> (inches)
1.5			1.641	5.0		

$D_b = [(4.184) (Cf) (E_n) (t/0.2) (610^X/E_b)]^{1/0.85}$  \*D8.5 EMPIRICALLY DERIVED  
 $E_b$  = INCIDENT ENERGY SET AT 5.0 J/cm<sup>2</sup>  
 $Cf = 1.5$  FOR VOLTAGES AT OR BELOW 1kV AND 1.0 FOR VOLTAGES ABOVE 1kV  
 $t$  = ARCING DURATION IN SECONDS  
 $X$  = DISTANCE EXPONENT, 1.473 FOR SWGR <=1kV, 0.973 FOR SWGR >1kV AND 1.641 FOR PANELS <=1kV

**ARC FLASH HAZARD ANALYSIS**

THE LABELS FOR EACH APPLICABLE EQUIPMENT ON THIS PLAN ARE FROM A PRELIMINARY STUDY PERFORMED BY THE ENGINEER OR RECORD. CONTRACTOR SHALL PROVIDE FINAL LABELS ACCORDING TO SECTION 26 05 73.19

⚠ **DANGER** ⚡

Arc - Flash Hazard and Shock Hazard

in Arc Flash Protection Boundary  
 \_\_\_ cal/cm<sup>2</sup> - Incident Energy Flash Hazard at 18 inches

CLASS \_\_\_\_\_  
Arc-Flash Hazard Risk Category

Appropriate PPE Required for both Arc-Flash and Shock Hazards:  
 Safety Glasses/Goggles, Hard Hat, Flash Suit Hood, Leather Gloves, Leather Work Shoes, Hearing Protection, FR clothing system with an ATPV rating >= X cal/cm<sup>2</sup>, Class 00 Voltage Rated Gloves, Voltage Rated Tools

480 VAC -- Shock Hazard with covers/doors open  
 3' - 6" -- Limited Approach Boundary  
 1' - 0" -- Restricted Approach Boundary  
 0' - 1" -- Prohibited Approach Boundary

Shock Hazard

LOCATION : PS-0000      PROTECTIVE DEVICE: XXXXXX  
 MAX FAULT CURRENT BY FP&L: \_\_\_\_\_  
 STUDY DONE BY: XXXXXX      DATE: XXXXXX      FILE NAME: XXXXXX

- NOTES:**
- LABEL BACKGROUND SHALL BE WHITE COLOR.
  - LABEL LETTERING SHALL BE BLACK COLOR.
  - 'DANGER' WORD SHALL BE WHITE COLOR WITH RED BACKGROUND.
  - LABEL SIZE SHALL BE 4 X 6 INCHES.
  - INFORMATION PRINTED ON LABEL SHALL CONFORM TO THE REQUIREMENTS OF SECTION 26 05 73.19. SUB SECTIONS 3.04 AND 3.07 SHALL BE VERIFIED AND PROVED BY CONTRACTOR.
  - THE LABEL FOR EACH OF THE APPLICABLE EQUIPMENT SHALL BE LOCATED SO AS TO BE CLEARLY VISIBLE TO QUALIFIED PERSONS BEFORE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE OF THE EQUIPMENT NEC 110.16.
  - SEE NOTE #24, ELECTRICAL GENERAL NOTES SHEET E-1.

**ARC FLASH LABEL**

**ABBREVIATIONS:**

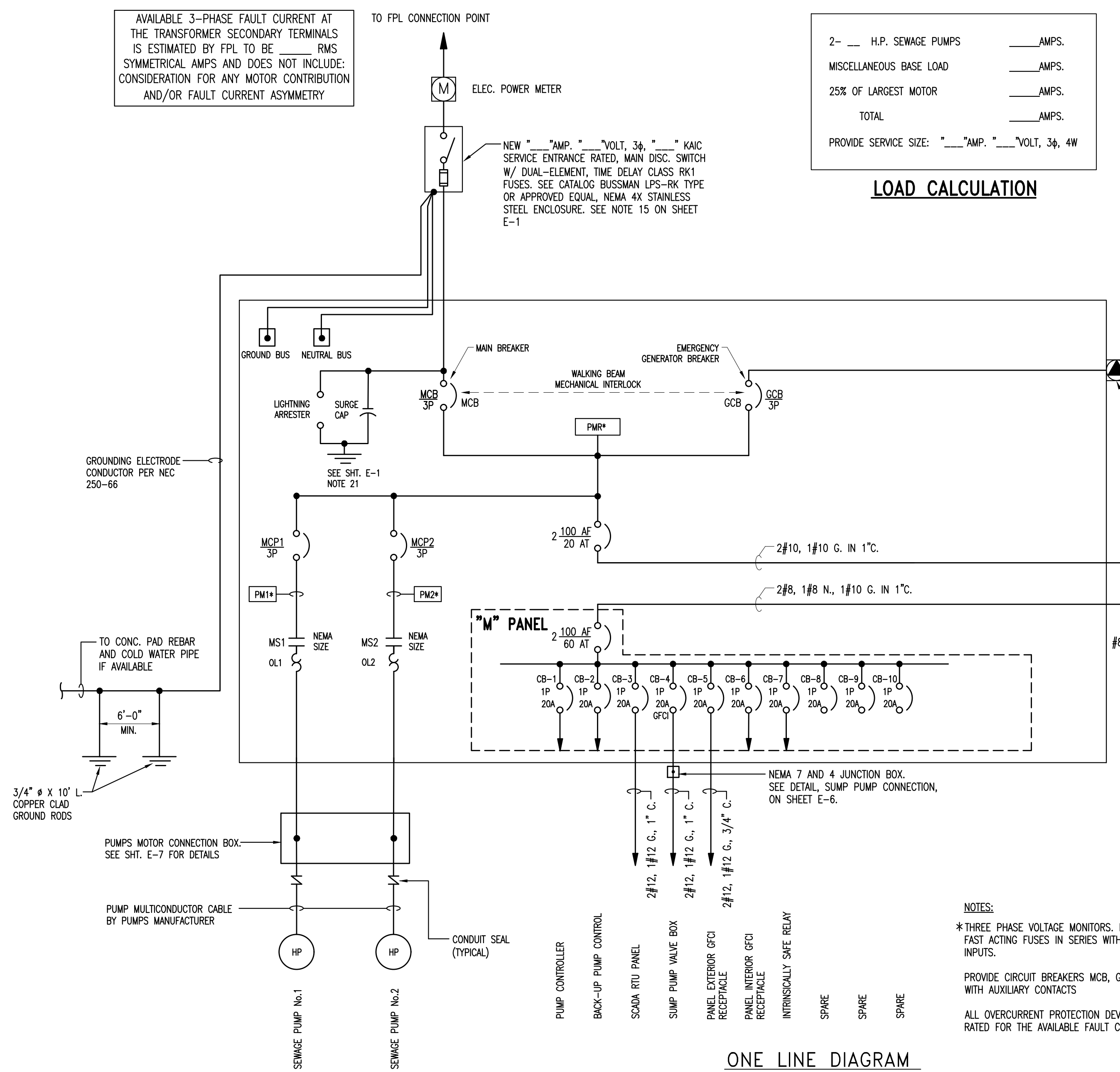
- MCB MAIN CIRCUIT BREAKER
- MPC MOTOR CIRCUIT PROTECTION
- GCB GENERATOR CIRCUIT BREAKER
- RTU REMOTE TERMINAL UNIT

THESE ARE NOT CONSTRUCTION DRAWINGS. THE INFORMATION HEREIN CONTAINED SHALL ONLY BE USED AS GENERAL GUIDELINE OF THE INTENDED OPERATION AND FUNCTIONS AND SHALL NOT BE CONSTRUED AS ALL INCLUSIVE. ENGINEERS OF RECORD AND CONSULTANTS USING THESE GUIDELINES SHALL VERIFY AND MODIFY ANY REQUIREMENT NOT NECESSARILY SHOWN AS MAY BE REQUIRED BY ANY AND ALL APPLICABLE CODES AND STANDARDS.

2- H.P. SEWAGE PUMPS	_____AMPS.
MISCELLANEOUS BASE LOAD	_____AMPS.
25% OF LARGEST MOTOR	_____AMPS.
TOTAL	_____AMPS.

PROVIDE SERVICE SIZE: "\_\_\_\_"AMP. "\_\_\_\_"VOLT, 3φ, 4W

**LOAD CALCULATION**



SERVICE: 1-PH, 3φ & 1φ(G) VOLTAGE: 240/120V										MAIN: 2P-40A M.C.B. LOCATION: CONTROL PANEL																					
PANEL 'M'										PANEL 'M'																					
VA	POLE	TRIP	COND.	WIRE	REMARKS					REMARKS	WIRE	COND.	TRIP	POLE	VA																
540	1	20	3/4"	2#12 & (G)	PUMP CONTROL	1				2	BACK-UP PUMP CONTROL	2#12 & (G)	3/4"	20	1	180															
750	1	20	1"	2#12 & (G)	SCADA RTU PANEL	3				4	SUMP PUMP VALVE BOX	2#12 & (G)	1"	20	1	1200															
180	1	20	3/4"	2#12 & (G)	PANEL EXT. GFCI RECEPTACLE	5				6	PANEL INT. GFCI RECEPTACLE	2#12 & (G)	3/4"	20	1	180															
180	1	20	3/4"	2#12 & (G)	INTRINSICALLY SAFE RELAY	7				8	SPARE	-	-	20	1	1000															
1000	1	20	-	-	SPARE	9				10	SPARE	-	-	20	1	1000															
						11				12																					
						13																									
2650	TOTAL										TOTAL CONNECTED LOAD: 6210 VA @ 240/120 VOLTS										TOTAL										3560

BREAKERS, WIRING AND CONDUIT SCHEDULE									
VOLTS & PHASE	MOTOR HP	MOTOR AMP CODE	START SIZE	MOTOR CIRCUIT PROTECT. AMPS	MOTOR WIRE THWN CU. NOTE 11 ON E-1	SIZED FOR TWO PUMP STATIONS			
						MAIN & STAND-BY BREAKERS	SERVICE		POWER
							GROUNDING		
240-1φ	5	28	2	60	3#8 IN 1 1/2" C	100	#6		3#2, IN 1-1/2" C
240-1φ	7.5	40	2	80	2#6 & 1#8G. IN 1-1/2" C	150	#6		3#1/0, IN 2" C
240-3φ	5	15.2	1	30	4#10 IN 1 1/2" C	100	#6		4#2, IN 1-1/2" C
240-3φ	7.5	22	2	50	4#8 IN 1 1/2" C	100	#6		4#2, IN 1-1/2" C
240-3φ	10	28	2	50	3#6 & 1#8G. IN 1-1/2" C	100	#6		4#2, IN 1-1/2" C
240-3φ	15	42	3	100	3#4 & 1#8G. IN 2" C	150	#6		4#1/0, IN 2" C
480-3φ	5	7.6	1	15	4#12 IN 1 1/2" C	70	#6		4#3, IN 1-1/2" C
480-3φ	7.5	11	1	30	4#12 IN 1 1/2" C	70	#6		4#3, IN 1-1/2" C
480-3φ	10	14	2	30	4#10 IN 1 1/2" C	70	#6		4#3, IN 1-1/2" C
480-3φ	15	21	2	50	4#10 IN 1 1/2" C	70	#6		4#3, IN 1-1/2" C
480-3φ	20	27	2	50	4#8 IN 2" C	125	#6		4#1, IN 2" C
480-3φ	25	34	3	50	3#6 & 1#8G. IN 2" C	150	#6		4#1/0, IN 2" C
480-3φ	30	40	3	100	3#6 & 1#8G. IN 2" C	200	#4		4#3/0, IN 2" C
480-3φ	40	52	3	100	3#4 & 1#6G. IN 2" C	200	#4		4#3/0, IN 2" C
480-3φ	50	65	4	100	3#3 & 1#6(G) IN 2" C	200	#4		4#3/0, IN 2" C
480-3φ	60	77	4	150	3#2 & 1#6(G) IN 2" C	225	#2		4#4/0, IN 2 1/2" C