FIRE PUMP AND PRESSURE MAINTENANCE PUMPS

A. **FIRE PUMP:** 25HP, 460VOLTS, 3 PHASE
FULL LOAD CURRENT: 34 A
CONDUCTOR SIZE: NOT LESS 125%: 42.5 A
USE: 3-8.0 SQ. MM. THW STRANDED COPPER WIRE
CORRECTION FACTOR BASED ON 35°C AMBIENT TEMPERATURE:
=50 (0.94) A
= 47 A
USE: 20MM DIAMETER EMT
DISCONNECTING DEVICE
NOT LESS 250%: 85 A
USE: 100 AT, 460V, 3P, CIRCUIT BREAKER

B. **JOCKEY PUMP:** 3HP, 460VOLTS, 3 PHASE
FULL LOAD CURRENT: 4.8 A
CONDUCTOR SIZE: NOT LESS 125%: 6 A
USE: 3-5.5 SQ. MM. THW STRANDED COPPER WIRE
CORRECTION FACTOR BASED ON
35°C AMBIENT TEMPERATURE: 35 (0.94) A
= 32.9 A
USE: 20MM DIAMETER EMT
DISCONNECTING DEVICE
NOT LESS 250%: 12 A
USE: 30 AT, 460V, 3P, CIRCUIT BREAKER

C. **MAIN CONDUCTOR AND PROTECTION**

FULL LOAD CURRENT FOR 25HP, 460VOLTS, 3 PHASE:	34 A
FULL LOAD CURRENT FOR 3HP, 460VOLTS, 3 PHASE:	4.8 A
	38.8 A

TOTAL KVA REQUIREMENT:
(1.73 x 460 x 38.8 x 1.25)/1000 = 38.5963 KVA
USE: 3-14.0 SQ. MM. THW STRANDED COPPER WIRE
1-14.0 SQ. MM. THW STRANDED COPPER GROUND WIRE
20MM DIAMETER EMT

LOCKED ROTOR CURRENT FOR 25HP, 460VOLTS, 3 PHASE:	183 A
LOCKED ROTOR CURRENT FOR 3HP, 460VOLTS, 3 PHASE:	32 A
	215 A

USE: 200 AT, 460V, 3P, OVERCURRENT PROTECTION

COMBINE LOAD:

A. FOR 460 VOLTS SIDE

FIRE PUMP:	38,596.30 VA
Exist. LPP1:	35,811.00 VA
Exist. LPP2:	41,779.50 VA
LPP1:	13,348.82 VA
LPP2:	13,090.00 VA
LPP3:	52,980.86 VA
	195,606.48 VA

EQUIVALENT AMPERE: 245.80 A

USE: 3-125 SQ MM THWN STRANDED COPPER WIRE
1-125 SQ MM TW STRANDED GREEN GROUND WIRE
63MM EMT PIPE
250 AMPS, 460 VOLTS, 3POLE, MAIN CIRCUIT BREAKER

B. FOR 230 VOLTS SIDE

Exist. LPP1:	35,811.00 VA
Exist. LPP2:	41,779.50 VA
LPP1:	13,348.82 VA
LPP2:	13,090.00 VA
LPP3:	52,980.86 VA
	157,010.18 VA

EQUIVALENT AMPERE: 394.60 A

USE: 2sets of 3-125 SQ MM THWN STRANDED WIRE
1-125 SQ MM TW STRANDED GREEN GROUND WIRE
2sets - 63MM PVC CONDUIT
400 AMPS, 240 VOLTS, 3POLE, MAIN CIRCUIT BREAKER

C. TRANSFORMER SIZE

TOTAL KVA AT 240VOLT LOAD:	157.01 KVA
@ 125% SAFETY FACTOR:	196.26 KVA

USE: 225 KVA, 3PHASE, 460V/230V STEP DOWN TRANSFORMER

REVISIONS			
REV.	DATE	BY	DESCRIPTION

PROJECT: PROPOSED LABORATORY RENOVATION, ZCWD WATER TREATMENT PLANT, ZAMBOANGA CITY

SHEET CONTENT: AS INDICATED

DRAWN BY: ARTHUR A. REYES, PRINCIPAL DRAFTSMAN B - DESIGN DIVISION

PREPARED BY: ARIANN D. GODINEZ, SENIOR ENGINEER A - DESIGN DIVISION

CHECKED & REVIEWED BY: REX D. SALE, JR., SUPERVISING ENGINEER A - DESIGN DIVISION

REVIEWED AND SUBMITTED BY: EDITO M. BAUTISTA, JR., OIC - DESIGN DIVISION

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APPROVED FOR PROJECT IMPLEMENTATION: Digitally signed by Vasquez Leonardo Rey Dimaguila Date: 2021-08-17 14:39:53 LEONARDO REY D. VASQUEZ, GENERAL MANAGER

SHEET NO. 53

SCHEDULE OF LOAD (IMPEDANCE PER PEC)

Cable No.	Conductor				Conduit		Current	XL (REACTANCE)	R
	Description	mm^2	Type	Length (m)	mmØ	Type	Amps	ohm/305m	ohm/305m
1	TRANSFORMER TO MDP	125	THWN	13	63	STEEL	394.60	0.052	0.054
2	MDP TO EXIST. LPP1	60	THW	9	50	STEEL	72.00	0.054	0.100
3	MDP TO EXIST. LPP2	60	THW	7	50	STEEL	84.00	0.054	0.100
4	MDP TO LPP1	14	THW	6	32	STEEL	35.20	0.064	0.490
5	MDP TO LPP2	14	THW	6	32	STEEL	32.90	0.064	0.490
6	MDP TO LPP3	80	THW	6	63	STEEL	178.28	0.052	0.079

SCHEDULE OF LOAD (POSITIVE IMPEDANCE)

Cable No.	Conductor	EQUIVALENT IMPEDANCE		BASES		PER UNIT IMPEDANCE			
		X (Ω)	R (Ω)	MVA	kV	X (pu)	R (pu)	|Z|	X/R
Z_t	TRANSFORMER	0.046	0.019	20.000	0.23	4.1262	1.6504	4.444	2.500
Z_{C1}	TRANSFORMER TO MDP	0.00222	0.00230	20.000	0.23	0.8380	0.8702	1.20805	0.963
Z_{C2}	MDP TO EXIST. LPP1	0.00159	0.00295	20.000	0.23	0.6024	1.1156	1.26789	0.540
Z_{C3}	MDP TO EXIST. LPP2	0.00124	0.00230	20.000	0.23	0.4686	0.8677	0.98614	0.540
Z_{C4}	MDP TO LPP1	0.00126	0.00964	20.000	0.23	0.4760	3.6444	3.67532	0.131
Z_{C5}	MDP TO LPP2	0.00126	0.00964	20.000	0.23	0.4760	3.6444	3.67532	0.131
Z_{C6}	MDP TO LPP3	0.00102	0.00155	20.000	0.23	0.3867	0.5876	0.70342	0.658

REVISIONS

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PROJECT: PROPOSED LABORATORY RENOVATION, ZCWD WATER TREATMENT PLANT, ZAMBOANGA CITY

SHEET CONTENT: AS INDICATED

DRAWN BY: ARTHUR A. REYES, PRINCIPAL DRAFTSMAN B - DESIGN DIVISION

PREPARED BY: ARIANN D. GODINEZ, SENIOR ENGINEER A - DESIGN DIVISION

CHECKED & REVIEWED BY: REX D. SALE, JR., SUPERVISING ENGINEER A - DESIGN DIVISION

REVIEWED AND SUBMITTED BY: EDITO M. BAUTISTA, JR., OIC - DESIGN DIVISION

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SHEET NO. 54

BASE IMPEDANCE

MVA base = 20 MVA
kVbL = 0.23 kV
$ZbL = (kVbL)^2 / MVAb$
$ZbL = (0.23\ kVbL)^2 / 20\ MVAb$
ZbL = 0.002645 O

BASE CURRENT

Ib = 20MVA / (0.23 KV * 1.732)
Ib = 50205.84 A

PER UNIT COMPUTATION

Zpu = Z / Zb

Per unit impedance of 225 kVA Transformer

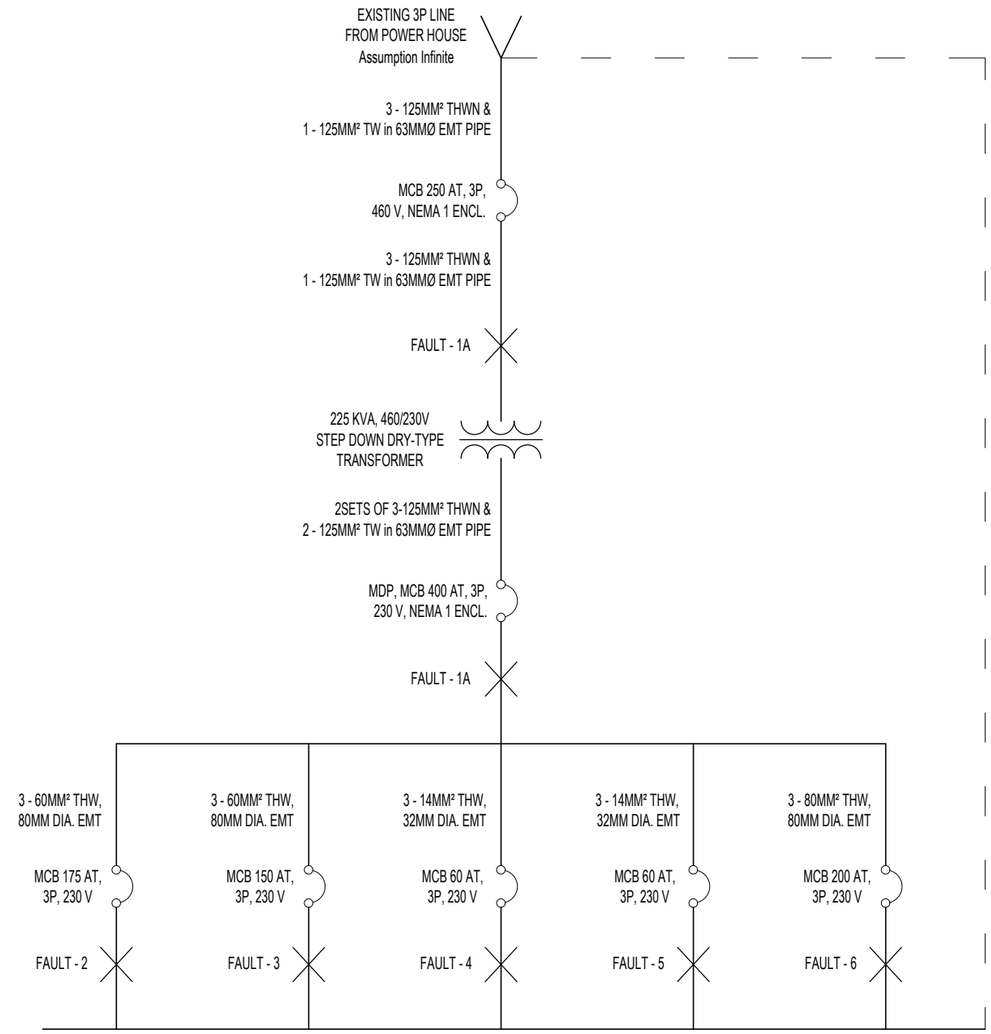
%Z = 5, X/R=2.5, at 0.46 kV primary voltage, R=0.019, X=0.046
MVA base = 20 MVA
Voltage base = 230 V

$Z_{tpu} = Z_o ((MVA_b^n * kV^{o2}) / (MVA_b^o * kV^{n2}))$
$Z_{tpu} = 4.444$
?t = arctan (X/R) = 68.2°
$Z_{tpu} = 4.444 \angle 68.2° = 1.6504 + j4.1262$

FAULT -1

TOTAL Z = Zt + Zc1
TOTAL Z = ('1.6504+4.1262i) + (0.838+0.6607i)
TOTAL Z = 5.652 ∠62.53 ° pu

$I_{f3Ø} = E_Ø / Z_{F-1}$
$I_{f3Ø} = 0.177 \angle -62.53$ ° pu
FOR 20MVA, 0.23KV BASE
$I_{3Ø}$ = 8882.762389 A



ONE LINE DIAGRAM

SCALE: NTS

REVISIONS			
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PROJECT: PROPOSED LABORATORY RENOVATION, ZCWD WATER TREATMENT PLANT, ZAMBOANGA CITY

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REVIEWED AND SUBMITTED BY: EDITO M. BAUTISTA, JR., OIC - DESIGN DIVISION

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SHEET NO. 55

SCHEDULE OF FAULTS

FAULT NO.	TOTAL IMPEDANCE (Z)	3PHASE FAULT (A)	KAIC
FAULT-1A	5.65205	0.176926861	4.44
FAULT-1B	5.65205	0.176926861	8.88
FAULT-2	6.91994	0.144509895	7.26
FAULT-3	6.63819	0.15064351	7.56
FAULT-4	9.32737	0.107211337	5.38
FAULT-5	9.32737	0.107211337	5.38
FAULT-6	6.35547	0.157344653	7.90

VOLTAGE DROP CALCULATION

Cable No.	Conductor				Conduit		Current	XL (REACTANCE)	R (RESISTANCE)	Voltage at Sending End	Voltage Drop	Voltage at Receiving End	Percent Voltage Drop
	Description	mm^2	Type	Length (m	mmØ	Type	Amps	ohm/305m	ohm/305m	Vs	Vd	Vr	%
1	TRANSFORMER TO MDP	125	THW	13	63	STEEL	394.60	0.052	0.054	230.00	1.26	228.74	0.55%
2	MDP TO EXIST. LPP1	60	THW	9	50	STEEL	72.00	0.054	0.100	228.74	0.24	228.50	0.11%
3	MDP TO EXIST. LPP2	60	THW	7	50	STEEL	84.00	0.054	0.100	228.74	0.22	228.52	0.10%
4	MDP TO LPP1	14	THW	6	32	STEEL	35.20	0.064	0.490	228.52	0.34	228.18	0.15%
5	MDP TO LPP2	14	THW	6	32	STEEL	32.90	0.064	0.490	228.18	0.32	227.86	0.14%
6	MDP TO LPP3	80	THW	6	63	STEEL	178.28	0.052	0.079	227.86	0.33	227.53	0.15%

CONDUCTOR: 125 SQ. MM.

R 0.05 OHM PER 305 m

X 0.052 OHM PER 305 m

A. VOLTAGE DROP AT THE MAIN BREAKER

$VD = I\sqrt{(R^2 + X^2)}$

$VD = 394.60\sqrt{(0.05)^2 + (0.052)^2)} \times (13/305)$

$VD = 1.26$ VOLTS

VOLTAGE AT PANEL BOARD

$Vr = Vs - Vd$

$Vr = 230V - 1.26V$

$Vr = 228.74$ VOLTS

B. VOLTAGE DROP PERCENTAGE

$\%VD = \frac{Vs-Vd}{Vs} X\ 100$

$\%VD = ((230-228.74) / 230) X\ 100$

$\%VD = 0.55\%$

REVISIONS			
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DRAWN BY: ARTHUR A. REYES, PRINCIPAL DRAFTSMAN B - DESIGN DIVISION

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SHEET NO. 56