AUG 07 1998

STATION 4 (25) ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 622245

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8. Originator Remarks: For approval and release of a new supporting document. This document has been generated to ensure retrievability of the Project W-320 "Electrical Calculations, Vol. 1".				9. Equip./Component No.: n/a	
				10. System/Bldg./Facility: 241-C-106	
11. Receiver Remarks:		11A. Design Baseline Document? [X] Yes [] No		12. Major Assm. Dwg. No.: n/a	
				13. Permit/Permit Application No.: n/a	
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(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	HNF-2487	-	0	Project W-320, 241-C-106 Sluicing, Electrical Calculations, Vol. 1	NA			-

16. KEY											
Approval Designator (F)		Reason for Transmittal (G)				Disposition (H) & (I)					
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information				4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)					
		1. Approved 2. Approved w/comment 3. Disapproved w/comment				4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged					
17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
2	1	Design Authority	JW Bailey	7/25/88	S2-48						
		Design Agent	MC Davenport	7/25/90							
2	1	Cog. Eng.	JE Greaves	7/25/88	S2-48						
2	1	Cog. Mgr	JW Bailey	7/25/88	S2-48						
		QA									
		Safety									
		Env.									
18. MC Davenport Signature of EDT Date 7/25/88		19. Authorized Representative for Receiving Organization		20. JW Bailey Design Authority/ Cognizant Manager Date 7/25/90		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments					

8D-7400-172-2 (05/96) GEF097

8D-7400 172-1

Project W-320, 241-C-106 Sluicing Electrical Calculations, Vol. 1

John W. Bailey

Numatec Hanford Co., Richland, WA 99352

U.S. Department of Energy Contract DE-AC09-96RL13200

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Abstract: This supporting document has been prepared to make the FDNW calculations for Project W-320, readily retrievable.

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Karol Broz
Release Approval

8/7/98
Date

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Approved for Public Release

*Coversheet
page 1 of 2*

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Project W-320, 241-C-106 Sluicing Electrical Calculations, Vol. 1

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W320-31-001

Fault Current Analysis

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline ELECTRICAL WO/Job No. W320/ER4289 Calculation No. W320-31-00
Project No. & Name W320 EQUIPMENT REMOVAL SYSTEM
Calculation Item FAULT CURRENT ANALYSIS

These calculations apply to:

Dwg. No. H-2-B20748 SH1 Rev. No. 0
Dwg. No. H-2-B20749 SH1, SH2 Rev. No. 0
Other (Study, CDR) _____ Rev. No. _____

The status of these calculations is:

☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated _____)
☐ Void Calculation (Reason Voided _____)

Incorporated in Final Drawings?

☒ Yes☐ No

This calculation verified by independent "check" calculations?

☒ Yes☐ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	<i>J. Del Rosario</i> 2/25/94		
Checked by	<i>Dan Larson</i> 5/27/94		
Approved by	<i>J. Krasnyk</i> 8/31/94		
Checked Against Approved Vendor Data	<i>J. Krasnyk</i> 7/24/98		

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6	ONE LINE DIAGRAM, PER UNIT IMPEDANCE DIAGRAM
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9, 10	SUMMARY OF Z_{EX} , MVA P_{EX} , I_{EX} , CB CLEARING TIME, MT, TDT, FINDINGS & CONCLUSIONS
APPENDICES A-1 THRU A-7	3 ϕ FAULT CALC. BY UTILITIES, COND. MELTING CURVE, INS. THERMAL DAMAGE CURVE/ BREAKER TIME CURRENT CURVES.

DESIGN VERIFICATION SCREENING CRITERIA

Project/Document No. W320 / W320-31-001

When the design or design change affects hardware, formal design verification must be performed if one or more of the following questions must be answered affirmatively (YES).

YES

NO

_____	✓
_____	1. Does the design or design change involved meet the established criteria to be considered Safety Class 1?
_____	✓
_____	2. Does this design or design change cause or permit changes to Safety Class 1 instrument or alarm setpoints outside of previously approved operational limits?
_____	✓
_____	3. Does this design or design change significantly affect the nuclear or environmental safety consequences of a malfunction or failure of the structure, system, or component?
_____	✓
_____	4. Does this design or design change involve or change design that has previously undergone formal design verification?

Assigned Lead Engineer

7/17/94

Date

Responsible Discipline Manager_____
Date

Original Design Package Distribution:

Project Manager

Design Verification Officer

Engineering Document Control

Design Change Distribution:

Attach to Engineering Change Notice

HNF-2487, Rev. 0

Page A-3

DESIGN ANALYSIS

Calc. No. W 320 - 31 - 001

Revision 0

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Client W4C WO/Job No. ER 4285
Subject FAULT CURRENT ANALYSIS, Date 2/25/94 By J.C. DEL ROSARIO
FEEDER CABLE & CB SIZING Checked 5/27/94 By D.E. Larson
Location TANK FARM C, 200 EAST AREA Revised By

1. OBJECTIVE: THE PURPOSE OF THIS CALCULATIONS IS TO SUPPORT W320 TANK 241-C-106 IN-TANK EQUIPT, REMOVAL PHASE. THE MAXIMUM FAULT CURRENTS THAT THE CIRCUIT BREAKER WILL BE REQUIRED TO INTERRUPT WILL BE DETERMINED TO PROPERLY SELECT THE CIRCUIT BREAKERS THAT WILL PROTECT THE FEEDER CABLES.

2. REFERENCES:

- A. G.E. INDUSTRIAL POWER SYSTEM COORDINATION
B. WEST, CATALOG 55-000 10TH ED. 1991-1992
C. 1993 NEC
D. 3 ϕ FAULT CALC. AT TANK FARM - FROM ELECTRICAL UTILITIES ENG'G.
E. INDUSTRIAL POWER SYSTEM HANDBOOK BY BEEMAN
F. GE CB T-C CURVES G. CU COND MELTING TEMP. H. CABLE SC WITH STAND CURVES

3. DATA:

LOAD DATA

HPPT- HIGH PRESS. PUMP TRLR - (ELEG SYST BY W4C/VENDOR) INFO FURNISHED BY W4C

MAIN PUMP MOTOR - 100HP, 3 ϕ , 480V - 124ABOOSTER PUMP - 2 HP, 3 ϕ , 480V - 3.4AHOSE REEL MOTOR - 2 HP, 3 ϕ , 480V - 3.4AOTHER LOADS 3 ϕ , 480V - 0.5A

TOTAL CONNECTED LOAD - 127.9A

ONE USED AT
A TIME
AMPACITIES
FROM NEC

100HP MAIN PUMP MOTOR HAS 150A BRANCH CB & 200A FUSES INSTALLED BY THE PUMP AND CONTROLLER VENDOR TO LIMIT THE STARTING & RUNNING CURRENT INPUT TO THE VARIABLE FREQUENCY CONTROLLER. THE 100HP INDUCTION MOTOR WILL BE STARTED AT LOW SPEED (AND STARTING CURRENT), THEN ACCELERATED TO REQUIRED PUMP OPERATING SPEED.

SBT STRONG BACK TRAILER - 50A, (ESTIMATE)
LATEST INFO FROM WEST. IS THAT 2-10HP, 3 ϕ , 480V MOTORS WILL ALTERNATELY BE USED. THE OTHER LOADS ARE NOT YET AVAILABLE.

SPT - SINGLE PHASE TRANSFORMER BANK - 1-50KVA, 1 ϕ , 480-120/240V FOR CONSTRUCTION TRAILERS

70A, 120/240V, 1 ϕ SERVICES FOR 3 TRAILERS FOR KEH CONSTRUCTION FORCES.

3- CONSTRUCTION TRAILERS @ 15KVA CONN. LOAD EA = 45 KVA.

DESIGN ANALYSIS

Calc. No. W 320-31-00

Revision 0

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Client WHC

WO/Job No. ER 4285

Subject FAULT CURRENT ANALYSIS

Date 2/25/94

By J. C. DEL ROSARIO

FEEDER CABLE & CB SIZING

Checked 5/27/94

By Dan Larson

Location TANK FARM C, 200 EAST AREA

Revised

By

3. DATA

CABLES:

- a) 13.8KV PRIMARY - 3-1/2 #2 AWG, CU, 15KV INS, IN 3" STL C
 b) 480V SECONDARY - 3/0 CU, TYPE MC (STEEL ARMOR)
 WITH GED COND, DIRECT BURIAL

CABLE SIZE 2(L-N)R FROM TO LENGTH 2(L-N) REMARKS
 TAG ID (AWG) PER-1000 FT REF A P 35/36 (FT) OHMS

13.8KV #2 .210 POLE E02ST TRANSF 400 .084 R

480V 2-350 .027 TRANSF TI CDDP-1 50 .00135 R
 SEC KCMIL

IT 2/0 .11 CDDP-1 CT 400 .044 R

HPP 4/0 .0745 CDDP-1 HPP 400 .103 R

SBT 2 .207 CDDP-1 SBT 500 .104 R

SRT 1/0 .135 CDDP-1 SPT 70 .01 R

ST 4 .325 SPT ST 50 .016 R

SHORTEST RUN

• SEE DWGS. H-2-820740 SH1 & SH2 FOR CABLE LENGTH

13.8KV 3φ TRANSF - Z_L PU REFA P 22

DRY-TYPE 50KVA, 1φ, 600 CLASS TRANSF FOR CONST TRAILER

FULL WINDING %R, %X, %Z REF E TABLE 1.17 P 96

%R = 1.3% , %X = 2.2% %Z = 2.6%

HALF WINDING (120V) %R, %X REF E P 748 TS

%R_{HALF WDG} = 1.44 x 1.3 = 1.87% , %X_{HALF WDG} = 1.2 x 2.2 = 2.64%

%Z_{HW} = $\sqrt{(1.87)^2 + (2.64)^2}$ = 3.2% = TRANSF. IMPEDANCE OF 120V WINDING

PAD MOUNTED TRANSF. BANK 3φ MVA = .225 MVA

%Z = 4.43 ON .225 MVA BASE (FROM TRANSF NAMEP

DESIGN ANALYSIS

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Client <u>WHC</u>	WO/Job No. <u>ER 4289</u>
Subject <u>FAULT CURRENT ANALYSIS,</u>	Date <u>2/25/94</u> By <u>J.C. DEL ROSARIO</u>
<u>FEEDER CABLE & CB SIZING</u>	Checked <u>5/27/94</u> By <u>Dan Larson</u>
Location <u>TANK FARM C, 200 EAST AREA</u>	Revised _____ By _____

4. METHOD OF CALCULATIONS :

MANUAL METHOD USING PER UNIT FAULT CURRENT CALCULATIONS
PER REFERENCE A.

5. FORMULAS

PER UNIT IMPEDANCES ON MVA BASE

UTILITY SYSTEM :

$$Z_{UT. SYST} \text{ IN PER UNIT} = \frac{\text{MVA BASE}}{\text{MVA SC UTILITY SYSTEM}} \quad \text{REF A P31}$$

FEEDER CABLE :

$$\begin{aligned} Z_{PU} (L-N), \text{ FDR} &= \frac{Z_{OHM} (L-N) \times \text{KVA BASE}}{\text{KV}^2 \times 1000} \quad \text{REF A} \\ &= Z_{OHM} (L-N) \left(\frac{\text{MVA BASE}}{\text{KV}^2} \right) \end{aligned}$$

TRANSFORMER :

$$Z_{T \text{ IN PER UNIT ON 10 MVA BASE}} = Z_{T \text{ pu on own MVA}} \times \frac{\text{MVA BASE}}{\text{MVA T}} \quad \text{REF A P34}$$

MOTOR :

$$Z_M \text{ IN PER UNIT ON 10 MVA BASE} = Z_{M \text{ pu on own MVA}} \times \frac{\text{MVA BASE}}{\text{MVA m}} \quad \begin{matrix} Z_{M \text{ pu}} (\text{REF A p21}) \\ \text{on motor} \\ \text{base} \end{matrix} \quad \text{REF A P33}$$

$$\begin{aligned} Z_{FX} &= \sum Z_{\text{PER UNIT FROM UTILITY SYSTEM TO POINT OF FAULT}} \\ &= Z_{UT. SYST} + Z_T + Z_{FDR} \end{aligned}$$

WHERE F1 = FAULT AT PDP (POWER DIST. PNL) BUS

F2 = FAULT AT HPP

F3 = FAULT AT CT CB LOAD SIDE

F4 = FAULT AT SBT CB

F5 = FAULT AT SPT PRIMARY SIDE OF SPT

F6 = FAULT AT ST (SERVICE TRAILERS)

$$\text{MVA}_{FX} = \frac{\text{MVA BASE}}{Z_{FX}} = \text{SHORT CIRCUIT MVA AT POINT OF FAULT FX} \quad \text{REF A P37}$$

$$I_{FX} (\text{KA}) = \frac{\text{MVA}_{FX}}{\sqrt{3} \text{ KV}} \quad \text{WHERE KV = PREFault VOLTAGE IN KILOVOLTS AT POINT OF FAULT}$$

DESIGN ANALYSIS

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Client W.H.C. WO/Job No. ER 4289
Subject FAULT CURRENT ANALYSIS Date 2/25/92 By J.C. DEL ROSARIO
FEEDER CABLE & CB SIZING Checked 5/27/94 By Don Jones
Location TANK FARM C, 200 EAST AREA Revised _____ By _____

5. FORMULAS

WHERE: $MVA_{BASE} = 10$ (CHOSEN BASE - SEE REF A)
 $MVA_{SC} = 50$ (ELECT. UTILITIES CALC - REF D)
 $KV =$ PREFault VOLTAGE IN KILOVOLT AT POINT OF CALCULATION.

$Z_{LNM} (L-N) =$ LINE TO NEUTRAL IMPEDANCE OF FEEDER CABLE IN OHMS

Z_{FDR} IN P.U. = FEEDER CABLE (L-N) PER UNIT IMPEDANCE ON 10 MVA BASE

$\%Z_T =$ TRANSF. % IMPEDANCE ON ITS OWN MVA

Z_T IN P.U. = TRANSF. PER UNIT IMPEDANCE ON 10 MVA BASE

$\%Z_m =$ MOTOR % IMPEDANCE ON ITS OWN MVA

Z_m IN P.U. = MOTOR PER UNIT IMPEDANCE ON 10 MVA BASE

$$Z_{UT \text{ SYST IN P.U.}} = \frac{MVA_{BASE}}{MVA_{SC} (UT. SYST)} \quad P3$$

NOTE THAT $Z_{UT \text{ SYST P.U.}}$ DECREASES AS THE AVAILABLE SC, MVA_{SC} FROM UTILITY SYSTEM INCREASES. FOR INFINITE UTILITY BUS $Z_{UT \text{ SYST}}$ IS IGNORED. ($Z_{UT} = 0$)

FOR INFINITE UTILITY BUS:

$$MVA_{FI} = \frac{MVA_{BASE}}{Z_{FI}} = \frac{MVA_{BASE}}{Z_{UT \text{ SYST}} + Z_T (P.U.)} = \frac{MVA_{BASE}}{Z_T (P.U.)} \quad P3$$

(AT PDP SEC. BUS) $\uparrow (Z_{UT} = 0)$
13.8 KV LINE IMPEDANCE IS NEGLECTED.

$$MVA_{FI} = \frac{MVA_{BASE}}{\frac{\%Z_T}{100} \left(\frac{MVA_{BASE}}{MVA_T} \right)} = \frac{MVA_T}{\frac{\%Z_T}{100}} = \frac{MVA_T}{Z_T (P.U.)} \quad P3$$

FAULT MVA_{FI} AT TRANSFORMER SECONDARY TERMINAL (FI) NEGLECTING $Z_{UT \text{ SYST}}$ (INFINITE UTILITY BUS) IS DIRECTLY PROPORTIONAL TO THE BANK CAPACITY AND INVERSELY PROPORTIONAL TO $\%Z_T$ OR $Z_T (P.U.)$

FOR 225 KVA BANK, $MVA_{FI} = \frac{225}{0.443} = 5.08 \text{ MVA}$

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	FAULT CURRENT ANALYSIS	Date	2/25/94
	FEEDER CABLE & CB SIZING	By	J.C. DEL ROSARIO
Location	TANK FARM C 200 EAST AREA	Checked	5/23/94
		By	Don Jensen
		Revised	
		By	

6 CALCULATIONS:

CONSIDER WORST CASE OF SHORT-CIRCUIT CONDITION - 3 ϕ BOLT
FAULT FOR ALL 3 ϕ LOADS AND 120V L-G FAULT FOR 120/240V,
3W CONSTRUCTION TRAILER SERVICE.

$$MVA \text{ BASE} = 10, \quad \frac{MVA \text{ BASE}}{KV^2}, \quad \text{FOR } 480V = \frac{10}{(48)^2} = 43.4$$

$$\text{FOR } 13.8KV = \frac{10}{(13.8)^2} = 0.052$$

PER UNIT IMPEDANCE ON MVA BASE:

$$a) Z_{UTILITY \text{ SYSTEM}} = \frac{MVA \text{ BASE}}{MVA \text{ SC UT. SYST}} = \frac{10}{50} = .2 \text{ PU}$$

$$b) Z_{13.8KV \text{ PRI}} = Z_{OHM(L-N)} \left(\frac{MVA \text{ BASE}}{KV^2} \right) = .084 \times 0.0525 = .0044 \text{ PU}$$

(FROM PG 2) (NEGLIGIBLE)

$$c) Z_{3\phi \text{ TRANSF}} = \frac{\%Z}{100} \times \frac{MVA \text{ BASE}}{MVA_T} = \frac{4.43}{100} \times \frac{10}{2.25} = 1.97 \text{ P.U.}$$

$$d) Z_{1\phi \text{ TRANSF}} = \frac{3.2}{100} \times \frac{10}{.05} = 6.4 \text{ RU.}$$

$$e) Z_{480V \text{ FEEDER CABLES}} = Z_{OHM(L-N)} \left(\frac{MVA \text{ BASE}}{KV^2} \right)$$

$$Z_{SEC(L-N)} = .00135 \times 43.4 = .059 \text{ P.U. (NEGLIGIBLE)}$$

$$Z_{IT(L-N)} = .044 \times 43.4 = 1.91 \text{ PU.}$$

$$Z_{HPP(L-N)} = .03 \times 43.4 = 1.3 \text{ PU.}$$

$$Z_{SBT(L-N)} = .104 \times 43.4 = 4.5 \text{ P.U.}$$

$$Z_{SPT(L-N)} = .01 \times \frac{10}{(48)^2} = .434 \text{ P.U.}$$

$$Z_{ST(L-N)} = 0.016 \times \frac{10}{(.12)^2} = 11.1 \text{ PU.}$$

$$f) Z_{MOTOR \text{ P.U. ON } 10 \text{ MVA BASE}} = Z_{M \text{ PU ON MOTOR BASE}} \times \frac{MVA \text{ BASE}}{MVA_T}$$

MOTOR CONTRIBUTION IS NOT INCLUDED SINCE THE
VARIABLE FREQUENCY CONTROLLER WILL NOT PASS
THE MOTOR CONTRIBUTION TO THE SUPPLY SIDE.

DESIGN ANALYSIS

Client WHC

WO/Job No. ER 4289

Subject FAULT CURRENT ANALYSIS

Date 2/25/94 By J.C. DEL ROSARIO

FEEDER CABLE & CB SIZING

Checked 5/27/94 By Don Larson

Location TANK FARM C, 200 EAST AREA

Revised _____ By _____

ONE LINE DIAGRAM

PER UNIT IMPEDANCE (Z_{pu}) DIAGRAM

DESIGN ANALYSIS

Client WAC

WO/Job No. ER4289

Subject FAULT CURRENT ANALYSIS

Date 2/25/94 By J.C. DEL ROSARIO

FEEDER CABLE & CB SIZING

Checked 5/27/94 By Don Jensen

Location TANK FARM C, 200 EAST AREA

Revised By

100 HP MOTOR WILL NOT PASS MOTOR CONTRIBUTION TO FAULT THRU VARIABLE FREQUENCY CONTROLLER.

FAULT AT CPDR-1 MAIN CB (F1)

$$MVA_{F1} = \frac{10}{Z_{F1}} = \frac{10}{2.17} = 4.61 \text{ MVA}$$

$$I_{F1} = \frac{MVA_{F1}}{\sqrt{3} \times 48} = 5.5 \text{ KA}$$

FAULT AT HPPT (F2)

$$MVA_{F2} = \frac{10}{Z_{F2}} = \frac{10}{3.47} = 2.88 \text{ MVA}$$

$$I_{F2} = \frac{MVA_{F2}}{\sqrt{3} \times 48} = 3.47 \text{ KA}$$

FAULT AT IT (F3)

$$MVA_{F3} = \frac{10}{Z_{F3}} = \frac{10}{4.08} = 2.45 \text{ MVA}$$

$$I_{F3} = \frac{MVA_{F3}}{\sqrt{3} \times 48} = 2.95 \text{ KA}$$

DESIGN ANALYSIS

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Client WHC WO/Job No. ER4289
Subject FAULT CURRENT ANALYSIS Date 2/25/94 By JC DEL ROSARIO
FEDER CABLE & CB SIZING Checked 5/27/94 By Don Farson
Location TANK FARM C 200 EAST AREA Revised By

FAULT AT SBT (F4)

$$MVA_{F4} = \frac{10}{Z_{F4}} = \frac{10}{6.67} = 1.50 \text{ MVA}$$

$$I_{F4} = \frac{MVA_{F4}}{\sqrt{3} \times 48} = \frac{1.50}{\sqrt{3} \times 48} = 1.81 \text{ KA}$$

1Ø FAULT AT ST PRI (F5)

$$MVA_{SPT PRI} = \frac{10}{5.21} = 1.92$$

$$I_{SPT PRI} = \frac{1.92}{\sqrt{3} \times 48} = 4.0$$

$$MVA_{F5} = \frac{10}{Z_{F5}} = \frac{10}{22.72} = .44 \text{ MVA}$$

$$I_{F5} = \frac{MVA_{F5}}{\sqrt{3} \times 48} = \frac{.44}{\sqrt{3} \times 48} = 3.67 \text{ KA}$$

STANDBY GENERATOR:

AVAILABLE MVA_{SC} AT GEN. POWER WIREWAY WITH 275KW (.344 KVA) STANDBY GEN WITH 60' - 3/4 350 KCMIL FEEDER TO WIREWAY ASSUME $Z_{gen} = 15\%$
 $MVA_{SC GEN} = .344 / .15 = 2.29 \text{ MVA}$, $Z_{PU GEN} = \frac{10 \text{ MVA BASE}}{2.29} = 4.366$

$$Z_{\Omega} \text{ OF } 60' \text{ 3/4 350 KCMIL} = .06 \times .21 = .0126 \Omega$$

$$Z_{PU} = .0126 \times 43.4 = .547 \text{ PU}$$

$$Z_{TOTAL (GPN)} \text{ AT WIREWAY} = Z_{PU (GEN)} + Z_{PU (FEEDER)} = 4.36 \text{ PU} + .547 \text{ PU} = 4.9 \text{ PU AT THE WIREWAY}$$

$$MVA_{SC} \text{ AT THE WIREWAY} = \frac{10 \text{ MVA BASE}}{4.9} = 2.04 \text{ MVA}$$

$$\text{STANDBY GEN } I_{GPN} \text{ (KA)} = \frac{2.04}{\sqrt{3} \times 480} = 2.46 \text{ KA (RMS 5 min)}$$

DESIGN ANALYSIS

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Client WHC WO/Job No. ER 4289
Subject FAULT CURRENT ANALYSIS Date 2/25/94 By J.C. DEL ROSARIO
FEEDER CABLE & CB SIZING Checked 5/2/94 By Jim Farrow
Location TANK FARM C Revised By

SUMMARY OF 3Ø SHORT CIRCUIT MVA (MVA_{SC})
FAULT CURRENTS IN KILOAMPS (KA_{SC}) AND
PER UNIT IMPEDANCE (Z_E P.U.) AT POINT OF FAULT.
BASED ON NORMAL POWER (13.8KV TRANSF)
SOURCE.

NORMAL: 480 VOLT 3Ø									120/240V, 1Ø		
FAULT LOCATION UNITS	PDP MAIN/CB	F1	HPPT	F2	IT	F3	SBT	F4	FAULT LOCATION UNITS	ST	F5
ZF PU (L-N)	2.17		3.47		4.08		6.67		ZF PU (L-L)	22.72	
MVA _{SC}	4.61		2.88		2.45		1.50		MVA _{SC}	1.44	
KA _{SC} (L-L)	5.5		3.47		2.95		1.81		KA _{SC} (L-L)	3.47	

275KW / 344 KVA STANDBY GEN	MVA _{SC}	Z _{TOTAL} @ GPN IN P.U.	I _{SC} @ GPN IN KA	REMARKS
	2.04	4.9	2.48	GEN. I _{SC} = 2.46KA NORM. PWR I _{F1} = 5.5 KA USED 10KA CBS.

BREAKER CLEARING TIME (CT) USING G.E MOLDED
CASE CIRCUIT BREAKERS TO PROTECT FEEDER
CABLES TO TRAILERS, GROUND CONDUCTOR MELTING
TIME (MT) FOR GROUND FAULT CURRENT MAGNITUDE
ASSUMED EQUAL TO 3Ø FAULT, INSULATION WITHSTAND
TIME (THERMAL DAMAGE TIME IN SEC - TDT ARE
SUMMARIZED BELOW:

①		② $\frac{1 \times 1000}{(2)}$		A-4, A-5, A-6		A-2	A-3	REMARKS
LOAD (FAULT, Fx)	FAULT KA	CB TRIP	MULT. OF TRIP	WIRE SIZE PHASE	GRD	CB CT (S)	GRD WIRE MT (S)	
HPPT (F2)	4	225	18	3/0	4	A-4 (10325)	> 10S	OK
IT (F3)	3	175	17	2/0	6	A-4 (10305)	> 10S	OK
SBT (F4)	2	100	20	2	6	A-5 (10215)	3.5	OK
SPT -	4 SEE EPT. PG	150	25	1/0	6	A-6 (1025)	1.9	OK
ST (F5)	3.67	70	52	4	6	A-5 (50195)	1.1	OK

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	FAULT CURRENT ANALYSIS	Date	2/25/94
	FEEDER CABLE & CB SIZING.	By	J.C. DEL ROSARIO
Location	TANK FARM C	Checked	5/27/94
		Revised	By

5. FINDINGS AND CONCLUSIONS:

THE SUMMARY OF 30 FAULT CURRENTS SHOWS MAXIMUM FAULT OF APPROXIMATELY 5.5 KA AT THE 22.5 KVA TRANSFORMER SECONDARY TERMINALS. THE FAULT MAGNITUDE VARIES FROM 1.81 TO 3.47 KA AT THE DIFFERENT ER TRAILERS, AT THE NEAREST CONSTRUCTION TRAILER FAULT ACROSS THE 120VAC TERMINALS IS 3.67 KA.

MOLDED CASE CB WITH MINIMUM INTERRUPTING RATING OF 10 KA AT 480V SHALL BE USED. THE TRANSFER SWITCHES SHALL HAVE THE SAME INTERRUPTING RATING AS THE CB'S. THE USE OF HIGHER IC ON THE RE-USABLE TRANSFER SWITCHES/ BREAKERS SKID WILL PERMIT ITS USE ON LOCATIONS WITHIN ITS IC DUTY. FOR THE SINGLE PHASE 120/240 TRAILERS 240V 2P MOLDED CASE CB'S WITH 5 KA INTERRUPTING RATINGS SHALL BE USED.

THE BREAKERS WILL CLEAR THE FAULT BEFORE INSULATION ARE DAMAGED DUE TO OVERHEATING AND THE GROUND CONDUCTORS MELT AS INDICATED IN THE TABLE SUMMARIZING BREAKER CLEARING TIME, INSULATION THERMAL DAMAGE TIME AND GROUND WIRE MELTING TIME.

3-Phase Fault Duty at AY Tank Farm. Fault duty is calculated at the 13.8kV side of the 3-25KVA transformers.

$$I_f := 2200\text{-amp} \quad X_R := 2.97$$

Three phase fault current and X/R ratio at point previously calculated (node 6500 of H-2-818278 Sheet 6, Rev.0).

$$MVA_B := 100 \cdot 10^6 \cdot \text{volt} \cdot \text{amp} \quad kV_B := 13.8 \cdot 10^3 \cdot \text{volt}$$

$$I_B := \frac{MVA_B}{\sqrt{3} \cdot kV_B} \quad Z_B := \frac{kV_B^2}{MVA_B}$$

$$\begin{aligned} Z_9 &:= 0.00841 + 0.01846j & Z_{10} &:= 0.01137 + 0.02497j \\ Z_{96} &:= 0.01256 + 0.01893j & Z_{97} &:= 0.02746 + 0.04141j \\ Z_{126} &:= 0.12516 + 0.03578j \end{aligned}$$

Positive sequence impedances of line segments between the calculation point and the point of previous calculation.

$$Z_{pu} := \left(\frac{I_f}{I_B} \right)^{-1}$$

$$Z_{FB} := \sqrt{\frac{Z_{pu}^2}{1 + X_R^2} + X_R} \cdot \sqrt{\frac{Z_{pu}^2}{1 + X_R^2}} j$$

Per unit impedance at the upstream fault box.

$$Z_{Tpu} := Z_{FB} + Z_9 + Z_{10} + Z_{96} + Z_{97} + Z_{126}$$

$$I_{Tpu} := (Z_{Tpu})^{-1}$$

$$Z_{Tpu} = 0.79178 + 1.94181j$$

Total positive sequence per unit impedance at calculation point (100MVA base).

$$F_{3\phi} := I_{Tpu} I_B$$

$$F_{3\phi} = 1.99505 \cdot 10^3 \cdot \text{amp}$$

13.8 kV three phase fault current at calculation point.

Overcurrent Effects in Bare Conductors

Nov. 17, 1958

Constant— I^2t Characteristics for Copper Conductors to Reach the Melting Temperature

Notes: These characteristics permit close estimates for the conditions and assumptions below:

1. Currents are in terms of constant rms values which may be a-c or d-c for the assumptions named.
2. Heat dissipation is neglected.
3. Resistance of 1 cm cube of copper at 0 C is 1.589 microhms.
4. Temperature coefficient of resistance of copper per degree C is $1/234$.
5. Melting temperature of copper is 1083 C.
6. Starting temperature of copper is 40 C.

(Photo 1104129)

Fig. 1. Times required for overcurrents to produce stored-heat melting temperatures in uncooled copper conductors*

* Data taken from the Standard Handbook for Electrical Engineers, 9th Edition.

OVERCURRENT DEVICE COORDINATION TIME-CURRENT CHARACTERISTIC CURVES

JOB TITLE:

LOCATION:

CURVES DRAWN FROM INSULATED POWER CABLE ENGINEERS ASSOCIATION PUBLICATION P-32-382.

DWG. NO:

DATE:

AB DE-ION® CIRCUIT BREAKERS

Types JB and KB MARK 75® Type HKB

Application Data
29-161

W320-31-001

APPENDIX A-4

70-250 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
250 Volts Dc

CURRENT IN PERCENT OF BREAKER TRIP UNIT RATING

REF. F2

AB DE-ION® CIRCUIT BREAKERS

Application Data
29-161

W 320-31-001

Types EB, EHB, FB, MARK 75® HFB

APPENDIX A-5

Type EB: 50-70 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Type EHB: 50-70 Amperes, 2 and 3 Poles, 480 Volts Ac Max.
Type FB: 50-70 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
Type HFB: 50-70 Amperes, 2 and 3 Poles, 600 Volts Ac Max.

CURRENT IN PERCENT OF BREAKER TRIP UNIT RATING

AB DE-ION® CIRCUIT BREAKERS

Types EB, EHB, FB, MARK 75® HFB

APPENDIX A-6

Type EB: 90-100 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Type EHB: 90-100 Amperes, 2 and 3 Poles, 480 Volts Ac Max.
Type FB: 90-150 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
Type HFB: 90-150 Amperes, 2 and 3 Poles, 600 Volts Ac Max.

From IEEE Buff Book IEEE 242 1986

ANSI/IEEE
Std 242-1986

CHAPTER 2

Table 14
Impedance Data for Single-Phase Transformers

kVA 1 ϕ	Suggested X/R Ratio for Calculation	Normal Range of Percent Impedance (%Z)*	Impedance Multipliers**	
			for Line-to-Neutral Fault for %X	for %R
25.0	1.1	1.2-6.0	0.6	0.75
37.5	1.4	1.2-6.5	0.6	0.75
50.0	1.6	1.2-6.4	0.6	0.75
75.0	1.8	1.2-6.6	0.6	0.75
100.0	2.0	1.3-5.7	0.6	0.75
167.0	2.5	1.4-6.1	1.0	0.75
250.0	3.6	1.9-6.8	1.0	0.75
333.0	4.7	2.4-6.0	1.0	0.75
500.0	5.5	2.2-5.4	1.0	0.75

* National standards do not specify %Z for single-phase transformers. Consult manufacturer for values to use in calculation.

** Based on rated current of the winding (one-half nameplate kVA divided by secondary line-to-neutral voltage).

2.2.2 Calculation Method. Two methods of making short-circuit calculations are presented. They are identified as the *direct method* and the *per-unit method*. While they represent different calculation concepts, if both use the same data, they produce results of the same degree of accuracy.

The direct method of short-circuit calculation presented here is so designated because, for the most part, it uses the system one-line diagram directly, uses system and equipment data such as volts, amperes, and ohms directly, and uses basic electrical equations and relationships directly without utilizing special diagrams, abstract units, or mathematical techniques.

The per-unit method is more representative of conventional electrical circuit analysis. It involves converting the system one-line diagram into an equivalent impedance diagram and reducing this to a single impedance value. This is best accomplished especially when several voltage levels are involved by using a special mathematical technique that establishes base (or reference) values for volts, current, kVA, and ohms and then refers the actual parameters to these bases in special equations to derive per-unit (or sometimes percent) values. Applying these values in special equations produces the short-circuit values.

For those who do not specialize in short-circuit calculation work, the direct method is usually easier to comprehend since it uses the familiar system one-line diagram and is compatible with the intuitive analogy of water flowing from sources to point of fault. Also, it instills confidence since system and equipment data are applied directly to familiar electrical equations producing recognizable values that can be immediately appraised.

The direct method is particularly adapted to progressive analysis of a whole or portion of a system starting at the source, considering each eschelon step by step, and determining short-circuit values at each location out to the end of the various

W320-31-002

Standby Generator Sizing

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline ELECTRICAL WO/Job No. W320/ER4289 Calculation No. W320-31-002
 Project No. & Name W320 EQUIPMENT REMOVAL SYSTEM
 Calculation Item STANDBY GENERATOR SIZING

These calculations apply to:

Dwg. No. H-2-820748 SH1 Rev. No. 0
 Dwg. No. H-2-820749 SH2 Rev. No. 0
 Other (Study, CDR) _____ Rev. No. _____

The status of these calculations is:

☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated _____)
☐ Void Calculation (Reason Voided _____)

Incorporated in Final Drawings?

☒ Yes ☐ No

This calculation verified by independent "check" calculations?

☒ Yes ☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	<i>Glenn Brown</i> 3/30/94		
Checked by	<i>Dan Larson</i> 5/27/94		
Approved by	<i>Maanik</i> 8/31/94		
Checked Against Approved Vendor Data	<i>J. Maanik</i> 7/24/95		

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<u>5</u>	<u>DATA, ASSUMPTIONS</u>
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DESIGN VERIFICATION SCREENING CRITERIA

Project/Document No. W320 / W320-31-002

When the design or design change affects hardware, formal design verification must be performed if one or more of the following questions must be answered affirmatively (YES).

YES

NO

_____ ✓

1. Does the design or design change involved meet the established criteria to be considered Safety Class 1?

_____ ✓

2. Does this design or design change cause or permit changes to Safety Class 1 instrument or alarm setpoints outside of previously approved operational limits?

_____ ✓

3. Does this design or design change significantly affect the nuclear or environmental safety consequences of a malfunction or failure of the structure, system, or component?

_____ ✓

4. Does this design or design change involve or change design that has previously undergone formal design verification?

 Assigned Lead Engineer

7/19/94

 Date

 Responsible Discipline Manager

 Date

Original Design Package Distribution:

Project Manager

Design Verification Officer

Engineering Document Control

Design Change Distribution:

Attach to Engineering Change Notice

 HNF-2487, Rev. 0
 Page B-2

Subject Calculation No. W320-31-002

Page ii of iii[illegible]

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	STANDBY GENERATOR SIZING	Date	3/30/94 By J.C. DEL ROSARIO
		Checked	5/23/94 By Tom Jorann
Location	TANK FARMS C.RAY 200 EAST AREA	Revised	By

I OBJECTIVE:

DETERMINE THE MINIMUM REQUIRED CAPACITY OF THE TEMPORARY GENERATOR ADEQUATE TO SUPPORT A 2 WEEK EQUIPMENT REMOVAL OPERATION TO BE PERFORMED IN AUGUST BEFORE THE START OF THE SLICING PHASE

II REFERENCES / SOURCES:

1. WESTINGHOUSE INSTR. TLR DWG H-2-78535 (APPENDIX A-7)
2. WESTINGHOUSE HIGH PRESS. PUMP RATING & PROT (APPENDIX A-8)
3. KOHLER PRINTOUT OF GENERATOR CALCULATIONS & SPECS USING QUICKSIZE VERSION 5.1 SOFTWARE,
4. INDUSTRIAL POWER DISTRIBUTION SYSTEM HDBK BY BEEMAN
5. MOTOR EFFICIENCIES & MOTOR NEMA CODE DESIGNATIONS FROM CATERPILLAR GEN. CATALOG,
6. GENERATOR CORRECTION FACTOR DUE TO ALTITUDE (SEE ORANGE BOOK)

III DATA:

ELEVATION OF SITE — 300 FT

LOCATION MAX. TEMPERATURE = 50°C (122°F)

DIRECTIVE TO INSTALL STANDBY GENERATOR — GIVEN BY CHARLES O'NEILL, I REQUESTED FOR ITS INCLUSION OF GENERATOR REQUIREMENT IN LOI

CONSTRUCTION GROUP TO FURNISH / LEASE THE GENERATOR PER C. O'NEILL

LOADS: SEE REF. 1, 2 AND PAGES 2 & 3 OF CALC.
W320-31-03

1. HIGH PRESSURE PUMP (HPP) 100 HP, 3Ø, 460V

2. INST. TRAILER — 75 KW
AND 1-12.5HP 460V MOTOR

3. STRONG BACK TRAILER WITH REDUNDANT 10 HP, 3Ø, 460V HYD. PUMP — ONE SHALL BE OPERATED AT A TIME.

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	STANDBY GENERATOR SIZING	Date	8/30/94
		By	J.C. DEL ROSARIO
		Checked	5/27/94
		By	Don Farrow
Location	TANK FARMS C & AY 200 EAST AREA	Revised	
		By	

III DATA : CONTINUED

A DIESEL GENERATOR SHALL SUPPLY STANDBY POWER TO THE EQUIPMENT REMOVAL TRAILERS (LOADS) SHOULD THE NORMAL POWER LOSS OCCUR DURING THE EQUIPMENT REMOVAL OPERATION.

THE STANDBY GENERATOR WILL BE MANUALLY STARTED AFTER THE FEEDER CBS IN THE TRANSFER SWITCH BREAKERS SKID ARE CHECKED TO BE IN OPEN POSITION.

THE TRANSFER SWITCH FOR HPPT IS MANUALLY SWITCHED TO THE STANDBY GENERATOR. THE HPP-FB IS CLOSE STANDBY GENERATOR POWER IS SIMILARLY TRANSFERRED IN STEPS TO THE INSTRUMENT TRAILER AND THEN TO THE STRONG-BACK TRAILER.

IV ASSUMPTIONS:

1. THE HPPT IS STARTED FIRST, AFTER THE GENERATOR HAS ATTAINED SPEED TO RECEIVE FULL LOAD. MAXIMUM GEN. VOLTAGE DIP DUE TO STARTING OF THE LARGEST MOTOR (100HP) IS LIMITED TO 20% OF GEN. VOL.
2. WORST HPPT INDUCTION MOTOR STARTING CONDITION IS ASSUMED - HPPT IS STARTED AT FULL SPEED (THAT THE 200A FUSES AT THE DISCONNECT SWITCH & THE SETTING OF THE 250AF VARIABLE FREQUENCY DRIVE WILL PASS THIS STARTING CURRENT). 100HP IS FULLY LOADED.
3. NO DEMAND FACTOR IS APPLIED ON ANY OF THE LOADS. CONNECTED LOADS ARE USED IN THE CALCULATIONS.

4. TRAILER MOTOR LOAD DATA:

LOAD	EFF.	PF _R	NEMA CODE LETTER	KVA/HP	PF _S
100HP HPP	.92	.80	F	5.6	.30
12.5HP PUMP	.89	.80	G	6.29	.53
10 HP	.89	.80	G	6.29	.53

5. OTHER INSTRUMENT TRAILER LOADS - 2.25KVA, 0 TRANSFORMER. ASSUMED 75 KVA BALANCED 3Ø LOAD, 85%

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	STANDBY GENERATOR SIZING	Date	3/30/94
		By	J.C. DEL ROSARIO
		Checked	5/27/94
		By	Don Farrow
Location	TANK FARMS CLAY 200 EAST AREA	Revised	
		By	

V CALCULATIONS: (MANUAL)

$$(A) KWR (RUNNING) = \frac{HP \times .746}{EFF}$$

$$KWR (100 HP) = \frac{100 \times .746}{.92} = 81 KWR$$

$$KWR (12.5 HP) = \frac{12.5 \times .746}{.89} = 10.5 KWR$$

$$KWR (10 HP) = \frac{10 \times .746}{.89} = 8.4 KWR$$

$$(B) KVAR (RUNNING) = \frac{KWR}{PFR}$$

WHERE $PFR = \text{RUNNING PF}$

$$KVAR (100 HP) = 81 / .80 = 101 KVA$$

$$KVAR (12.5 HP) = 10.5 / .80 = 13 KVA$$

$$KVAR (10 HP) = 8.4 / .80 = 10.5 KVA$$

$$(C) KVA_S (STARTING) = HP \times KVA / HP$$

$$KVA_S (100 HP) = 100 \times 5.6 = 560 KVA$$

$$KVA_S (12.5 HP) = 12.5 \times 6.29 = 78.63 KVA$$

$$KVA_S (10 HP) = 10 \times 6.29 = 62.9 KVA$$

Client	W H C	WO/Job No.	ER 4289
Subject	STANDBY GENERATOR SIZING	Date	3/30/94 By J.C. DEL ROSARIO
		Checked	5/27/94 By Dan Jensen
Location	TANK FARMS C & A Y, 200 EAST AREA Revised		

IV CALCULATIONS (CONT)

$$(D) \text{ KWS (STARTING)} = \text{KVA}_R \times \text{PF}_S$$

$$\text{KWS (100HP HPT)} = 560 \times .3 = 168 \text{ KW}$$

$$\text{KWS (12.5HP HYD.PP)} = 72.63 \times .53 = 41.67$$

$$\text{KWS (10HP STB HYD.PP)} = 62.9 \times .53 = 33 \text{ KW}$$

(E) FROM REF 4 FIG 4.42 %KVA_S OF MOTOR X GEN KVA
 FOR 20% DIP (0 INITIAL LOAD), RATED GEN VOLTAGE = 1.
 FOR 250 KVA GEN THIS IS = $250 \times 1.7 = 425 \text{ KVA}$
 USE KOHLER 200R02D. MAX. KVA_S @ 20% DIP = 560 KVA

(F) SUMMARY OF RESULTS:

STEP	LOAD	PFR	KWR	RKVAR	KVAR	PF _S	KWS	RKVA _S	KVA _S	% DIP
STEP 1	100HP HPT	.80	81	60.6	101	.30	168	543	560	20%
STEP 2	12.5HP HYD.PP	.80	10.5	7.8	13.0	.53	41.67	66.68	78.63	
	MISC INSTR.	.85	64.5	4.0	76	.85	64.5	40	76	
	TRUCK LOAD									
STEP 2 - TOTALS ONLY		.84	75	47.8	89	.70	106.17	106.68	150.5	
STEP 2 + STEP 1 STEADY STATE		.82	156	108.4	190	.746	187.17	107.28	251	8.96
STEP 3 ONLY	10 HP STB PP	.80	8.4	6.3	10.5	.53	33	53.3	62.9	
STEP 3 + STEP 2 STEADY STATE		.82	164.44	114.7	200.49	.76	189	161.7	248.73	8.89

G. GENERATOR DERATING DUE TO ALTITUDE 300F
 & AMBIENT TEMP (20°F) = .99 (KOHLER QUICKS)
 ALSO SEE REF. C

$$200 \text{ KW GEN DERATED RATING} = 198 \text{ KW}$$

$$H. \% \text{ OF DERATED CAPACITY USED} = \frac{164.44}{198} \times 100 = 83$$

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	STANDBY GENERATOR SIZING	Date	3/30/94
		By	J.C. DEL ROSARIO
		Checked	5/21/94
		By	Don Jensen
Location	TANK FARMS C&AY 200 EAST AREA	Revised	
		By

DESIGN ANALYSIS

Calc. No. W 320-31-00
Revision 0
Page No. 6 of 6

Client	<u>W/HC</u>	WO/Job No.	<u>ER4289</u>	
Subject	<u>STANDBY GENERATOR</u>	Date	<u>3/30/94</u>	By <u>J.C. DEL ROSARIO</u>
	<u>SIZING</u>	Checked	<u>5/21/94</u>	By <u>Don Foren</u>
Location	<u>TANK FARMS C & AY, 200 EAST AREA</u>			

FINDINGS & CONCLUSIONS:

THE SUMMARY OF RESULTS & THE LOAD PROFILE SHOW A STEADY STATE (RUNNING) LOAD OF 164.44 KW OR 200 KVA LOAD AT 82% PF. MAXIMUM STARTING KVA (560) OCCURS DURING FULL SPEED START OF 100HP HIGH PRESSURE PUMP CAUSING MAXIMUM VOLTAGE DIP OF 20%. (ALLOWABLE VOLTAGE DIP IS UP TO 30%)

A 200 KW GENERATOR (DERATED TO 198 KW), 250 KVA AT 80% PF WILL BE SUFFICIENT TO SUPPLY THE EQUIPMENT REMOVAL LOADS AND LIMIT THE VOLTAGE DIP TO LESS THAN 20% IF STARTED IN 3 STEPS AS SHOWN IN THE SUMMARY OF RESULTS.

KOHLER GENERATOR COMPUTER CALCULATIONS USING "QUICKSIZE 5.1" SOFTWARE IS ALSO ATTACHED FOR COMPARISON. (APPENDIX A-6)

DIESEL GENERATOR PRESENTLY IN

COLD TEST FACILITY AS OF 8/24/94:

CATERPILAR 3406

275 KW, 344 KVA, 80% PF, 3Ø Y

From REF 4

256 VOLTAGE—STANDARD RATINGS, VARIATIONS, CALCULATION OF DROPS

FIG. 4.42 Restored generator voltage.

Advantages of Voltage Regulators. Figures 4.38, 4.39, and 4.42 show dashed curves, marked *N*, which indicate the results to be expected if no regulator is used. It is apparent that regulators are very beneficial. They practically always justify their cost whenever the starting of large motors is involved. For example, consider a 480-volt 125-kva 1200-rpm generator. From Fig. 4.40 this may have a performance factor *K* of about 1.7 with a regulator. From Fig. 4.39, 110 per cent motor-starting load or 138 kva will cause a 28 per cent voltage dip.

This load would correspond to starting a 25-hp motor at full voltage.

To obtain the same motor-starting performance without a regulator would require a 438-kva generator, because the curve *N* shows that about 32 per cent motor-starting load will cause a 28 per cent voltage drop if no regulator is used. (138 kva is about 32 per cent of 438 kva.) The 438-kva generator would cost over twice as much as a 125-kva machine. The best and least expensive arrangement would be to provide a regulator adding less than 15 per cent to the cost of the 125-kva generator. This would permit successful starting of the 25-hp motor even against full-load torque and would improve normal generator performance.

In Fig. 4.39 are curves, marked *E*, which show the performance available when using an electric excitation system. It is other very high-response limit to the improvement

FROM REF 6

Fig 29
Typical Performance Correction Factor for Altitude

P131

Fig 28
Modular Packaged Gas-Turbine-Generator Set Mounted on Trailer

P131

Fig 19
Induction Motor Open Circuit Voltage Decay
(Based on Constant Speed)

Orin's Book

(4) Generator characteristics are assumed as follows: (a) Generators rated 1000 kVA or less: Performance factor $k = 10$; transient reactance $X_d' = 25\%$; synchronous reactance $X_d = 120\%$. (b) Generators rated above 1000 kVA: Characteristics for 3600 r/min turbine generators.

VOLTAGE CONSIDERATIONS

ANSI/IEEE
Std 141-1986Table 14
Comparison of Motor-Starting Methods

Type of Starter (Settings Given Are the More Common for Each Type)	Motor Terminal Voltage (Percent Line Voltage)	Starting Torque (Percent Full- Voltage Starting Torque)	Line- Current (Percent Full- Voltage Starting Current)
Full-voltage starter	100	100	100
Autotransformer			
80% tap	80	64	68
65% tap	65	42	46
50% tap	50	25	30
Resistor starter, single step (adjusted for motor voltage to be 80% of line voltage)	80	64	80
Reactor			
50% tap	50	25	50
45% tap	45	20	46
37.5% tap	37.5	14	37.5
Part-winding starter (low-speed motors only)			
75% winding	100	75	75
50% winding	100	50	50

NOTE: For a line voltage not equal to the motor-rated voltage, multiply all values in the first and last columns by the ratio (actual voltage)/(motor-rated voltage). Multiply all values in the second column by the ratio [(actual voltage)/(motor-rated voltage)]².

Fig 20
Typical Generator Voltage Behavior Due to
Full-Voltage Starting of a Motor

Motor-starting kVA = 100% of
generator rating
A — No initial load on generator
B — 50% initial load on generator
C — No regulator

Red Book

Solution. Enter the chart on the horizontal scale at 2000 kVA, extend a line vertically to its intersection with the 0.85 power factor curve. Extend a line horizontally from this point to the left to its intersection with the vertical scale. This point on the vertical scale gives the percent voltage drop for rated load. Multiply this value by the ratio of actual load to rated load:

$$\text{percent drop at rated load} = 3.67$$

$$\begin{aligned}\text{percent drop at 1500 kVA} &= 3.67 \cdot \frac{1500}{2000} \\ &= 2.75\end{aligned}$$

$$\begin{aligned}\text{actual voltage drop} &= 2.75\% \cdot 480 \\ &= 13.2 \text{ V}\end{aligned}$$

Figure 19 applies to the 34.5 kV insulation class power transformer in ratings from 1500-10 000 kVA. These curves can be used to determine the voltage drop for transformers in the 46 and 69 kV insulation classes by using appropriate multipliers at all power factors except unity.

To correct for 46 kV, multiply the percent voltage drop obtained from the chart by 1.065, and for 69 kV, multiply by 1.15.

3.11.5 Motor-Starting Voltage Drop. It is characteristic of ac motors that the current that they draw on starting is much higher than their normal running current. Synchronous and squirrel-cage induction motors started on full voltage may draw a current as high as seven or eight times their full-load running current. This sudden increase in the current drawn from the power system may result in excessive drop in voltage unless it is considered in the design of the system. The motor-starting load in kilovolt-amperes, imposed on the power supply system, and the available motor torque are greatly affected by the method of starting used. Table 14 gives a comparison of several common methods.

3.11.6 Effect of Motor Starting on Generators. Figure 20 shows the behavior of the voltage of a generator when an induction motor is started. Starting a synchronous motor has a similar effect up to the time of pull-in torque. The case used for this illustration utilizes a full-voltage starting device, and the full-voltage motor starting load in kilovolt-amperes is about 100% of the generator rating. It is assumed for curves A and B that the generator is provided with an automatic voltage regulator.

Similar to Fig 19

The minimum voltage of the generator as shown in Fig 20 is an important quantity because it is a determining factor affecting undervoltage devices and contactors connected to the system and the stalling of motors running on the system. The curves of Fig 21 can be used for estimating the minimum voltage occurring at the terminals of a generator supplying power to a motor being started.

3.11.7 Effect of Motor Starting on Distribution System. Frequently in the case of purchased power, there are transformers and cables between the starting motor and the generator. Most of the drop in this case is within the distribution equipment. When all the voltage drop is in this equipment, the voltage falls immediately

03/18/94

K O H L E R G E N E R A T O R S

Page: 1

ER4289 STANDBY GENERATOR
Data for model - 200ROZD

03/18/94 08:20:09

GENERATOR DATA

```
*****
Kohler genset model ..... 200ROZD   Liquid cooled
Alternator model ..... 4U13   (OVERSIZE)
Voltage and phase selected ..... 277/480 volts, 3 phase 60 hz
Fuel selected ..... Diesel
Altitude (meters) ..... 300
Temperature (C) ..... 50
Generator's KW Standby rating ..... 200.0
Generator's derated running KW's ..... 197.8
Percent of available KW's used ..... 90 %
Generator's KVA rating..... 250.0
Maximum starting KVA at 20% voltage dip ..... 560.0
Generator's power factor ..... 0.8
*****
```

This generator meets the minimum requirements for a 20% voltage dip
When loads are started as specified by the loads report.
Largest actual voltage dip is 15.0 %

N O T E: When the available KW's used exceeds 85%, please read the
following three notes before you specify this equipment:

1. During actual operation, the sequence of load application may vary from the data you input.
2. If motor code letters were assumed, actual motor starting could vary from the output data.
3. Reserve capacity for abnormal conditions or expansion is limited.

Kohler Company offers the full line of generator sets and accessories as well as other equipment which may be required for this application SUCH AS:

- Automatic Transfer Switches
- Bypass Isolation Switches
- Synchronizing Switchgear
- Weather Proof Housings

If you have any questions regarding this application call your local distributor or the Kohler Company Generator Division, Applications Engineering Department, at 414-565-3381.

03/18/94

KOHLER GENERATORS

Appendix A-6
PAGE: 2ER4289 STANDBY GENERATOR
DATA FOR MODEL - 200ROZD

03/18/94 08:20:09

LOADS REPORT

QTY	RUN KW	RUN KVA	RUN PF	START KW	START KVA	DESCRIPTION
STEP - 1						
Loaded 100.00 hp code F motor						
1	84.00	105.00	0.80	126.00	420.00	High Pressure Pump
STEP TOTAL -						
STEP - 2	84.00	105.00	0.80	126.00	420.00	15 % V. DIP
Loaded 12.50 hp code G motor						
1	10.90	13.63	0.80	35.31	74.38	Hyd. Pumps
Miscellaneous Load						
1	75.00	75.00	1.00	75.00	75.00	Instrument Trailer Load
STEP TOTAL -						
STEP - 3	85.90	88.63	0.97	194.31	233.05	8 % V. DIP
Loaded 10.00 hp code G motor						
1	8.80	11.00	0.80	28.54	59.50	Strongback Hyd. Pp
STEP TOTAL -						
	8.80	11.00	0.80	198.44	241.27	9 % V. DIP
=====						
TOTALS	178.70	204.63	0.87			

W320-31-003

Feeder Cable Sizes & % Voltage Drop

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline ELECTRICAL WO/Job No. W 320, ER 4289 Calculation No. W 320 - 31-003
Project No. & Name EQUIPMENT REMOVAL PROJECT
Calculation Item FEEDER CABLE SIZES & % VOLTAGE DROP

These calculations apply to:

Dwg. No. H-2-820749 SH1, SH2 Rev. No. 0
Dwg. No. _____ Rev. No. _____
Other (Study, CDR) _____ Rev. No. _____

The status of these calculations is:

- ☐ Preliminary Calculations
- ☒ Final Calculations
- ☐ Check Calculations (On Calculation Dated _____)
- ☐ Void Calculation (Reason Voided _____)

Incorporated in Final Drawings?

☒ Yes

☐ No

This calculation verified by independent "check" calculations?

☒ Yes

☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	<i>J. H. Harris</i> 2/18/84		
Checked by	<i>Don Larson</i> 5/27/84		
Approved by	<i>J. H. Harris</i> 8/31/84		
Checked Against Approved Vendor Data	<i>J. H. Harris</i> 7/24/88		

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Description

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DESIGN VERIFICATION SCREENING CRITERIA

Project/Document No. W 320 / W320-31-003

When the design or design change affects hardware, formal design verification must be performed if one or more of the following questions must be answered affirmatively (YES).

YES

NO

_____

_____ | _____
✓

✓

✓

✓ | 1. Does the design or design change involved meet the established criteria to be considered Safety Class 1?

2. Does this design or design change cause or permit changes to Safety Class 1 instrument or alarm setpoints outside of previously approved operational limits?

3. Does this design or design change significantly affect the nuclear or environmental safety consequences of a malfunction or failure of the structure, system, or component?

4. Does this design or design change involve or change design that has previously undergone formal design verification? |
|----------------------------------|--|---|

Assigned Lead Engineer

Date

 Responsible Discipline Manager

 Date

Original Design Package Distribution:

Project Manager

Design Verification Officer

Engineering Document Control

Design Change Distribution:

Attach to Engineering Change Notice

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DESIGN ANALYSIS

Client WHC

WO/Job No. ER4289

Subject FEEDER CABLE SIZES

Date 2/17/94 By J.C. DEL ROSARIO

R. % VOLTAGE DROP

Checked 5/27/99 By Don Janson

Location TANK FARM C, 200 EAST AREA

Revised

By

I. OBJECTIVE:

DETERMINE THE FEEDER CABLE SIZE BASED ON 1993 NEC AMPACITY AND VOLTAGE DROP REQUIREMENTS. THE FEEDER VOLTAGE DROP SHALL NOT BE MORE THAN 2% OF THE NOMINAL 480 VAC, OR 240 VAC FOR THE CONSTRUCTION TRAILER SERVICES.

EQUIPMENT REMOVAL WILL BE DONE IN TWO WEEKS IN AUGUST, BEFORE THE SLUICING PHASE. FAST INSTALLATION OF ER TRAILERS AND EQUIPMENT NECESSITATES THE USE OF TEMPORARY SERVICE WIRING METHOD THAT IS QUICKLY AND EASILY INSTALLED AND REMOVED.

II. DATA:

HIGH PRESSURE PUMP AND CONTROL TRAILERS (DESIGNED BY WHC) ARE PROVIDED WITH 150A, 3P 480V CIRCUIT BREAKERS AND 200A, 3P, DISCONNECT SW. WITH 200A FUSE

AMBIENT TEMPERATURE - 115°F (AUGUST)

3/C COPPER TYPE MC CABLE WITH GROUND APPROVED FOR DIRECT BURIAL INSTALLATION IS USED.

ASSUMPTIONS:

DEMAND CURRENT WILL BE CB RATING AS GIVEN BY WHC FOR INSTRUMENT TRAILER & HIGH PRESSURE PUMP TRAILER

DEMAND CURRENT FOR STRONG BACK TRAILER IS ASSUMED 50A. (THIS FIGURE WILL BE CHECKED AGAINST VENDORS INFO.)

THE FEEDER CABLE AMPACITIES FOR DRY 90°C WILL BE

DERATED FOR USE IN 115°F AMBIENT TEMP.

Client WHC

WO/Job No. ER4289

Subject FEEDER CABLE SIZES

Date 2/17/94 By J.C. DEL ROSARIO

VOLTAGE DROP

Checked 5/27/94 By Newfrew

Location TANK FARM C, 200 EAST AREA

Revised By

ASSUMPTIONS:

- NO DEMAND FACTORS WILL BE APPLIED ON TRAILER LOADS.
200A FUSES WILL LIMIT HPPT VF CONTROLLER INPUT STARTING CURRENT AND 150A CB WILL LIMIT MOTOR RUNNING CURRENT.
VF CONTROLLER IS TO "SOFT START" THE 100 HP HPP.
ASSUME 1 HP = 1 KVA (SEE P3)
AT IT TRAILER WITH 2 - 25KVA, 480V, 1Ø TRANSFORMER
ASSUME 25 KVA, 480V, 1Ø LOAD ON UNLOADED PHASE
TO BALANCE THE LOADS ACROSS THE THREE PHASES
ASSUME 50A MAXIMUM DEMAND ON THE SBT ON P3
D. METHOD TO BE USED:
MANUAL CALCULATION

E. REFERENCES /SOURCES:

1. 1993 NEC, NFPA-70
2. WESTINGHOUSE CPT. 55-0000 1991-1992
3. WEST. TRAILER DWG. H:2-78935 (INST. TRAILER)
4. HIGH PRESSURE PUMP HP RATING & PROTECTION

III. CALCULATIONS:

1. DETERMINE TRAILER LOADS:

a) HIGH PRESSURE PUMP TRAILER (HPPT)
LOAD FURNISHED BY WHC - (REF. 4)

- 1 - 100 HP, 460V PUMP MOTOR WITH VF CONTROLLER PROTECTED BY 150A, 460V, 3Ø CB
- 2 - 2HP MOTORS @ 34A EA, 460V WITH CB (ONE 2 HP MOTOR OPERATED AT A TIME)
- 3 - MISC 460V, 1Ø LOAD @ 1.5A

FROM NEC I_{FL} FOR 100HP, 460V 3Ø MOTOR = 124A
(TABLE 430-150) FOR 2HP, 3Ø I_{FL} = 3.4A

TOTAL I_{FL} FROM HIGH PRESSURE PUMP TRAILER
= 124 + 3.4A + 1.5 = 127.9A

HPP TRAILER INCLUDING PROTECTION - BY WESTINGHOUSE

CAT. SHEETS OF VF CONTROLLER WERE REQUESTED
FROM MR. JACK DOWELL OF WESTINGHOUSE.

DESIGN ANALYSIS

Calc. No. W 320-31-003
Revision 0
Page No. 3 of 7

Client	WHC	WO/Job No.	ER 4289
Subject	FEEDER CABLE SIZES & VOLTAGE DROP	Date	2/17/94 By J. C. DEL ROSARIO
Location	TANK FARM C, 200 EAST AREA	Checked	5/27/94 By Dan Jensen
		Revised	By

BRANCH CIRCUIT PROTECTION INSTALLED BY PUMP VENDOR
150ACCB WITH 200A FUSED DISCONNECT SWITCH.

$$I_{TOTAL} + .25 I_{LARGEST MOTOR} = 127.9 + 0.25 \times 124 \\ = 127.9 + 31 = 158.9A$$

USE 4/0 AWG, DERATED AMPACITY @ 120°F = 213A
SEE SH 5

FEEDER CB - 225AT DERATED FOR 122°F (50°C) AMBIENT
TEMP. = 205A SEE REF 2, P 263
(USED WEST. TYPE FB & JB BREAKERS FOR CALCS)

b. INSTRUMENT TRAILER (IT): 150A, 3P, 480V (BY VENDOR)
(DESIGNED BY WHC - REF. 3)

3P LOAD - 1 - 12.5HP PUMP (ASSUME 1 HP = 1 KVA)
= 12.5 KVA (INFO FROM WESTINGHOUSE
(JACK DOWELL))

2 - 25 KVA, 1φ 480-120/240V TRANSF
3 x 25 = 75 KVA ASSUME BALANCE 3φ LO

TOTAL CONNECTED LOAD = 75 + 12.5 = 87.5K

$$I_{FL} = 87.5KVA / \sqrt{3} \times .48KV = 105A$$

USE 2/0 AWG. - DERATED AMP = 160A

USE 175AT F-225 MOLDED CASE CB, DERATED AMP = 159A
@ 122°F AMBIENT TEMP. REF 2 P 263

c. STRONG BACK TRAILER:

2 - 10HP, 3φ, 460V PUMPS: OPERATING ALTER-
NATELY. ASSUME 50A MAX. LOAD

USE 3/4 # 2 AWG - DERATED AMPACITY

@ 122°F = 107A, USE 100AT FEEDER CB,
DERATED @ 122°F TO 94A REF 2 P 263

DESIGN ANALYSIS

Client WHC

WO/Job No. ER 4289

Subject FEEEDER CABLE SIZES
& VOLTAGE DROP

Date 2/17/94 By J.C. DEL ROSARIO

Checked 5/27/94 By Don Johnson

Location

Revised By

a.) CONSTRUCTION TRAILER POWER

BASED ON AVERAGE ESTIMATED CONN. LOAD OF 15 KVA
PER TRAILER:

LOAD PER TRAILER = 15 KVA

TOTAL LOAD FOR 3 TRAILERS = 45 KVA

ASSUME 100% DEMAND FACTOR.

ESTIMATED KVA DEMAND = 45 KVA

USE 50 KVA, 1Ø TRANSFORMER

I_{PRI} = 104 AMPS

1.25 I_{PRI} = 130 A, USE 3/Ø # 10 AWG, 90°C INS.
AMPACITY @ 120°F = 139A
SEE PAGE 5

USE 150 A, 2P CB TRANSFORMER PRIMARY CB
DERATED AMPACITY @ 120°F = 138A - REF 2 p 20

$$I_{\text{TRAILER}} = \frac{15 \text{ KVA}}{24 \text{ KV}} = 62.5 \text{ A}$$

$$1.25 I_{\text{TRAILER}} = 78.125 \text{ A}$$

USE # 4 AWG
DERATED AMP. @ 120°F
= 78A SEE PAGE 5

USE 70A, 2P, 240V SERVICE FEEDER PROTECTION

TOTAL CURRENT RATING OF TRANSF SEC. CB
= 3 x 70 = 210 AMPS

$$\text{TRANSFORMER SEC. } I_{FL} = \frac{50 \text{ KVA}}{24 \text{ KV}} = 208 \text{ A}$$

@ 240V SEC.

DESIGN ANALYSIS

Calc. No. W320-31-00

Revision 0

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Client WHC

WO/Job No. ER 4289

Subject FEEDER CABLE SIZES

Date 2/17/94 By J.C. DEL ROSARIO

& VOLTAGE DROP

Checked 5/27/94 By J.C. Fourn

Location TANK FARM C

200 EAST AREA

Revised

By

DERATING FACTOR FOR 120°F AMBIENT TEMP.
FOR 60-90° COPPER CABLE = .82 REF. TABLE 310-16

DERATED AMPACITIES OF 90°C (DRY) COPPER CABLES W/ XHHW INS.

AWG/ KCMIL	AMPACITY (A) @ 30°C (86°F)	AMPACITY (A) @ 120°F
6	75	62
4	95	78
2	130	107
1/0	170	139
2/0	195	160
4/0	260	213
250	290	238
350	350	287
500	430	353

EQUIPMENT REMOVAL LOADS IN AMPS @ 480V, 3Ø
(EXCLUDING CONSTRUCTION TRAILER LOADS)

LOAD	AMP
HPPT	128
IT	105
STB	25

TOTAL (LESS CONSTR. TRLR) = 258 A USE 350 KCMIL CONT. RATING @ 120°F = 287 A
CONSTR. TRLR CONN. LOAD = 50,000 / 480 = 104 A
TOTAL CONN. LOAD INCLUDING CONSTR. TRAILERS = 362 A
USE 2-350 KCMIL / Ø TRANSF. SEC. FOR TD PDP AT TANK FARM
CONTINUOUS CURRENT AMPACITY @ 120°F = 574 A

DESIGN ANALYSIS

Client WHC WO/Job No. ER 4280
Subject FEEDER CABLE SIZES Date 2/17/94 By J.C. DEL ROSARIO
8% % VOLTAGE DROP Checked 5/21/94 By Don Jarama
Location TANK FARM C. 200 EAST AREA Revised By

ASSUME TRANSF. SECONDARY VOLTAGE AT TERMINAL = 480V										
CABLE DATA: TRANSF. FULL LOAD %IZ = 4.43% (NOT INCLUDED)										
* VOLTAGE DROP FACTOR FOR COPPER CONDUCTORS IN MAGNETIC DUCT @ 80% PF 3Ø Ø-Ø = VOLTS/AMPS/100 FT REF 2 P32										
□ SEE DWG H-2-820749 (C-FARM) & H-2-820752 (AT-FARM) FOR CABLE LAYOUT										
1 (ITEM)	2 CABLE TAG	3 FROM	4 TO	5 AMP LOAD	6 SIZE AWG / KCMIL	7 L (FT)	8 VD FACTOR REF 2 P32	9 Ø-Ø (VOLTS)	10 %VD	REMARKS
1	ERG-3PI	GEN	GPW	258	#350	60	.0102	2.6	.73%	50KVA CONSR. T LOAD EXC
2	SBT-3PI	-PDP-1	SBT-TS	25	#2	60	.0323	.5	.1%	
3	IT-3PI	-PDP-1	IT-TS	105	#2 1/2	60	.0187	1.2	.25%	
4	HPPT-3PI	-PDP-1	HPPT-TS	128	#4 1/2	60	.0136	1.0	.2%	MAX. C RUN FE 2% XL
5	HPPT-3P4	HPPT-TS	HPPT	128	#4 1/2	470	.0136	8.18	1.7%	6' 400' N: 500'
6	IT-3P4	IT-TS	IT	105	#2 1/2	420	.0187	8.12	1.72%	6' 400' N: 430'
7	SBT-3P4	SBT-TS	SBT	25	#2	540	.0323	4.13	.8%	6' 330' N: 1050'
8	C106-3PI 1Ø, 480V	-PDP-1	SPT	104	#1 1/2	100	.0257	2.66	.055%	(SEEP)
9	C106-3PI 15-1Ø, 240V	SPT	RE	62.5	#4	280	.056	9.8	4.08%	
10	13.8 KV CABLE	POLE E257	TRANSF TI	10	#2	400	.0323	1.3	.94 x 10 ⁻⁴	NEGATIVE SLE

$$VD \phi - \phi (8) = VD \text{ FACTOR (7)} \times L (6) / 100 \times \text{AMP LOAD (4)}$$

$$\% VD (9) = \frac{VD \phi - \phi (8)}{V \phi - \phi} \times 100\% \quad V \phi - \phi = 480V, 1V$$

POINT OF REFERENCE OF %VD - TRANSF. SEC. TERM'L'S, OR 13,800V (H)
MAXIMUM ALLOWABLE VOLTAGE DROP PER REF ART 210-19 P 70

BRANCH - 3%, COMBINED BRANCH & FEEDER - 5%, FEEDER 2%

NORMAL POWER LOAD ON - PDP-1 = 258^(1,4) + 50,000/480 = 362

% VOLTAGE DROP ON TRANSF. SEC. FEEDER FROM TRANSF TO PDP = .23%
SEE NEXT PAGE

NORMAL POWER FEEDER % VOLTAGE DROP:

FR TRANSF SEC TO IT VIA PDP, TS = .23 + .25% (3.9) + 1.72% (5.9) = 2.2% (WORST CASE)

FR TRANSF SEC TO HPPT VIA PDP, TS = .23 + 2% (4.9) + 1.7% (5.9) = 2.13%

FR TRANSF SEC TO SBT VIA PDP, TS = .23 + 1.1 (2.9) + .9 (7.9) = 1.23% (5.9)

GENERATOR POWER % FEEDER VOLTAGE DROPS = .33% (1.9) + 1.70% (5.9) = 2.0%

MAXIMUM CABLE LENGTH FOR MAX. PERMISSIBLE 2% FEEDER DROP (INCLUDING GEN. FEEDER %VD) FOR RUN SBT, TS & HPPT:

$$= (2.0 - .33) \times 480 = 460' \text{ OF } \#4/6 \quad **$$

$$128 \times .0136$$

DESIGN ANALYSIS

Client	WHC	WO/Job No.	ER 4289
Subject	FEEDER CABLE SIZES	Date	2/17/94 By J.C. DEL ROSARIO
	% VOLTAGE DROP	Checked	5/27/94 By Bonfante
Location	TANK FARM C	Revised	By

MAXIMUM CABLE LENGTH BET. TS & HPPT IN NORMAL POWER:

$$= \frac{(2.0 - .23)}{128 \times .0136} \times 480 = 488' \text{ USE } 470'$$

MAXIMUM CABLE LENGTH FOR TRAILER IT ON ST. BY GEN POWER (2%)

$$\text{LENGTH OF CABLE RUN IN FT FROM TS TO IT TRAILER} \\ = \frac{(2.0 - .33) 480}{105 \times .0187} = 408' \text{ SAY } 400' \text{ OF \#2}$$

MAX. RUN ON NORMAL POWER BETWEEN C-PDP-1 & IT VIA TS

$$= \frac{(2.0 - .23) 480}{105 \times .0187} = 433' \text{ SAY } 430'$$

MAXIMUM CABLE LENGTH FOR SBT, ON STD BY GEN PWR

ASSUMING MAXIMUM TOTAL % VD OF 2%, LESS 1% V

LENGTH OF CABLE RUN IN FT FROM TS TO TRAILER SBT

$$= \frac{(2.0 - .33) 480}{25 \times .0325} = 992' \text{ SAY } 990' \text{ ***}$$

MAX RUN ON NORMAL POWER BETWEEN C-PDP-1 & SBT VIA TS

$$= \frac{(2.0 - .23) 480}{25 \times .0325} = 1050' \text{ FT}$$

THE ABOVE CALCULATIONS LIMIT THE FEEDER DROP TO 2% MAXIMUM. SINCE THE BRANCH CIRCUITS IN THE TRAILERS ARE SHORT, THE BRANCH CIRCUIT VOLTAGE DROPS ARE NEGLIGIBLE. 5% COMBINED FEEDER AND BRANCH CIRCUIT VOLTAGE DROP WILL NOT BE EXCEEDED EVEN ON STANDBY GENERATOR POWER.

TRANSFORMER SECONDARY FEEDER TO CPDP-1

2 - 350 KCMIL / ϕ , Z PER 100' = .0051 Ω

FEEDER LENGTH = 60'

$$\text{LOAD} = 2.58 (1.4) + 50,000 / 480 = 362 \text{ A}$$

$$\% \text{ VD} = 362 \times \frac{60}{480} \times .0051 = .23\%$$

THE TRANSFORMER PRIMARY % VD = $.94 \times 10^{-4} \%$ (10.5%)
IS NEGLIGIBLE.

% VOLTAGE DROP AT FURTHEST CONST TRAILER ASSUMING 100% DE
FACTOR = $.23 + .55 + 4.08 = 4.86\%$ LESS THAN 5%

FINDINGS AND CONCLUSIONS:

THE PRECEDING CALCULATIONS SHOW THAT THE SIZES OF THE 3/4" TYPE MC CABLES ARE ADEQU FOR THE LOADS AND THE CALCULATED % VOLTAGE DROPS ARE WITHIN THE NEC PERMISSIBLE LIMIT

Voltage Drop

Voltage Drop

Volts per Amp per 100 Feet: 3-Phase, Phase-to-Phase

Copper Conductors

Conductor Size AWG or MCM	Magnetic Conduit (Steel)					Nonmagnetic Conduit (Aluminum or Nonmetallic)				
	Load Power Factor, %					Load Power Factor, %				
	60	70	80	90	100	60	70	80	90	100
14	.3390	.3910	.4430	.4940	.5410	.3370	.3900	.4410	.4930	.540
12	.2170	.2490	.2810	.3130	.3410	.2150	.2480	.2800	.3120	.340
10	.1390	.1590	.1790	.1980	.2150	.1370	.1580	.1780	.1970	.214
8	.0905	.1030	.1150	.1260	.1350	.0888	.1010	.1140	.1250	.134
6	.0595	.0670	.0742	.0809	.0850	.0579	.0656	.0730	.0800	.084
4	.0399	.0443	.0485	.0522	.0534	.0384	.0430	.0473	.0513	.051
2	.0275	.0300	.0323	.0342	.0336	.0260	.0287	.0312	.0333	.031
1	.0233	.0251	.0267	.0279	.0267	.0218	.0238	.0256	.0270	.026
1/0	.0198	.0211	.0222	.0229	.0213	.0183	.0198	.0211	.0220	.020
2/0	.0171	.0180	.0187	.0190	.0170	.0156	.0167	.0176	.0181	.016
3/0	.0148	.0154	.0158	.0158	.0136	.0134	.0141	.0147	.0149	.013
4/0	.0130	.0134	.0135	.0133	.0109	.0116	.0121	.0124	.0124	.010
250	.0122	.0124	.0124	.0120	.0094	.0107	.0111	.0112	.0110	.008
300	.0111	.0112	.0111	.0106	.0080	.0097	.0099	.0099	.0096	.007
350	.0104	.0104	.0102	.0096	.0069	.0090	.0091	.0091	.0087	.006
500	.0100	.0091	.0087	.0080	.0053	.0078	.0077	.0075	.0070	.004
600	.0088	.0086	.0082	.0074	.0046	.0074	.0072	.0070	.0064	.003
750	.0084	.0081	.0077	.0069	.0040	.0069	.0067	.0064	.0058	.003
1000	.0080	.0077	.0072	.0063	.0035	.0064	.0062	.0058	.0052	.002

Aluminum Conductors

Conductor Size AWG or MCM	Magnetic Conduit (Steel)					Nonmagnetic Conduit (Aluminum or Nonmetallic)				
	Load Power Factor, %					Load Power Factor, %				
	60	70	80	90	100	60	70	80	90	100
12	.3296	.3811	.4349	.4848	.5330	.3312	.3802	.4328	.4848	.533
10	.2133	.2429	.2741	.3180	.3583	.2090	.2410	.2740	.3052	.333
8	.1305	.1552	.1758	.1951	.2106	.1286	.1534	.1745	.1933	.211
6	.0898	.1018	.1142	.1254	.1349	.0887	.1011	.1127	.1249	.133
4	.0595	.0660	.0747	.0809	.0862	.0583	.0654	.0719	.0800	.084
2	.0403	.0443	.0483	.0523	.0535	.0389	.0435	.0473	.0514	.051
1	.0332	.0357	.0386	.0423	.0428	.0318	.0349	.0391	.0411	.040
1/0	.0286	.0305	.0334	.0350	.0341	.0263	.0287	.0322	.0337	.033
2/0	.0234	.0246	.0275	.0284	.0274	.0227	.0244	.0264	.0274	.026
3/0	.0208	.0220	.0231	.0241	.0217	.0180	.0191	.0218	.0233	.022
4/0	.0172	.0174	.0179	.0177	.0170	.0152	.0159	.0171	.0179	.017
250	.0158	.0163	.0162	.0159	.0145	.0138	.0144	.0147	.0155	.014
300	.0137	.0139	.0143	.0144	.0122	.0126	.0128	.0133	.0132	.011
350	.0130	.0133	.0128	.0131	.0100	.0122	.0123	.0119	.0120	.010
500	.0112	.0111	.0114	.0099	.0076	.0093	.0094	.0094	.0091	.007
600	.0101	.0106	.0097	.0090	.0063	.0084	.0085	.0085	.0081	.006
750	.0095	.0094	.0090	.0084	.0056	.0081	.0080	.0078	.0072	.005
1000	.0085	.0082	.0078	.0071	.0043	.0069	.0068	.0065	.0058	.004

SEE IEEE REDBOOK P 39
FOR 1Ø MULTIPLIER (1.18)

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Molded Case Breakers

FROM REF 2

General Description

Table K: Derating Chart for Non-Compensated Thermal Magnetic Breakers
Calibrated for 40°C

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type EB			
15	17	13	11
20	22	18	16
25	28	23	21
30	33	28	26
35	39	30	25
40	44	37	34
50	55	46	42
60	66	56	52
70	77	65	60
80	89	84	78
100	110	94	87

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type EHB			
15	17	13	11
20	22	18	16
25	28	23	21
30	33	28	26
35	39	30	25
40	44	37	34
50	55	46	42
60	66	56	52
70	77	65	60
80	89	84	78
100	110	94	87

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type FB			
15	17	13	11
20	22	18	16
25	28	23	21
30	33	28	26
35	39	30	25
40	44	37	34
50	55	46	42
60	66	56	52
70	77	65	60
80	89	84	78
100	110	94	87
125	137	116	105
150	165	138	125

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type CA			
125	137	114	100
150	165	136	120
175	192	159	140
200	220	182	160
225	247	205	180

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type JB, KB			
70	79	63	55
90	102	81	71
100	115	89	76
125	140	114	102
150	171	134	116
175	200	156	134
200	230	178	153
225	252	205	183
250	281	227	201

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type DA			
250	275	235	220
300	330	276	252
350	385	325	301
400	440	372	340

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type LBB, LB			
70	85	63	55
90	107	82	73
100	121	90	79
125	145	116	106
150	188	132	111
175	210	159	141
200	243	180	157
225	255	212	198
250	284	230	208
300	364	270	236
350	412	322	291
400	471	368	333

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type LA 600 Amp Frame			
250	275	235	220
300	330	276	252
350	385	325	301
400	440	372	340
500	550	468	435
600	660	564	525

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type MA			
125	138	115	103
150	165	139	128
175	192	163	151
200	220	186	170
225	247	210	195
250	275	232	213
300	332	277	252
350	388	322	292
400	444	368	334
450	495	418	383
500	550	458	435
600	660	564	525
700	770	658	613
800	880	754	704

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type NB			
700	770	658	613
800	880	754	704
900	990	828	749
1000	1100	900	825
1200	1320	1090	1000

Breaker Ampere Rating at 40° C	Ampere Rating At		
	25° C (77° F)	50° C (122° F)	60° C (140° F)
Type PB			
600	660	540	474
700	770	630	554
800	880	728	632
900	990	820	720
1000	1100	920	800
1100	1210	1010	891
1200	1320	1115	972
1400	1540	1304	1148
1600	1760	1500	1320
1800	1980	1690	1485
2000	2200	1880	1650
2500	2750	2350	2050
3000	3300	2820	2470

Molded Case Breakers for Application on Resistance Welding Circuits

Short circuit protection for resistance welding devices can be obtained by properly applying instantaneous trip molded case circuit breakers. These breakers permit normally high welding currents, but trip instantaneously if a short circuit develops.

These breakers include standard molded case circuit breaker features such as trip-free operation, dead front and single phase protection. Because the breakers are resistant to tipping, replacement costs and downtime are minimized.

The proper breaker can be selected by using the instantaneous trip range tables (Table L) using the "during-weld" amperes and % duty cycle.

Duty Cycle is based on the one minute averaging time of the breaker, and can be determined as follows:

$$\% \text{ Duty Cycle} = \frac{\text{Weld Time} \div 100}{\text{Weld Time} + \text{Off Time}}$$

"During-weld" amperes can be obtained from the welder manufacturer, or as follows:

$$\text{During-weld Amperes} = \frac{\text{During-weld KVA} \div 1000}{\text{Voltage}}$$

Interrupting capacity of the breaker should be within the maximum available at the point of application.

For application information on Series C breakers in welding circuits, refer to Westinghouse.

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APPENDIX A-

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PLAN - AY FARM

ESTIMATED CABLE LENGTH OF RUN SHOWN ON THIS PLAN
RECOMMENDATED CABLE LENGTHS FOR USE ON BOTH FARMS
SO AS NOT TO EXCEED 50% VD LIMIT

NORTH

SCALE IN FEET
PLAN - C-FARM

NOTES:

- THIS WORK IS FOR PERMANENT INSTALLATION OF PAD MOUNTED 13.8KV-400V/277V TRANSFORMER T1 13.8KV UNDERGROUND FEEDER TO EXISTING POLE E257 AND POWER DISTRIBUTION PANEL C-PDP-1 TO PROVIDE POWER TO THE EQUIPMENT REMOVAL SYSTEM AND SUDJING PHASES OF W320. THE EQUIPMENT REMOVAL SYSTEM (ERS) COMPONENTS (WHICH CONSISTS OF THREE EQUIPMENT TRAILERS, ONE TRANSFER SWITCH/BREAKERS SKID, ONE STANDBY GENERATOR AND ASSOCIATED TYPE MC POWER CABLES) ARE NOT ALWAYS PRESENT AND WILL BE INSTALLED IN C-FARM AS SHOWN ON AN AS NEEDED BASIS DURING PROJECT W320; THERE IS ONLY ONE SET OF ERS COMPONENTS, WHICH CAN BE INSTALLED IN EITHER C-FARM OR AT-FARM, AND THEN RELOCATED AS NECESSARY. THE TYPICAL DURATION FOR AN EQUIPMENT REMOVAL OPERATION IS ONE MONTH.
- CABLE FOR THE EQUIPMENT REMOVAL TRAILERS SHALL BE 3/C COPPER 600V, 2000V INSULATED TYPE MC (GALVANIZED STEEL ARMOR JACKETED) APPROVED FOR DIRECT BURIAL WITH STRANDED BARE COPPER GROUND CONDUCTOR SIZED PER 1993 NEC.
- EQUIPMENT LOCATIONS ARE PRELIMINARY. CABLE LENGTHS SHALL INCLUDE SUFFICIENT ALLOWANCE TO PERMIT RE-USE AT TANK FARM A.Y.
MAXIMUM CABLE LENGTHS FROM C-PDP-1 VIA TRANSFER SWITCHES TO THE TRAILERS:
SBT - 600'
IT - 480'
HPPT - 430'
- ROUTE CABLE AFTER CRANES AND TRAILERS ARE POSITIONED. CLEAR CABLES AWAY FROM WORK AREAS AND CRANE OPERATION AREA. REMOVE TEMPORARY CABLES AND EQUIPMENT AFTER EQUIPMENT REMOVAL AND BEFORE CRANE AND TRAILERS ARE TRANSPORTED OUT.
- SYMBOLS PER ANSI Y14.15 AND/OR Y32.2 AND ABBREVIATIONS PER ANSI Y11.1.

LEGEND: CALC S

1. NUMBER INSIDE SQUARE DENOTES ITEM NO. SHOWN IN COLUMN 0 (CABLE DATA P6 OF CALC # W320-31-003)
2. INFO/DATA USED IN CALCULATIONS

LEGEND

- UNDERGROUND CONDUIT/CABLE (PERMANENT UNLESS OTHERWISE SPECIFIED)
- ABOVE GROUND TEMPORARY CABLE
- ELECTRICAL EQUIPMENT OR DEVICE AS INDICATED

CONDUIT/CABLE NUMBERING LEGEND

W320-31-003
APPENDIX A-4

EQUIPMENT COORDINATES

SCALE: NONE
NOTE: LOCATION SHOWN FOR ELECTRICAL EQUIPMENT IS APPROXIMATE. FIELD TO DETERMINE EXACT LOCATION.

NO.	DESCRIPTION	DATE	BY	CHKD	APP'D	REV	DATE	DESCRIPTION
1	W320-31-003	2/2/88	ACD	12.08.88				
2	W320-31-003	2/2/88	ACD	12.08.88				
3	W320-31-003	2/2/88	ACD	12.08.88				
4	W320-31-003	2/2/88	ACD	12.08.88				
5	W320-31-003	2/2/88	ACD	12.08.88				
6	W320-31-003	2/2/88	ACD	12.08.88				
7	W320-31-003	2/2/88	ACD	12.08.88				
8	W320-31-003	2/2/88	ACD	12.08.88				
9	W320-31-003	2/2/88	ACD	12.08.88				
10	W320-31-003	2/2/88	ACD	12.08.88				

W320-31-010

C-106 Demand Load Analysis,
Size Feeders, Voltage Drop and
Fault Study

Fluor Daniel Northwest	CALCULATION IDENTIFICATION AND INDEX	Page i of 3 Date <div style="text-align: center; font-weight: bold;">07/21/98</div>
-------------------------------	---	---

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline **Electrical** WO/Job No. **Task Order N09** Calculation No. **W320-31-010**
 Project No. & Name **W320, Tank 241-C-106 Sluicing**
 Calculation Item **C-106 Demand Load Analysis, Size Feeders, Voltage Drop, and Fault Study**

These calculations apply to:

Dwg. No. **H-2-818680, Sheet 1** Rev. No. **1**
 Dwg. No. Rev. No.
 Other (Study, CDR)

The status of these calculations is:

☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated)
☐ Void Calculation (Reason Voided)

Incorporated in Final Drawings? ☒ Yes ☐ No
 This calculation verified by independent "check" calculations? ☐ Yes ☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	TJ Kasnick 10/3/95	<i>TJ Kasnick</i> 7/24/98	
Checked by	SA Najjar 10/3/95	<i>TJ Kasnick</i> 7/24/98	
Approved by	TJ Kasnick 10/3/95	<i>TJ Kasnick</i> 7/24/98	
Checked Against Approved Vendor Data	N/A	<i>TJ Kasnick</i> 7/24/98	

INDEX

Design Analysis Page No.	Description
i	Calculation Identification and Index
ii	Calculation Cross Index
1	Objective
2-3	Design Inputs
3	Calculations
4	Findings and Conclusions
A-1 to A-7	Attachment A: Study Input Report
B-1 to B-11	Attachment B: Demand Load Analysis
C-1 to C-9	Attachment C: Size Feeders and Transformers
D-1 to D-14	Attachment D: Load Flow and Voltage Drop
E-1 to E-36	Attachment E: Short Circuit Analysis
F	Attachment F: Drawing H-2-818680

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CALCULATION CROSS INDEX (Typical)

Subject Calculation No.: W320-31-010

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DESIGN ANALYSIS

Client Numatec Hanford Corporation
Subject C-106 Demand Load Analysis, Size
Feeders, Voltage Drop, Fault Study
Location 200E, C Tank Farm

WO/Job No. Task Order N09
Date 9/5/95 By TJ Kasnick
Checked 10/3/95 By SA Najjar
Revised 5/14/98 By Cris Carlson

1. OBJECTIVE

Determine the size of electrical equipment necessary to support the loads required for Project W320, Tank 241-C-106 Sluicing, at Tank C-106.

2. DESIGN INPUTS

2.1 Function Design Criteria for Tank 241-C-106 Waste Retrieval, Project W-320, HNF-SD-W320-FDC-001 Rev. 5.

2.2 Given or Known Data

The loads are shown on drawing H-2-818680, Sheet 1, Rev. 1. The size of motors and other equipment data are based on the Project W-320 vendor information file #22668.

2.2.1 The Variable Speed Drives (VSD) are 95% efficient.

2.2.2 Motor currents, full load amperes (FLA), which are based on the 1993 National Electrical Code (NEC) for the motor nameplate values except for the 250 HP motor which is based on vendor information, are tabulated as follows:

- 1) In-line Booster Pump (P-1362), at 250 HP (273A), driven by VSD.
- 2) Submersible (Immersible) pump (P-1361), at 40 HP (52A), driven by a soft starter.
- 3) Slurry Winch (W-1361), at 1.5 HP (2.6A).
- 4) Exhaust Skid:
 - Exhaust Fan (FN-1362), at 7.5 HP (11A), driven by VSD.
 - Vacuum pumps (P-1366 & P-1367), at 3 HP (4.8A) each.
- 5) Chiller Skid:
 - Circ Pumps (P-1364 & P-1365), at 15 HP (21A) each.
 - Compressor (R-1361), at 56 KVA.
- 6) Process Bldg: Recirc Fan (FN-1361), at 7.5 HP (11A).
- 7) Service Bldg: Compressor (CPR-1361), at 7.5 HP (11A).
- 8) Sluicer Pkg: Hydraulic Power Unit (SHC-1361), at 3 HP (4.8A)

2.2.3 Other loads:

- 1) Process Bldg:
 - HVAC Process Heater (HC-1361), at 30 KW.
 - Space Heaters (UH-1361 & UH-1362), at 4 KW each.
- 2) Exhaust Skid: Process Heater (HC-1362), at 3 KW.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Demand Load Analysis, Size
 Feeders, Voltage Drop, Fault Study
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/5/95 By TJ Kasnick
 Checked 10/3/95 By SA Najjar
 Revised 5/14/98 By Cris Carlson

2.2.4 Mini-Power Panels are loaded to the transformer rating:

- 1) C106-PP1 (Process Bldg) is 7.5 KVA.
- 2) C106-PP2 (EES) is 15 KVA.
- 3) C106-PP3 (Exhaust Skid) is 5 KVA.
- 4) C106-PP4 (Chiller Skid) is 3 KVA.
- 5) C106-PP5 (Service Bldg) is 5 KVA.
- 6) Sluicer Package is 0.3 KVA.

2.3 Assumptions

2.3.1 Miscellaneous loads:

- 1) Construction Support Trailers:
 Office Trailer, at 16.6 KVA.
 WRAM Trailer, at 16.6 KVA.
 Conex Trailer, at 16.6 KVA.

2.3.2 Transformer impedances used are typical NEMA three phase values.

2.3.3 The utility fault current values are assumed typical values derived from previous projects and data obtained from the utilities department.

2.3.4 Dapper treats all loads as three phase loads: feeders for single phase loads must be considered separately (not part of this calculation).

2.4 Method to be used

2.4.1 The FDNW approved (for design use) software: SKM Power Tools, version 3.4.0.1, 1995-1997.

2.5 References/Sources

- 2.5.1 Drawing H-2-818680, Sheet 1, Rev. 1, Electrical C-Farm One-Line Diagram
- 2.5.2 NFPA 70, National Electrical Code (NEC), 1993 edition.
- 2.5.3 ANSI C2, National Electrical Safety Code, (NESC) 1990.
- 2.5.4 U.S. Department of Energy (DOE), order DOE 6430.1A, General Design Criteria
- 2.5.5 Vendor information file #22668.

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DESIGN ANALYSIS

client Numatec Hanford Corporation
 subject C-106 Demand Load Analysis, Size
 Feeders, Voltage Drop, Fault Study
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/5/95 By TJ Kasnick
 Checked 10/3/95 By SA Najjar
 Revised 5/14/98 By Cris Carlson

3. CALCULATIONS

- 3.1 Attachment A: Input Report: This is the feeder, transformer, and generation input data that is used by the studies below.
- 3.2 Attachment B: Demand Load Analysis: This analysis calculates the total system loads based upon system bus load inputs and summarizes them on a bus by bus basis, including total system load and power factor.
- 3.3 Attachment C: Size Feeders and Transformers: This analysis provides the NEC Code sized feeders and transformers to meet the minimum load requirements of the Demand Load Analysis Study - Total Connected Load, and the evaluation of a fixed-size feeder to the MCC. Impedance and capacity information for the feeders and transformers were taken directly from the Dapper library, which represents typical values found in the industry. Conduit sizes determined are the minimum size required.
- 3.4 Attachment D: Load Flow and Voltage Drop: This analysis calculates the exact system operating voltages, loads flows, and system losses.
- 3.5 Attachment E: Short Circuit Analysis: This analysis calculates the system short circuit fault currents. The calculations are based upon typical Hanford 13.8 Kv utility fault current contributions, plus those from any motors running within the system.

4. FINDINGS AND CONCLUSIONS

- 4.1 Refer to Attachment C for system equipment sizing. Refer to other Attachments for various design information related to the distribution system equipment.
- 4.2 Refer to drawing H-2-818680 for one-line diagram of the electrical distribution equipment necessary to support the loads.

Attachment A

Project W-320 / Tank 241-C-106 Sluicing
C-Farm Electrical Distribution
Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)
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ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

SKM POWER*TOOLS FOR WINDOWS
INPUT DATA REPORT
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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE.

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM NAME	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	DESCRIPTION TYPE	DUCT	INSUL
Ug Rsr Pl E257	XFMR C-T-1 Pri	1	13800	260.0	FT	2	C M	EPR
+/- Impedance: 0.2050 + J 0.0727 OHMS/M Length 0.0280 + J 0.0099 PU								
Z0	Impedance: 0.6461 + J 0.1790			OHMS/M Length		0.0882 + J	0.0244	PU
XFMR C-T-1 Sec	C-PDP-1 600A	2	480	25.0	FT	600	C M	THWN
+/- Impedance: 0.0250 + J 0.0480 OHMS/M Length 0.1356 + J 0.2604 PU								
Z0	Impedance: 0.0788 + J 0.1182			OHMS/M Length		0.4275 + J	0.6413	PU
C-PDP-1 600A	Xfmr Skid	1	480	50.0	FT	1/0	C M	MCXH
+/- Impedance: 0.1200 + J 0.0550 OHMS/M Length 2.60 + J 1.19 PU								
Z0	Impedance: 0.3782 + J 0.1355			OHMS/M Length		8.21 + J	2.94	PU
C-PDP-1 600A	MCC-N1 800A	3	480	30.0	FT	350	C M	THWN
+/- Impedance: 0.0390 + J 0.0500 OHMS/M Length 0.1693 + J 0.2170 PU								
Z0	Impedance: 0.1229 + J 0.1231			OHMS/M Length		0.5335 + J	0.5345	PU
Process Bldg	C106-PP1 Bus	1	480	15.0	FT	8	C M	THHN
+/- Impedance: 0.7400 + J 0.0650 OHMS/M Length 4.82 + J 0.4232 PU								
Z0	Impedance: 2.33 + J 0.1601			OHMS/M Length		15.18 + J	1.04	PU
MCC-N1 800A	Process Bldg	1	480	240.0	FT	2	C M	THWN
+/- Impedance: 0.1900 + J 0.0570 OHMS/M Length 19.79 + J 5.94 PU								
Z0	Impedance: 0.5988 + J 0.1404			OHMS/M Length		62.37 + J	14.62	PU
MCC-N1 800A	C106-PP2 Bus	1	480	5.0	FT	12	C M	THWN
+/- Impedance: 1.90 + J 0.0680 OHMS/M Length 4.12 + J 0.1476 PU								
Z0	Impedance: 5.99 + J 0.1675			OHMS/M Length		12.99 + J	0.3634	PU
Process Bldg	FN-1361 Bus	1	480	40.0	FT	10	C M	THHN
+/- Impedance: 1.14 + J 0.0630 OHMS/M Length 19.79 + J 1.09 PU								
Z0	Impedance: 3.59 + J 0.1552			OHMS/M Length		62.37 + J	2.69	PU
Process Bldg	HC-1361 Bus	1	480	40.0	FT	4	C M	THHN
+/- Impedance: 0.3000 + J 0.0600 OHMS/M Length 5.21 + J 1.04 PU								
Z0	Impedance: 0.9455 + J 0.1478			OHMS/M Length		16.41 + J	2.57	PU

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM NAME	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	DESCRIPTION TYPE	DUCT	INSUL
Process Bldg	UH-1362 Bus	1	480	50.0	FT	12	C M	THHN
+/- Impedance:	1.90 + J	0.0680	OHMS/M	Length	41.23 + J		1.48	PU
Z0 Impedance:	5.99 + J	0.1675	OHMS/M	Length	129.95 + J		3.63	PU
Process Bldg	UH-1361 Bus	1	480	30.0	FT	12	C M	THHN
+/- Impedance:	1.90 + J	0.0680	OHMS/M	Length	24.74 + J		0.8854	PU
Z0 Impedance:	5.99 + J	0.1675	OHMS/M	Length	77.97 + J		2.18	PU
MCC-N1 800A	Service Bldg	1	480	65.0	FT	10	C M	THWN
+/- Impedance:	1.14 + J	0.0630	OHMS/M	Length	32.16 + J		1.78	PU
Z0 Impedance:	3.59 + J	0.1552	OHMS/M	Length	101.36 + J		4.38	PU
Service Bldg	CPR-1361 Bus	1	480	15.0	FT	10	C M	THWN
+/- Impedance:	1.14 + J	0.0630	OHMS/M	Length	7.42 + J		0.4102	PU
Z0 Impedance:	3.59 + J	0.1552	OHMS/M	Length	23.39 + J		1.01	PU
Xfmr Skid	Office Trl Bus	1	480	50.0	FT	4	C M	MCXH
+/- Impedance:	0.3000 + J	0.0600	OHMS/M	Length	6.51 + J		1.30	PU
Z0 Impedance:	0.9455 + J	0.1478	OHMS/M	Length	20.52 + J		3.21	PU
Xfmr Skid	Conex Trl Bus	1	480	100.0	FT	4	C M	MCXH
+/- Impedance:	0.3000 + J	0.0600	OHMS/M	Length	13.02 + J		2.60	PU
Z0 Impedance:	0.9455 + J	0.1478	OHMS/M	Length	41.04 + J		6.41	PU
MCC-N1 800A	Chiller Skid	1	480	30.0	FT	4/0	C M	THWN
+/- Impedance:	0.0630 + J	0.0510	OHMS/M	Length	0.8203 + J		0.6641	PU
Z0 Impedance:	0.1985 + J	0.1256	OHMS/M	Length	2.59 + J		1.64	PU
MCC-N1 800A	Exhaust Skid	1	480	320.0	FT	10	C M	THWN
+/- Impedance:	1.14 + J	0.0630	OHMS/M	Length	158.33 + J		8.75	PU
Z0 Impedance:	3.59 + J	0.1552	OHMS/M	Length	499.00 + J		21.55	PU
MCC-N1 800A	EXH Fan Vfd	1	480	10.0	FT	12	C M	THWN
+/- Impedance:	1.90 + J	0.0680	OHMS/M	Length	8.25 + J		0.2951	PU
Z0 Impedance:	5.99 + J	0.1675	OHMS/M	Length	25.99 + J		0.7269	PU

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM		FEEDER TO		QTY	VOLTS	LENGTH	FEEDER DESCRIPTION			
NAME		NAME		/PH	L-L		SIZE	TYPE	DUCT	INSUL
Xfmr	Skid	WRAM Tlr	Bus	1	480	220.0	FT	4	C M	MCXH
+/ -	Impedance:	0.3000 + J	0.0600		OHMS/M	Length	28.65 + J		5.73	PU
Z0	Impedance:	0.9455 + J	0.1478		OHMS/M	Length	90.28 + J		14.11	PU
=====										
MCC-N1	800A	MCC-N2		2	480	70.0	FT	350	C M	THWN
+/ -	Impedance:	0.0390 + J	0.0500		OHMS/M	Length	0.5924 + J		0.7595	PU
Z0	Impedance:	0.1229 + J	0.1231		OHMS/M	Length	1.87 + J		1.87	PU
=====										
MCC-N1	800A	Sluicer Skid		1	480	240.0	FT	12	C M	THWN
+/ -	Impedance:	1.90 + J	0.0680		OHMS/M	Length	197.92 + J		7.08	PU
Z0	Impedance:	5.99 + J	0.1675		OHMS/M	Length	623.74 + J		17.44	PU
=====										
MCC-N1	800A	Slurry Winch		1	480	240.0	FT	12	C M	THWN
+/ -	Impedance:	1.90 + J	0.0680		OHMS/M	Length	197.92 + J		7.08	PU
Z0	Impedance:	5.99 + J	0.1675		OHMS/M	Length	623.74 + J		17.44	PU
=====										
MCC-N2		Booster Vfd		1	480	10.0	FT	500	C M	THWN
+/ -	Impedance:	0.0290 + J	0.0480		OHMS/M	Length	0.1259 + J		0.2083	PU
Z0	Impedance:	0.0914 + J	0.1182		OHMS/M	Length	0.3967 + J		0.5131	PU
=====										
MCC-N2		P-1361 SS		1	480	1.000	FT	1/0	C N	THWN
+/ -	Impedance:	0.1200 + J	0.0440		OHMS/M	Length	0.0521 + J		0.0191	PU
Z0	Impedance:	0.1908 + J	0.1119		OHMS/M	Length	0.0828 + J		0.0486	PU
=====										
P-1361	SS	P-1361 Bus		1	480	280.0	FT	1/0	C M	THWN
+/ -	Impedance:	0.1200 + J	0.0550		OHMS/M	Length	14.58 + J		6.68	PU
Z0	Impedance:	0.3782 + J	0.1355		OHMS/M	Length	45.96 + J		16.46	PU
=====										
Booster	Vfd	P-1362 Bus		1	480	330.0	FT	500	C M	THWN
+/ -	Impedance:	0.0290 + J	0.0480		OHMS/M	Length	4.15 + J		6.88	PU
Z0	Impedance:	0.0914 + J	0.1182		OHMS/M	Length	13.09 + J		16.93	PU
=====										
EXH Fan	Vfd	FN-1362 Bus		1	480	320.0	FT	12	C M	THWN
+/ -	Impedance:	1.90 + J	0.0680		OHMS/M	Length	263.89 + J		9.44	PU
Z0	Impedance:	5.99 + J	0.1675		OHMS/M	Length	831.66 + J		23.26	PU

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM NAME	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER DESCRIPTION SIZE TYPE DUCT INSUL
Service Bldg	C106-PP3 Bus	1	480	5.0	FT 10 C M THWN
+/- Impedance:	1.14 + J	0.0630	OHMS/M	Length	2.47 + J 0.1367 PU
Z0 Impedance:	3.59 + J	0.1552	OHMS/M	Length	7.80 + J 0.3367 PU

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TRANSFORMER INPUT DATA

PRIMARY RECORD NO NAME	VOLTS L-L	* SECONDARY RECORD NO NAME	VOLTS L-L	FULL-LOAD KVA	NOMINAL KVA
XFMR C-T-1 Pri D	13800.0	XFMR C-T-1 Sec YG	480.00	258.80	225.00
Pos. Seq. Z%:	1.20 + j	2.96 5.34 + j	13.13 PU		
Zero Seq. Z%:	1.20 + j	2.96 5.34 + j	13.13 PU		
Taps Pri. -2.50 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.					

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GENERATION DATA

BUS NAME	GENERATION	VOLT	SIZE	InitKW	MaxKVAR	TYPE
Ug Rsr P1 E257 C8-L6 13.8Kv	1.03 pu					SB
	Three Phase Contribution: 3219.00 AMPS X/R :			1.75		
	Line to Earth Contribution: 1260.00 AMPS X/R :			1.0000		
Pos sequence impedance (100 MVA base)	0.6448 + J			1.13 PU		
Zero sequence impedance (100 MVA base)	5.75 + J			4.79 PU		

Attachment B

Project W-320 / Tank 241-C-106 Sluicing
C-Farm Electrical Distribution
Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

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TIME: 17:17:11.62

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION
AND APPLICATION BY A REGISTERED ENGINEER ONLY

SKM POWER*TOOLS FOR WINDOWS
DEMAND LOAD ANALYSIS REPORT
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*** SOLUTION COMMENTS ***

=====

LOAD ANALYSIS INCLUDES ALL LOADS.

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LOAD SUMMARY

LOAD SCHEDULE FOR Ug Rsr P1 E257 13800. VOLTS LINE TO LINE
SOURCE OF PWR SOURCE BUS

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
XFMR C-T-1 Pri	501.1	21.0	501.1	21.0	566.9	23.7	89.63
TOTALS	501.1	21.0	501.1	21.0	566.9	23.7	89.63

LOAD SCHEDULE FOR XFMR C-T-1 Pri 13800. VOLTS LINE TO LINE
SOURCE OF PWR Ug Rsr P1 E257

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
XFMR C-T-1 Sec	501.1	21.0	501.1	21.0	566.9	23.7	89.63
TOTALS	501.1	21.0	501.1	21.0	566.9	23.7	89.63

LOAD SCHEDULE FOR XFMR C-T-1 Sec 480. VOLTS LINE TO LINE
SOURCE OF PWR XFMR C-T-1 Pri

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
C-PDP-1 600A	501.1	602.7	501.1	602.7	566.9	681.9	89.63
TOTALS	501.1	602.7	501.1	602.7	566.9	681.9	89.63

LOAD SCHEDULE FOR C-PDP-1 600A 480. VOLTS LINE TO LINE
SOURCE OF PWR XFMR C-T-1 Sec

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
Xfmr Skid	49.8	59.9	49.8	59.9	49.8	59.9	90.00
MCC-N1 800A	451.3	542.8	451.3	542.8	517.2	622.0	89.59
TOTALS	501.1	602.7	501.1	602.7	566.9	681.9	89.63

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

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LOAD SUMMARY

LOAD SCHEDULE FOR Xfmr Skid
SOURCE OF PWR C-PDP-1 600A

480. VOLTS LINE TO LINE

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
BRANCH LOADS							
Office Trl Bus	16.6	20.0	16.6	20.0	16.6	20.0	90.00
Conex Tlr Bus	16.6	20.0	16.6	20.0	16.6	20.0	90.00
WRAM Tlr Bus	16.6	20.0	16.6	20.0	16.6	20.0	90.00
=====							
TOTALS	49.8	59.9	49.8	59.9	49.8	59.9	90.00

LOAD SCHEDULE FOR MCC-N1 800A
SOURCE OF PWR C-PDP-1 600A

480. VOLTS LINE TO LINE

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
BRANCH LOADS							
Process Bldg	52.8	63.5	52.8	63.5	64.2	77.3	98.77
C106-PP2 Bus	15.0	18.0	15.0	18.0	15.0	18.0	90.00
Service Bldg	14.1	16.9	14.1	16.9	16.4	19.7	83.69
Chiller Skid	76.4	91.9	76.4	91.9	90.4	108.8	80.38
Exhaust Skid	11.6	14.0	11.6	14.0	13.3	16.0	92.11
EXH Fan Vfd	9.1	11.0	9.1	11.0	11.4	13.7	80.50
MCC-N2	269.5	324.1	269.5	324.1	326.2	392.4	89.17
Sluicer Skid	4.3	5.2	4.3	5.2	5.3	6.4	80.65
Slurry Winch	2.2	2.6	2.2	2.6	2.7	3.2	80.00
=====							
TOTALS	451.3	542.8	451.3	542.8	517.2	622.0	89.59

LOAD SCHEDULE FOR C106-PP1 Bus
SOURCE OF PWR Process Bldg

480. VOLTS LINE TO LINE

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
GENERAL LOADS							
	7.5	9.0	7.5	9.0	7.5	9.0	90.00
=====							
TOTALS	7.5	9.0	7.5	9.0	7.5	9.0	90.00

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LOAD SUMMARY

LOAD SCHEDULE FOR		Process Bldg		480. VOLTS LINE TO LINE				
SOURCE OF PWR		MCC-N1 800A						
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
=====								
END USE LOADS								
BRANCH LOADS								
C106-PP1 Bus	7.5	9.0	7.5	9.0	7.5	9.0	90.00	
FN-1361 Bus	9.1	11.0	9.1	11.0	11.4	13.7	80.50	
HC-1361 Bus	30.0	36.1	30.0	36.1	37.5	45.1	100.00	
UH-1362 Bus	4.0	4.8	4.0	4.8	5.0	6.0	100.00	
UH-1361 Bus	4.0	4.8	4.0	4.8	5.0	6.0	100.00	
=====								
TOTALS	52.8	63.5	52.8	63.5	64.2	77.3	98.77	

LOAD SCHEDULE FOR		C106-PP2 Bus		480. VOLTS LINE TO LINE				
SOURCE OF PWR		MCC-N1 800A						
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
=====								
END USE LOADS								
GENERAL LOADS								
	15.0	18.0	15.0	18.0	15.0	18.0	90.00	
=====								
TOTALS	15.0	18.0	15.0	18.0	15.0	18.0	90.00	

LOAD SCHEDULE FOR		FN-1361 Bus		480. VOLTS LINE TO LINE				
SOURCE OF PWR		Process Bldg						
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
=====								
END USE LOADS								
LARGEST KVA MTR								
	9.1	11.0	9.1	11.0	11.4	13.7	80.50	
=====								
TOTALS	9.1	11.0	9.1	11.0	11.4	13.7	80.50	

LOAD SCHEDULE FOR		HC-1361 Bus		480. VOLTS LINE TO LINE				
SOURCE OF PWR		Process Bldg						
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
=====								
END USE LOADS								
HEATING								
	30.0	36.1	30.0	36.1	37.5	45.1	100.00	
=====								
TOTALS	30.0	36.1	30.0	36.1	37.5	45.1	100.00	

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LOAD SUMMARY

LOAD SCHEDULE FOR UH-1362 Bus		480. VOLTS LINE TO LINE						
SOURCE OF PWR Process Bldg								
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
END USE LOADS								
HEATING	4.0	4.8	4.0	4.8	5.0	6.0	100.00	
TOTALS	4.0	4.8	4.0	4.8	5.0	6.0	100.00	

LOAD SCHEDULE FOR UH-1361 Bus		480. VOLTS LINE TO LINE						
SOURCE OF PWR Process Bldg								
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
END USE LOADS								
HEATING	4.0	4.8	4.0	4.8	5.0	6.0	100.00	
TOTALS	4.0	4.8	4.0	4.8	5.0	6.0	100.00	

LOAD SCHEDULE FOR Service Bldg		480. VOLTS LINE TO LINE						
SOURCE OF PWR MCC-N1 800A								
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
END USE LOADS								
BRANCH LOADS								
C106-PP3 Bus	5.0	6.0	5.0	6.0	5.0	6.0	90.00	
CPR-1361 Bus	9.1	11.0	9.1	11.0	11.4	13.7	80.50	
TOTALS	14.1	16.9	14.1	16.9	16.4	19.7	83.69	

LOAD SCHEDULE FOR C106-PP3 Bus		480. VOLTS LINE TO LINE						
SOURCE OF PWR Service Bldg								
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F	
END USE LOADS								
GENERAL LOADS	5.0	6.0	5.0	6.0	5.0	6.0	90.00	
TOTALS	5.0	6.0	5.0	6.0	5.0	6.0	90.00	

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LOAD SUMMARY

LOAD SCHEDULE FOR CPR-1361 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Service Bldg

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	9.1	11.0	9.1	11.0	11.4	13.7	80.50
TOTALS	9.1	11.0	9.1	11.0	11.4	13.7	80.50

LOAD SCHEDULE FOR Office Trl Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Xfmr Skid

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	16.6	20.0	16.6	20.0	16.6	20.0	90.00
TOTALS	16.6	20.0	16.6	20.0	16.6	20.0	90.00

LOAD SCHEDULE FOR Conex Tlr Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Xfmr Skid

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	16.6	20.0	16.6	20.0	16.6	20.0	90.00
TOTALS	16.6	20.0	16.6	20.0	16.6	20.0	90.00

LOAD SCHEDULE FOR Chiller Skid 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-NI 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	3.0	3.6	3.0	3.6	3.0	3.6	90.00
KVA TYPE MTR	17.5	21.0	17.5	21.0	17.5	21.0	80.00
LARGEST KVA MTR	56.0	67.4	56.0	67.4	70.0	84.2	80.00
TOTALS	76.4	91.9	76.4	91.9	90.4	108.8	80.38

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LOAD SUMMARY

LOAD SCHEDULE FOR Exhaust Skid 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	5.0	6.0	5.0	6.0	5.0	6.0	90.00
HEATING	3.0	3.6	3.0	3.6	3.8	4.5	100.00
LARGEST KVA MTR	4.0	4.8	4.0	4.8	5.0	6.0	80.00
TOTALS	11.6	14.0	11.6	14.0	13.3	16.0	92.11

LOAD SCHEDULE FOR EXH Fan Vfd 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
FN-1362 Bus	9.1	11.0	9.1	11.0	11.4	13.7	80.50
TOTALS	9.1	11.0	9.1	11.0	11.4	13.7	80.50

LOAD SCHEDULE FOR WRAM Tlr Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Xfmr Skid

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	16.6	20.0	16.6	20.0	16.6	20.0	90.00
TOTALS	16.6	20.0	16.6	20.0	16.6	20.0	90.00

LOAD SCHEDULE FOR MCC-N2 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
P-1361 SS	43.2	52.0	43.2	52.0	54.0	65.0	80.30
Booster Vfd	227.0	273.0	227.0	273.0	283.7	341.2	90.30
TOTALS	269.5	324.1	269.5	324.1	326.2	392.4	89.17

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LOAD SUMMARY

LOAD SCHEDULE FOR Sluicer Skid 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	0.3	0.4	0.3	0.4	0.3	0.4	90.00
LARGEST KVA MTR	4.0	4.8	4.0	4.8	5.0	6.0	80.00
TOTALS	4.3	5.2	4.3	5.2	5.3	6.4	80.65

LOAD SCHEDULE FOR Slurry Winch 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	2.2	2.6	2.2	2.6	2.7	3.2	80.00
TOTALS	2.2	2.6	2.2	2.6	2.7	3.2	80.00

LOAD SCHEDULE FOR P-1361 SS 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N2

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
P-1361 Bus	43.2	52.0	43.2	52.0	54.0	65.0	80.30
TOTALS	43.2	52.0	43.2	52.0	54.0	65.0	80.30

LOAD SCHEDULE FOR P-1361 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR P-1361 SS

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	43.2	52.0	43.2	52.0	54.0	65.0	80.30
TOTALS	43.2	52.0	43.2	52.0	54.0	65.0	80.30

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LOAD SUMMARY

LOAD SCHEDULE FOR Booster Vfd 480. VOLTS LINE TO LINE
SOURCE OF PWR MCC-N2

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
BRANCH LOADS							
P-1362 Bus	227.0	273.0	227.0	273.0	283.7	341.2	90.30
=====							
TOTALS	227.0	273.0	227.0	273.0	283.7	341.2	90.30

LOAD SCHEDULE FOR P-1362 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Booster Vfd

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
LARGEST KVA MTR	227.0	273.0	227.0	273.0	283.7	341.2	90.30
=====							
TOTALS	227.0	273.0	227.0	273.0	283.7	341.2	90.30

LOAD SCHEDULE FOR FN-1362 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR EXH Fan Vfd

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
LARGEST KVA MTR	9.1	11.0	9.1	11.0	11.4	13.7	80.50
=====							
TOTALS	9.1	11.0	9.1	11.0	11.4	13.7	80.50

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TOTAL SOURCE LOAD SUMMARY

LOAD DESCRIPTION TYPE	UNITS	CONNECTED LOAD	DEMAND LOAD	DESIGN LOAD	POWER FACTOR %
=====					
GENERAL LOADS	KW	77.0	77.0	77.0	
	KVAR	37.3	37.3	37.3	
	KVA	85.6	85.6	85.6	90.00 LAGGING
HEATING	KW	41.0	41.0	51.2	
	KVAR	0.0	0.0	0.0	
	KVA	41.0	41.0	51.2	100.00 UNITY
KVA TYPE MTR	KW	123.7	123.7	123.7	
	KVAR	92.2	92.2	92.2	
	KVA	154.3	154.3	154.3	80.17 LAGGING
LARGEST KVA MTR	KW	204.9	204.9	256.2	
	KVAR	97.5	97.5	121.9	
	KVA	227.0	227.0	283.7	90.30 LAGGING

TOTAL LOADS	KW	446.7	446.7	508.2	
	KVAR	227.0	227.0	251.4	
	KVA	501.1	501.1	566.9	
	% PF	89.1	89.1	89.6	
		LAGGING	LAGGING	LAGGING	

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

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LOAD DEMAND TABLE

LOAD DESCRIPTION	LOAD TYPE	FIRST DEMAND KVA	%	SECOND DEMAND KVA	%	THIRD DEMAND KVA	%	DESIGN FACT
GENERAL LOADS	Z	100.	100.	ALL	50.	ALL	50.	1.00
LIGHTING	K	ALL	100.	ALL	100.	ALL	100.	1.25
RECEPTACLES	Z	10.	100.	ALL	50.	ALL	50.	1.00
Load Not Defined	K	ALL	0.	ALL	0.	ALL	0.	1.00
HEATING	Z	ALL	100.	ALL	100.	ALL	100.	1.25
OFFICE EQUIPMENT	Z	ALL	100.	ALL	100.	ALL	100.	1.00
WATER PUMPS	K	ALL	100.	ALL	100.	ALL	100.	1.00
VAR SPEED DRIVE	K	ALL	5.	ALL	5.	ALL	5.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
HVAC MTR LOAD	K	ALL	100.	ALL	100.	ALL	100.	1.00
HVAC LGST MTR	K	ALL	100.	ALL	100.	ALL	100.	1.25
ACC MTR LOAD	K	ALL	100.	ALL	100.	ALL	100.	1.00
ACC LGST MTR	K	ALL	100.	ALL	100.	ALL	100.	1.25
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00

NOTES: LARGEST MOTOR CIRCUIT IDENTIFIED,
 AND USED TO CALCULATE DEMAND LOAD BASED ON NEC ART 430
 DEMAND AND DESIGN FACTORS APPLIED AT EACH LOAD BUS
 AND ALL LOAD TOTALS ARE POWER FACTOR CORRECTED
 DESIGN LOAD VALUES BASED ON MOTOR RUNING OR STARTING CONDITION

Attachment C

Project W-320 / Tank 241-C-106 Sluicing
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SKM POWER*TOOLS FOR WINDOWS
FEEDER AND TRANSFORMER SIZING REPORT
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=====

FEEDER AND TRANSFORMER STUDY CRITERIA

=====

SIZE AND REPORT, DO NOT CHANGE THE DATA BASE

BRANCH VOLTAGE DROP CRITERIA 3.00 %

VOLTAGE DROP CALCULATIONS ARE PRELIMINARY
EXECUTE VOLTAGE DROP AND LOAD FLOW STUDY FOR MORE ACCURATE RESULTS

PRIMARY/SECONDARY TRANSFORMER FDRS SIZED AT 125. % OF TX FULL LOAD RATING

*** NOTICE *** FEEDER SIZED TO 125. PERCENT OF TRANSFORMER SIZE
BRANCH FROM XFMR C-T-1 Pri TO XFMR C-T-1 Sec
TX KVA: 501.1 TR FLA: 21.0
MINIMUM FEEDER AMPACITY: 26.2

*** NOTICE *** FEEDER SIZED TO 125. PERCENT OF TRANSFORMER SIZE
BRANCH FROM XFMR C-T-1 Pri TO XFMR C-T-1 Sec
TX KVA: 501.1 TR FLA: 602.7
MINIMUM FEEDER AMPACITY: 753.3

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FEEDER SIZE REPORT

FEEDER SCHEDULE

FEEDER ROUTING NO NAME	FEEDER VOLTAGE	NO /PH	WIRE QTY	SIZE FDR	TYPE MAT	INSUL TYPE	GROUND WIRE	RACEWAY SIZE	TYPE
FROM Ug Rsr P1 E257 *****	13800.								
TO XFMR C-T-1 Pri	EX	(1)	3	2	CU	EPR		2 1/2" C	M
FROM XFMR C-T-1 Sec *****	480.								
TO C-PDP-1 600A	EX	(2)	5	600	CU	THWN	2/0	3 1/2" C	M
FROM C-PDP-1 600A *****	480.								
TO Xfmr Skid	EX	(1)	4	1/0	CU	MCXH		DB	M
TO MCC-N1 800A	EX	(3)	5	350	CU	THWN	2/0	3" C	M
FROM Process Bldg *****	480.								
TO C106-PP1 Bus	EX	(1)	4	8	CU	THHN	10	3/4" C	M
FROM MCC-N1 800A *****	480.								
TO Process Bldg	EX	(1)	4	2	CU	THWN	8	1 1/4" C	M
TO C106-PP2 Bus	EX	(1)	4	12	CU	THWN	12	1/2" C	M
FROM Process Bldg *****	480.								
TO FN-1361 Bus	EX	(1)	4	10	CU	THHN	10	1/2" C	M
TO HC-1361 Bus	EX	(1)	4	4	CU	THHN	8	1" C	M
TO UH-1362 Bus	EX	(1)	4	12	CU	THHN	12	1/2" C	M
TO UH-1361 Bus	EX	(1)	4	12	CU	THHN	12	1/2" C	M
FROM MCC-N1 800A *****	480.								
TO Service Bldg	EX	(1)	4	10	CU	THWN	10	1/2" C	M
FROM Service Bldg *****	480.								
TO CPR-1361 Bus	EX	(1)	5	10	CU	THWN	10	1/2" C	M

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FEEDER SIZE REPORT

F E E D E R S C H E D U L E

FEEDER ROUTING NO NAME	FEEDER VOLTAGE	NO /PH	WIRE QTY	SIZE FDR	TYPE MAT	INSUL TYPE	GROUND WIRE	RACEWAY SIZE	TYPE
=====									
FROM Xfmr Skid	480.								

TO Office Trl Bus	EX	(1)	4	4	CU	MCXH		DB	M
TO Conex Tlr Bus	EX	(1)	4	4	CU	MCXH		DB	M
FROM MCC-N1 800A	480.								

TO Chiller Skid	EX	(1)	4	4/0	CU	THWN	4	2" C	M
TO Exhaust Skid	EX	(1)	4	10	CU	THWN	10	1/2" C	M
TO EXH Fan Vfd	EX	(1)	4	12	CU	THWN	12	1/2" C	M
FROM Xfmr Skid	480.								

TO WRAM Tlr Bus	EX	(1)	4	4	CU	MCXH		DB	M
FROM MCC-N1 800A	480.								

TO MCC-N2	EX	(2)	5	350	CU	THWN	1/0	3" C	M
TO Sluicer Skid	EX	(1)	4	12	CU	THWN	12	1/2" C	M
TO Slurry Winch	EX	(1)	4	12	CU	THWN	12	1/2" C	M
FROM MCC-N2	480.								

TO Booster Vfd	EX	(1)	4	500	CU	THWN	3	3" C	M
TO P-1361 SS	EX	(1)	4	1/0	CU	THWN	6	1 1/2" C	N
FROM P-1361 SS	480.								

TO P-1361 Bus	EX	(1)	4	1/0	CU	THWN	6	1 1/2" C	M
FROM Booster Vfd	480.								

TO P-1362 Bus	EX	(1)	4	500	CU	THWN	3	3" C	M
FROM EXH Fan Vfd	480.								

TO FN-1362 Bus		(1)	3	12	CU	THWN		1/2" C	M

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FEEDER SIZE REPORT

FEEDER SCHEDULE

```
=====
FEEDER ROUTING      FEEDER NO WIRE SIZE TYPE  INSUL GROUND  RACEWAY
NO NAME            VOLTAGE /PH QTY FDR  MAT TYPE WIRE  SIZE  TYPE
=====
FROM  Service Bldg      480.
*****
TO    C106-PP3 Bus      EX    ( 1) 4    10    CU  THWN  10  1/2" C  M
=====
```

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FEEDER EVALUATION

FEEDER DESIGN LOAD ANALYSIS

FEEDER ROUTING NO NAME	EXTG % VD /PH	QTY FDR	SIZE MAT	FEEDER DESCRIPTION INSUL AMBIENT	DESIGN LOAD	DERATED CAPACITY
FROM Ug Rsr P1 E257	13800.					

TO XFMR C-T-1 Pri	EX 0.02	1	CU	EPR 30.	24. A	150. A
FROM XFMR C-T-1 Sec	480.					

TO C-PDP-1 600A	EX 0.13	2	CU	THWN 30.	682. A	840. A
FROM C-PDP-1 600A	480.					

TO Xfmr Skid	EX 0.14	1	CU	MCXH 30.	60. A	150. A
TO MCC-N1 800A	EX 0.13	3	CU	THWN 30.	622. A	930. A
FROM Process Bldg	480.					

TO C106-PP1 Bus	EX 0.03	1	CU	THHN 70.	9. A	23. A
FROM MCC-N1 800A	480.					

TO Process Bldg	EX 1.32	1	CU	THWN 30.	77. A	95. A
TO C106-PP2 Bus	EX 0.06	1	CU	THWN 30.	18. A	20. A
FROM Process Bldg	480.					

TO FN-1361 Bus	EX 0.19	1	CU	THHN 70.	14. A	17. A
TO HC-1361 Bus	EX 0.20	1	CU	THHN 70.	45. A	41. A
TO UH-1362 Bus	EX 0.21	1	CU	THHN 70.	6. A	12. A
TO UH-1361 Bus	EX 0.12	1	CU	THHN 70.	6. A	12. A
FROM MCC-N1 800A	480.					

TO Service Bldg	EX 0.46	1	CU	THWN 30.	20. A	30. A
FROM Service Bldg	480.					

TO CPR-1361 Bus	EX 0.07	1	CU	THWN 30.	14. A	30. A

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FEEDER EVALUATION

FEEDER DESIGN LOAD ANALYSIS

FEEDER ROUTING NO NAME	EXTG VD	% /PH	QTY FDR	SIZE MAT	FEEDER INSUL	DESCRIPTION AMBIENT	DESIGN LOAD	DERATED CAPACITY
FROM Xfmr Skid		480.						

TO Office Trl Bus	EX	0.11	1		CU	MCXH 30.	20. A	70. A
TO Conex Tlr Bus	EX	0.21	1		CU	MCXH 30.	20. A	70. A
FROM MCC-N1 800A		480.						

TO Chiller Skid	EX	0.10	1		CU	THWN 30.	109. A	230. A
TO Exhaust Skid	EX	1.98	1		CU	THWN 30.	16. A	30. A
TO EXH Fan Vfd	EX	0.08	1		CU	THWN 30.	14. A	20. A
FROM Xfmr Skid		480.						

TO WRAM Tlr Bus	EX	0.47	1		CU	MCXH 30.	20. A	70. A
FROM MCC-N1 800A		480.						

TO MCC-N2	EX	0.28	2		CU	THWN 30.	392. A	620. A
TO Sluicer Skid	EX	0.87	1		CU	THWN 30.	6. A	20. A
TO Slurry Winch	EX	0.44	1		CU	THWN 30.	3. A	20. A
FROM MCC-N2		480.						

TO Booster Vfd	EX	0.06	1		CU	THWN 30.	341. A	380. A
TO P-1361 SS	EX	0.00	1		CU	THWN 30.	65. A	150. A
FROM P-1361 SS		480.						

TO P-1361 Bus	EX	0.85	1		CU	THWN 30.	65. A	150. A
FROM Booster Vfd		480.						

TO P-1362 Bus	EX	1.90	1		CU	THWN 44.	341. A	380. A
FROM EXH Fan Vfd		480.						

TO FN-1362 Bus		2.49	1	12	CU	THWN 30.	14. A	20. A

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FEEDER EVALUATION

FEEDER DESIGN LOAD ANALYSIS

```
=====
FEEDER ROUTING      EXTG % QTY SIZE FEEDER DESCRIPTION  DESIGN DERATED
NO NAME            VD /PH FDR  MAT  INSUL AMBIENT  LOAD  CAPACITY
=====
FROM  Service Bldg      480.
*****
TO    C106-PP3 Bus    EX 0.01 1          CU   THWN   30.    6. A   30. A
```


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TRANSFORMER SIZE REPORT

TRANSFORMER SCHEDULE

LOCATION	DESCRIPTION	VOLTAGE	CONN	PCT.	TRANSFORMER	DESCRIPTION
BUS NO.	NAME	LEVELS	CODE	TAP		
FROM	XFMR C-T-1 Pri	13800.	D	-2.5	TYPE: <Us	SIZE: 0.0 KVA
TO	XFMR C-T-1 Sec	480.	YG		DESCRIPTION: XFMR C-T-1	
DEMAND	LOAD: 501.1 KVA		EX		3.19 %Z NOMINAL RATING	0.0 KVA

Attachment D

Project W-320 / Tank 241-C-106 Sluicing
C-Farm Electrical Distribution
Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

DATE: 7:21:1998
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SKM POWER*TOOLS FOR WINDOWS
LOAD FLOW AND VOLTAGE DROP ANALYSIS REPORT
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Project W-320 / Tank 241-C-106 Sluicing
C-Farm Electrical Distribution

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*** SOLUTION COMMENTS ***

=====

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA	:	3.00 %
BUS VOLTAGE CRITERIA	:	5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS	:	1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS:	:	1.00
EXACT(ITERATIVE) SOLUTION	:	YES
UTILITY IMPEDANCE	:	YES
TRANSFORMER PHASE SHIFT	:	NO

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

LOAD FLOW IS BASED ON CALCULATED DEMAND LOAD RESULTS
FROM THE DEMAND LOAD ANALYSIS STUDY.
LOAD ANALYSIS INCLUDES ALL LOADS.

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

SWING GENERATORS		
SOURCE NAME	VOLTAGE	ANGLE
=====		
C8-L6 13.8Kv	1.030	0.00

LARGEST LOAD:	226.96 KVA
CONVERGENCE CRITERIA:	0.011 KVA
LARGEST BUS MISMATCH	P-1362 Bus 10.559 KVA
LARGEST BUS MISMATCH	P-1362 Bus 0.766 KVA
LARGEST BUS MISMATCH	P-1362 Bus 0.060 KVA
LARGEST BUS MISMATCH	P-1362 Bus 0.005 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

SOURCE	VOLTAGE	ANGLE	KW	KVAR	VD% (UTILITY IMPEDANCE)
C8-L6 13.8Kv	1.030	0.00	463.98	269.07	0.58 0.64485+J 1.12848

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: Ug Rsr Pl E257 DESIGN VOLTS: 13800 BUS VOLTS: 14133 %VD: -2.42

===== PU BUS VOLTAGE: 1.024 ANGLE: -0.2 DEGREES

*** SWING GENERATOR: C8-L6 13.8Kv 464.0 KW 269.1 KVAR

LOAD TO: XFMR C-T-1 Pri FEEDER AMPS: 21.7 VOLTAGE DROP: 2. %VD: 0.02

PROJECTED POWER FLOW: 462.2 KW 266.0 KVAR 533.3 KVA PF: 0.87 LAGGING

LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

==== BUS: XFMR C-T-1 Pri DESIGN VOLTS: 13800 BUS VOLTS: 14131 %VD: -2.40

===== PU BUS VOLTAGE: 1.024 ANGLE: -0.2 DEGREES

LOAD FROM: Ug Rsr Pl E257 FEEDER AMPS: 21.7 VOLTAGE DROP: 2. %VD: 0.02

PROJECTED POWER FLOW: 462.2 KW 266.0 KVAR 533.2 KVA PF: 0.87 LAGGING

LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

LOAD TO: XFMR C-T-1 Sec TRANSF AMPS: 21.7 VOLTAGE DROP: 407. %VD: 2.95

PROJECTED POWER FLOW: 462.2 KW 266.0 KVAR 533.2 KVA PF: 0.87 LAGGING

LOSSES THRU TRANSF: 13.8 KW 33.9 KVAR 36.5 KVA

==== BUS: XFMR C-T-1 Sec DESIGN VOLTS: 480 BUS VOLTS: 477 %VD: 0.55

===== PU BUS VOLTAGE: 0.994 ANGLE: -2.7 DEGREES

LOAD FROM: XFMR C-T-1 Pri TRANSF AMPS: 20.6 VOLTAGE DROP: 14. %VD: 2.95

PROJECTED POWER FLOW: 462.2 KW 266.0 KVAR 533.2 KVA PF: 0.87 LAGGING

LOSSES THRU TRANSF: 13.8 KW 33.9 KVAR 36.5 KVA

LOAD TO: C-PDP-1 600A FEEDER AMPS: 610.6 VOLTAGE DROP: 1. %VD: 0.12

PROJECTED POWER FLOW: 448.4 KW 232.1 KVAR 504.9 KVA PF: 0.89 LAGGING

LOSSES THRU FEEDER: 0.3 KW 0.7 KVAR 0.8 KVA

==== BUS: C-PDP-1 600A DESIGN VOLTS: 480 BUS VOLTS: 477 %VD: 0.67

===== PU BUS VOLTAGE: 0.993 ANGLE: -2.8 DEGREES

LOAD FROM: XFMR C-T-1 Sec FEEDER AMPS: 610.6 VOLTAGE DROP: 1. %VD: 0.12

PROJECTED POWER FLOW: 448.0 KW 231.5 KVAR 504.3 KVA PF: 0.89 LAGGING

LOSSES THRU FEEDER: 0.3 KW 0.7 KVAR 0.8 KVA

LOAD TO: Xfmr Skid FEEDER AMPS: 59.2 VOLTAGE DROP: 1. %VD: 0.14

PROJECTED POWER FLOW: 44.1 KW 21.3 KVAR 48.9 KVA PF: 0.90 LAGGING

LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: MCC-N1 800A FEEDER AMPS: 551.4 VOLTAGE DROP: 1. %VD: 0.11
 PROJECTED POWER FLOW: 404.0 KW 210.2 KVAR 455.4 KVA PF: 0.89 LAGGING
 LOSSES THRU FEEDER: 0.4 KW 0.5 KVAR 0.6 KVA

==== BUS: Xfmr Skid DESIGN VOLTS: 480 BUS VOLTS: 476 %VD: 0.81
 ===== PU BUS VOLTAGE: 0.992 ANGLE: -2.8 DEGREES

LOAD FROM: C-PDP-1 600A FEEDER AMPS: 59.2 VOLTAGE DROP: 1. %VD: 0.14
 PROJECTED POWER FLOW: 44.0 KW 21.3 KVAR 48.9 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

LOAD TO: Office Trl Bus FEEDER AMPS: 19.7 VOLTAGE DROP: 1. %VD: 0.11
 PROJECTED POWER FLOW: 14.7 KW 7.1 KVAR 16.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: Conex Tlr Bus FEEDER AMPS: 19.7 VOLTAGE DROP: 1. %VD: 0.21
 PROJECTED POWER FLOW: 14.7 KW 7.1 KVAR 16.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: WRAM Tlr Bus FEEDER AMPS: 19.7 VOLTAGE DROP: 2. %VD: 0.46
 PROJECTED POWER FLOW: 14.6 KW 7.1 KVAR 16.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

==== BUS: MCC-N1 800A DESIGN VOLTS: 480 BUS VOLTS: 476 %VD: 0.79
 ===== PU BUS VOLTAGE: 0.992 ANGLE: -2.8 DEGREES

LOAD FROM: C-PDP-1 600A FEEDER AMPS: 551.4 VOLTAGE DROP: 1. %VD: 0.11
 PROJECTED POWER FLOW: 403.6 KW 209.7 KVAR 454.9 KVA PF: 0.89 LAGGING
 LOSSES THRU FEEDER: 0.4 KW 0.5 KVAR 0.6 KVA

LOAD TO: Process Bldg FEEDER AMPS: 62.6 VOLTAGE DROP: 5. %VD: 1.07
 PROJECTED POWER FLOW: 51.0 KW 8.7 KVAR 51.7 KVA PF: 0.99 LAGGING
 LOSSES THRU FEEDER: 0.5 KW 0.2 KVAR 0.6 KVA

LOAD TO: C106-PP2 Bus FEEDER AMPS: 17.8 VOLTAGE DROP: 0. %VD: 0.06
 PROJECTED POWER FLOW: 13.3 KW 6.4 KVAR 14.8 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: Service Bldg FEEDER AMPS: 17.0 VOLTAGE DROP: 2. %VD: 0.40
 PROJECTED POWER FLOW: 11.8 KW 7.6 KVAR 14.0 KVA PF: 0.84 LAGGING
 LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

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C-Farm Electrical Distribution
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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: Chiller Skid FEEDER AMPS: 92.6 VOLTAGE DROP: 0. %VD: 0.08
PROJECTED POWER FLOW: 61.5 KW 45.4 KVAR 76.4 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.1 KVA

LOAD TO: Exhaust Skid FEEDER AMPS: 13.8 VOLTAGE DROP: 8. %VD: 1.72
PROJECTED POWER FLOW: 10.5 KW 4.5 KVAR 11.4 KVA PF: 0.92 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.0 KVAR 0.2 KVA

LOAD TO: EXH Fan Vfd FEEDER AMPS: 11.3 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 7.6 KW 5.4 KVAR 9.3 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: MCC-N2 FEEDER AMPS: 332.5 VOLTAGE DROP: 1. %VD: 0.24
PROJECTED POWER FLOW: 242.7 KW 127.8 KVAR 274.3 KVA PF: 0.88 LAGGING
LOSSES THRU FEEDER: 0.5 KW 0.6 KVAR 0.7 KVA

LOAD TO: Sluicer Skid FEEDER AMPS: 5.2 VOLTAGE DROP: 3. %VD: 0.71
PROJECTED POWER FLOW: 3.5 KW 2.5 KVAR 4.3 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: Slurry Winch FEEDER AMPS: 2.6 VOLTAGE DROP: 2. %VD: 0.35
PROJECTED POWER FLOW: 1.7 KW 1.3 KVAR 2.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: C106-PP1 Bus DESIGN VOLTS: 480 BUS VOLTS: 471 %VD: 1.89
===== PU BUS VOLTAGE: 0.981 ANGLE: -2.9 DEGREES
NET BRANCH DIVERSITY LOAD: 6.5 KW 3.1 KVAR

LOAD FROM: Process Bldg FEEDER AMPS: 8.8 VOLTAGE DROP: 0. %VD: 0.03
PROJECTED POWER FLOW: 6.5 KW 3.1 KVAR 7.2 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Process Bldg DESIGN VOLTS: 480 BUS VOLTS: 471 %VD: 1.86
===== PU BUS VOLTAGE: 0.981 ANGLE: -2.9 DEGREES

LOAD FROM: MCC-N1 800A FEEDER AMPS: 62.6 VOLTAGE DROP: 5. %VD: 1.07
PROJECTED POWER FLOW: 50.4 KW 8.6 KVAR 51.2 KVA PF: 0.99 LAGGING
LOSSES THRU FEEDER: 0.5 KW 0.2 KVAR 0.6 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: C106-PP1 Bus	FEEDER AMPS: 8.8	VOLTAGE DROP: 0. %VD: 0.03
PROJECTED POWER FLOW: 6.5 KW	3.1 KVAR	7.2 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: FN-1361 Bus	FEEDER AMPS: 11.2	VOLTAGE DROP: 1. %VD: 0.15
PROJECTED POWER FLOW: 7.4 KW	5.4 KVAR	9.2 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: HC-1361 Bus	FEEDER AMPS: 35.3	VOLTAGE DROP: 1. %VD: 0.15
PROJECTED POWER FLOW: 28.9 KW	0.0 KVAR	28.9 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: UH-1362 Bus	FEEDER AMPS: 4.7	VOLTAGE DROP: 1. %VD: 0.16
PROJECTED POWER FLOW: 3.8 KW	0.0 KVAR	3.8 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: UH-1361 Bus	FEEDER AMPS: 4.7	VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 3.8 KW	0.0 KVAR	3.8 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

==== BUS: C106-PP2 Bus	DESIGN VOLTS: 480	BUS VOLTS: 476	%VD: 0.84
=====	PU BUS VOLTAGE: 0.992	ANGLE: -2.8 DEGREES	
NET BRANCH DIVERSITY LOAD:	13.3 KW	6.4 KVAR	

LOAD FROM: MCC-N1 800A	FEEDER AMPS: 17.8	VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 13.3 KW	6.4 KVAR	14.7 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

==== BUS: FN-1361 Bus	DESIGN VOLTS: 480	BUS VOLTS: 470	%VD: 2.01
=====	PU BUS VOLTAGE: 0.980	ANGLE: -2.8 DEGREES	
NET BRANCH DIVERSITY LOAD:	7.4 KW	5.4 KVAR	

LOAD FROM: Process Bldg	FEEDER AMPS: 11.2	VOLTAGE DROP: 1. %VD: 0.15
PROJECTED POWER FLOW: 7.4 KW	5.4 KVAR	9.1 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: HC-1361 Bus DESIGN VOLTS: 480 BUS VOLTS: 470 %VD: 2.01
===== PU BUS VOLTAGE: 0.980 ANGLE: -2.9 DEGREES
NET BRANCH DIVERSITY LOAD: 28.8 KW 0.0 KVAR

LOAD FROM: Process Bldg FEEDER AMPS: 35.3 VOLTAGE DROP: 1. %VD: 0.15
PROJECTED POWER FLOW: 28.8 KW 0.0 KVAR 28.8 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: UH-1362 Bus DESIGN VOLTS: 480 BUS VOLTS: 470 %VD: 2.02
===== PU BUS VOLTAGE: 0.980 ANGLE: -2.9 DEGREES
NET BRANCH DIVERSITY LOAD: 3.8 KW 0.0 KVAR

LOAD FROM: Process Bldg FEEDER AMPS: 4.7 VOLTAGE DROP: 1. %VD: 0.16
PROJECTED POWER FLOW: 3.8 KW 0.0 KVAR 3.8 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: UH-1361 Bus DESIGN VOLTS: 480 BUS VOLTS: 471 %VD: 1.95
===== PU BUS VOLTAGE: 0.980 ANGLE: -2.9 DEGREES
NET BRANCH DIVERSITY LOAD: 3.8 KW 0.0 KVAR

LOAD FROM: Process Bldg FEEDER AMPS: 4.7 VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 3.8 KW 0.0 KVAR 3.8 KVA PF: 1.00 UNITY
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Service Bldg DESIGN VOLTS: 480 BUS VOLTS: 474 %VD: 1.18
===== PU BUS VOLTAGE: 0.988 ANGLE: -2.7 DEGREES

LOAD FROM: MCC-N1 800A FEEDER AMPS: 17.0 VOLTAGE DROP: 2. %VD: 0.40
PROJECTED POWER FLOW: 11.8 KW 7.6 KVAR 14.0 KVA PF: 0.84 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

LOAD TO: C106-PP3 Bus FEEDER AMPS: 5.9 VOLTAGE DROP: 0. %VD: 0.01
PROJECTED POWER FLOW: 4.4 KW 2.1 KVAR 4.9 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: CPR-1361 Bus FEEDER AMPS: 11.1 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 7.4 KW 5.4 KVAR 9.2 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: C106-PP3 Bus DESIGN VOLTS: 480 BUS VOLTS: 474 %VD: 1.20
 ===== PU BUS VOLTAGE: 0.988 ANGLE: -2.7 DEGREES
 NET BRANCH DIVERSITY LOAD: 4.4 KW 2.1 KVAR

LOAD FROM: Service Bldg FEEDER AMPS: 5.9 VOLTAGE DROP: 0. %VD: 0.01
 PROJECTED POWER FLOW: 4.4 KW 2.1 KVAR 4.9 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: CPR-1361 Bus DESIGN VOLTS: 480 BUS VOLTS: 474 %VD: 1.24
 ===== PU BUS VOLTAGE: 0.988 ANGLE: -2.8 DEGREES
 NET BRANCH DIVERSITY LOAD: 7.4 KW 5.4 KVAR

LOAD FROM: Service Bldg FEEDER AMPS: 11.1 VOLTAGE DROP: 0. %VD: 0.06
 PROJECTED POWER FLOW: 7.4 KW 5.4 KVAR 9.1 KVA PF: 0.81 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Office Trl Bus DESIGN VOLTS: 480 BUS VOLTS: 476 %VD: 0.92
 ===== PU BUS VOLTAGE: 0.991 ANGLE: -2.8 DEGREES
 NET BRANCH DIVERSITY LOAD: 14.7 KW 7.1 KVAR

LOAD FROM: Xfmr Skid FEEDER AMPS: 19.7 VOLTAGE DROP: 1. %VD: 0.11
 PROJECTED POWER FLOW: 14.7 KW 7.1 KVAR 16.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Conex Tlr Bus DESIGN VOLTS: 480 BUS VOLTS: 475 %VD: 1.03
 ===== PU BUS VOLTAGE: 0.990 ANGLE: -2.8 DEGREES
 NET BRANCH DIVERSITY LOAD: 14.6 KW 7.1 KVAR

LOAD FROM: Xfmr Skid FEEDER AMPS: 19.7 VOLTAGE DROP: 1. %VD: 0.21
 PROJECTED POWER FLOW: 14.6 KW 7.1 KVAR 16.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Chiller Skid DESIGN VOLTS: 480 BUS VOLTS: 476 %VD: 0.87
 ===== PU BUS VOLTAGE: 0.991 ANGLE: -2.8 DEGREES
 NET BRANCH DIVERSITY LOAD: 61.4 KW 45.4 KVAR

LOAD FROM: MCC-N1 800A FEEDER AMPS: 92.6 VOLTAGE DROP: 0. %VD: 0.08
 PROJECTED POWER FLOW: 61.4 KW 45.4 KVAR 76.4 KVA PF: 0.80 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.1 KVA

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: Exhaust Skid DESIGN VOLTS: 480 BUS VOLTS: 468 %VD: 2.51
===== PU BUS VOLTAGE: 0.975 ANGLE: -2.5 DEGREES
NET BRANCH DIVERSITY LOAD: 10.3 KW 4.5 KVAR

LOAD FROM: MCC-N1 800A FEEDER AMPS: 13.8 VOLTAGE DROP: 8. %VD: 1.72
PROJECTED POWER FLOW: 10.3 KW 4.5 KVAR 11.3 KVA PF: 0.92 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.0 KVAR 0.2 KVA

==== BUS: EXH Fan Vfd DESIGN VOLTS: 480 BUS VOLTS: 476 %VD: 0.85
===== PU BUS VOLTAGE: 0.991 ANGLE: -2.8 DEGREES

LOAD FROM: MCC-N1 800A FEEDER AMPS: 11.3 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 7.6 KW 5.4 KVAR 9.3 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: FN-1362 Bus FEEDER AMPS: 11.3 VOLTAGE DROP: 10. %VD: 2.06
PROJECTED POWER FLOW: 7.6 KW 5.4 KVAR 9.3 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.0 KVAR 0.2 KVA

==== BUS: WRAM Tlr Bus DESIGN VOLTS: 480 BUS VOLTS: 474 %VD: 1.28
===== PU BUS VOLTAGE: 0.987 ANGLE: -2.7 DEGREES
NET BRANCH DIVERSITY LOAD: 14.6 KW 7.1 KVAR

LOAD FROM: Xfmr Skid FEEDER AMPS: 19.7 VOLTAGE DROP: 2. %VD: 0.46
PROJECTED POWER FLOW: 14.6 KW 7.1 KVAR 16.2 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.0 KVAR 0.1 KVA

==== BUS: MCC-N2 DESIGN VOLTS: 480 BUS VOLTS: 475 %VD: 1.03
===== PU BUS VOLTAGE: 0.990 ANGLE: -2.9 DEGREES

LOAD FROM: MCC-N1 800A FEEDER AMPS: 332.5 VOLTAGE DROP: 1. %VD: 0.24
PROJECTED POWER FLOW: 242.3 KW 127.2 KVAR 273.6 KVA PF: 0.89 LAGGING
LOSSES THRU FEEDER: 0.5 KW 0.6 KVAR 0.7 KVA

LOAD TO: P-1361 SS FEEDER AMPS: 52.8 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 35.0 KW 25.9 KVAR 43.5 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: Booster Vfd FEEDER AMPS: 280.4 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 207.3 KW 101.4 KVAR 230.7 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

==== BUS: Sluicer Skid DESIGN VOLTS: 480 BUS VOLTS: 473 %VD: 1.50
===== PU BUS VOLTAGE: 0.985 ANGLE: -2.5 DEGREES
NET BRANCH DIVERSITY LOAD: 3.5 KW 2.5 KVAR

LOAD FROM: MCC-N1 800A FEEDER AMPS: 5.2 VOLTAGE DROP: 3. %VD: 0.71
PROJECTED POWER FLOW: 3.5 KW 2.5 KVAR 4.3 KVA PF: 0.81 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Slurry Winch DESIGN VOLTS: 480 BUS VOLTS: 475 %VD: 1.14
===== PU BUS VOLTAGE: 0.989 ANGLE: -2.7 DEGREES
NET BRANCH DIVERSITY LOAD: 1.7 KW 1.3 KVAR

LOAD FROM: MCC-N1 800A FEEDER AMPS: 2.6 VOLTAGE DROP: 2. %VD: 0.35
PROJECTED POWER FLOW: 1.7 KW 1.3 KVAR 2.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: P-1361 SS DESIGN VOLTS: 480 BUS VOLTS: 475 %VD: 1.03
===== PU BUS VOLTAGE: 0.990 ANGLE: -2.9 DEGREES

LOAD FROM: MCC-N2 FEEDER AMPS: 52.8 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 35.0 KW 25.9 KVAR 43.5 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: P-1361 Bus FEEDER AMPS: 52.8 VOLTAGE DROP: 3. %VD: 0.69
PROJECTED POWER FLOW: 35.0 KW 25.9 KVAR 43.5 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.3 KW 0.1 KVAR 0.3 KVA

==== BUS: P-1361 Bus DESIGN VOLTS: 480 BUS VOLTS: 472 %VD: 1.72
===== PU BUS VOLTAGE: 0.983 ANGLE: -2.8 DEGREES
NET BRANCH DIVERSITY LOAD: 34.7 KW 25.8 KVAR

LOAD FROM: P-1361 SS FEEDER AMPS: 52.8 VOLTAGE DROP: 3. %VD: 0.69
PROJECTED POWER FLOW: 34.7 KW 25.8 KVAR 43.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.3 KW 0.1 KVAR 0.3 KVA

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: Booster Vfd DESIGN VOLTS: 480 BUS VOLTS: 475 %VD: 1.08
===== PU BUS VOLTAGE: 0.989 ANGLE: -2.9 DEGREES

LOAD FROM: MCC-N2 FEEDER AMPS: 280.4 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 207.2 KW 101.2 KVAR 230.6 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

LOAD TO: P-1362 Bus FEEDER AMPS: 280.4 VOLTAGE DROP: 8. %VD: 1.57
PROJECTED POWER FLOW: 207.2 KW 101.2 KVAR 230.6 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 2.3 KW 3.7 KVAR 4.4 KVA

==== BUS: P-1362 Bus DESIGN VOLTS: 480 BUS VOLTS: 467 %VD: 2.65
===== PU BUS VOLTAGE: 0.974 ANGLE: -3.5 DEGREES
NET BRANCH DIVERSITY LOAD: 204.9 KW 97.5 KVAR

LOAD FROM: Booster Vfd FEEDER AMPS: 280.4 VOLTAGE DROP: 8. %VD: 1.57
PROJECTED POWER FLOW: 204.9 KW 97.5 KVAR 227.0 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 2.3 KW 3.7 KVAR 4.4 KVA

==== BUS: FN-1362 Bus DESIGN VOLTS: 480 BUS VOLTS: 466 %VD: 2.92
===== PU BUS VOLTAGE: 0.971 ANGLE: -2.0 DEGREES
NET BRANCH DIVERSITY LOAD: 7.4 KW 5.4 KVAR

LOAD FROM: EXH Fan Vfd FEEDER AMPS: 11.3 VOLTAGE DROP: 10. %VD: 2.06
PROJECTED POWER FLOW: 7.4 KW 5.4 KVAR 9.1 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.0 KVAR 0.2 KVA

==== BUS: C8-L6 13.8Kv DESIGN VOLTS: 1 BUS VOLTS: 1 %VD: -3.00
===== PU BUS VOLTAGE: 1.030 ANGLE: 0.0 DEGREES
*** SWING GENERATOR: C8-L6 13.8Kv 464.0 KW 269.1 KVAR

LOAD TO: Ug Rsr P1 E257 FEEDER AMPS: 291888 VOLTAGE DROP: 0. %VD: 0.58
PROJECTED POWER FLOW: 464.0 KW 269.1 KVAR 536.4 KVA PF: 0.87 LAGGING
LOSSES THRU FEEDER: 1.7 KW 3.1 KVAR 3.5 KVA

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BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY

BUS NAME	BASE VOLT	PU VOLT	BUS NAME	BASE VOLT	PU VOLT
Ug Rsr Pl E257	13800.00	1.0242	XFMR C-T-1 Pri	13800.00	1.0240
XFMR C-T-1 Sec	480.00	0.9945	C-PDP-1 600A	480.00	0.9933
Xfmr Skid	480.00	0.9919	MCC-N1 800A	480.00	0.9921
C106-PP1 Bus	480.00	0.9811	Process Bldg	480.00	0.9814
C106-PP2 Bus	480.00	0.9916	FN-1361 Bus	480.00	0.9799
HC-1361 Bus	480.00	0.9799	UH-1362 Bus	480.00	0.9798
UH-1361 Bus	480.00	0.9805	Service Bldg	480.00	0.9882
C106-PP3 Bus	480.00	0.9880	CPR-1361 Bus	480.00	0.9876
Office Trl Bus	480.00	0.9908	Conex Tlr Bus	480.00	0.9897
Chiller Skid	480.00	0.9913	Exhaust Skid	480.00	0.9749
EXH Fan Vfd	480.00	0.9915	WRAM Tlr Bus	480.00	0.9872
MCC-N2	480.00	0.9897	Sluicer Skid	480.00	0.9850
Slurry Winch	480.00	0.9886	P-1361 SS	480.00	0.9897
P-1361 Bus	480.00	0.9828	Booster Vfd	480.00	0.9892
P-1362 Bus	480.00	0.9735	FN-1362 Bus	480.00	0.9708

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM NAME	TO NAME	TYPE	VD%	AMPS	KVA	RATING%
Ug Rsr Pl E257	XFMR C-T-1 Pri	FDR	0.02	21.79	533.31	14.52
XFMR C-T-1 Pri	XFMR C-T-1 Sec	TX2	2.95	21.79	533.23	206.04
XFMR C-T-1 Sec	C-PDP-1 600A	FDR	0.12	610.69	504.91	72.70
C-PDP-1 600A	Xfmr Skid	FDR	0.14	59.26	48.93	39.50
C-PDP-1 600A	MCC-N1 800A	FDR	0.11	551.45	455.38	59.30
Xfmr Skid	Office Trl Bus	FDR	0.11	19.78	16.31	28.26
Xfmr Skid	Conex Tlr Bus	FDR	0.21	19.76	16.30	28.23
Xfmr Skid	WRAM Tlr Bus	FDR	0.46	19.71	16.25	28.16
MCC-N1 800A	Process Bldg	FDR	1.07	62.69	51.71	65.99
MCC-N1 800A	C106-PP2 Bus	FDR	0.06	17.89	14.76	89.45
MCC-N1 800A	Service Bldg	FDR	0.40	17.02	14.03	56.72
MCC-N1 800A	Chiller Skid	FDR	0.08	92.68	76.44	40.29
MCC-N1 800A	Exhaust Skid	FDR	1.72	13.88	11.45	46.27
MCC-N1 800A	EXH Fan Vfd	FDR	0.06	11.33	9.35	56.65
MCC-N1 800A	MCC-N2	FDR	0.24	332.56	274.31	53.64
MCC-N1 800A	Sluicer Skid	FDR	0.71	5.23	4.31	26.15
MCC-N1 800A	Slurry Winch	FDR	0.35	2.62	2.16	13.09
Process Bldg	C106-PP1 Bus	FDR	0.03	8.85	7.22	38.15
Process Bldg	FN-1361 Bus	FDR	0.15	11.23	9.16	64.52
Process Bldg	HC-1361 Bus	FDR	0.15	35.36	28.85	87.09
Process Bldg	UH-1362 Bus	FDR	0.16	4.71	3.85	40.64

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BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM NAME	TO NAME	TYPE	VD%	AMPS	KVA	RATING%
Process Bldg	UH-1361 Bus	FDR	0.10	4.72	3.85	40.67
Service Bldg	C106-PP3 Bus	FDR	0.01	5.94	4.88	19.81
Service Bldg	CPR-1361 Bus	FDR	0.06	11.14	9.15	37.13
EXH Fan Vfd	FN-1362 Bus	FDR	2.06	11.33	9.34	56.65
MCC-N2	P-1361 SS	FDR	0.00	52.88	43.51	35.26
MCC-N2	Booster Vfd	FDR	0.05	280.41	230.73	73.79
P-1361 SS	P-1361 Bus	FDR	0.69	52.88	43.51	35.26
Booster Vfd	P-1362 Bus	FDR	1.57	280.41	230.62	73.79

NOTE: FDR RATING% = % AMPS RATING BASED ON LIBRARY FLA OR BRANCH INPUT FLA
TX2 RATING% = % KVA RATING BASED ON TRANSFORMER FL KVA

30 BUSES

*** TOTAL SYSTEM LOSSES ***
20. KW 41. KVAR

Attachment E

Project W-320 / Tank 241-C-106 Sluicing
C-Farm Electrical Distribution
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ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

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SHORT CIRCUIT ANALYSIS REPORT
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C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

SWING GENERATORS			
SOURCE	NAME	VOLTAGE	ANGLE
=====			
C8-L6	13.8Kv	1.03	0.00

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Project W-320 / Tank 241-C-106 Sluicing

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***** PRE - FAULT VOLTAGE PROFILE *****

BUS#	NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
Ug Rsr P1 E257		13800.00	1.0300	0.
XFMR C-T-1 Pri		13800.00	1.0300	0.
XFMR C-T-1 Sec		480.00	1.0564	-30.
C-PDP-1 600A		480.00	1.0564	-30.
Xfmr Skid		480.00	1.0564	-30.
MCC-N1 800A		480.00	1.0564	-30.
C106-PP1 Bus		480.00	1.0564	-30.
Process Bldg		480.00	1.0564	-30.
C106-PP2 Bus		480.00	1.0564	-30.
FN-1361 Bus		480.00	1.0564	-30.
HC-1361 Bus		480.00	1.0564	-30.
UH-1362 Bus		480.00	1.0564	-30.
UH-1361 Bus		480.00	1.0564	-30.
Service Bldg		480.00	1.0564	-30.
C106-PP3 Bus		480.00	1.0564	-30.
CPR-1361 Bus		480.00	1.0564	-30.
Office Trl Bus		480.00	1.0564	-30.
Conex Tlr Bus		480.00	1.0564	-30.
Chiller Skid		480.00	1.0564	-30.
Exhaust Skid		480.00	1.0564	-30.
EXH Fan Vfd		480.00	1.0564	-30.
WRAM Tlr Bus		480.00	1.0564	-30.
MCC-N2		480.00	1.0564	-30.
Sluicer Skid		480.00	1.0564	-30.
Slurry Winch		480.00	1.0564	-30.
P-1361 SS		480.00	1.0564	-30.
P-1361 Bus		480.00	1.0564	-30.
Booster Vfd		480.00	1.0564	-30.
P-1362 Bus		480.00	1.0564	-30.
FN-1362 Bus		480.00	1.0564	-30.

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Project W-320 / Tank 241-C-106 Sluicing

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***** FAULT ANALYSIS REPORT *****

FAULT TYPE: 3PH

MODEL INDUCTION MOTOR CONTRIBUTION: YES

MODEL TRANSFORMER TAPS: YES

MODEL TRANSFORMER PHASE SHIFT: YES

Ug Rsr P1 E257 VOLTAGE BASE LL: 13800.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3338.1 / -60. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 0.638 +j 1.122 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.759

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3430.7	3338.1	3338.1	3338.1	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES

---PHASE A---	---PHASE B---	---PHASE C---
3430.7	3430.7	3430.7

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XFMR C-T-1 Pri VOLTAGE BASE LL: 13800.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3281.3 / -60. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 0.666 +j 1.132 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.701

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3361.9	3281.3	3281.3	3281.3	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 3361.9 3361.9 3361.9

XFMR C-T-1 Sec VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8872.2 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 5.342 +j 13.288 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.487

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
9555.5	8872.2	8872.2	8872.2	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9555.5 9555.4 9555.5

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Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

C-PDP-1 600A VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8722.2 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 5.448 +j 13.511 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.480

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
9389.1	8722.2	8722.2	8722.2	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9389.1 9389.1 9389.1

Xfmr Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7579.3 / -91. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 8.052 +j 14.705 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.826

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
7818.4	7579.3	7579.3	7579.3	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 7818.4 7818.4 7818.4

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Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

MCC-N1 800A VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8590.1 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 5.582 +j 13.698 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.454

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
9230.0	8590.1	8590.1	8590.1	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9230.0 9230.0 9230.0

C106-PP1 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3505.5 / -64. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 30.192 +j 20.059 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.664

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3505.8	3505.5	3505.5	3505.5	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 3505.8 3505.8 3505.8

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Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Process Bldg VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 3960.4 / -68. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 25.374 +j 19.636 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.774

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
3961.6	3960.4	3960.4	3960.4		

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
3961.6 3961.6 3961.6

C106-PP2 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 7514.8 / -85. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 9.706 +j 13.846 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.427

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
7606.1	7514.8	7514.8	7514.8		

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
7606.1 7606.1 7606.1

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FN-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2556.9 / -55. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 45.166 +j 20.730 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.459

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
2556.9	2556.9	2556.9	2556.9	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2556.9 2556.9 2556.9

HC-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3442.0 / -64. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 30.582 +j 20.678 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.676

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3442.3	3442.0	3442.0	3442.0	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 3442.3 3442.3 3442.3

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C-Farm Electrical Distribution

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UH-1362 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1818.5 / -48. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 66.607 +j 21.112 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.317

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1818.5		1818.5	1818.5	1818.5

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1818.5 1818.5 1818.5

UH-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2346.5 / -52. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 50.114 +j 20.521 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.409

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
2346.5		2346.5	2346.5	2346.5

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2346.5 2346.5 2346.5

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C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Service Bldg VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3114.9 / -52. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 37.744 +j 15.476 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.410

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3114.9	3114.9	3114.9	3114.9	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
3114.9		3114.9		3114.9

C106-PP3 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2945.3 / -51. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 40.218 +j 15.612 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.388

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
2945.3	2945.3	2945.3	2945.3	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
2945.3		2945.3		2945.3

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CPR-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2654.0 / -49. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 45.166 +j 15.886 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.352

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
2654.0	2654.0	2654.0	2654.0	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME = 0.5 CYCLES				
---PHASE A---	---	---	---	---
2654.0		2654.0		2654.0

Office Trl Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5871.9 / -78. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 14.562 +j 16.007 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.099

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
5891.2	5871.9	5871.9	5871.9	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME = 0.5 CYCLES				
---PHASE A---	---	---	---	---
5891.2		5891.2		5891.2

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C-Farm Electrical Distribution

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Conex Tlr Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 4659.5 / -69. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 21.073 +j 17.309 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.821

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
4661.8	4659.5	4659.5	4659.5	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
4661.8		4661.7		4661.7

Chiller Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8115.8 / -96. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 6.322 +j 14.324 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.266

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
8607.9	8115.8	8115.8	8115.8	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
8607.9		8607.9		8607.9

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Exhaust Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 768.0 / -38. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 163.916 +j 22.448 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.137

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
768.0		768.0	768.0	768.0

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
768.0		768.0		768.0

EXH Fan Vfd VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 6458.7 / -75. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 13.829 +j 13.993 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.012

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
6471.6		6458.7	6458.7	6458.7

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
6471.6		6471.6		6471.6

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WRAM T1r Bus VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 3025.2 / -59. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 36.698 +j 20.434 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.557

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
3025.2	3025.2	3025.2	3025.2		

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
3025.2 3025.2 3025.2

MCC-N2 VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 8121.7 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 6.111 +j 14.402 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.357

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
8667.9	8121.7	8121.7	8121.7		

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
8667.9 8667.9 8667.9

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Sluicer Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 621.2 / -36. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 203.499 +j 20.782 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.102

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
621.2	621.2	621.2	621.2	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 621.2 621.2 621.2

Slurry Winch VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 621.2 / -36. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 203.499 +j 20.782 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.102

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
621.2	621.2	621.2	621.2	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 621.2 621.2 621.2

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

P-1361 SS

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8103.4 / -97. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 6.158 +j 14.421 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.342

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
8639.4	8103.4	8103.4	8103.4	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	8639.4	---PHASE B---	8639.4	---PHASE C---
				8639.4

P-1361 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 4504.3 / -78. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 18.708 +j 21.114 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.129

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
4521.5	4504.3	4504.3	4504.3	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	4521.5	---PHASE B---	4521.5	---PHASE C---
				4521.5

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Booster Vfd

VOLTAGE BASE LL: 480.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 7998.5 / -97. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 6.237 +j 14.611 (PU)

THEVENIN IMPEDANCE X/R RATIO: 2.342

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
8528.1	7998.5	7998.5	7998.5	

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		

---PHASE A---	---PHASE B---	---PHASE C---
8528.1	8528.1	8528.1

P-1362 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 5324.2 / -94. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 10.391 +j 21.485 (PU)

THEVENIN IMPEDANCE X/R RATIO: 2.068

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
5573.4	5324.2	5324.2	5324.2	

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		

---PHASE A---	---PHASE B---	---PHASE C---
5573.4	5573.4	5573.4

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FN-1362 Bus

VOLTAGE BASE LL:

480.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 455.9 / -35. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 277.718 +j 23.438 (PU)

THEVENIN IMPEDANCE X/R RATIO: 0.084

ASYM RMS INTERRUPTING AMPS

1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES

455.9 455.9 455.9 455.9

ASYM RMS FAULTED CURRENT (AMPS)

AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---

455.9 455.9 455.9

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

***** FAULT ANALYSIS REPORT *****

FAULT TYPE: SLG

MODEL INDUCTION MOTOR CONTRIBUTION: YES

MODEL TRANSFORMER TAPS: YES

MODEL TRANSFORMER PHASE SHIFT: YES

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Ug Rsr P1 E257 VOLTAGE BASE LL:          13800.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 1300.2 / -45. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 7.030 +j 7.031 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.000
SEQUENCE EQUIVALENT IMPEDANCE Z1: 0.638 +j 1.122 (PU)
                                   Z2: 0.638 +j 1.122 (PU)
                                   Z0: 5.754 +j 4.787 (PU)
  
```

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES	
1302.6		1300.2	1300.2	1300.2	

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---	---PHASE C---	
1302.6		0.0	0.0	

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

XFMR C-T-1 Pri VOLTAGE BASE LL: 13800.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1283.1 / -45. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.173 +j 7.075 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.986
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 0.666 +j 1.132 (PU)
 Z2: 0.666 +j 1.132 (PU)
 Z0: 5.842 +j 4.811 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1285.3		1283.1	1283.1	1283.1

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1285.3 0.0 0.0

XFMR C-T-1 Sec VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8902.0 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 16.024 +j 39.711 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.478
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 5.342 +j 13.288 (PU)
 Z2: 5.342 +j 13.288 (PU)
 Z0: 5.340 +j 13.134 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
9581.3		8902.0	8902.0	8902.0

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9581.3 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

C-PDP-1 600A VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8649.9 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 16.663 +j 40.798 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.448
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 5.448 +j 13.511 (PU)
 Z2: 5.448 +j 13.511 (PU)
 Z0: 5.768 +j 13.776 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
9290.7	8649.9	8649.9	8649.9	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9290.7 0.0 0.0

Xfmr Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 6922.5 / -87. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 30.079 +j 46.126 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.533
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 8.052 +j 14.705 (PU)
 Z2: 8.052 +j 14.705 (PU)
 Z0: 13.975 +j 16.716 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
7036.6	6922.5	6922.5	6922.5	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 7036.6 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

MCC-N1 800A VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 8430.6 / -97. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 17.466 +j 41.707 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.388
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 5.582 +j 13.698 (PU)
 Z2: 5.582 +j 13.698 (PU)
 Z0: 6.301 +j 14.310 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
9017.1	8430.6	8430.6

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 9017.1 0.0 0.0

C106-PP1 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2377.0 / -56. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 144.242 +j 70.093 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.486
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 30.192 +j 20.059 (PU)
 Z2: 30.192 +j 20.059 (PU)
 Z0: 83.859 +j 29.975 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
2377.0	2377.0	2377.0

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2377.0 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Process Bldg VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2771.8 / -60. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 119.424 +j 68.204 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.571
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 25.374 +j 19.636 (PU)
 Z2: 25.374 +j 19.636 (PU)
 Z0: 68.675 +j 28.932 (PU)

ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 2771.8 2771.8 2771.8 2771.8

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2771.8 0.0 0.0

C106-PP2 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 6642.8 / -78. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 38.707 +j 42.365 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.095
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 9.706 +j 13.846 (PU)
 Z2: 9.706 +j 13.846 (PU)
 Z0: 19.296 +j 14.673 (PU)

ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 6664.1 6642.8 6642.8 6642.8

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 6664.1 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FN-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1635.1 / -48. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 221.381 +j 73.085 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.330
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 45.166 +j 20.730 (PU)
 Z2: 45.166 +j 20.730 (PU)
 Z0: 131.050 +j 31.626 (PU)

ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 1635.1 1635.1 1635.1 1635.1

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1635.1 0.0 0.0

HC-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2333.0 / -56. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 146.255 +j 72.853 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.498
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 30.582 +j 20.678 (PU)
 Z2: 30.582 +j 20.678 (PU)
 Z0: 85.090 +j 31.498 (PU)

ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 2333.0 2333.0 2333.0 2333.0

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2333.0 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

UH-1362 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1120.6 / -43. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 331.836 +j 74.790 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.225
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 66.607 +j 21.112 (PU)
 Z2: 66.607 +j 21.112 (PU)
 Z0: 198.622 +j 32.567 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1120.6		1120.6	1120.6	1120.6

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1120.6 0.0 0.0

UH-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1482.1 / -46. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 246.871 +j 72.156 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.292
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 50.114 +j 20.521 (PU)
 Z2: 50.114 +j 20.521 (PU)
 Z0: 146.644 +j 31.113 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1482.1		1482.1	1482.1	1482.1

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1482.1 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Service Bldg VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 2008.9 / -45. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 183.147 +j 49.639 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.271
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 37.744 +j 15.476 (PU)
 Z2: 37.744 +j 15.476 (PU)
 Z0: 107.660 +j 18.687 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
2008.9		2008.9	2008.9	2008.9

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 2008.9 0.0 0.0

C106-PP3 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1884.9 / -44. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 195.892 +j 50.249 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.257
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 40.218 +j 15.612 (PU)
 Z2: 40.218 +j 15.612 (PU)
 Z0: 115.456 +j 19.024 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1884.9		1884.9	1884.9	1884.9

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1884.9 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

CPR-1361 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1677.2 / -43. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 221.381 +j 51.469 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.232
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 45.166 +j 15.886 (PU)
 Z2: 45.166 +j 15.886 (PU)
 Z0: 131.050 +j 19.697 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1677.2		1677.2	1677.2	1677.2

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1677.2 0.0 0.0

Office Trl Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 4641.6 / -69. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 63.619 +j 51.937 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.816
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 14.562 +j 16.007 (PU)
 Z2: 14.562 +j 16.007 (PU)
 Z0: 34.494 +j 19.924 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
4643.7		4641.6	4641.6	4641.6

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 4643.7 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Conex T1r Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3372.7 / -61. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 97.158 +j 57.749 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.594
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 21.073 +j 17.309 (PU)
 Z2: 21.073 +j 17.309 (PU)
 Z0: 55.012 +j 23.131 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
3372.8		3372.7	3372.7	3372.7

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 3372.8 0.0 0.0

Chiller Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7698.2 / -94. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 21.530 +j 44.593 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.071
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 6.322 +j 14.324 (PU)
 Z2: 6.322 +j 14.324 (PU)
 Z0: 8.886 +j 15.945 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
8060.3		7698.2	7698.2	7698.2

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 8060.3 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Exhaust Skid VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 455.4 / -36. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 833.128 +j 80.756 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.097
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 163.916 +j 22.448 (PU)
 Z2: 163.916 +j 22.448 (PU)
 Z0: 505.297 +j 35.859 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
455.4	455.4	455.4	455.4	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 455.4 0.0 0.0

EXH Fan Vfd VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5166.1 / -66. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 59.948 +j 43.024 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.718
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 13.829 +j 13.993 (PU)
 Z2: 13.829 +j 13.993 (PU)
 Z0: 32.290 +j 15.037 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
5166.9	5166.1	5166.1	5166.1	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 5166.9 0.0 0.0

DATE: 7:21:1998 TIME:17:18: 6. 0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

WRAM T1r Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1989.8 / -52. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 177.653 +j 71.697 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.404
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 36.698 +j 20.434 (PU)
 Z2: 36.698 +j 20.434 (PU)
 Z0: 104.257 +j 30.829 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
1989.8	1989.8	1989.8	1989.8	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1989.8 0.0 0.0

MCC-N2 VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7718.0 / -96. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 20.391 +j 44.985 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.206
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 6.111 +j 14.402 (PU)
 Z2: 6.111 +j 14.402 (PU)
 Z0: 8.168 +j 16.180 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
8153.0	7718.0	7718.0	7718.0	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 8153.0 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Sluicer Skid

VOLTAGE BASE LL: 480.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 366.7 / -34. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: INFINITE

THEVENIN IMPEDANCE X/R RATIO: 0.071

SEQUENCE EQUIVALENT IMPEDANCE Z1: 203.499 +j 20.782 (PU)

Z2: 203.499 +j 20.782 (PU)

Z0: 630.045 +j 31.754 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
366.7	366.7	366.7

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		
---PHASE A---	---PHASE B---	---PHASE C---
366.7	0.0	0.0

Slurry Winch

VOLTAGE BASE LL: 480.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 366.7 / -34. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: INFINITE

THEVENIN IMPEDANCE X/R RATIO: 0.071

SEQUENCE EQUIVALENT IMPEDANCE Z1: 203.499 +j 20.782 (PU)

Z2: 203.499 +j 20.782 (PU)

Z0: 630.045 +j 31.754 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
366.7	366.7	366.7

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		
---PHASE A---	---PHASE B---	---PHASE C---
366.7	0.0	0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

P-1361 SS

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7694.5 / -95. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 20.568 +j 45.070 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.191
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 6.158 +j 14.421 (PU)
 Z2: 6.158 +j 14.421 (PU)
 Z0: 8.251 +j 16.229 (PU)

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
8120.1	7694.5	7694.5	7694.5		

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME = 0.5 CYCLES				
---PHASE A---	---	---PHASE B---	---PHASE C---	
8120.1		0.0	0.0	

P-1361 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3220.8 / -69. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 91.629 +j 74.912 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.818
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 18.708 +j 21.114 (PU)
 Z2: 18.708 +j 21.114 (PU)
 Z0: 54.213 +j 32.685 (PU)

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES		
3222.3	3220.8	3220.8	3220.8		

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME = 0.5 CYCLES				
---PHASE A---	---	---PHASE B---	---PHASE C---	
3222.3		0.0	0.0	

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

Booster Vfd

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7547.6 / -95. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 21.040 +j 45.915 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.182
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 6.237 +j 14.611 (PU)
 Z2: 6.237 +j 14.611 (PU)
 Z0: 8.565 +j 16.694 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
7960.4	7547.6	7547.6	7547.6	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 7960.4 0.0 0.0

P-1362 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 4353.3 / -91. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 42.438 +j 76.594 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.805
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 10.391 +j 21.485 (PU)
 Z2: 10.391 +j 21.485 (PU)
 Z0: 21.656 +j 33.624 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
4485.3	4353.3	4353.3	4353.3	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 4485.3 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

FN-1362 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 268.1 / -33. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: INFINITE
 THEVENIN IMPEDANCE X/R RATIO: 0.060
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 277.718 +j 23.438 (PU)
 Z2: 277.718 +j 23.438 (PU)
 Z0: 863.949 +j 38.296 (PU)

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES	
268.1		268.1	268.1	268.1	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
268.1		0.0		0.0

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Project W-320 / Tank 241-C-106 Sluicing

C-Farm Electrical Distribution

Calc. No. W320-31-010 (Reference Drawing H-2-818680, SH 1, Rev. 1)

***** FAULT ANALYSIS SUMMARY *****

BUS NAME	VOLTAGE L-L	AVAILABLE 3 PHASE	FAULT CURRENT X/R LINE/GRND	X/R	
Ug Rsr P1 E257	13800.	3338.1	1.8	1300.2	1.0
XFMR C-T-1 Pri	13800.	3281.3	1.7	1283.1	1.0
XFMR C-T-1 Sec	480.	8872.2	2.5	8902.0	2.5
C-PDP-1 600A	480.	8722.2	2.5	8649.9	2.4
Xfmr Skid	480.	7579.3	1.8	6922.5	1.5
MCC-N1 800A	480.	8590.1	2.5	8430.6	2.4
Process Bldg	480.	3960.4	0.8	2771.8	0.6
C106-PP1 Bus	480.	3505.5	0.7	2377.0	0.5
C106-PP2 Bus	480.	7514.8	1.4	6642.8	1.1
FN-1361 Bus	480.	2556.9	0.5	1635.1	0.3
HC-1361 Bus	480.	3442.0	0.7	2333.0	0.5
UH-1362 Bus	480.	1818.5	0.3	1120.6	0.2
UH-1361 Bus	480.	2346.5	0.4	1482.1	0.3
Service Bldg	480.	3114.9	0.4	2008.9	0.3
CPR-1361 Bus	480.	2654.0	0.4	1677.2	0.2
Office Trl Bus	480.	5871.9	1.1	4641.6	0.8
Conex Tlr Bus	480.	4659.5	0.8	3372.7	0.6
Chiller Skid	480.	8115.8	2.3	7698.2	2.1
Exhaust Skid	480.	768.0	0.1	455.4	0.1
EXH Fan Vfd	480.	6458.7	1.0	5166.1	0.7
WRAM Tlr Bus	480.	3025.2	0.6	1989.8	0.4
MCC-N2	480.	8121.7	2.4	7718.0	2.2
Sluicer Skid	480.	621.2	0.1	366.7	0.1
Slurry Winch	480.	621.2	0.1	366.7	0.1
Booster Vfd	480.	7998.5	2.3	7547.6	2.2
P-1361 SS	480.	8103.4	2.3	7694.5	2.2
P-1361 Bus	480.	4504.3	1.1	3220.8	0.8
P-1362 Bus	480.	5324.2	2.1	4353.3	1.8
FN-1362 Bus	480.	455.9	0.1	268.1	0.1
C106-PP3 Bus	480.	2945.3	0.4	1884.9	0.3

***** FAULT ANALYSIS REPORT COMPLETED *****

Calc. No. W-320-31-000
Revision 1
ATTACHMENT F

IMMERIBLE SLURRY PUMP
P-1361

INLINE SLURRY BOOSTER
PUMP P-1362

ADD
REFER TO H-2818423 NOTE 1 FOR
RECOMMENDED
CLASSIFICATION OF COMPONENTS.

ESSENTIAL DRAWING

U.S. DEPARTMENT OF ENERGY

JCF KAISER HANFORD COMPANY
ELECTRICAL

C-FARM ONE-LINE DIAGRAM

W-320 TANK 241-C-106 SLICING	11	010000
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NONE	yes no	ER4319	very 1
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[illegible]

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W320-31-011

Tank C-106 Load Determination,
Feeder/Protection Sizing, Voltage
Drop, Lighting Calculations and
Conduit Sizing

Fluor Daniel Northwest	CALCULATION IDENTIFICATION AND INDEX	Page 1 of 34
		Date 7/22/98

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline **Electrical** WO/Job No. **Task Order N09** Calculation No. **W320-31-011**
 Project No. & Name **W-320 Tank 241-C-106 Sluicing**
 Calculation Item **TANK C-106 LOAD DETERMINATION, FEEDER/PROTECTION SIZING, VOLTAGE DROP, LIGHTING CALCULATIONS, & CONDUIT SIZING**

These calculations apply to:

Dwg. No. **See Continuation Sheet** Rev. No.
 Dwg. No. Rev. No.
 Other (Study, CDR) Rev. No.

The status of these calculations is:

- ☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated)
☐ Void Calculation (Reason Voided)

Incorporated in Final Drawings? ☒ Yes ☐ No
 Calculation verified by independent "check" calculations? ☐ Yes ☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	DE Larson 9-21-95	<i>[Signature]</i> 7/24/98	
Checked by	SA Najjar 9-21-95	<i>[Signature]</i> 7/24/98	
Approved by	TJ Kasnick 9-27-95	<i>[Signature]</i> 7/24/98	
Checked Against Approved Vendor Data	N/A	<i>[Signature]</i> 7/24/98	

INDEX

Design Analysis
Page No.

Description

i-ii	Calculation Identification and Index, Continuation sheets
iii-iv	Calculation Cross Index
1	Objectives
1-2	Design Inputs
2	Given Data
3	Assumptions
3	Methods of Analysis
3 - 4	References
4 - 33	Calculations
34	Conclusions
A-1 to A-31	Appendix A: Supporting Documentation

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Fluor Daniel Northwest	CALCULATION IDENTIFICATION AND INDEX Continuation Sheet		Page ii of 34 Date 7/22/98
Discipline Electrical	WO/Job No. Task Order N09	Calculation No. W320-31-011	
	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	DE Larson 9-21-95	<i>E. De</i> 7/22/98	
Checked by	SA Najjar 9-21-95		

These calculations apply to:

H-2-818673, Sheet 1, Rev. 0
 H-2-818674, Sheet 1, Rev. 0
 H-2-818674, Sheet 2, Rev. 0
 H-2-818674, Sheet 3, Rev. 0
 H-2-818674, Sheet 5, Rev. 0
 H-2-818676, Sheet 1, Rev. 0
 H-2-818676, Sheet 2, Rev. 0
 H-2-818676, Sheet 3, Rev. 0
 H-2-818676, Sheet 4, Rev. 0
 H-2-818676, Sheet 5, Rev. 0
 H-2-818677, Sheet 1, Rev. 0
 H-2-818677, Sheet 2, Rev. 0
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 H-2-818678, Sheet 2, Rev. 0
 H-2-818678, Sheet 3, Rev. 0
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 H-2-818678, Sheet 5, Rev. 0
 H-2-818679, Sheet 3, Rev. 0
 H-2-818680, Sheet 1, Rev. 0
 H-2-818681, Sheet 1, Rev. 0
 H-2-818681, Sheet 2, Rev. 0
 H-2-818681, Sheet 3, Rev. 0
 H-2-818690, Sheet 1, Rev. 0
 H-2-818702, Sheet 1, Rev. 0
 H-2-818702, Sheet 2, Rev. 0
 H-2-818704, Sheet 1, Rev. 0
 H-2-818704, Sheet 2, Rev. 0
 H-2-818704, Sheet 3, Rev. 0
 H-2-818704, Sheet 4, Rev. 0

CALCULATION CROSS INDEX (Typical)

Subject Calculation No.: W320-31-011

Page iii of 34

Subject Calculation Revision No.	Superseded by Calculation No.	These interfacing calculation/documents provide input to the subject calculation, and if revised may require revision of the subject calculation.		Results and conclusions of the subject calculation are used in these interfacing calculations and/or documents		Does the output interface calculation/documents require revision?		Has the output interface calculation/documents been revised?		Discipline manager's signature and date indicating evaluation complete.
		Calculation/Document No.	Revision No.	Calculation/Document No.	Revision No.	Yes	No	Yes		
0	N/A	H-2-818680	0	H-2-818673	0		X		X	
				H-2-818674, sh 1	0		X		X	
				H-2-818674, sh 2	0		X		X	
				H-2-818674, sh 3	0		X		X	
				H-2-818674, sh 4	0		X		X	
				H-2-818676, sh 1	0		X		X	
				H-2-818676, sh 2	0		X		X	
				H-2-818676, sh 3	0		X		X	
				H-2-818676, sh 4	0		X		X	
				H-2-818677, sh 1	0		X		X	
				H-2-818677, sh 2	0		X		X	
				H-2-818678, sh 1	0		X		X	
				H-2-818678, sh 2	0		X		X	
				H-2-818678, sh 3	0		X		X	
				H-2-818678, sh 4	0		X		X	
				H-2-818678, sh 5	0		X		X	
				H-2-818679, sh 1	0		X		X	
				H-2-818681, sh 1	0		X		X	
				H-2-818681, sh 2	0		X		X	

Subject Calculation No.: W320-31-011

Discipline manager's signature and date indicating evaluation complete.

[illegible]

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/13/95 by DE Larson
 Checked 7/19/95 by TJ Kasnick
 Revised 5/6/98 by Cris Carlson

1. OBJECTIVES

- 1.1 To determine the total connected load and estimate the maximum demand for the Tank 241-C-106 portion of Project W-320, Tank 241-C-106 Sluicing.
- 1.2 To size the feeder/branch circuit conductors, protection and conduits.
- 1.3 To calculate the voltages at motor terminals during normal running and starting conditions in order to ensure proper operation of pump motors.
- 1.4 To determine number of light fixtures required to provide adequate illumination levels.
- 1.5 To determine conduit sizes for cables used.
- 1.6 To determine adequacy of buried pullboxes (handholes).

2. DESIGN INPUTS

- 2.1 Function Design Criteria for Tank 241-C-106 Waste Retrieval, Project W-320, HNF-SD-W320-FDC-001 Rev. 5.
- 2.2 Attached Electrical One-Line Diagram, Drawing (DWG) H-2-818680.
- 2.3 NFPA-70, National Electrical Code (NEC), 1993 edition.
 - a. Branch circuit conductors shall be sized to carry at least 125% of the largest load plus the sum of other loads, for multiple load circuits.
 - b. Single conductor copper wires, with 90°C XHHW, 600 VAC insulation in buried raceway and conductor ampacity per Reference 6.1, NEC, Table 310-16 for 86°F (30°C) ambient temperature, shall be used.
 - c. Minimum conduit size shall be based on NEC Chapter 9, Tables 1 and 3B.
 - d. Motor rated full load amperes (FLA) shall be based on Reference 6.1, NEC, Table 430-150, except for the 250 HP motor which is based on vendor information, specifically that provided under Lawrence Pump P.O. 961744 / Westinghouse P.O. W-78259-Z4 / Reliance S.O. 897719.
 - e. Motor Circuit Protector (MCP) for motor protection and motor starters shall be sized per Reference 6.4.
- 2.4 MCC N1 main 800 amp incoming circuit breaker shall provide the main service disconnecting means to the C-Farm loads supplied via the Electrical Equipment Skid (EES), Building 241-C-51.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/13/95 By DE Larson
 Checked 7/19/95 By TJ Kasnick
 Revised 5/6/98 By Cris Carlson

- 2.5 Effective impedance (Z_{eff}) at 85% Power Factor (PF), shown in NEC Chapter 9 Table 9, shall be used for voltage drop calculations.

3. GIVEN DATA

- 3.1 The 225 KVA transformer bank installed by the Equipment Removal Phase of Project W-320 is the source of power for these sluicing loads.
- 3.2 The 225 KVA distribution transformer %Z = 3.19, based on nameplate of the transformer.
- 3.3 Minimum allowable voltage at the motor terminals is 414 volts based on NEMA motor rating of 460 V $\pm$ 10%.
- 3.4 The EES housing 241-C-51 and Seismic Shutdown System missile shield enclosures 241-C-51A and 51B are air conditioned.
- 3.5 Motors shown on the Electrical One-Line Diagram, Drawing H-2-818680 are induction motors rated 460 VAC, 3 ϕ , 60 Hz. Motor FLA are from the NEC, except for the 250 HP motor which is based on vendor information in CVI file #22668.
- 3.6 The Variable Speed Drive (VSD) controller for the 250 HP In-Line Booster pump motor has been furnished by Reliance Electric via Lawrence Pump (Procurement Specification W-320-P17). VSD controller maximum input current is 325 A. (150% Torque Limit for 60 SEC. maximum). See Attachment A, page A-8.
- 3.7 The 40 HP submersible (immersible) pump is started before the booster pump. The submersible (immersible) pump is interlocked with the booster pump so that the booster pump can only be started with adequate NPSH detected as the pressure switch exceeds the pressure switch setpoint. A "Soft Start" unit is to be used to limit torque effect to submersible pump hoses to prevent excess twisting.
- 3.8 Ambient temperature of pits 241-C-06A pump pit and 241-C-06C sluice pit are 59°C (138.2°F) based on HVAC calculations.
- 3.9 Ambient temperature of room 1 in the Process Building may reach 65.6°C (150°F) based on data provided by HVAC discipline.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/13/95 By DE Larson
 Checked 7/19/95 By TJ Kasnick
 Revised 5/6/98 By Cris Carlson

4. ASSUMPTIONS

- 4.1 Estimated duration for this project is two years.
- 4.2 Transformer primary taps are set at 100% and secondary terminal voltage at no-load conditions is 480 V.
- 4.3 Demand factor (DF) for the booster and Immersible pumps motors is 80%. Other assumed demand factors may be found within the calculation.
- 4.4 "Soft-Start" unit used for 40 HP submersible pump, P-1361, is considered to have the same efficiency as a conventional motor starter. The basis for this is the description given in the Cutler Hammer document, "User's Manual Easy-Start Advantage EA Series." See Vendor Information file #22668.
- 4.5 Unless otherwise stated, PF = .95 and EFF = 0.95.

5. METHOD OF ANALYSIS

- 5.1 Hand calculations.

6. REFERENCES

- 6.1 Drawing H-2-818680, Sheet 1, Rev. 1, Electrical C-Farm One-Line Diagram.
- 6.2 NFPA-70, National Electrical Code, 1993 edition.
- 6.3 W320-31-010, C-106 Demand Load Analysis, Size Feeders, Voltage Drop and Fault study.
- 6.4 Westinghouse Cat. 25-000, Quick Selector 1993.
- 6.5 Additional References to Support C-Farm Demand Load Analysis:
 - a. Industrial Power Systems Handbook, Beeman, First Edition, Chapter 17 (Load and Cost Estimating Data).
 - b. Standard Handbook for Electrical Engineers, Fink and Beaty, Eleventh Edition, Chapter 18 (Demand and Diversity Factors).
 - c. The following assumptions were made for motor current calculations:
 PF=.95, Eff=.95.

DESIGN ANALYSIS

client Numatec Hanford Corporation

WO/Job No. Task Order N09

Subject C-106 Load Determination,
Feeder/Protection Sizing, Voltage Drop,
Lighting Calculations, & Conduit Sizing

Date 9/13/95

By DE Larson

Checked 7/19/95

By TJ Kasnick

Location 200E, C Tank Farm

Revised 5/6/98

By Cris Carlson

d. ANSI C57, "Distribution, Power & Regulating Transformers"

6.6 Vendor Information file #22668.

7. CALCULATIONS

The following motor current values are from NEC Table 430-150, except for the 250 HP motor which is based on vendor information. Single phase 480 volt loads are calculated as $I = VA/volts$. Three phase 480 volt loads are calculated as $I = VA / (volts \times \sqrt{3})$.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

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 Checked 7/19/95 By TJ Kasnick
 Revised 5/6/98 By Cris Carlson

7.1 Connected/Peak Load Determination for MCC-N1 and MCC-N2

<u>Load</u>	<u>Amperes</u>
Sluicer:	
3 HP Hydraulic Power Unit (SHC-1361)	4.8
0.3 KVA Transformer (control power)	.6 (ph A-B)
Service Building:	
7.5 HP compressor unit (CPR-1361)	11.0
5 KVA Mini Power Center (C106-PP3)	10.4 (ph A-B)
Process Building:	
7.5 HP Recirc Fan (FN-1361)	11.0
30 KW heating coil (HC-1361)	36.1
4 KW Space Heater (UH-1361)	4.8
4 KW Space Heater (UH-1362)	4.8
7.5 KVA Mini Power Center (C106-PP1)	15.6 (ph A-C)
Slurry Pump Winch: 1.5 HP (W-1361)	2.6
Chiller Skid:	
15 HP Circ Pump (P-1364 or P-1365)	21.0
56 KVA Air cooled chiller (R-1361)	70.3
3.0 KVA Mini-Power Center (C106-PP4)	6.25 (ph A-C)
Exhaust Skid:	
7.5 HP Exhaust Fan (VSD efficiency = 90%) (FN-1362)	11.0
3.0 KW heating coil (HC-1362)	3.6
5 KVA Mini Power Center (C106-PP5)	10.4 (ph A-B)
3.0 HP Vacuum pump (P-1366 or P-1367)	4.8
15 KVA Mini Power Panel (C106-PP2)(PF = 95%)	32.9 (ph B-C)
MCC-N2:	
40 HP Immersible Slurry Pump (P-1361)	52.0
250 HP In-Line Booster Pump (P-1362) (with VSD efficiency = 95%)	287.0

Max Total Load (C-phase) =579.6 A

Total Connected Load = 579.6 A x 480 V x $\sqrt{3}$ = 481.9 KVA

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7.2 Estimated Demand Determination

The following discussion is for the determination of the adequacy of the planned transformer for the C-Farm portion of the project. Three situations are given in tabular form following. The first is the "normal" operating situation. This is the anticipated load that would be expected after sluicing operations are underway. The second situation given is the demand load under the "worst case" startup situation. This load will be experienced by the transformer for short durations only. The third situation described in the following tables is the loading that would be considered under "normal" demand operation. The method used for these three situations is that used by Kaiser Utilities to size transformers. It is based on ANSI C57. See attached Electric Service Request EUE95-054.

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W-320 C-Farm Sluicing Operation Values - "Normal Demand"

<u>Load</u>	<u>Amps</u>	<u>Connected Load (KVA)</u>	<u>DF</u>	<u>Demand (AMP)</u>
Electrical Equipment Skid:				
Mini-Power Center	32.9	15.0	.30	9.87
Service Building:				
Mini-Power Center	10.4	5.0	.30	3.13
Compressor CPR-1361	11.0	8.8	.80	8.80
Process Building:				
Recirculation Fan	11.0	8.8	.80	8.80
Heating Coil	36.0	30.0	.80	28.87
Space Heating	9.6	8.0	.30	2.88
Mini-Power Center	15.6	7.5	.30	4.69
Chiller Skid:				
Circulation Pump 1 or 2	21.0	16.7	.80	16.80
Compressors/Fans	70.3	56.0	.80	56.24
Control Power	6.3	3.0	.30	1.88
Exhaust Skid:				
Heating Coil	3.6	3.0	.80	2.88
Exhaust Fan w/VSD	11.0	8.8	.80	8.80
Mini-Power Center	10.4	5.0	.30	3.13
Vacuum pump	4.8	3.8	.30	3.84
Sluicer Skid:				
Hydraulic Pump	4.8	3.8	.80	3.84
Mini-Power Center (control power)	0.6	0.3	.30	0.19
Slurry Booster Pump w/VSD	287.0	229.0	.80	229.60
Slurry Sub Pump w/soft-start	52.0	43.2	.80	41.60
Slurry Sub Pump Winch	2.6	2.1	.30	0.78
Construction Office Trailers (3):				
Space Heating/Heat Pump	30.1	25.0	.30	9.03
Lighting/Receptacles	30.1	25.0	.30	9.03
Total Demand Current =				454.68
Diversity Factor =				1.44
Estimated Current =				315.75
Estimated KVA =				262.5

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W-320 Transformer Demand Loading - Sluicing in Normal Operation

<u>Load</u>	<u>Amps</u>	<u>Connected Load (KVA)</u>	<u>DF</u>	<u>Demand (AMP)</u>
Electrical Equipment Skid:				
Mini-Power Center	32.9	15.0	.30	9.87
Service Building:				
Mini-Power Center	10.4	5.0	.30	3.13
Compressor CPR-1361	11.0	8.8	.80	8.80
Process Building:				
Recirculation Fan	11.0	8.8	1.0	11.00
Heating Coil	36.0	30.0	.80	28.87
Space Heating	9.6	8.0	.30	2.88
Mini-Power Center	15.6	7.5	.30	4.69
Chiller Skid:				
Circulation Pump 1 or 2	21.0	16.7	.80	16.80
Compressors/Fans	70.3	56.0	1.0	70.30
Control Power	6.3	3.0	.30	1.88
Exhaust Skid:				
Heating Coil	3.6	3.0	.80	2.88
Exhaust Fan w/VSD	11.0	8.8	1.0	11.00
Mini-Power Center	10.4	5.0	.30	3.13
Vacuum pump	4.8		.30	3.84
Sluicer Skid:				
Hydraulic Pump	4.8	3.8	1.0	4.80
Mini-Power Center (control power)	0.6	0.3	.30	0.19
Slurry Booster Pump w/VSD	287.0	229.0	1.0	287.00
Slurry Sub Pump w/soft-start	52.0	43.2	1.0	52.00
Slurry Sub Pump Winch	2.6	2.1	.00	0.00
Construction Office Trailers (3):				
Space Heating/Heat Pump	30.1	25.0	.30	9.03
Lighting/Receptacles	30.1	25.0	.30	9.03

Total Demand Current = 541.12
 Diversity Factor = 1.44
 Estimated Current = 375.78
 Estimated KVA = 312.42

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Summary of transformer loading:

"Normal" Demand $\approx 262.5 \text{ KVA} \div 225 \text{ KVA} \approx 117\%$ of Nameplate Rating.

"Peak" Demand on startup $\approx 481.9 \text{ KVA} \div 225 \text{ KVA} \approx 214\%$ of Nameplate.

"Normal" Sluicing Operation $\approx 312.4 \div 225 \text{ KVA} \approx 139\%$ of Nameplate.

Therefore, the 225 KVA transformer is adequate based on:

- 1) For "Normal" Operation, 130% of demand (or less) is acceptable per Electrical Utilities engineer, Dan Ford, and IEEE 57.91 & 92. See attachment.
- 2) Duration of "Worst Case" is less than 5 minutes for each occurrence. Project design life is only 2 years. Small losses of the transformer's 30 year design life expectancy are acceptable.

7.3 Breaker, Starter, Feeder and Conduit Sizing

7.3.1 Main feeder from C-PDP-1 into Electrical Equipment Skid (EES)

A lockable 800 ampere circuit breaker (service entrance rated) at the input to MCC-N1 is the main disconnect means for 241-C-51 (EES).

Feeder Sizing is in accordance with NEC 220-10, 240-21, 430-2, 430-22, 430-24 and 430-28 using actual loads listed in 7.1.

Please see the following table for feeder size evaluation. Single phase 480 V loads are considered as adding equally to all three phases. This is a conservative allowance. Motor ampacity values have been obtained from NEC Table 430-150. Non-motor loads have been evaluated at 480 volts. Non-motor continuous loads have their full load ampacity values multiplied by 1.25 in accordance with NEC 220-3.

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<u>Load</u>	<u>Amperes</u>
Sluicer:	
3 HP Hydraulic Power Unit (SHC-1361)	4.8
0.3 KVA Transformer (control power)	.6 (ph A-B)
Service Building:	
7.5 HP compressor unit (CPR-1361)	11.0
5 KVA Mini Power Center (C106-PP3)	10.4 (ph A-B)
Process Building:	
7.5 HP Recirc Fan (FN-1361)	11.0
30 KW heating coil (HC-1361)	36.1
4 KW Space Heater (UH-1361)	4.8
4 KW Space Heater (UH-1362)	4.8
7.5 KVA Mini Power Center (C106-PP1)	15.6 (ph A-C)
Slurry Pump Winch: 1.5 HP (W-1361)	2.6
Chiller Skid:	
15 HP Circ Pump (P-1364 or P-1365)	21.0
56 KVA Air cooled chiller (R-1361)	70.3
3.0 KVA Mini-Power Center (C106-PP4)	6.25 (ph A-C)
Exhaust Skid:	
7.5 HP Exhaust Fan (VSD efficiency = 90%) (FN-1362)	11.0
3.0 KW heating coil	3.6
5 KVA Mini Power Center (C106-PP5)	10.4 (ph A-B)
3.0 HP Vacuum pump (P-1366 or P-1367)	4.8
15 KVA Mini Power Panel (C106-PP2)(PF = 95%)	32.9 (ph B-C)
MCC-N2:	
40 HP Immersible Slurry Pump (P-1361)	52.0
250 HP In-Line Booster Pump (P-1362) (with VSD efficiency = 95%)	287.0

Max Total Load (C-phase) =579.6 A

Total Connected Load = $579.6 \text{ A} \times 480 \text{ V} \times \sqrt{3} = 481.9 \text{ KVA}$

An 800 ampere main breaker is required to protect the loads. The feeder must be capable of carrying 579.6 amperes. A choice has been made to use 3-350 kcmil conductors per phase from NEC Table 310-16. Install as three sets in 3 inch conduits to MCC-N1. Install 1/0 ground conductor in each conduit per NEC Table 250-95.

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Down-stream feeder conductors shall be 800 AMP rated @ 90°C:

- 1) Need 3-350 kcmil per phase.
- 2) Install three 350 kcmil conductors and 1#1/0 ground, in each of three 3" conduits.

Note: The three 3" conduits are extensions of conduits previously installed under ERS portion of project.

- 7.3.2 The 250 HP In-Line Booster Pump (P-1362) and VSD Controller
 (VSD molded case disconnect included with controller provided by booster pump vendor).

VSD Feeder:

VSD controller maximum input current = 325 A. (See Attachment "A", Page A-8) Per NEC 430-2, required feeder capacity = $1.0 \times 325 \text{ A} = 325 \text{ A}$. Per NEC Table 310-16, use 3-500 kcmil conductors with 1#1/0 ground wire in a 3½" conduit (upsized to 4" conduit to aid in cable pulling).

Motor Feeder:

Booster pump motor FLA = 273 A. Per NEC 430-22, required feeder ampacity = $1.25 \times 273 = 341 \text{ A}$. Per NEC Table 310-16, use 3-500 kcmil conductors with 1#1/0 ground wire (NEC Table 250-95) in 3½" conduit (upsized to 4" conduit to aid in cable pulling).

See 7.3.14 for "In-Pit" segment of motor feeder.

- 7.3.3 The 40 HP Immersible Slurry Pump (P-1361)

Motor Feeder:

Immersible pump motor FLA = 52.0 A. The required feeder ampacity = $1.25 \times 52.0 \text{ A} = 65.0 \text{ A}$. Use of 3#6 AWG (ampacity = 65 A) is adequate based on ampacity. Use of 3#1/0 with 1#4 ground wire in 2" conduit for conservatism will satisfy requirements.

Install 1#1/0 AWG per phase from MCC-N2 to pump pit 241-C-06A.

Note: Larger conductor size was used because motor was originally planned to be larger. Moisture sensor cables are routed with P-1361 wires so derating is required. Eighty per cent of 3#1/0 gives capability of 120 amps. ($.8 \times 150 \text{ amps} = 120 \text{ amps}$)

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A reduced voltage solid-state starter mounted within MCC-N2 shall be used for immersible pump operation. See 7.3.14 for "In-Pit" segment of motor feeder.

7.3.4 The 1.5 HP Winch (W-1361)Motor starter line and load side feeder conductors:

Winch motor FLA = 2.6 A. The required feeder ampacity = $1.25 \times 2.6 \text{ A} = 3.25 \text{ A}$. Use 3#10 with 1#12 ground wire in 3/4" conduit (upsized to 1" conduit for conservatism). Note that this feeder will be routed with other feeders (See Power Conduit Block Diagram in the appendix).

Use 7 A MCP and NEMA Size 1, Full Voltage Reversing (FVR) starter.

7.3.5 Chiller SkidFeeder circuit breaker "line and load side" Conductors:

The chiller load from above consists of the items listed below. Since the items are all mounted on a vendor supplied skid, there is no need to size individual load supply conductors. However, the feeder to the Chiller skid does need to be sized.

Loads:

15 HP Circ Pump (P-1364 or P-1365) FLA =	21.0 A.
56 KVA Comp pkg (70.3 X 1.25) FLA =	87.9 A.
3 KVA Mini-Power Panel (C106-PP4) (ph A-C)(1.25) =	7.8 A.

Total = 116.7 A.

Per NEC Table 310-16, use 3#1 AWG conductors with 1#6 AWG ground wire is adequate. For conservatism, a set of 3#4/0 conductors has been used (conduit C106-3P211). These conductors are capable of 230 amperes at 75° C. Circuit breaker size has been selected as 225 amp frame with 175 amp trip.

7.3.6 Mini-Power Panel

No feeder required because unit is supplied with MCC-N1.

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7.3.7 Service Building (241-C-73)

Loads:

7.5 HP compressor motor (CPR-1361)(1.25) 13.75 A
 5 KVA Mini-Power Center (C106-PP3)(ph A-B)(1.25) 13.00 A

Total = 26.75 A

Per NEC Table 310-16, use 3#10 AWG conductors with 1#10 AWG ground wire in a 1" conduit. A 100 AF breaker with a 30 AT will be used per NEC Table 310-16. The 7.5 HP compressor motor will require a minimum of 3#14 AWG, but use 3#10 AWG with 1#10 ground wire exceeding requirements of DOE 6430.1a. Fused disconnect will house 30 amp fuses to protect the motor supply conductors. The Mini-Power Panel is existing. See calculation W-320-31-015.

7.3.8 Process Building (241-C-91)

Loads:

7.5 HP Recirc Fan (FN-1361)(1.25) 13.75 A
 30 KW heating coil (HC-1361)(1.25) 45.10 A
 4 KW Space Heater (UH-1361)(1.25) 6.00 A
 4 KW Space Heater (UH-1362)(1.25) 6.00 A
 7.5 KVA Mini-Power Panel (C-106-PP1)(ph A-C)(1.25) 19.50 A

Total = 90.35 A

Per NEC Table 310-16, use 3#3 AWG conductors. This has been upsized to the more common size of 3#2 with 1#8 ground wire in a 1.5" conduit. A circuit breaker of 100 AF with a 90 AT will be adequate. Process building loads and protection are summarized below:

Load	Size of Supply Wire	90°C Amp Rating of Wire	Size of Protection
FN-1361	3#10	23.2	100AF w/ 17.5AT
HC-1361	3#4	55.1	45 A fuse
UH-1361	3#12	17.4	10 A fuse
UH-1362	3#12	17.4	10 A fuse
C106-PP-1	3#8	31.9	100AF/30AT CB

Loads in room #1 of the Process building are in a high ambient condition (150° F). A derating factor of .58 has been applied to the 90°C ampacity rating of the supply conductors to these loads per NEC Table 310-16.

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7.3.9 Sluicer Hydraulic Power Unit

Sluicer (SHC-1361):

3 HP motor (hydraulic power unit)(1.25)	6.0 A
0.3 KVA Trans (sluicer control power)(ph A-B)(1.25)	0.8 A

Total = 6.8 A

Per NEC Table 310-16, use 3#12 with 1#12 ground wire in a 1.5" conduit. Loads on the sluicer skid are vendor supplied and wired. A 100 AF with 15 AT circuit breaker shall be used to protect the sluicer.

7.3.10 Exhaust Fan VSD (FN-1362)

Exhaust Fan: 7.5 HP (with VSD efficiency = 90%) 12.2 A

VSD controller maximum input current = 12.2 A. Per NEC 430-2, required feeder capacity = $1.15 \times 12.2 \text{ A} \approx 14 \text{ A}$. Per NEC Table 310-16, use 3#12 AWG conductors with 1#12 ground wire in a 3/4" conduit. A 100 AF with 20 AT shall be used to protect the wiring.

7.3.11 Exhaust Skid

Loads:

3.0 KW heating coil @ 480V (1.25)	4.5 A
5 KVA Mini-Power Panel (C-106-PP5)(1.25)	13.0 A
3.0 HP vacuum pumps (P-1366 or P-1367)(1.25)	6.0 A

Total = 23.5 A

Per NEC Table 310-16, use of 3#10 AWG shall be adequate with 1#10 ground wire in a minimum 1" conduit. Loads on the exhaust skid are vendor supplied and wired. A circuit breaker with 100 AF and 30 AT shall be used to protect the wiring.

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7.3.12 Seismic Shutdown System Missile Enclosure

Loads are air conditioner and receptacles:

$$I = \frac{1320}{120} = 11 \text{ A}; \quad 11 \text{ A} \times 1.25 = 14 \text{ A capacity.}$$

Use 2#10 with 1#10 ground wire in a 3/4" conduit per Calculation W320-31-022 (upsized to 1" conduit for conservatism). The Seismic systems are supplied from C106-PP2 at the EES. 30 A circuit breakers shall be used to protect the wiring.

7.3.13 Typical 120 VAC branch circuit conductor loaded up to 1,500 VA

$$I = \frac{1500}{120} = 12.5 \text{ A}; \quad 12.5 \text{ A} \times 1.25 = 15.625 \text{ A capacity with a 20 A circuit breaker.}$$

Use 2#12 with 1#12 ground wire in minimum 3/4" conduit.

7.3.14 "In-Pit" Cord Sizing

NEC article 40 defines the requirements for the "In Pit" cords. NEC article 430-22 states that branch circuit conductors supplying a single motor shall have an ampacity not less than 125 percent of the motor full-load current rating.

Per Reference Information 40 HP motor FLA = 52.0 A. The 1993 NEC Table 430-150 does not include values for motors of 250 HP. Reliance Electric information shows that the 250 HP motor FLA is 273 amps.

The cords will be in free air within the pump pit. NEC Table 400-5(B) for Type G, portable power cord will be utilized. The Submersible and In-Line Booster pump cords are a thermoset cable that, if assumed equivalent to Type G, will need derating for high ambient conditions using similar correction factors to those in NEC Table 310-16.

Per Project W-320 Motor Cooling Evaluation dated 6/7/95 (see attachments), the ambient temperature in the C-Farm pump pit will be 138°F (59°C). Per NEC Table 310-17, a correction factor of 0.58 will apply. Since this is considered cord (not cable in conduit), the calculation of the desired derating factor is based on the cable manufacturer's recommendation. Per the Rockbestos company, the

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following formula is used for determining an acceptable derating factor (see Attachment).

$$TCF = \sqrt{\frac{(Tc2 - Ta2)}{(Tc1 - Ta1)} \times \frac{(234.5 + Tc1)}{(234.5 + Tc2)}}$$

Tc1 = Maximum conductor temperature used to determine base ampacity.
 Ta1 = Ambient temperature used to determine base ampacity (30°C per
 NEC Table 400-5(b)).
 Tc2 = Maximum conductor temperature used to determine adjusted
 ampacity (90°C for Rockbestos Firewall III for 40 year
 qualified life).
 Ta2 = Ambient temperature used to determine adjusted ampacity;
 0.3°C additional is used as margin.

The cords for the pumps fall under the F category, i.e. no more than 3
 current carrying conductors. The 90°C column is used, because rating
 of the terminations in the pump terminal boxes will be defined to be
 90°C.

$$TCF = \sqrt{\frac{(90 - (59 + 0.3))}{(90 - 30)}} \times \frac{(234.5 + 90)}{(234.5 + 90)} = 0.71$$

(Since pump is rated for 90° C operation, we may safely use 90° wire.)

For sizing the 40 HP Immersible Pump cord:

(52.0 A X 1.25) / 0.71 = 91.6 A; per NEC Table 400-5(B) a minimum
 size of #4 AWG is required, use #4 AWG with 1#4 or larger ground
 wire.

For sizing the 250 HP Booster Pump cord:

(273 A X 1.25) / 0.71 = 480.6 A; per NEC Table 400-5(B), use twin
 sets of #4/0 with 1#3 or larger ground wire.

Rockbestos Firewall III XHHW P62-0104 is a #1/0 AWG cable with an
 overall diameter of 1.22" (Vendor furnished by procurement
 specification W-320-P17 for Immersible Pump).

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Rockbestos Firewall III XHHW P62-0404 is a #4/0 cable with an overall diameter of 1.54."

7.4 Steady State Voltage Drop Evaluation

Voltage drop considerations for the C-Farm portion of the W-320 project begin at the power source, C-PDP-1, and continue to the load. Calculations given below, which consider the supply transformer, are intended to validate that the transformer may be set at the 0% tap.

7.4.1 %VD on Transformer Bank

$$I_{PU} = \frac{312 \text{ KVA}}{225 \text{ KVA}} = 1.39 \quad (\text{Total Worst Case Dem/Xfmr Sz}) \quad [\text{from 7.2}]$$

$$\% \text{ VD} = \%Z \times I_{PU} = 3.19 \times 1.39 = 4.4\%$$

7.4.2 %VD on 250' of #2 AWG copper conductor from pole E257 in steel conduit

$$\% \text{ VD} = \frac{\sqrt{3} \times I \times Z_{eff}/1000' \times L}{4.8}$$

$$\text{Where } I_{SEC} = \frac{312 \text{ KVA}}{\sqrt{3} \times 480 \text{ V}} \approx 375 \text{ A} \quad [\text{from 7.2}]$$

$$I_{PRI} = \frac{312 \text{ KVA}}{\sqrt{3} \times 13,800} \approx 13.1 \text{ A} \quad [\text{from 7.2}]$$

$$Z_{eff} = .20; L = .250 \text{ [Units of 1000']}$$

$$\% \text{VD Service Drop} = \frac{\sqrt{3} \times 13.1 \times .20 \times .250}{13.8} = \underline{0.08\%}$$

7.4.3 %VD on Transformer to C-PDP-1: Parallel 600 kcmil Feeders

$$Z_{eff} = 0.047 \div 2 = 0.0235, L = 0.032 \text{ kft}$$

$$\% \text{VD 600 kcmil feeder} = \frac{\sqrt{3} \times 375 \times 0.0235 \times .032}{4.8} = \underline{0.1\%}$$

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7.4.4 %VD on C-PDP-1 to MCC-N1: Triple 350 kcmil feeders

$$Z_{eff} = 0.06 \div 3 = 0.02, L = 0.045 \text{ kft}$$

$$\%VD \text{ 350 kcmil feeder} = \frac{\sqrt{3} \times 375 \times 0.02 \times .045}{4.8} = \underline{0.12\%}$$

$$\%VD \text{ for transformer primary feeder} = 0.08\%$$

$$\%VD \text{ from transformer bank to EES} = 4.4 + 0.1 + 0.12 \approx 4.62\%$$

$$\text{Total \%VD from pole to EES} = 0.08 + 4.62 = \underline{4.70\%}$$

Since the voltage drop under highest load conditions exceeds 5% prior to the evaluation of voltage drop across any branch circuit wiring, the supply transformer taps should be set at the lowest setting to boost the supply voltage by 5%. This should be adequate since peak demand is expected very infrequently.

7.4.5 %VD from MCC-N1 to SSA (55 ft of twin 350 kcmil feeders)

$$Z_{eff} = 0.06 \div 2 = 0.03, L = 0.055 \text{ kft}$$

$$\%VD \text{ 350 kcmil feeders} = \frac{\sqrt{3} \times (287+52) \times 0.03 \times .055}{4.8} = \underline{0.21\%}$$

7.4.6 %VD from SSA to SSB (12 ft of twin 350 kcmil feeders)

$$Z_{eff} = 0.06 \div 2 = 0.03, L = 0.012 \text{ kft}$$

$$\%VD \text{ 350 kcmil feeders} = \frac{\sqrt{3} \times (287+52) \times 0.03 \times .012}{4.8} = \underline{0.04\%}$$

7.4.7 %VD from SSB to MCC-N2 (50 ft of twin 350 kcmil feeders)

$$Z_{eff} = 0.06 \div 2 = 0.03, L = 0.050 \text{ kft}$$

$$\%VD \text{ 350 kcmil feeders} = \frac{\sqrt{3} \times (287+52) \times 0.03 \times .050}{4.8} = \underline{0.18\%}$$

See Sketch on page following that summarizes voltage drops:

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7.4.8 %VD from VSD Controller to Pump P-1362 Motor Terminal Block (300' of 500 kcmil copper motor feeder in steel conduit)

Motor FLA = 273 A; Z_{eff} = .05 ohms; L = 0.3 kft

$$\text{Total \%VD} = \frac{\sqrt{3} \times 273 \times .05 \times .3}{4.8} = 1.48\%$$

%VD from Pump P-1362 Motor Terminal Block to Pump P-1362 (20' of twin 4/0 through pump pit cover block)

$$\text{Total \%VD} = \frac{\sqrt{3} \times 273 \times .037 \times .02}{4.8} = 0.07\% \quad [\text{from 7.314}]$$

Summary:

$$\text{Total \%VD at motor terminals} = .12 + .21 + .04 + .18 + 1.48 + .07 = \underline{2.10\%}$$

Motor terminal voltage = 480 (1 - 0.0210) ≈ 469.9 V

Minimum permissible voltage = 414 V

7.4.9 %VD on Immersible Pump P-1361 Feeder (#1/0 copper feeder in steel conduit - 300' to pump pit and 60' down into Tank C-106)

Motor FLA = 52 A; Z_{eff} for #1/0 AWG = .13; L = .30 + .06 = .36

$$\text{\%VD} = \frac{\sqrt{3} \times 52 \times .13 \times .36}{4.8} = 0.88\%$$

$$\text{Total \%VD at motor terminals} = .12 + .21 + .04 + .18 + .88 = 1.43\%$$

Motor terminal voltage = 480 (1 - .0143) ≈ 473.1 V

Minimum permissible voltage = 414 V

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7.5 % Voltage Dip During Submersible Pump Startup

Initially, all anticipated loads operating. "Peak" values used for current value.

7.5.1 Total Current Supplied:

[from 7.2]

$$I_{\text{SURGE}} = (6 \times I_{P-1361}) + (I_{\text{Peak}} - I_{P-1361} - I_{P-1362})$$

$$I_{\text{SURGE}} = (6 \times 52) + (375 - 52 - 273) = 362 \text{ A}$$

7.5.2 %VD on Feeders up to EES (MCC-N2) with $I_{\text{SURGE}} = 362 \text{ A}$

$$\%VD \text{ 350 kcmil feeders to MCC-N1} = \frac{\sqrt{3} \times 362 \times 0.02 \times .045}{4.8} = \underline{0.12\%}$$

Total feeder length of 350 kcmil feeders MCC-N1 to MCC-N2 is 117 ft.

$$\%VD \text{ 350 kcmil feeders to MCC-N2} = \frac{\sqrt{3} \times 362 \times 0.03 \times .117}{4.8} = \underline{0.46\%}$$

$$\text{Total \%VD to MCC-N2} = .12\% + .46\% = .58\%$$

7.5.3 %VD on Immersible Pump Feeder

$$Z_{\text{eff}} \text{ for \#1/0} = .13; L = .360; I = 312 \text{ A (starting)}$$

$$\%VD = \frac{\sqrt{3} \times 312 \times .13 \times .360}{4.8} = 5.27\%$$

$$\text{Total \%VD at submersible pump motor terminals} = 5.27 + .58 = 5.85\%$$

$$\text{Motor terminal voltage} = 480 (1 - .0585) \approx 452 \text{ V}$$

Minimum permissible voltage = 414 V. The starting of the immersible pump (P-1361) represents the worst case condition that need be considered. The condition represented is very conservative since the immersible pump is started with a soft start unit and so should not have as large an inrush as was used in this calculation. No other motor starting need be considered. To be sure that starting will not be a problem we will consider voltage drop upstream of MCC-N1 as well.

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7.5.4 %VD on Submersible Pump Feeder including VD Across Supply Transformer

%VD on pole to transformer feeder:

Primary Current = Secondary Current X Xfmr turns ratio

$$I = 362 \times (480/13,800) = 12.6 \text{ amps}$$

$$\%VD = \frac{\sqrt{3} \times 12.6 \times .20 \times .250}{13.8} = 0.08\%$$

%VD across supply transformer:

$$I_{BASE} = \text{Transformer VA} / (480 \text{ V} \times \sqrt{3})$$

$$I_{BASE} = 225,000 / (480 \text{ V} \times \sqrt{3}) = 270.6 \text{ A}$$

$$I_{PU} = I/I_{BASE} = 362 / 270.6 = 1.34$$

$$\%VD = I_{PU} \times \text{Transformer \%Z} = 1.34 \times 3.19 = 4.27\%$$

%VD across 600 kcmil feeders to PDP:

$$\%VD = \frac{\sqrt{3} \times 362 \times .024 \times .032}{4.8} \approx 0.10\%$$

$$\text{Total \%VD} \approx 0.08\% + 4.27\% + 0.10\% + 5.85\% \approx 10.3\% \quad [\text{from 7.5.3}]$$

Initially, the "soft start" unit was utilized to limit the torque effect of the submersible pump as it hangs down into the tank. Additionally, the "soft start" unit may be configured to limit the starting current to compensate for the high voltage drop across the supply transformer.

7.6 % Voltage Dip With Booster Pump Starting

7.6.1 %VD to MCC N1 from PDP:

$$I = (325) + (375-325) = 375 \text{ A} \quad [\text{from 7.3.14 \& 7.4.2}]$$

$$\%VD = \frac{\sqrt{3} \times 375 \times .02 \times .045}{4.8} \approx 0.12\%$$

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7.6.2 %VD to MCC N1 to MCC N2:

$$I = (325) + (375 - 325) = 375 \text{ A}$$

[from 7.3.2 & 7.4.2]

$$\%VD = \frac{\sqrt{3} \times 375 \times .03 \times .117}{4.8} \approx 0.47\%$$

7.6.3 %VD on 500 kcmil and #4/0 Feeders:

$$\%VD = \frac{\sqrt{3} \times (325) \times [(.05 \times .3) + ((.074/2) \times .02)]}{4.8} = 1.85\%$$

$$\text{Total \%VD} \approx 0.12 + .47 + 1.85 \approx 2.44\%$$

$$\text{Motor terminal voltage} = 480 (1 - 0.0244) \approx 468 \text{ V}$$

$$\text{Minimum permissible voltage} = 414 \text{ V}$$

7.7 Outdoor Lighting Calculations

Each entrance needs 3 footcandles of lighting. Total area that needs to be illuminated is approximately 6' x 3' = 18 ft².

The fixture selected for outdoor use is the Voigt SOX-35 Wall-Most. The manufacturer's data may be used to determine whether this fixture is adequate for our needs. The Footcandle Isolux diagram shows the footcandles available from Voigt SOX-55 at a height of 15 ft. This must be adjusted to obtain values for the SOX-35 at 10 feet.

To adjust for the lower lamp output, the footcandles will be multiplied by 0.6. This is obtained from the ratio of the lumen output of the lamps. The Westinghouse Lighting Handbook provides guidance for adjusting for the height difference. Per page 2-14 of the 1969 Westinghouse Lighting Handbook, "Footcandles for other mounting heights than the one shown are obtained by multiplying the values given on the curves by the ratio of the square of the present mounting height to the square of the new mounting height."

$$\text{This adjustment factor will be } (15^2 / 10^2) = 2.25.$$

We will consider an area 3 ft away from the wall. The chart shows this as approximately 7 footcandles.

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Using the adjustment factors, 7 footcandles $\times$ 2.25 $\times$ 0.6 = 9.5 footcandles.

A similar analysis for the SOX-18 (18W) lights used for the Process Bldg shows that there is adequate light at the many entrances by the Process Bldg.

The lower lamp lumen output is adjusted from the 55 watt data by multiplying by .225, the ratio of the lamp lumens. Using the adjustment factors:

7 footcandles $\times$ 2.25 $\times$.225 = 3.543 footcandles.

Outdoor fixture selected will give adequate light over doorways.

7.8 Indoor Lighting Calculations

Inside Lighting: Per IES, an average of 50 (approximately) footcandles is adequate. The Zonal-Cavity Method will be used to determine the number of fixtures. There are two buildings that need be considered here, the Electrical Equipment Skid (241-C-51) and the Process Building (241-C-91).

Room Cavity Ratio (RCR) = $[5 \times h \times (L + W)] / (L \times W)$

where h = height of light
L = room length
W = room width

RCR = $[5 \times 8 \times (13 + 7)] / (13 \times 7) = 8.8$

Using the Crouse-Hinds photometric data (see attachments), with an assumed ceiling reflectance of 80% and an assumed wall reflectance of 50%, the coefficient of utilization is 0.25. Footcandle values of 20-30-50 will be utilized for areas of high contrast or large size per IESNA Figure 11.1.

7.8.1 Electrical Equipment Skid

of fixtures = $(FC \times AREA) / (\# \text{ of lamps} \times \text{lumens/lamp} \times CU \times MF)$

of fixtures = $(30 \times 11 \times 9) / (2 \times 3200 \times .25 \times .9) = 2.06$

Use two fixtures. The actual size of the room is effectively reduced since the electrical cabinets are pseudo-walls.

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7.8.2 Process Building

Due to the geometry of the Process Building, two areas must be considered, Room 1 and Room 2. The dimensions of these two rooms may be obtained from drawings H-2-818455 sheet 3 and H-2-818451 sheet 1.

Room 2:

$$\begin{aligned}\# \text{ of fixtures} &= (\text{FC} \times \text{AREA}) / (\# \text{ of lamps} \times \text{lumens/lamp} \times \text{CU} \times \text{MF}) \\ \# \text{ of fixtures} &= ((30 \times 8 \times 4) + (30 \times 13 \times 5)) / \\ & \quad (2 \times 3200 \times .25 \times .9) \\ &= 2.02\end{aligned}$$

Therefore, use two fixtures in second part of Room 2.

Room 1:

Room 1 of the Process Building needs less light. It is intended that this room be occupied on a rare basis. Visual tasks are only occasionally performed here. Fifteen footcandles should be adequate.

$$\begin{aligned}\# \text{ of fixtures} &= (\text{FC} \times \text{AREA}) / (\# \text{ of lamps} \times \text{lumens/lamp} \times \text{CU} \times \text{MF}) \\ \# \text{ of fixtures} &= ((15 \times 9 \times 8) + (15 \times 10 \times 13)) / \\ & \quad (2 \times 3200 \times .25 \times .9) \\ &= 2.1\end{aligned}$$

Therefore, use two fixtures in Room 1.

7.9 Conduit Fill7.9.1 General

Three categories of conduits are used for the C-Farm installation, Power, Instrument (signal) and Control. The three categories are intended to be separate and distinct in the interests of safety and to minimize the propagation of electrical noise onto the signal wiring.

Conduit fill of power cabling shall be considered first. To minimize the number of conduits necessary, power cables will be combined. This is restricted by Note 8 to the ampacity tables of NEC article 310.

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The attached conduit block diagrams shows how cables will be combined. Some variation exists between these documents and official design documents. Combining cable routes with #10 AWG conductors within them will allow the use of less conduits.

7.9.2 Specific Power Conduits

Conduit Numbers C106-3P201, C106-3P202, and C106-3P203 are three inch conduits that are extensions of stub-outs installed under the ERS portion of the project. Each is intended to carry 4-350 kcmil conductors of type XHHW-2. Per NEC Chapter 9 Table 3B, three inch conduits may carry up to 5-350 kcmil conductors.

The following table shows the C-Farm loads, the size feeder to the load and the minimum required conduit size. Power conduits will also include a ground conductor to conform with DOE's 6430.1A, 1639-1. Those loads that share conduits will be evaluated separately.

Load	Feeder Size	Minimum Conduit Size/Actual
Sluicer (SHC-1361)	4-#12 AWG	1/2" (3P226 1")
Service Building (241-C-73)	4-#10 AWG	1/2" (3P210 1")
Process Building (241-C-91)	3-#2, 1-#6 AWG	1-1/4" (3P001 1.5")
Slurry Pump Winch (W-1361)	4-#12 AWG	1/2" (3P224 1")
Chiller Skid	3-#4/0, 1-#2 AWG	2" (3P211 2")
Exhaust Fan (FN-1362)	4-#12 AWG	1/2" (3P213 1")
Exhaust Skid / Exhaust Fan	8-#10 AWG	1/2" (3P225 1")
Immersible Slurry Pump	3-#1/0, 1-#4, 3-#4 AWG	1-1/2" (3P223 2")
Booster Pump	3-500 kcmil 1-#2 AWG	3" (3P222 4")

All conduits for each of these feeders is larger than the minimum.

7.9.3 Shared Power Conduits

The Exh Fan, Exhaust Skid, & Winch all share a conduit. (C106-3P218)

The derating factor of 70% is applied. The conductors are checked to verify they have the required capacity.

Exh Fan: 70% X 30 A = 21 A, which is satisfactory.

Exhaust Skid: 70% X 40 A = 28 A; which is satisfactory.

Winch: 70% X 30 = 21, which is satisfactory.

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The Exhaust Fan & Exhaust Skid share a conduit. (C106-3P225)

The derating factor of 80% is applied.

Exhaust Skid: $80\% \times 40 \text{ A} = 32 \text{ A}$, which is satisfactory.

Exhaust Fan: $80\% \times 30 \text{ A} = 24 \text{ A}$, which is satisfactory.

7.9.4 Control Conduits

The smallest control conduit used is $\frac{3}{4}$ " in diameter. Per NEC Chapter 9 Table 3B, this can carry 24-#14 AWG conductors. See the attached Block Diagram. The most conductors in any conduit is 24-#14 AWG and 3-#12 for the winch limit switches. By inspection, these conductors will not overfill the 1.5" conduit (C106-3C018) planned for this purpose.

7.9.5 Instrument Conduits

The NEC defines the number of allowable conductors in a conduit in Chapter 9 Table 1. This will be followed when evaluating the % fill of our instrument conduits. Refer to drawing H-2-818676 sheets 1-4 as an aid in following this evaluation.

The formula used to evaluate the fill of a conduit is:

$$\% \text{ Fill} = \text{sum of Cable Area(s)} / \text{conduit area}$$

$$= \text{sum of } (\pi \times D^2/4) / \text{Conduit Area}$$

Conduit Areas are in NEC Chapter 9 Table 4, third column.

The type of instrument cable being used is Rockbestos. See attached catalog sheet for specifics on each type. The following evaluation is done for each of the larger conduits.

Conduit C106-3S021: Wire Runs W106-90, 91, 92 & 93

$$1 \text{ triad @ } .09 \text{ in}^2 + 1 \text{ triad @ } .09 \text{ in}^2 + 1 \text{ pair @ } .08 \text{ in}^2 + 2 \text{ pair @ } .31 \text{ in}^2 = .57 \text{ in}^2$$

$$.57 \text{ in}^2 / 40\% = 1.43 \text{ in}^2$$

This translates to a diameter = 1.35"; Use a 1.5" conduit.

$$\text{Fill} = 27.5\%$$

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Conduit C106-3S019: Wire Runs W106-92A, 93F, 96, 97A, 154B & 154C

$1 \text{ pair @ } .08 \text{ in}^2 + 2 \text{ pair @ } .31 + 16 \text{ pair @ } 1.13 \text{ in}^2 + 3 \text{ pair @ } .34 \text{ in}^2 + 2 \text{ #14 @ } .028 \text{ in}^2 + 2 \text{ #14 @ } .028 \text{ in}^2 = 1.92 \text{ in}^2$

$1.92 \text{ in}^2 / 40\% = 4.79 \text{ in}^2$

This translates to a diameter = 2.47"; Use a 3" conduit.

Fill = 25.6%

Conduit C106-3S027: Wire Runs W106-88, 88A & 89A

$1 \text{ triad @ } .09 \text{ in}^2 + 1 \text{ triad @ } .09 \text{ in}^2 + 2 \text{ pair @ } .16 \text{ in}^2 = .34 \text{ in}^2$
 $.34 \text{ in}^2 / 40\% = .85 \text{ in}^2$

This translates to a diameter = 1.04"; Use a 2.5" conduit.

Fill = 7.0%

Conduit C106-3S028: Wire Runs W106-95 & 95A

Wire Run #-95A is part of the 4 pair cable of Wire Run #-95.

$4 \text{ pair @ } .41 \text{ in}^2$

$.41 \text{ in}^2 / .53 = .77 \text{ in}^2$

This translates to a diameter of 1"; Use a 1½" conduit.

Fill = 20.1%

Conduit C106-3S029: Wire Runs W106-95 & 95A, & 154

Wire Run #-95A is part of the 4 pair cable of Wire Run #-95.

$4 \text{ pair @ } .41 \text{ in}^2 + 1 \text{ pair @ } .08 \text{ in}^2 = .49 \text{ in}^2$

$.49 \text{ in}^2 / .31 = 1.58 \text{ in}^2$

This translates to a diameter = 1.41"; Use a 1.5" conduit.

Fill = 24.1%

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Conduit C106-3S031: Wire Runs W106-84, 85, 87, 87A, 87B, 97B, 154, 154A, 154B, 158, 159 & 169

Wire Run #-84	3 pair @	.24 in ²
Wire Run #-85	2 pair @	.31 in ²
Wire Run #-87	1 #-14 @	.20 in ²
Wire Run #-87A	8 trd @	.64 in ²
Wire Run #-87B	8 trd @	.64 in ²
Wire Run #-97B	1 pair @	.08 in ²
Wire Run #-154	1 pair @	.08 in ²
Wire Run #-154A	2#14 @	.03 in ²
Wire Run #-154B	2#14 @	.03 in ²
Wire Run #-158	1 pair @	.08 in ²
Wire Run #-159	1 pair @	.08 in ²
Wire Run #-169	1 pair @	.08 in ²

Total Area.....2.49 in²

2.49 in² / .40 = 6.23 in²

This translates to a diameter of 2.82 inches; Use a 3" conduit.

Fill = 37.9 %

Conduit C106-3S032: Wire Runs W106-81, 81A, 84, 85, 86, 137, 154A, 158 & 159

Wire Run #-81	4#14 @	.06 in ²
Wire Run #-81A	3#14 @	.04 in ²
Wire Run #-84	3 pair @	.24 in ²
Wire Run #-85	2 pair @	.31 in ²
Wire Run #-137	Belden 1049A @	.20 in ²
Wire Run #-154A	2#14 @	.03 in ²
Wire Run #-158	1 pair @	.08 in ²
Wire Run #-159	1 pair @	.08 in ²
Total Area.....		1.04 in ²

1.04 in² / 40% = 2.6 in²

This translates to a diameter = 1.82 "; Use a 3" conduit.

Fill = 13.9%

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Conduit C106-3S036: Wire Runs W106-94, 95, & 95A

Wire Run #-95A is part of the 4 pair cable of Wire Run #-95.

Wire Run #-94 1 pair #16 @ .08 in²

Wire Run #-955 4 pair @ .41 in²

Total area = .49 in²

.49 in² / .31 = 1.58 in²

This translates to a diameter = 1.41"; Use a 1.5" conduit.

Fill = 24.1%

Conduit C106-3S033: Wire Runs W106-82

2 pair @ .31 in²

Total area = .31 in²

.31 in² / .53 = .58 in²

This translates to a diameter = .85"; Use a 1.5" conduit.

Fill = 15%

Conduit C106-3S016: Wire Runs W106-70, 92A, 93F, 96, 97A, 97B, 154C & 169

Wire Run #-70	1 pair @	.08 in ²
Wire Run #-92A	1 pair @	.08 in ²
Wire Run #-93F	2 pair @	.31 in ²
Wire Run #-96	16 pair @	1.13 in ²
Wire Run #-97A	3 pair @	.34 in ²
Wire Run #-97B	1 pair @	.08 in ²
Wire Run #-154C	2 #14 @	.03 in ²
Wire Run #-169	1 pair @	.08 in ²
Total area.....		2.13 in ²

2.13 in² / .4 = 5.4 in²

This translates to a diameter = 2.6"; Use a 3" conduit.

Fill = 28.4%

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Date 9/13/95 By DE Larson
Checked 7/19/95 By TJ Kasnick
Revised 5/6/98 By Cris Carlson

Conduit C106-3S018: Wire Runs W106-92A, 93F, 96, 97A & 154C

Wire Run #-92A	1 pair	@	.08 in ²
Wire Run #-93F	2 pair	@	.31 in ²
Wire Run #-96	16 pair	@	1.13 in ²
Wire Run #-97A	3 pair	@	.34 in ²
Wire Run #-154C	2#14	@	.03 in ²
Total Area.....			1.89 in ²

$$1.89 \text{ in}^2 / .4 = 4.73 \text{ in}^2$$

This translates to a diameter of 2.5"; Use a 3" conduit.

Fill = 25.2%

Conduit C106-3S030: Wire Runs W106-87, 87A, 87B, 137, & 154B

Wire Run #-87	1#14	@	.01 in ²
Wire Run #-87A	8 triads	@	.64 in ²
Wire Run #-87B	8 triads	@	.64 in ²
Wire Run #-137	Belden 1049A	@	.20 in ²
Wire Run #-154B	2#14	@	.03 in ²
Total area.....			1.52 in ²

$$1.52 \text{ in}^2 / .4 = 3.8 \text{ in}^2$$

This translates to a diameter = 2.2"; Use a 3" conduit.

Fill = 20%

Conduit C106-3S037: Wire Runs W106-87, 87A & 87B

Wire Run #-87	1#14	@	.01 in ²
Wire Run #-87A	8 triads	@	.64 in ²
Wire Run #-87B	8 triads	@	.64 in ²
Total area.....			1.29 in ²

$$1.29 \text{ in}^2 / .40 = 3.2 \text{ in}^2$$

This translates to a diameter = 2.03"; Use a 3" conduit.

Fill = 17.2%

Remaining conduit runs are short and contain few cables.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
Subject C-106 Load Determination,
Feeder/Protection Sizing, Voltage Drop,
Lighting Calculations, & Conduit Sizing
Location 200E, C Tank Farm

WO/Job No. Task Order N09
Date 9/13/95 By DE Larson
Checked 7/19/95 By TJ Kasnick
Revised 5/6/98 By Cris Carlson

7.10 Pullbox Sizing

Six pullboxes are used for the W-320 C-Farm installation work. They must all be checked to see whether they have been sized properly per NEC 370-28. The pullboxes will be tested to determine whether they satisfy the NEC rules for # 4 and larger cables (NEC 370-16). This will be a conservative test. If this criteria is not satisfied, the electricians will need to add another row in the boxes. The boxes are rather deep and so this should present no problem. All pulls are considered as being made into the farm since this is necessary to avoid the spread of contamination.

7.10.1 Power Pullboxes

Refer to drawing H-2-818674 Sheet 3.

Pullbox 7B

All conduits are considered to be in one row. The conductors for the following size conduits pass straight through: 4", 2", 1.5", 1" and 1".

$$8 \times 4" = 32"$$

Box is 42" x 42"; pullbox has 42" available for pulling. Box size is satisfactory.

Pullbox 8B

There are angle pulls into the C-Farm. Conduit sizes are 4", 2", 1.5", 1", 1". Straight pulls are for small conduits and need not be evaluated.

$$6 \times 4" + 2" + 1.5" + 1" + 1" = 29.5"$$

Box is 42" x 42"; pullbox has 42" available for pulling. Box size is satisfactory.

7.10.2 Control PullboxesPullbox 7A

Both conduits are for straight pulls and for angle pulls. Conduit sizes are 1.5" and 1".

Straight Pull: $8 \times 1.5" = 12"$; minimum inside size is 2'-0".

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/13/95 By DE Larson
 Checked 7/19/95 By TJ Kasnick
 Revised 5/6/98 By Cris Carlson

Angle pull: $6 \times 1.5" + 1" = 10."$; minimum inside size is 2'-0".

Box is 24" x 36"; box size is satisfactory.

Pullbox 8A

Conduits are 1.5" or three 1".

Straight Pull: $8 \times 1.5" = 12"$

Angle pull: $6 \times 1" + 1" + 1" = 8"$

Box is 24" x 36"; box size is satisfactory.

7.10.3 Instrument Pullboxes

Pullbox 7

Conduits are 3", 1.5", 1" and .75".

Straight Pull: $8 \times 3" = 24"$

Angle Pull: $6 \times 3" + 1.5" + 1" + .75" = 21.25"$ (24" is opposite dimension.)

Angle Pull: $6 \times 3" + 3" + 2" + 1.5" + .75" = 25.25"$ (36" is opposite dimension.) This does meet the test. Our largest instrument cable is a 16 pair. It's overall diameter is 1.20". The bending radius of this cable is our limiting factor.

$8 \times 1.20" = 9.6"$

Box is 24" X 36"; There is room for the largest cable to bend. Box size is satisfactory.

Pullbox 8

Conduits are 2", 3", 3" and 1.5".

Straight Pull: $8 \times 3" = 24"$

Angle Pull: $6 \times 3" + 3" + 1.5" + 2" = 24.5"$

Box is 24" x 36"; Box size is unsatisfactory as oriented on the drawings unless another row is added for conduits in the box.

DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject C-106 Load Determination,
 Feeder/Protection Sizing, Voltage Drop,
 Lighting Calculations, & Conduit Sizing
 Location 200E, C Tank Farm

WO/Job No. Task Order N09
 Date 9/13/95 By DE Larson
 Checked 7/19/95 By TJ Kasnick
 Revised 5/6/98 By Cris Carlson

8. CONCLUSIONS

8.1 Total connected load $\approx$ 481.9 KVA.

Maximum estimated demand for sluicing project $\approx$ 481.9 KVA (Startup)

Estimated NORMAL demand on transformer bank $\approx$ 262.5 KVA. (Operation)

8.2 The planned double 600 kcmil feeder to C-PDP-1 and the triple 350 kcmil feeders to the EES are adequate for the C-Farm sluicing demand.

8.3 500 kcmil feeder for the 250 HP VSD motor is adequate to maintain proper terminal voltage level during motor starting with the soft start option of VSD.

8.4 The C-Farm distribution to Submersible Pump P-1361 is adequate. Use of the soft start unit will aid in starting.

8.5 A single outdoor light fixture is adequate over the door. Four two-lamp fixtures are required inside the Process Building.

8.6 Pullbox sizes shown on the drawings are adequate.

Calculation No.
W320-31-011
Page A-1

ALL DATA SHOWN IN THIS BOX ARE PART OF
JOB ERS735 AND ARE FOR REFERENCE ONLY
REFER TO DWG H-2-820748 SHEET 1

ONE LINE DIAGRAM (C-106 SLUICING)

ESSENTIAL DRAWING

DESIGNED BY	KNOWNLES	DATE	10/26/87
CHECKED BY	LARSON	DATE	10/26/87
APPROVED BY	CLARK	DATE	10/26/87
PROJECT	U.S. DEPARTMENT OF ENERGY OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY JEP WATERS HANFORD COMPANY		
DRAWING NO.	ONE-LINE DIAGRAM		
PROJECT NO.	H-2-81860		
REVISION	1		

24675-059
(For Utilities Use Only) 27

Request Number ~~E4E 93-064 R1~~

Originator T.J. Kasnick Date 7/18/95

Phone 373-2692

Title/Org. Lead Electrical Engineer

Telephone 373-3021

Facility Rep. Roger Taft

[X] WHC [X] KEH [] PNL [] BCS

Loc./MSIN S2-47

Alternate Power []

Emergency Power []

(Stand-by or Emergency requests must be accompanied by applicable sections of PSE, PSAR, NSAR, SAR or OSR and must also include a completed ESR supplemental form.)

Dates Service Required:

August 1995

(temporary)

(permanent)

Design Status: Preconceptual ☐ Conceptual ☐ Functional ☐ Definitive ☒

Existing Service (if any): Volts ☐ 10 ☐ 30 ☐ other ☐ Y ☐ Δ

Desired New or Additional Service: 480 Volts ☐ 10 ☒ 30 ☐ Other ☐ Y ☐ Δ

CONNECTED LOAD	EXISTING	NEW	(For Utilities Use Only)
Process Heat	KW	32.5 KW	
Water Heat	KW	KW	
Space Heat	KW	33 KW	
Air Conditioning	HP	5 HP	
Refrigeration	HP	60 HP	
Lighting (Including Receptacles)	KW	51 KW	
Motors	HP	390 HP	
Other	KW	16 KW	
Average Demand	KW		

Largest Existing Motor (if any):

250 HP, 480 Volts, 3 Phase; Purpose: Slurry Booster pump (VSD)

(For Utilities Use Only)

Recommendations:

(For Utilities Use Only)
Recommendations: *USE ORIGINAL SERVICE SPECIFIED IN ORIGINAL
ESR ENE93-087, REQUIRING A ~~22~~ 25 KVA PAD MTD. XFMR.
THIS SUPERSEDES ESR ENE93-087*

Meter Required?

☒ Yes ☐ No

Area Engineer

Date _____

RETURN TO: ELECTRICAL UTILITIES ENGINEERING, MSIN S2-12, WHC

Calculation W320-31-011
Page A-2

W-320 C-Farm
SLUICING

LOAD -----	CONN LOAD -----	DF -----	DEM (KW) -----
COMP. SKID SERVICE BLDG.	4.13	0.80	3.31
MINI POWER CEN. (SERV. BLDG.)	10.00	0.30	3.00
MINI POWER CENTER	25.00	0.30	7.50
RECIRC. FAN (PROCESS BLDG)	6.20	0.80	4.96
HEATING COIL (PROCESS BLDG)	35.00	0.80	28.00
MINI POWER CEN. (PROC. BLDG)	10.00	0.30	3.00
PUMP 1 (CHILLER SKID)	8.27	0.80	6.61
PUMP 2 (CHILLER SKID)	8.27	0.80	6.61
COMP. & FAN (CHILLER SKID)	71.00	0.80	56.80
MINI POWER CEN. (CHIL. SKID)	5.00	0.30	1.50
HEATING COIL (EXHAUST SKID)	3.50	0.80	2.80
MINI POWER CEN. (EXHAUST SKID)	5.00	0.30	1.50
EXHAUST FAN (EXHAUST SKID)	6.20	0.80	4.96
UNINTERRUPTABLE POWER SUPPLY	15.00	0.60	9.00
SLURRY PUMP WINCH	0.83	0.30	0.25
SLURRY PUMP	82.66	0.80	66.13
TOTAL DEMAND LOAD			205.93
DIVERSITY FACTOR			1.44
ESTIMATED LOAD			143.00

Calculation W320-31-011
Page A-3

REFERENCES:

1. INDUSTRIAL POWER SYSTEMS HANDBOOK, BEEMAN, FIRST ED.
CHAPTER 17 (LOAD AND COST ESTIMATING DATA)
2. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, FINK AND BEATY
ELEVENTH EDITION, CHAPTER 18 (DEMAND AND DIVERSITY FACTORS)

Project W320: Tank C-106 Sluicing >> C-FARM

LOAD	HP	CONN LOAD (KVA)	DF	DEM (KVA)
ELECTRICAL EQUIPMENT SKID:				
MINI-POWER CENTER		15.00	0.30	4.50
SERVICE BUILDING:				
MINI-POWER CENTER		5.00	0.30	1.50
COMPRESSOR SKID	7.50	6.20	0.80	4.96
PROCESS BUILDING:				
RECIRCULATION FAN	7.50	6.20	0.80	4.96
HEATING COIL		30.00	0.80	24.00
SPACE HEATING		8.00	0.30	2.40
MINI-POWER CENTER		5.00	0.30	1.50
CHILLER SKID:				
CIRCULATION PUMP 1	10	8.27	0.80	6.61
CIRCULATION PUMP 2	10	8.27	0.80	6.61
COMPRESSORS/FANS		71.00	0.80	56.80
MINI-POWER CENTER		5.00	0.30	1.50
EXHAUST SKID:				
HEATING COIL		2.50	0.80	2.00
EXHAUST FAN (WITH VSD)	7.50	6.20	0.80	4.96
MINI-POWER CENTER		5.00	0.30	1.50
VACUUM PUMP	0.75	0.62	0.80	0.50
SLUICER SKID:				
HYDRAULIC PUMP	5	4.13	0.80	3.31
MINI-POWER CENTER		1.00	0.30	0.30
SLURRY BOOSTER PUMP (WITH VSD)	250	206.65	0.80	165.32
SLURRY SUBMERSIBLE PUMP (SOFT START	75	61.99	0.80	49.60
SLURRY SUBMERSIBLE PUMP WINCH	2	1.65	0.30	0.50
CONSTRUCTION OFFICE TRAILERS (3)				
SPACE HEATING/HEAT PUMP		25.00	0.30	7.50
LIGHTING/RECEPTACLES		25.00	0.30	7.50

Calculation W320-31-011
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TOTAL DEMAND LOAD	358.32
DIVERSITY FACTOR	1.44
ESTIMATED LOAD	248.83

REFERENCES:

1. INDUSTRIAL POWER SYSTEMS HANDBOOK, BEEMAN, FIRST ED.
CHAPTER 17 (LOAD AND COST ESTIMATING DATA)
2. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, FINK AND BEATY
ELEVENTH EDITION, CHAPTER 18 (DEMAND AND DIVERSITY FACTORS)
3. THE FOLLOWING ASSUMPTIONS WERE MADE: PF = .95, EFF = .95

Project W320: Tank C-106 Sluicing >> C-FARM

LOAD	HP	CONN LOAD (KVA)	DF	DEM (KVA)
ELECTRICAL EQUIPMENT SKID:				
MINI-POWER CENTER		15.00	0.30	4.50
SERVICE BUILDING:				
MINI-POWER CENTER		5.00	0.30	1.50
COMPRESSOR SKID	7.50	6.20	0.80	4.96
PROCESS BUILDING:				
RECIRCULATION FAN	7.50	6.20	1.00	6.20
HEATING COIL		30.00	0.80	24.00
SPACE HEATING		8.00	0.30	2.40
MINI-POWER CENTER		5.00	0.30	1.50
CHILLER SKID:				
CIRCULATION PUMP 1	10	8.27	0.80	6.61
CIRCULATION PUMP 2	10	8.27	0.80	6.61
COMPRESSORS/FANS		71.00	1.00	71.00
MINI-POWER CENTER		5.00	0.30	1.50
EXHAUST SKID:				
HEATING COIL		2.50	0.80	2.00
EXHAUST FAN (WITH VSD)	7.50	6.20	1.00	6.20
MINI-POWER CENTER		5.00	0.30	1.50
VACUUM PUMP	0.75	0.62	0.80	0.50
SLUICER SKID:				
HYDRAULIC PUMP	5	4.13	1.00	4.13
MINI-POWER CENTER		1.00	0.30	0.30
SLURRY BOOSTER PP (VSD)	250	206.65	1.00	206.65
SLURRY SUBMERSIBLE PUMP (SOFT START)	75	61.99	1.00	61.99
SLURRY SUBMERSIBLE PUMP WINCH	2	1.65	0.00	0.00
CONSTRUCTION OFFICE TRAILERS (3)				
SPACE HEATING/HEAT PUMP		25.00	0.30	7.50
LIGHTING/RECEPTACLES		25.00	0.30	7.50

Calculation W320-31-011
Page A-5

TOTAL DEMAND LOAD 429.06
DURING STARTUP
(APPROX. 5 MIN)

Transformer loading =====> 191%

REFERENCES:

1. INDUSTRIAL POWER SYSTEMS HANDBOOK, BEEMAN, FIRST ED.
CHAPTER 17 (LOAD AND COST ESTIMATING DATA)
2. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, FINK AND BEATY
ELEVENTH EDITION, CHAPTER 18 (DEMAND AND DIVERSITY FACTORS)
3. THE FOLLOWING ASSUMPTIONS WERE MADE: PF = .95, EFF = .95

Project W320: Tank C-106 Sluicing >> C-FARM

LOAD	HP	CONN LOAD (KVA)	DF	DEM (KVA)
ELECTRICAL EQUIPMENT SKID:				
MINI-POWER CENTER		15.00	0.30	4.50
SERVICE BUILDING:				
MINI-POWER CENTER		5.00	0.30	1.50
COMPRESSOR SKID	7.50	6.20	0.80	4.96
PROCESS BUILDING:				
RECIRCULATION FAN	7.50	6.20	1.00	6.20
HEATING COIL		30.00	0.80	24.00
SPACE HEATING		8.00	0.30	2.40
MINI-POWER CENTER		5.00	0.30	1.50
CHILLER SKID:				
CIRCULATION PUMP 1	10	8.27	0.80	6.61
CIRCULATION PUMP 2	10	8.27	0.80	6.61
COMPRESSORS/FANS		71.00	1.00	71.00
MINI-POWER CENTER		5.00	0.30	1.50
EXHAUST SKID:				
HEATING COIL		2.50	0.80	2.00
EXHAUST FAN (WITH VSD)	7.50	6.20	1.00	6.20
MINI-POWER CENTER		5.00	0.30	1.50
VACUUM PUMP	0.75	0.62	0.80	0.50
SLUICER SKID:				
HYDRAULIC PUMP	5	4.13	1.00	4.13
MINI-POWER CENTER		1.00	0.30	0.30
SLURRY BOOSTER PP (VSD) (85.2/.937)	91	75.22	1.00	75.22 SS
SLURRY SUBMERSIBLE PP (SS) (47.9/.95)	50	41.33	1.00	41.33
SLURRY SUBMERSIBLE PUMP WINCH	2	1.65	0.00	0.00
CONSTRUCTION OFFICE TRAILERS (3)				
SPACE HEATING/HEAT PUMP		25.00	0.30	7.50
LIGHTING/RECEPTACLES		25.00	0.30	7.50

Calculation W320-31-011
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TOTAL DEMAND LOAD 276.96
WHEN SLUICING
IN OPERATION

Transformer loading =====> 123%

REFERENCES:

1. INDUSTRIAL POWER SYSTEMS HANDBOOK, BEEMAN, FIRST ED.
CHAPTER 17 (LOAD AND COST ESTIMATING DATA)
2. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, FINK AND BEATY
ELEVENTH EDITION, CHAPTER 18 (DEMAND AND DIVERSITY FACTORS)
3. THE FOLLOWING ASSUMPTIONS WERE MADE: PF = .95, EFF = .95

TRANSFORMER NAME PLATE DATA

KVA: 225 ^{CANT.}
RISE 65°C

SER: 95J877059

STYLE: V5EE5H1TN

HV: 13800 LV: 480Y277

TAP:

HV: AL

LV: AL

1. 14490

HV: BIL: 95

LV: BIL: 30

2. 14145

3. 13800

MFG. DATE: JUN. 95

4. 13455

5. 13110

IMPEDANCE 3.19

GAL. OIL 148

WT. LBS 3210

CLASS: DA 60 HERTZ THREE PHASE

BOB CAINE

373-6949

INVERTRON VGI

A-C DRIVES

Calculation W320-31-011

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SPECIFICATIONS

Controller Ratings

Controller Model Number	HP/KW Rating ⁽¹⁾	Input Voltage	Input KVA	Input Amps	Maximum Output Amps
8ED1125	125 HP	460	131	160	150 ⁽²⁾
8ED1150	150 HP	460	144	200	180 ⁽²⁾
8ED1200	200 HP	460	192	255	240 ⁽²⁾
8ED1250	250 HP	460	240	325	300 ⁽²⁾
8ED1300	300 HP	460	288	380	360 ⁽²⁾
8ED1350	350 HP	460	336	435	420 ⁽³⁾
8ED1400	400 HP	460	394	490	480 ⁽⁴⁾
-	500-1200 HP	Contact Reliance Electric			
8ED3150	90 KW	380	117	200	180 ⁽²⁾
8ED3200	125 KW	380	159	255	240 ⁽²⁾
8ED3250	150 KW	380	192	325	300 ⁽²⁾
8ED3300	185 KW	380	243	380	360 ⁽²⁾
8ED3350	220 KW	380	279	435	420 ⁽³⁾
8ED3400	250 KW	380	324	490	480 ⁽⁴⁾

SERVICE CONDITIONS

Elevation to 3300 ft (1000 meters)
 Ambient Temperature Range:
 • Cabinet -10°C to 40°C (14°F to 104°F)
 • Chassis -10°C to 55°C (14°F to 131°F)
 Atmosphere Non-Condensing Relative Humidity
 5 to 95%

A-C Line Voltage Variation plus or minus 10%

A-C Line Frequency

Variation 50 Hz $\pm$ 2 Hz or 60 Hz $\pm$ 2 Hz
 Storage Temperature -40°C to 65°C
 (-40°F to 149°F)

- (1) NEMA B induction motor rating only. Application load and speed requirements must be considered to properly size the motor and controller.
 (2) Load rating is 100% continuous, or 150% for 1 minute.
 (3) Load rating is 100% continuous, or 125% for 1 minute.
 (4) Load rating is 100% continuous, or 110% for 1 minute.
 (5) % of base speed with proper adjustment of slip compensation.

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 IBM® is a registered trademark of International Business Machines Corp.

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APPLICATION DATA

Pulse Width Modulation (PWM) Flux regulated sine wave
 Displacement Power Factor 0.96
 Long Term Frequency Stability:
 With Digital Keypad01% of base frequency
 With Optional Analog Input1% of base frequency
 Communications RS232/RS422,
 via any ASCII terminal (optional)
 Speed Reference Inputs 0-10 VDC (+/-) Analog
 0-20 mA Analog
 4-20 mA Analog
 2KHz-1MHz (Pulse Train)
 Control Inputs 24 VDC Standard
 115 VAC Optional

PROGRAMMABLE ADJUSTMENTS

Acceleration Time Linear 1 to 3277 sec.
 Deceleration Time Linear 1 to 3277 sec.
 Volts/Hertz Selectable
 Minimum Frequency 0 Hz
 Maximum Frequency 200 Hz
 Slip Compensation⁽⁵⁾ 0.5% Speed Regulation
 Current Limit 20%-100%
 Manual Torque Boost 0 to 30% of Rated Voltage

DIMENSIONS AND WEIGHTS

Digital Keypad

Inverter Disconnect

**Dimensions for
150-400 HP and
90-250 KW Controllers**

Height in./mm	Width in./mm	Depth in./mm
86.6/2200	66.9/1700	24/609

WEIGHT
lbs 1300
kgs 590

Note: Contact Reliance for dimensions of controls above 400 HP

HNF-2487, Rev. 0

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Effective February 1, 1994

**RELIANCE
ELECTRIC**

TEFC E•MASTER • THREE-PHASE

HP	Synch RPM	Frame Size	Full Load RPM	Amps @ 460V		Torque (Ft-Lbs)			Full Load		NEMA Code
				Full Load	Locked Rotor	Full Load	Break Down	Locked Rotor	Nom. Eff.	Power Factor	
25	3600	284TS	3533	29.3	181	37.2	98.0	62.0	91.0	87.5	G
	1800	284T	1768	31.0	180	74.3	180	149	92.4	81.7	G
	1200	324T	1178	32.2	174	111	250	205	91.7	79.1	F
	900	326T	879	33.7	177	149	345	230	90.2	76.6	G
30	3600	286TS	3529	35.7	217	44.6	120	75.0	91.0	86.2	G
	1800	286T	1764	37.0	216	89.3	210	175	92.4	82.1	G
	1200	326T	1178	39.2	214	134	305	255	91.7	78.0	G
	900	364T	879	39.9	210	179	422	255	91.0	77.4	F
40	3600	324TS	3551	48.4	280	59.2	144	94.0	91.7	84.0	F
	1800	324T	1773	49.5	282	119	281	205	93.0	81.1	G
	1200	364T	1182	49.4	289	178	415	335	93.0	81.2	G
	900	365T	880	53.1	288	239	585	365	91.0	76.9	G
50	3600	326TS	3550	59.3	357	74.0	183	130	92.4	84.9	G
	1800	326T	1769	61.9	340	148	340	240	93.0	81.1	F
	1200	365T	1181	61.9	362	222	520	425	93.0	81.1	G
	900	404T	880	65.0	362	298	775	460	91.7	78.5	G
60	3600	364TS	3556	69.8	433	88.6	250	154	93.0	86.3	G
	1800	364T	1778	73.4	428	177	445	300	93.6	81.5	G
	1200	404T	1182	70.5	415	267	655	410	93.6	85.1	F
	900	405T	880	77.5	420	358	860	535	91.7	78.9	F
75	3600	365TS	3551	84.2	538	111	307	186	93.0	89.7	G
	1800	365T	1779	87.0	542	221	555	400	94.1	85.5	G
	1200	405T	1181	87.9	542	333	815	530	93.6	85.2	G
	900	444T	886	94.0	542	444	1025	600	93.6	79.7	G
100	3600	405TS	3567	115	725	147	411	220	93.6	86.9	G
	1800	405T	1780	116	710	145	735	475	94.5	85.3	G
	1200	444T	1187	121	710	443	1115	725	94.1	82.2	G
	900	445T	886	123	695	593	1335	825	93.6	81.0	F
125	3600	444TS	3567	144	885	184	520	246	94.5	85.7	G
	1800	444T	1781	140	902	369	930	595	94.5	88.4	G
	1200	445T	1185	149	860	554	1303	860	94.1	83.3	F
	900	445T	885	154	885	741	1700	1044	94.1	80.8	G
150	3600	445TS	3567	168	1075	221	600	310	94.5	88.1	G
	1800	445T	1785	170	1070	441	1120	650	95.0	86.8	G
	1200	445T	1186	176	1085	664	1628	1097	95.0	84.1	G
	900	447T	886	177	1070	899	2085	1295	94.5	83.8	G
200	3600	445TS	3573	225	1450	294	810	445	95.0	87.5	G
	1800	445T	1784	225	1440	589	1540	965	95.0	87.3	G
	1200	447T	1188	230	1395	884	2150	1295	95.0	85.6	F
	3600	447TS	3570	278	1825	368	1025	600	95.0	88.5	G
250	1800	447T	1784	279	1820	736	1900	1140	95.4	87.9	G
	1200	449T	1187	280	1825	1105	2800	1660	95.4	87.4	G
300	1800	449TS	1783	335	2115	883	2356	1309	95.4	87.6	G

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The following table shows the maximum heat dissipation at rated current for the controllers.

Figure 5.1
Maximum Heat Dissipation

SMC PLUS Controller Current Size	24A	35A	54A	97A	135A
Maximum Watts	110	150	200	285	410

All soft start losses shall be as heat loss.

Non-ventilated enclosures:

For NEMA Type 12 or non-ventilated enclosures, it is recommended that a by-pass contactor be used. This will allow the controller to start the motor. Once up to full voltage, the controller would be by-passed. Note that the features of the controller would no longer be available. See Page 8-3 for this configuration.

Per NEC Table 430-150, a 75 HP motor draws 96 amperes: $KVA\ total = VI\sqrt{3}$
 $KVA\ total = (460\ volts)(96\ amps)\sqrt{3} = 76,485.12\ VA$

$$Eff = \frac{Output}{Input}$$

$$Eff = \frac{76,485.12\ VA}{76,485.12 + 285\ VA}$$

$$Eff = .996\ or\ 99.6\ \% \ eff$$

Mounting

The controller is convection cooled except for the 97A and 135A fan cooled unit. It is important to locate the controller in a position which allows free air flow vertically through the power module. The controller must be mounted with heatsink fins in a vertical plane and have a minimum of 6 inches free space above and below the controller. See Figures 5.2, 5.3 and 5.4.

Figure 5.2
Dimension Drawings (24A Controller)

Unit	A width	B height	C depth	D	E	F	Approx. Ship. Wt.
Millimeter	155	180	160	50	140	160	4.5 kg
Inches	6-3/32	7-3/32	6-5/16	1-31/32	5-33/64	6-5/16	10 lbs

All dimensions are approximate and are not to be used for construction purposes. Refer to nearest Sales Office or the Sales Department at Milwaukee, Wisconsin, for complete dimension drawings.

Dan Larson
Hanford Nuclear

FAX: (509) 373-3343

June 21, 1995

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In response to your request for an ampacity correction factor for ampacities calculated using the Nehrer McGrath Method (similar to that shown in NEC Table 310-16), the following factor may be used:

Formula derived from IEEE S-135 Vol. 1, equation 5 (See Attachment)

$$TCF = \sqrt{\frac{(Tc2 - Ta2)}{(Tc1 - Ta1)} \cdot \frac{(234.5 + Tc1)}{(234.5 + Tc2)}}$$

Where:

- Tc1= maximum conductor temperature used to determine base ampacity
- Ta1= ambient temperature used to determine base ampacity
- Tc2= maximum conductor temperature used to determine adjusted ampacity
- Ta2= ambient temperature used to determine adjusted ampacity

If you need any additional information, please let me know.

Sincerely,

Robert Konnik
Application/Design Engineer

RLK/ja

E005095

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A member of The Marmon Group of companies

GIVEN

BASIC NEREX-MCGRATH
FORMULA FROM
NEC ARTICLE 310-15

$$I = \sqrt{\frac{T_C - (T_A + \Delta T_D)}{R_{DC} (1 + Y_C) R_{CA}}}$$

$$I' = \sqrt{\frac{T_C' - (T_A' + \Delta T_D')}{R_{DC}' (1 + Y_C') R_{CA}'}}$$

$$\frac{I'}{I} = \frac{\sqrt{\frac{T_C' - (T_A' + \Delta T_D')}{R_{DC}' (1 + Y_C') R_{CA}'}}}{\sqrt{\frac{T_C - (T_A + \Delta T_D)}{R_{DC} (1 + Y_C) R_{CA}}}}$$

$$\frac{I'}{I} = \sqrt{\frac{T_C' - (T_A' + \Delta T_D')}{T_C - (T_A + \Delta T_D)}} \times \frac{R_{DC} (1 + Y_C) R_{CA}}{R_{DC}' (1 + Y_C') R_{CA}'}$$

SPECIAL CASE 1

(same concrete and concrete temperature)
 (same concrete in same environment)
 (same insulation condition, etc.)

IF $R_{BC} = R_{BC}$
 AND $\psi_C = \psi_C$
 AND $R_{CA} = R_{CA}$

Then:

$$\frac{I'}{I} = \sqrt{\frac{T_C - (T_A + \text{DELM } T_D')}{T_C - (T_A + \text{DELM } T_D)}}$$

SUBCASE-A

IF $\text{DELM } T_D \text{ AND } \text{DELM } T_D' = 0$ (maximum length cases)

Then:

$$\frac{I'}{I} = \sqrt{\frac{(T_C' - T_A')}{(T_C - T_A)}}$$

OR (solving for T_C')

$$T_C' = \left(\frac{I'}{I} \right)^2 \cdot (T_C - T_A) + T_A'$$

NOTE: THIS CASE CAN ONLY BE USED IF ALL ASSUMPTIONS ARE MET.

SPECIAL CASE 2

IF $Y_C = Y_C'$
AND $R_{CA} = R_{LA}$

AND GIVEN

$$R_{DC} = \frac{(F + T_C)}{(F + T_C')} R_{DC}'$$

THEN

$$\frac{I'}{I} = \sqrt{\frac{T_C' - (T_A' + \Delta T_{A-T_D})}{T_C - (T_A + \Delta T_{A-T_D})}} \times \frac{(F + T_C)}{(F + T_C')}$$

SUBCASE A

IF ΔT_{A-T_D} AND $\Delta T_{A-T_D}' = 0$
AND $F = 234.5$ (FOR 100% IACS COPPER)

THEN

$$\frac{I'}{I} = \sqrt{\frac{(T_C' - T_A')}{(T_C - T_A)}} \times \frac{(234.5 + T_C)}{(234.5 + T_C')}$$

OR (SOLVING FOR T_C')

$$T_C' = \left(\frac{I'}{I}\right)^2 \cdot (T_C - T_A) \cdot \frac{(234.5 + T_C')}{(234.5 + T_C)} + T_A'$$

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Cables with metallic tape shield components
9 and fewer components----- 12 x component O.D. 14 x component O.D.
10-19 components----- 24 x " 28 x "
more than 19 components--- 36 x " 42 x "

C. Cables with metallic tape shield components
9 and fewer components----- 6 x components O.D. 10 x component O.D.
10-19 components----- 10 x " 14 x "
more than 19 components--- 14 x " 18 x "

B. Cables with braid or wire shield components
9 and fewer components----- 4 x component O.D. 8 x component O.D.
10-19 components----- 8 x " 12 x "
more than 19 components--- 12 x " 16 x "

A. Non-metallic sheath cable-no shields

Cable Type Column A Column B

TABLE I

Note: For both I and II, a component may be a single conductor or twisted pair or triad including any covering or jacket. Full laminate shields over components or cable are not to be considered as metallic shielding and can be neglected for these determinations.

II. Recommended minimum bending radii for cables being installed under pulling tensions -- in accordance with Table I Column B.

I. Recommended bending radii for permanent training during installation when no significant pulling tension is required -- in accordance with Table I Column A. These bending radii limits do not apply to conduit bends, sheaves or other curved surfaces around which cable may be pulled under tension while being installed.

These are the general rules concerning bending radii and general installation practices for our products. The bending radii recommended below are calculated from minimum radii specified in ICEA Standards applicable to the cable components.

SUBJECT: BENDING RADI & INSTALLATION PRACTICES

D. *Cables with braid or wire shields over assembly (overall)-----	6 x cable O.D.	10 x cable O.D.
E. *Cables with metallic tape shields over assembly (overall)-----	8 x cable O.D.	12 x cable O.D.
F. ALS (Gardex) Cables - smooth		
Cable Dia. 0.750" and less----	10 x cable O.D.	12 x cable O.D.
" " 0.751" to 1.50"-----	12 x " "	14 x " "
" " 1.501" to larger---	15 x " "	18 x " "
G. **ALS (Gardex) Cables - Corrugated and Interlocked Armored cables-----	7 x cable O.D.	10 x cable O.D.
H. Coaxial Cables -----	8 x cable O.D.	12 x cable O.D.
J. Composite Cables -----	minimum radii permitted for largest component within the cable will apply.	

* These bending radii apply regardless of component construction.

** If cable has metallic tape shield over core assembly, minimum bend radius Column A is changed to 8 x cable O.D., and Column B is changed to 12 x cable O.D.

III. Maximum pulling tensions - straight runs - in pounds - T

$T = .008 \times \text{CMA}$ for Single Conductors

$T = .008 \times N \times \text{CMA}$ for Multiconductors Cables

$T = .008 \times N \times \text{CMA} \times K$ For Multiple Cables

CMA = Circular Mil Area of One Conductor

N = Number of Conductors*

K = Load Sharing Factor = .8

(*Do not include ground wires, drain wires or control conductor in power cables.)

Specify calculated T or 10,000 lbs., whichever is less.

When calculating maximum pulling tension for coaxial cables with high strength inner conductor, the conductor is considered as regular annealed copper of equal size. Recommended maximum pulling tensions for our Firewall coaxial product line has been calculated and are listed in Table II.

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IV. Maximum side wall pressure - lbs per ft. of bend radius

Coaxial cable	
-solid dielectric -----	200
-foam dielectric -----	150
Non-metallic sheath cables	
-non-shielded -----	1000
-shielded -----	500
ALS (Gardex) smooth & corrugated -----	400
Steel interlocked armor -----	500
Silicone insulated cable -----	300

V. Maximum pulling tension of III and IV above for all product except coaxial cable apply when pulling by gripping the conductors. When pulling with a basket-weave type pulling grip applied over a non-metallic sheath only, the maximum pulling tension should not exceed 1000 pounds.

Recommended method of pulling coaxial cable is by the basket weave type grip applied over the outer sheath, and maximum pulling tensions listed are based on this pulling method.

When the basket weave type grip method is used for pulling any type product, the section of cable which was under the grip should be cut off and discarded after pulling has been completed.

VI. Minimum installing temperature - all products:

-10°C (14°F)

VII. Some of the recommended pulling compounds for use with our products are listed below. Other available pulling compounds may work equally as well with our products. Suggest manufacturer be contacted for recommended use.

* Vololay Bentonite - Whittaker
Clark & Daniels, Inc.
So. Plainfield, NJ

Y-er EAS - Electro Compound Co.
Cleveland, Ohio

Slip-X-300- American Colloid
Smokie, Ill.

Polywater Lub. A, C, G, J or H
- Polywater Corp
Still Water, Mn.

Ductlube - Utility Industries
Somerdale, N.J.

Flaxsoap - Sherwin-Williams

Aqua-Gel - Ideal Industries Inc.
Sycamore, IL

* Materials may dry out and harden with age. Not recommended where subsequent removal of cable is anticipated.

foregoing, such deviations should be reviewed and approved by the Technical Department.

TABLE II
RECOMMENDED PULLING TENSIONS
FOR COAXIAL CABLES

<u>RSS #</u>	<u>Max. Tension in Lbs.</u>
6-100/LE	20
100A/LE	10
101/LE	100
104/LE	25
105/LE	25
106/LE	60
107/LE	60
108/LE	120
109/LE	80
110A/LE	125
111/LE	45
112/LE	100
113/LE	30
114/LE	50
115/LE	100
116/LE	145
6-200	25
201	115
202	185
203	25
204	35
205	35
206	70
207	85
208	110
208B	80
208C	170
209	50
210	140
211	30
212	65
213	100
214	120
215	95

Prepared by: E. D'Aquanno

INSTRUMENTATION CABLE

FR-EP Instrumentation Cable UL Type TC
Flame-Retardant EP Insulation,
CPE Jacket
Multiple Shielded Pairs,
Triads or Conductors
With Overall Shield
600 Volts 90°C

Catalog No.

 No. of
Pairs

 Insula-
tion
Thick-
ness
Inch

 Jacket
Thick-
ness
Inch

 Overall
Dia-
meter

Inch

 Net
Weight

lbs/
mft.

CALL
1-800-HOU-WIRE

18AWG Shielded Pairs with Overall Shield

C1501803	2	.025	.045	.48	86
C1501804	4	.025	.045	.61	158
C1501808	8	.025	.080	.89	305
C1501812	12	.025	.080	.99	418
C1501816	16	.025	.080	1.10	531
C1501820	20	.025	.080	1.22	691
C1501824	24	.025	.080	1.35	747

16AWG Shielded Pairs with Overall Shield

C1501602	2	.025	.060	.62	127
C1501603	3	.025	.060	.60	169
C1501604	4	.025	.060	.67	202
C1501606	6	.025	.060	.79	264
C1501607	7	.025	.060	.79	305
C1501608	8	.025	.080	.90	380
C1501610	10	.025	.080	.97	460
C1501612	12	.025	.080	1.07	551
C1501616	16	.025	.080	1.20	698
C1501624	24	.025	.080	1.48	993

16AWG Shielded Triads with Overall Shield

C1501604T	4	.025	.060	.70	261
C1501606T	6	.025	.060	.88	411
C1501608T	8	.025	.080	.96	530
C1501612T	12	.025	.080	1.18	721

18AWG Multiconductor Shielded

C1501801	2C	.025	.060	.33	55
C1501801T	3C	.025	.060	.35	63

16AWG Multiconductor Shielded

C1501601	2C	.025	.060	.36	63
C1501601T	3C	.025	.060	.40	80
C1501601Q	4C	.025	.060	.48	94

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**Factory
Mutual
System**

X-Link® TC

Instrumentation Cable
Multi-Conductor Shielded
(XLPO/LSZH-XLPO)

90°C*, 600 Volt
NEC Type TC
UL Listed

Spec. RSS-3-089

Scope

X-Link® TC is the smallest thermoset, UL listed, Type TC Instrumentation cable available in the industry today. X-Link® TC is 30% to 40% smaller in diameter than standard 600 volt cable. It may be installed in wet and dry locations, indoors and outdoors, in metal trays, ducts, conduits, or in direct burial applications.

It is ideal for applications in substations, cogeneration, waste/energy and industrial facilities to perform a variety of signaling, data acquisition and monitoring functions. Designed for use on circuits where shielding from external electrostatic interference is not required.

Features

- Thermoset insulation and jacket for enhanced thermal stability
- Small diameter & light weight
- Economical
- More cables per tray or conduit
- 600 volt rating allows cables to be run in trays without separation (300 vs 600 volt)
- Flame retardant
- Flexible
- Heat, sunlight, oil and abrasion resistant
- Easily pulled (low friction jacket)
- Tin-coated conductors for improved terminations and corrosion resistance
- Jackets have printed sequential footage markers for improved inventory control
- Jacket strippability facilitates termination
- Reduced halogen design
- Low smoke jacket
- Lead free jacket
- Superior insulation and jacket moisture resistance

Performance Standards

- UL listed, Type TC (UL 1277) in accordance with the NEC - Article 340
- UL listed sunlight resistance
- Factory Mutual Research Corp. group "I" fire rated per "Specification Test Standard for Cable Fire Propagation, Class 3972"†
- Passes IEEE-383 70,000 BTU/hr vertical tray flame test and ICEA 70,000 BTU/hr vertical tray flame test (T-30-520)
- Single conductors pass UL VW-1 flame test
- Single conductors in accordance with performance requirements of ICEA S-66-524 and UL 44, Class XL
- Single conductors in accordance with AWM style No. 3502
- Jacket exceeds the requirements of UL Class XL/90°C and ICEA Publication T-33-653, Type II
- UL approved for 90°C operation in both wet and dry locations
- Cable components are in compliance with the maximum leachable lead level required by the EPA in 40CFR, Part 261
- Meets the requirements of UL Standard No. 1685 to allow for a UL "LS" designation for limited smoke

† 2/C #16 and larger

Construction

Conductor:

Tin-coated copper conductors. Class "B" strand (ASTM B-8 & B-33)

Insulation:

20 mils of flame retardant crosslinked polyolefin meeting performance requirements of ICEA S-66-524 and UL 44 Class XL

Circuit Identification:

Colored insulation per ICEA Method 1, Table K-2***

Fillers:

(Where required)

Shield System:

Helically applied aluminum/polyester laminated tape shield in continuous contact with flexible strand, tin-coated copper drain wire

Binder Tape:***

Helically applied polyester

Jacket:

Reduced wall, black, flame retardant, low smoke, zero halogen, crosslinked polyolefin jacket

* Rated 90°C for normal operation in wet and dry locations, 130°C for emergency overload conditions, and 250°C for short circuit conditions.

** Not required on 2, 3, and 4 conductor configurations

*** Also available in K-1 color identification

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X-Link® TC

Instrumentation Cable

Multi-Conductor Shielded
(XLPO/LSZH-XLPO)

90°C*, 600 Volt
NEC Type TC
UL Listed

Factory
Mutual
System

Spec. RSS-3-089

16 AWG, 7 Strand

Product Code	Number of Conductors	Insulation Thickness (Inch)	Insulation Thickness (mm)	Insulated Conductor Diameter (Inch)	Drain Wire Size/Stranding	Jacket Thickness (Mils)	Nominal Overall Diameter (Inch)	Nominal Overall Diameter (mm)	Approximate Net Weight (Lbs/M')
183-0021	2	.020	5.08	.10	18 AWG (16/s)	35	.27	6.86	45
183-0031	3	.020	5.08	.10	18 AWG (16/s)	35	.29	7.37	60
183-0041	4	.020	5.08	.10	18 AWG (16/s)	35	.31	7.87	70
183-0051	5	.020	5.08	.10	18 AWG (16/s)	35	.37	9.40	95
183-0071	7	.020	5.08	.10	18 AWG (16/s)	35	.40	10.16	120
183-0091	9	.020	5.08	.10	18 AWG (16/s)	35	.46	11.68	150
183-0121	12	.020	5.08	.10	18 AWG (16/s)	35	.51	12.95	190
183-0151	15	.020	5.08	.10	18 AWG (16/s)	45	.59	14.99	240
183-0191	19	.020	5.08	.10	18 AWG (16/s)	45	.61	15.49	290
183-0271	27	.020	5.08	.10	18 AWG (16/s)	45	.73	18.54	395
183-0371	37	.020	5.08	.10	18 AWG (16/s)	45	.81	20.57	520

18 AWG, 7 Strand

184-0021	2	.020	5.08	.09	20 AWG (10/s)	35	.25	6.35	35
184-0031	3	.020	5.08	.09	20 AWG (10/s)	35	.26	6.60	45
184-0041	4	.020	5.08	.09	20 AWG (10/s)	35	.29	7.37	55
184-0051	5	.020	5.08	.09	20 AWG (10/s)	35	.33	8.38	70
184-0071	7	.020	5.08	.09	20 AWG (10/s)	35	.36	9.14	90
184-0091	9	.020	5.08	.09	20 AWG (10/s)	35	.41	10.41	110
184-0121	12	.020	5.08	.09	20 AWG (10/s)	35	.46	11.68	140
184-0151	15	.020	5.08	.09	20 AWG (10/s)	35	.51	12.95	165
184-0191	19	.020	5.08	.09	20 AWG (10/s)	45	.55	13.97	210
184-0271	27	.020	5.08	.09	20 AWG (10/s)	45	.65	16.51	285
184-0371	37	.020	5.08	.09	20 AWG (10/s)	45	.72	18.29	375

* Rated 90°C for normal operation in wet and dry locations, 130°C for emergency overload conditions, and 250°C for short circuit conditions.

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Pg E-58A

Firewall® III Instrumentation Cable Multi-Conductor Shielded (XLPE/CSPE)

90°C*, 600 Volt
Class 1E Nuclear
NEC Type TC
UL Listed

Spec. RSS-3-021

Scope

Firewall® III Instrumentation Cable is a totally thermoset construction specifically designed for applications in power generation plants, substations and other similar locations. It is intended for use in harsh and demanding environments, including Class

1E Nuclear applications. It may be installed in trays, ducts, conduits or in direct burial applications to perform a variety of signaling and related functions. *Designed for use on circuits where shielding from external electrostatic interference is not required.*

Features

- Thermoset insulation and jacket for enhanced thermal stability
- Specially formulated insulation for superior long term water resistance
- Extremely flame retardant
- Nuclear qualified with a minimum 40-year thermal life expectancy at 90°C
- Radiation resistant (up to 200 megarads)
- Full traceability
- Excellent mechanical properties
- Tin-coated copper conductors for improved terminations and corrosion resistance
- All singles pass a wet dielectric (tank) test prior to cabling to verify electrical integrity
- All jackets have printed sequential footage markers for improved inventory control
- Easy strippability for installation ease

* Rated 90°C for normal operation in wet and dry locations, 130°C for emergency overload conditions, and 250°C for short circuit conditions.

** Not required on 2, 3 and 4 conductor configurations

Performance Standards

- Insulation in accordance with ICEA Standard S-66-524 and UL approved for 90°C applications in both wet & dry locations
- Jackets in accordance with ICEA Standard S-19-81 for heavy-duty chlorosulfonated polyethylene (CSPE)
- Class 1E qualified in accordance with IEEE-383 and IEEE-323 (Rockbestos Reports QR-5804 or QR-5805)
- Cable passes IEEE-383 70,000 BTU/hr vertical tray flame test as modified by NRC Reg. Guide 1.131
- Cable passes ICEA 210,000 BTU/hr vertical tray flame test (Standard T-29-520)
- Single conductors pass the vertical flame tests specified in IEEE-383 para. 2.5.6 (ICEA S-19-81 Section 6.19.6) and UL VW-1
- Quality Assurance program in accordance with 10 CFR 50 Appendix B
- UL Listed Type TC for cable tray installations (UL 1277)
- In accordance with the National Electrical Code - Article 340 (approved for Class I, Division 2 hazardous locations)
- Cable components are in compliance with the maximum leachable lead level required by the EPA in 40 CFR, Part 261

Construction

Conductor:

Annealed, tin-coated copper. Class "B" strand (ASTM B-8 & B-33)

Insulation:

Proprietary heat, moisture and radiation resistant flame retardant crosslinked polyethylene

Circuit Identification:

Colored insulation per ICEA Method 1, Table K-1

Fillers:

(When required)

Shield System:

Helically applied aluminum/polyester laminated tape shield in continuous contact with a flexible strand, tin-coated copper drain wire **

Binder Tape: **

Helically applied

Jacket:

Black, heavy-duty chlorosulfonated polyethylene (also available in neoprene and FR-XLPE)

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Firewall® III
Instrumentation Cable
 Multi-Conductor Shielded
 (XLPE/CSPE)
 90°C*, 600 Volt
 Class 1E Nuclear
 NEC Type TC
 UL Listed
 Spec. RSS-3-021

16 AWG, 7 Strand

Product Code	Number of Conductors	Insulation Thickness (Inch) (mm)	Insulated Conductor Diameter (Inch)	Drain Wire Size/ Stranding	Jacket Thickness (Mils)	Nominal Overall Diameter (Inch) (mm)	Approximate Net Weight (Lbs/M')
146-0021	2	.025 6.35	.11	18 AWG (16/s)	45	.31 7.87	65
146-0031	3	.025 6.35	.11	18 AWG (16/s)	45	.33 8.38	81
146-3433	4	.025 6.35	.11	18 AWG (16/s)	45	.36 9.14	100
146-3444	5	.025 6.35	.11	18 AWG (16/s)	45	.42 10.76	135
146-3425	7	.025 6.35	.11	18 AWG (16/s)	45	.45 11.43	145
146-3447	9	.025 6.35	.11	18 AWG (16/s)	45	.52 13.21	180
146-3449	12	.025 6.35	.11	18 AWG (16/s)	60	.61 15.49	250
146-3450	15	.025 6.35	.11	18 AWG (16/s)	60	.66 16.76	295
146-3451	19	.025 6.35	.11	18 AWG (16/s)	60	.70 17.78	345
146-5979	27	.025 6.35	.11	18 AWG (16/s)	60	.82 20.83	465
146-5980	37	.025 6.35	.11	18 AWG (16/s)	80	.95 24.13	650

18 AWG, 7 Strand

157-0021	2	.025 6.35	.10	20 AWG (10/s)	45	.29 7.37	55
157-0031	3	.025 6.35	.10	20 AWG (10/s)	45	.31 7.87	65
157-0041	4	.025 6.35	.10	20 AWG (10/s)	45	.33 8.38	80
157-0051	5	.025 6.35	.10	20 AWG (10/s)	45	.38 9.65	105
157-0071	7	.025 6.35	.10	20 AWG (10/s)	45	.41 10.41	110
157-0091	9	.025 6.35	.10	20 AWG (10/s)	45	.47 11.94	140
157-0121	12	.025 6.35	.10	20 AWG (10/s)	45	.52 13.21	170
157-0151	15	.025 6.35	.10	20 AWG (10/s)	60	.61 15.49	225
157-0191	19	.025 6.35	.10	20 AWG (10/s)	60	.63 16.00	260
157-0271	27	.025 6.35	.10	20 AWG (10/s)	60	.75 19.05	350
157-0371	37	.025 6.35	.10	20 AWG (10/s)	60	.83 16.00	450

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 Pg E-59A

* Rated 90°C for normal operation in wet and dry locations. 130°C for emergency overload conditions, and 250°C for short circuit conditions.

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Voigt

Wall-MostTM

FAMILY OF OUTDOOR LUMINAIRES

Aesthetically styled in pure architectural form for all low pressure sodium lamps (18 watt, 35 watt, 55 watt, 90 watt, 135 watt, 180 watt).

Voigt Lighting Industries, Inc.

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Page E-60

Outdoor Energy-Dollar Saver Check-Chart

If You Now Use or Plan to Use	Use Voigt Wall-Most for Equivalent Lighting Results—Instead	Watts Saved for Each Unit Used	Annual Dollar Saving for Nightly Use (66/Kwhr)
1-300 Watt Incandescent Fish Bowl Unit	No. 0-36 (35 watt)	240	58
3-150 Watt Inc. Reflector Lamp Cluster	No. 0-36 (55 watt)	370	89
1-500 Watt Inc. Quartz Floodlight	No. 0-36 (55 watt)	420	101
1-1000 Watt Inc. Quartz Light	No. 0-39 (180 watt)	780	187
1-175 Watt Mercury Vapor Wall-Unit	No. 0-36 (55 watt)	125	30
1-400 Watt Mercury Vapor Wall-Unit	No. 0-38 (135 watt)	275	66
1-400 Watt Metal Halide Wall-Unit	No. 0-39 (180 watt)	245	59
1-250 Watt H.P.S. Wall-Unit	No. 0-38 (135 watt)	132	32

Whether you seek to

Protect visitors in a parking lot

Secure a fence against intruders

Highlight a building entrance

Provide visibility for your watchman

Pour light into a loading 18-wheeler

Or

Assure proper T.V. surveillance lighting

The Wall-Most family does it exceptionally well
and attractively using fewer watts and often for a
much smaller dollar outlay.

Relamping is accomplished through fully-gasketed door in end—keeping optical chamber sealed against bug and dirt entry.

Calculation W320-31-011
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Installation, even under adverse outdoor conditions, is remarkably easy; with all mounting bolts and wire splices fully accessible as lens & reflector slide out of the way.

Internally mounted uplight shield can be field installed or removed at any time (SD-1 shown with 0-36).

Polycarbonate lens resists breakage. Absence of ultraviolet in L.P.S. source eliminates lens embrittlement and yellowing over time.

Wide beam spread of Wall-Most achieves coverage of large areas adjacent to buildings and mounting walls.

Footcandle Isolux

Top View of Footcandles on Ground From Single Unit.

Mounting Height - 15'-0"

From: Voigt Wall-Most™ No. 0-36-120 with 55 watt Low Pressure Sodium Lamp.

(Data: Electrical Testing Laboratories Test No. 440926).

Larger (90 through 180 watts) Wall-Most have a more sharply defined distribution of light—to cover even larger areas. For 135 watts prorate data by multiplying factor of 1.67. For 180 watts multiply by 2.44.

Aesthetic elegance of Wall-Most can be enhanced by versions in black — or other architectural color finishes as desired. Simply specify color.

Additional Wall-Most notes.

Long luminous arc size, for all lamps, spreads the light over the entire Wall-Most lens face—reducing the viewing brightness—so that unit is comfortable to look at—even when viewed directly.

The yellow monochromatic light of Wall-Most does not attract bugs to your building. The light, however, does penetrate smoke, haze, fog & smog more forcefully than other sources of illumination.

Unique prismatic lens structure precisely designed for twin Arc L.P.S. source, significantly aids in control of light into efficient beam pattern; and optically disperses source for greater comfort.

Lamp Specifications and Ordering Information

LOW PRESSURE SODIUM LAMPS ONLY (Order Separately)				
CATALOG NUMBER	Watts	Rated Life (Hours)	Initial & Maintained Lumen Output	Max. O.A. Length In Inches
SOX-18	18	18,000	1,800	8-1/2
SOX-35	35	18,000	4,800	12-3/16
SOX-55	55	18,000	8,000	16-3/4
SOX-90	90	18,000	13,500	20-3/4
SOX-135	135	18,000	22,500	30-1/2
SOX-180	180	18,000	33,000	44-1/8

Table of Electrical Characteristics for Wall-Most

Low Pressure Sodium Lamps	180 WATTS				135 WATTS				90 WATTS				55 WATTS				35 WATTS			
Nominal Primary Voltage (Volts)	120	208	240	277	480	120	208	240	277	480	120	208	240	277	480	120	208	240	277	480
Starting Line Current (Amperes)	2.0	1.15	1.0	0.85	0.5	1.8	1.04	0.9	0.8	0.45	1.2	0.7	0.6	0.5	0.4	0.95	0.55	0.48	0.41	0.3
Operating Line Current (Amperes)	1.9	1.18	0.95	0.82	0.5	1.64	0.95	0.82	0.71	0.4	1.16	0.67	0.58	0.50	0.29	0.68	0.43	0.37	0.32	0.19
Open Circuit Current (Amperes)	5.2	2.9	2.6	2.3	1.9	5.2	2.9	2.6	2.3	1.9	4.0	2.3	2.0	1.7	1.9	2.5	1.45	1.25	1.1	0.5
Primary Dropout Voltage (Volts)	90	156	180	208	360	66	114	132	152	264	66	114	132	152	264	66	114	132	152	264
Ballast Power Initial (Watts)	40	40	40	40	40	43	43	43	43	43	35	35	35	35	35	25	25	25	25	25
Total Power Initial (Watts)	220	220	220	220	220	178	178	178	178	178	125	125	125	125	125	80	80	80	80	80
Power Factor	Over 90%				Over 90%				Over 90%				Over 90%				Over 90%			
Lamp Lumen Regulation	± 5% at ± 10% Voltage Regulation																			
Minimum Ambient Start Temp.	-20°F (Lower Temperature on Special Order)																			

Basic Wall-Most Specification and Ordering Information

CATALOG NUMBER	L.P.S. Nominal Lampwatts	Front View Silhouette	Dimensions in Inches				Approx. Weight Lbs.
			A	B	C	D	
0-34-000*	18		10	8	-	-	8
0-36-000*	55 OR 35		20	8	-	-	8
0-37-000*	90		24	8	13 1/2	17 1/2	31
0-38-000*	135		34	8	13 1/2	17 1/2	39
0-39-000*	180		47	8	13 1/2	17 1/2	44

*Specify voltage required: 120, 208, 240, 277 or 480 V., No. 0-36-120. Listed by Underwriters Laboratories, Inc. Units carry IBEW label.

For additional technical or application data or actual demonstration of the Voigt Wall-Most contact Voigt Lighting Industries, Inc. Headquarters, or:

*Calculation W320-31-011
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Voigt Lighting Industries, Inc.

Back View Mounting Details

0-39

0-38

0-37

0-36

Wall-Most with exposed portions wholly made of extruded and cast aluminum and transparent polycarbonate lens is the standard for strength and durability in outdoor wall mounted luminaires.

Optional Accessories

CATALOG NUMBER SUFFIX	Description
BLACK	Black Painted outside finish
CA2	Corner Adaptor for 0-34 + 0-36
COLOR	Painted Finish - specify color
ES	Emergency Lighting Socket for 15 watt Bayonet Base, T-7 Inc. Lamp
F	Single Fuse
FF	Double Fuse
NB	Unit without ballast to allow remote mounting
PI	Internally Mounted Photocell (120 volts only)
PR	Twist-Lock Photocell Receptacle
SD-1	Internal Shield for 0-36
SD-2	Internal Shield for 0-37
SD-3	Internal Shield for 0-38
SD-4	Internal Shield for 0-39
TP	Vandal Resistant, Tamper-Proof Screws

For additional accessories information contact Voigt Engineering Department. Cost for optional accessories available on request.

Headquarters Location
135 Fort Lee Road
Leonia, N.J. 07605
201 461-2493

Manufacturing Location
7347 Melrose Street
Philadelphia, PA 19136

Fig. 11-1. Currently Recommended Illuminance Categories and Illuminance Values for Lighting Design—Targeted Maintained Levels

The following table is a consolidated listing of the IESNA's current illuminance recommendations. This listing is intended to guide the designer in selecting an appropriate illuminance.

Guidance is provided in two forms: (1), in Parts I, II and III as an *Illuminance Category*, representing a range of illuminances; and (2), in Parts IV, V and VI as an *Illuminance Value*. Illuminance categories are represented by letter designations A through I. Illuminance Values are given in *lux* with equivalents in *footcandles* and as such are intended as *target* values with deviations expected. These target values also represent *maintained* values.

This table has been divided into six parts for ease of use. Part I lists both Illuminance Categories and Illuminance Values for generic types of interior activities and normally is to be used when Illuminance Categories for a specific Area/Activity cannot be found in Parts II and III. Parts IV, V and VI provide target maintained Illuminance Values for outdoor facilities, sports and recreational areas, and transportation vehicles where special considerations apply as discussed.

In all cases the recommendations in this table are based on the assumption that the lighting will be properly designed to take into account the visual characteristics of the task.

I. Illuminance Categories and Illuminance Values for Generic Types of Activities in Interiors

Type of Activity	Illuminance Category	Ranges of Illuminances		Reference Work-Plane
		Lux	Footcandles	
Public spaces with dark surroundings	A	20-30-50	2-3-5	General lighting throughout spaces
Simple orientation for short temporary visits	B	50-75-100	5-7.5-10	
Working spaces where visual tasks are only occasionally performed	C	100-150-200	10-15-20	
Performance of visual tasks of high contrast or large size	D	200-300-500	20-30-50	Illuminance on task
Performance of visual tasks of medium contrast or small size	E	500-750-1000	50-75-100	
Performance of visual tasks of low contrast or very small size	F	1000-1500-2000	100-150-200	
Performance of visual tasks of low contrast and very small size over a prolonged period	G	2000-3000-5000	200-300-500	Illuminance on task, obtained by a combination of general and local (supplementary lighting)
Performance of very prolonged and exacting visual task	H	5000-7500-10000	500-750-1000	
Performance of very special visual tasks of extremely low contrast and small size	I	10000-15000-20000	1000-1500-2000	

II. Commercial, Institutional, Residential and Public Assembly Interiors

Area/Activity	Illuminance Category	Area/Activity	Illuminance Category
Accounting (see Reading)		Churches and synagogues . . (see chapter 17) ⁴	
Air terminals (see Transportation terminals)		Club and lodge rooms	
Armories	C ¹	Lounge and reading	D
Art galleries (see Museums)		Conference rooms	
Auditoriums		Conferring	D
Assembly	C ¹	Critical seeing (refer to individual task)	
Social activity	B	Court rooms	
Banks (also see Reading)		Seating area	C
Lobby		Court activity area	E ³
General	C	Dance halls and discotheques	B
Writing area	D	Depots, terminals and stations	
Tellers' stations	E ³	(see Transportation terminals)	
Barber shops and beauty parlors	E		

For footnotes, see end of table.

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NFW Fluorescent Industrial Lighting Fixtures

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Page A-27

Wet Locations

Crouse-Hinds®

Application:

NFW fixtures are used:

- in non-hazardous locations where protection is required from wet, dirty and corrosive atmospheres
- where cleanliness and sanitation are prime factors, such as dairies, canneries, food processing plants, bottling plants, laboratories
- in dock areas for protection against salt spray

Features:

- One-piece high impact fiberglass housing provides durability and corrosion resistance
- Energy efficient ballast is standard
- One-piece prismatic acrylic lens for resistance to accidental damage
- Plastic latches apply positive, uniform pressure on gasketing to seal against dust and moisture. Six latches on four foot unit and twelve latches on eight foot unit
- Mounting lugs for ballast and channel are molded into housing

Standard Materials:

- Reflector housing and latches - reinforced fiberglass
- Prismatic lens - acrylic plastic
- Gasket - closed cell neoprene

Standard Finishes:

- Fiberglass - pearl gray
- Acrylic plastic - clear

Size Ranges:

- 4 and 8 foot lengths
- 2 and 4 lamp

Electrical Rating Ranges:

- 120 and 277 volt
- 60 hertz
- 40, 75, 110 watts

Compliances:

- UL Standard: 1570

Options:

The following special options are available from the factory by adding suffix to Cat. No.:

Description	Suffix to be Added to Fixture Cat. #
• Chain mounting assembly§	 CMA
• Chain sets	 CS
• Low temperature ballast - rated 0°F (40 & 75 watt) and -20°F (110 watt)	 BY
• Fuse and holder (one per fixture)	 FB
• Suitable for 220V 50Hz	 Consult Crouse-Hinds

* Two pairs of 4' lamps in tandem.

† 40 and 110 watt ballasts are rapid start; 75 watt ballasts are instant start.

§ Chain sets not included. Order chain sets by adding CS to Cat. No.

Line Voltage (60 hertz)	Watts	Length (Nominal-in Feet)	2 Lamp Cat. #	4 Lamp Cat. #
120	40	4	NFW4240	NFW8440*
	75	8	NFW8275	
	110	8	NFW82110	
	40	4	NFW4240/277	
277	75	8	NFW8275/277	NFW8440/277*
	110	8	NFW82110/277	

Lamps and Ballasts

Watts	Lamp	Ballast Type†
40	F40 (Med. Bi-Pin)	430 ma
75	F96T12 (Single Pin)	425 ma
110	F96T12HO (Recessed Double Contact)	800 ma

Dimensions

NFW & FMR Fluorescent Industrial Lighting Fixtures

Calculation W320-31-011
Page A-28

Crouse-Hinds®

Photometric Data

Fixture: NFW4240

Lamp: 2-40/T-12

Zonal Degrees: 0-30 0-40 0-60 0-90 0-180

Zonal Lumens: 857 1394 2478 3678 4211

Total Bare Lamp Lumens: $3200 \times 2 = 6400$

To determine number and placement of fixtures,
see Lighting Selector Guide, pages L-7 to L-12.

Coefficient of Utilization

Effective Floor Cavity Reflectance 20%

% Reflectance	Eff. Cell.	Room Cavity Ratio				
		Wall	1	2	3	4
80	50	.71	.61	.54	.47	.42
	30	.68	.56	.47	.40	.35
	10	.64	.51	.42	.35	.30
70	50	.69	.60	.52	.46	.41
	30	.66	.55	.46	.40	.34
	10	.63	.50	.41	.35	.30
50	50	.65	.56	.49	.43	.39
	30	.62	.52	.44	.38	.33
	10	.60	.48	.40	.34	.29
30	50	.61	.53	.46	.41	.37
	30	.59	.40	.42	.36	.32
	10	.57	.46	.38	.33	.28
10	50	.58	.50	.44	.39	.35
	30	.56	.47	.40	.35	.30
	10	.54	.44	.37	.31	.27
0	0	.52	.42	.35	.30	.25

% Reflectance	Eff. Cell.	Room Cavity Ratio				
		Wall	6	7	8	9
80	50	.38	.34	.31	.28	.26
	30	.31	.27	.25	.22	.20
	10	.26	.23	.20	.18	.16
70	50	.37	.33	.30	.28	.25
	30	.30	.27	.24	.22	.20
	10	.26	.23	.20	.18	.16
50	50	.35	.31	.29	.26	.24
	30	.29	.26	.23	.21	.19
	10	.25	.22	.20	.18	.16
30	50	.33	.30	.27	.25	.23
	30	.28	.25	.23	.21	.19
	10	.24	.21	.19	.17	.16
10	50	.31	.28	.26	.24	.22
	30	.27	.24	.22	.20	.18
	10	.24	.21	.19	.17	.15
0	0	.22	.19	.17	.15	.14

Fixture: FMR4240

Lamp: 2-40/T-12

Zonal Degrees: 0-30 0-40 0-60 0-90 0-180

Zonal Lumens: 761 1300 2508 3826 4601

Total Bare Lamp Lumens: $3200 \times 2 = 6400$

To determine number and placement of fixtures,
see Lighting Selector Guide, pages L-7 to L-12.

Coefficient of Utilization

Effective Floor Cavity Reflectance 20%

% Reflectance	Eff. Cell.	Room Cavity Ratio				
		Wall	1	2	3	4
80	50	.69	.59	.51	.45	.40
	30	.65	.53	.44	.38	.33
	10	.62	.48	.39	.33	.28
70	50	.66	.56	.49	.43	.38
	30	.63	.51	.43	.37	.32
	10	.59	.47	.38	.32	.27
50	50	.61	.52	.45	.39	.35
	30	.58	.48	.40	.34	.30
	10	.55	.44	.36	.30	.25
30	50	.56	.48	.41	.36	.32
	30	.54	.44	.37	.32	.28
	10	.51	.41	.34	.28	.24
10	50	.51	.44	.38	.33	.30
	30	.50	.41	.35	.30	.26
	10	.48	.38	.32	.27	.23
0	0	.45	.36	.29	.25	.21

% Reflectance	Eff. Cell.	Room Cavity Ratio				
		Wall	6	7	8	9
80	50	.35	.32	.29	.26	.24
	30	.29	.25	.23	.20	.18
	10	.24	.21	.18	.16	.15
70	50	.34	.31	.28	.25	.23
	30	.28	.25	.22	.20	.18
	10	.23	.20	.18	.16	.14
50	50	.31	.28	.26	.24	.22
	30	.26	.23	.21	.19	.17
	10	.22	.19	.17	.15	.14
30	50	.29	.26	.24	.22	.20
	30	.24	.22	.19	.18	.16
	10	.21	.18	.16	.14	.13
10	50	.27	.24	.22	.21	.19
	30	.23	.20	.18	.17	.15
	10	.20	.17	.15	.14	.12
0	0	.18	.16	.14	.12	.11

POWER CONDUIT BLOCK DIAGRAM

C-FARM 120V CONTROL BLOCK DIAGRAM

C-FARM INSTRUMENT CABLE BLOCK DIAGRAM

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W320-31-016

AY-102 Demand Load Analysis, Size
Feeders, Voltage Drop and Fault Study

7/24/98

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline **Electrical** WO/Job No. **Task Order N09** Calculation No. **W320-31-016**
 Project No. & Name **W320, Tank 241-C-106 Sluicing**
 Calculation Item **AY-102 Demand Load Analysis, Size Feeders, Voltage Drop, and Fault Study**

These calculations apply to:

Dwg. No. **H-2-818693, Sheet 1**Rev. No. **1**

Dwg. No.

Rev. No.

Other (Study, CDR)

Rev. No.

The status of these calculations is:

- ☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated)
☐ Void Calculation (Reason Voided)

Incorporated in Final Drawings?

☒ Yes ☐ No

This calculation verified by independent "check" calculations?

☒ Yes ☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	TJ Kasnick 8/7/95	<i>TJ Kasnick</i> 7/24/98	
Checked by	SA Najjar 8/7/95	<i>SA Najjar</i> 7/24/98	
Approved by	TJ Kasnick 8/7/95	<i>TJ Kasnick</i> 7/24/98	
Checked Against Approved Vendor Data	N/A	<i>TJ Kasnick</i> 7/24/98	

INDEXDesign Analysis
Page No.

Description

i	Calculation Identification and Index
ii	Calculation Cross Index
1	Objective
1-2	Design Inputs
3	Calculations
4	Findings and Conclusions
A-1 to A-5	Attachment A: Study Input Report
B-1 to B-7	Attachment B: Demand Load Analysis
C-1 to C-5	Attachment C: Size Feeders and Transformers
D-1 to D-8	Attachment D: Load Flow and Voltage Drop
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F	Attachment F: Drawing H-2-818693

Subject Calculation No.: W320-31-016

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DESIGN ANALYSIS

Client Numatec Hanford Corporation
Subject AY-102 Demand Load Analysis, Size
Feeders, Voltage Drop, and Fault Study
Location 200E, AY Tank Farm

WO/Job No. Task Order N09
Date 8/3/95 By TJ Kasnick
Checked 8/7/95 By SA Najjar
Revised 7/24/98 By TJ Kasnick

1. OBJECTIVE

Determine the size of electrical distribution equipment necessary to support the loads required for Project W320, Tank 241-C-106 Sluicing, at Tank AY-102.

2. DESIGN INPUTS**2.1 Criteria and Source**

Function Design Criteria For Tank 241-C-106 Waste Retrieval, Project W-320, HNF-SD-W320-FDC-001 Rev. 5.

2.2 Given or Known Data

The loads are shown on drawing H-2-818693, Sheet 1, Rev. 1. The size of motors and other equipment data are based on the Project W320 vendor information file #22668.

2.2.1 The Variable Speed Drives (VSD) are 95% efficient.

2.2.2 Motor currents, Full Load Amperes (FLA), which are based on the 1993 National Electrical Code (NEC) for the motor nameplate values except for the 250 HP motor which is based on vendor information, are tabulated as follows:

- 1) In-Line Booster pump (P-0622), at 250 HP (273 A), driven by VSD.
- 2) Submersible (Immersible) pump (P-0621), at 40 HP (52 A), driven by a soft starter.
- 3) Winch (W-0621), at 1.5 HP (2.6 A).
- 4) Pit 02E Chiller, at 10 amps.

2.2.3 Mini Power Panel is loaded to the 15 KVA transformer rating.

2.3 Assumptions

2.3.1 Transformer impedances used are typical NEMA three phase values.

2.3.2 The utility fault current values are assumed typical values derived from previous projects and data obtained from the utilities department.

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DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject AY-102 Demand Load Analysis, Size
 Feeders, Voltage Drop, and Fault Study
 Location 200E, AY Tank Farm

WO/Job No. Task Order N09
 Date 8/3/95 By TJ Kasnick
 Checked 8/7/95 By SA Najjar
 Revised 7/24/98 By TJ Kasnick

2.4 Method to be Used

2.4.1 The FDNW approved (for design use) software: SKM Power Tools, version 3.4.0.1, 1995-1997.

2.5 References/Sources

- 2.5.1 Drawing H-2-818693, Sheet 1, Rev. 1, Electrical AY-Farm One-Line Diagram
- 2.5.2 NFPA 70, National Electrical Code (NEC), 1993 edition.
- 2.5.3 ANSI C2, National Electrical Safety Code, (NESC) 1990.
- 2.5.4 U.S. Department of Energy (DOE), order DOE 6430.1A, General Design Criteria
- 2.5.5 Vendor information file #22668.

3. CALCULATIONS

- 3.1 Attachment A: Input Report: This is the feeder, transformer, and generation input data that is used by the studies below.
- 3.2 Attachment B: Demand Load Analysis: This analysis calculates the total system loads based upon system bus load inputs and summarizes them on a bus by bus basis, including total system load and power factor.
- 3.3 Attachment C: Size Feeders and Transformers: This analysis provides the NEC Code sized feeders and transformers to meet the minimum load requirements of the Demand Load Analysis Study - Total Connected Load, and the evaluation of a fixed-size feeder to the MCC. Impedance and capacity information for the feeders and transformers were taken directly from the Dapper library, which represents typical values found in the industry. Conduit sizes determined are the minimum size required.
- 3.4 Attachment D: Load Flow and Voltage Drop: This analysis calculates the exact system operating voltages, loads flows, and system losses.
- 3.5 Attachment E: Short Circuit Analysis: This analysis calculates the system short circuit fault currents. The calculations are based upon typical Hanford 13.8 Kv utility fault current contributions, plus those from any motors running within the system.

DESIGN ANALYSIS

client Numatec Hanford Corporation

WO/Job No. Task Order N09

Subject AY-102 Demand Load Analysis, Size
Feeders, Voltage Drop, and Fault Study

Date 8/3/95

By TJ Kasnick

Checked 8/7/95

By SA Najjar

Location 200E, AY Tank Farm

Revised 7/24/98

By TJ Kasnick

4. FINDINGS AND CONCLUSIONS

- 4.1 Refer to Attachment C for system equipment sizing. Refer to other Attachments for various design information related to the distribution system equipment.
- 4.2 Refer to drawing H-2-818693 for one-line diagram of the electrical distribution equipment necessary to support the loads.

Attachment A

Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)
Fri Jul 24 08:35:17 1998

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ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

SKM POWER*TOOLS FOR WINDOWS
INPUT DATA REPORT
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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE.

Fri Jul 24 08:35:17 1998

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM NAME	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	DESCRIPTION TYPE DUCT INSUL
Pole E1	XFMR Pri	1	13800	3.0	FT	1 C N BARE
+/- Impedance:	0.1320 + J	0.1355	OHMS/M	Length	0.00021 + J	0.00021 PU
Z0 Impedance:	0.2408 + J	0.2798	OHMS/M	Length	0.00038 + J	0.00044 PU
XFMR Sec	AY-PDP-1 800A	2	480	50.0	FT	350 C M THWN
+/- Impedance:	0.0390 + J	0.0500	OHMS/M	Length	0.4232 + J	0.5425 PU
Z0 Impedance:	0.1229 + J	0.1231	OHMS/M	Length	1.33 + J	1.34 PU
AY-PDP-1 800A	AY102-PP1 Bus	1	480	50.0	FT	4 C M THWN
+/- Impedance:	0.3000 + J	0.0600	OHMS/M	Length	6.51 + J	1.30 PU
Z0 Impedance:	0.9455 + J	0.1478	OHMS/M	Length	20.52 + J	3.21 PU
AY-PDP-1 800A	Tap Bus Asmbly	2	480	50.0	FT	350 C M THWN
+/- Impedance:	0.0390 + J	0.0500	OHMS/M	Length	0.4232 + J	0.5425 PU
Z0 Impedance:	0.1229 + J	0.1231	OHMS/M	Length	1.33 + J	1.34 PU
Group Cntlr	Pit Chllr Bus	1	480	110.0	FT	10 C M THWN
+/- Impedance:	1.14 + J	0.0630	OHMS/M	Length	54.43 + J	3.01 PU
Z0 Impedance:	3.59 + J	0.1552	OHMS/M	Length	171.53 + J	7.41 PU
Tap Bus Asmbly	Group Cntlr	1	480	2.0	FT	2/0 C M THWN
+/- Impedance:	0.1000 + J	0.0540	OHMS/M	Length	0.0868 + J	0.0469 PU
Z0 Impedance:	0.3152 + J	0.1330	OHMS/M	Length	0.2736 + J	0.1154 PU
Group Cntlr	Imrs SS	1	480	1.000	FT	1/0 C M THHN
+/- Impedance:	0.1200 + J	0.0550	OHMS/M	Length	0.0521 + J	0.0239 PU
Z0 Impedance:	0.3782 + J	0.1355	OHMS/M	Length	0.1641 + J	0.0588 PU
Group Cntlr	Winch Bus	1	480	120.0	FT	12 C M THHN
+/- Impedance:	1.90 + J	0.0680	OHMS/M	Length	98.96 + J	3.54 PU
Z0 Impedance:	5.99 + J	0.1675	OHMS/M	Length	311.87 + J	8.72 PU
Boostr VSD	P-0622 Bus	1	480	120.0	FT	500 C M THWN
+/- Impedance:	0.0290 + J	0.0480	OHMS/M	Length	1.51 + J	2.50 PU
Z0 Impedance:	0.0914 + J	0.1182	OHMS/M	Length	4.76 + J	6.16 PU

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

FEEDER INPUT DATA

FEEDER FROM NAME	FEEDER TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	DESCRIPTION TYPE	DUCT	INSUL
Imrs SS	P-0621 Bus	1	480	200.0	FT	1/0	C M	THWN
+/- Impedance:	0.1200 + J	0.0550	OHMS/M	Length	10.42 + J	4.77	PU	
Z0 Impedance:	0.3782 + J	0.1355	OHMS/M	Length	32.83 + J	11.76	PU	
Tap Bus Asmbly	Boostr VSD	I	480	10.0	FT	500	C M	THWN
+/- Impedance:	0.0290 + J	0.0480	OHMS/M	Length	0.1259 + J	0.2083	PU	
Z0 Impedance:	0.0914 + J	0.1182	OHMS/M	Length	0.3967 + J	0.5131	PU	

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

TRANSFORMER INPUT DATA

PRIMARY RECORD		VOLTS	* SECONDARY RECORD	VOLTS	FULL-LOAD	NOMINAL
NO	NAME	L-L	NO	NAME	L-L	KVA
XFMR Pri	D	13800.0	XFMR Sec	YG	480.00	172.50
Pos. Seq. Z%:		1.94 + j	4.07	12.93 + j	27.13	150.00
Zero Seq. Z%:		1.94 + j	4.07	12.93 + j	27.13	
Taps Pri. -5.00 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.						

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

GENERATION DATA

BUS NAME	GENERATION	VOLT	SIZE	InitKW	MaxKVAR	TYPE
Pole E1	C8-L6 13.8Kv	1.03 pu				SB
	Three Phase Contribution:	3219.00 AMPS	X/R :	1.75		
	Line to Earth Contribution:	1260.00 AMPS	X/R :	1.0000		
Pos sequence impedance (100 MVA base)	0.6448 + J	1.13 PU				
Zero sequence impedance (100 MVA base)	5.75 + J	4.79 PU				

Attachment B

Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

DATE: 7:24:1998
TIME: 8:34:53.83

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SKM POWER*TOOLS FOR WINDOWS
DEMAND LOAD ANALYSIS REPORT
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*** SOLUTION COMMENTS ***
=====

LOAD ANALYSIS INCLUDES ALL LOADS.

DATE: 7:24:1998 TIME: 8:34:53.83

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

LOAD SUMMARY

LOAD SCHEDULE FOR Pole E1 13800. VOLTS LINE TO LINE
 SOURCE OF PWR SOURCE BUS

ITEM DESCRIPTION *	CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
XFMR Pri	294.7	12.3	294.7	12.3	351.4	14.7	88.81
TOTALS	294.7	12.3	294.7	12.3	351.4	14.7	88.81

LOAD SCHEDULE FOR XFMR Pri 13800. VOLTS LINE TO LINE
 SOURCE OF PWR Pole E1

ITEM DESCRIPTION *	CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
XFMR Sec	294.7	12.3	294.7	12.3	351.4	14.7	88.81
TOTALS	294.7	12.3	294.7	12.3	351.4	14.7	88.81

LOAD SCHEDULE FOR XFMR Sec 480. VOLTS LINE TO LINE
 SOURCE OF PWR XFMR Pri

ITEM DESCRIPTION *	CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
AY-PDP-1 800A	294.7	354.5	294.7	354.5	351.4	422.7	88.81
TOTALS	294.7	354.5	294.7	354.5	351.4	422.7	88.81

LOAD SCHEDULE FOR AY-PDP-1 800A 480. VOLTS LINE TO LINE
 SOURCE OF PWR XFMR Sec

ITEM DESCRIPTION *	CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
Tap Bus Asmblly	279.9	336.7	279.9	336.7	336.6	404.9	89.14
AY102-PP1 Bus	15.0	18.0	15.0	18.0	15.0	18.0	80.00
TOTALS	294.7	354.5	294.7	354.5	351.4	422.7	88.81

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Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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LOAD SUMMARY

LOAD SCHEDULE FOR		Tap Bus Asmbl				480. VOLTS LINE TO LINE	
SOURCE OF PWR		AY-PDP-1 800A					
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
BRANCH LOADS							
Group Cntl'r	53.6	64.4	53.6	64.4	64.4	77.4	81.70
Boostr VSD	227.0	273.0	227.0	273.0	283.7	341.2	90.30
=====							
TOTALS	279.9	336.7	279.9	336.7	336.6	404.9	89.14

LOAD SCHEDULE FOR		Pit Chll'r Bus				480. VOLTS LINE TO LINE	
SOURCE OF PWR		Group Cntl'r					
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
GENERAL LOADS							
	8.3	10.0	8.3	10.0	8.3	10.0	90.00
=====							
TOTALS	8.3	10.0	8.3	10.0	8.3	10.0	90.00

LOAD SCHEDULE FOR		Group Cntl'r				480. VOLTS LINE TO LINE	
SOURCE OF PWR		Tap Bus Asmbl					
ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
=====							
END USE LOADS							
BRANCH LOADS							
Pit Chll'r Bus	8.3	10.0	8.3	10.0	8.3	10.0	90.00
Imrs SS	43.2	52.0	43.2	52.0	54.0	65.0	80.30
Winch Bus	2.2	2.6	2.2	2.6	2.7	3.2	80.00
=====							
TOTALS	53.6	64.4	53.6	64.4	64.4	77.4	81.70

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

LOAD SUMMARY

LOAD SCHEDULE FOR Imrs SS 480. VOLTS LINE TO LINE
 SOURCE OF PWR Group Cntlr

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
P-0621 Bus	43.2	52.0	43.2	52.0	54.0	65.0	80.30
TOTALS	43.2	52.0	43.2	52.0	54.0	65.0	80.30

LOAD SCHEDULE FOR Winch Bus 480. VOLTS LINE TO LINE
 SOURCE OF PWR Group Cntlr

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	2.2	2.6	2.2	2.6	2.7	3.2	80.00
TOTALS	2.2	2.6	2.2	2.6	2.7	3.2	80.00

LOAD SCHEDULE FOR AY102-PPI Bus 480. VOLTS LINE TO LINE
 SOURCE OF PWR AY-PDP-1 800A

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
GENERAL LOADS	15.0	18.0	15.0	18.0	15.0	18.0	80.00
TOTALS	15.0	18.0	15.0	18.0	15.0	18.0	80.00

LOAD SCHEDULE FOR Boostr VSD 480. VOLTS LINE TO LINE
 SOURCE OF PWR Tap Bus Asmbly

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
BRANCH LOADS							
P-0622 Bus	227.0	273.0	227.0	273.0	283.7	341.2	90.30
TOTALS	227.0	273.0	227.0	273.0	283.7	341.2	90.30

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Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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LOAD SUMMARY

LOAD SCHEDULE FOR P-0622 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Boostr VSD

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	227.0	273.0	227.0	273.0	283.7	341.2	90.30
TOTALS	227.0	273.0	227.0	273.0	283.7	341.2	90.30

LOAD SCHEDULE FOR P-0621 Bus 480. VOLTS LINE TO LINE
SOURCE OF PWR Imrs SS

ITEM DESCRIPTION	* CONNECTED KVA	LOAD AMPS	* DEMAND KVA	LOAD AMPS	* DESIGN KVA	LOAD AMPS	* % P F
END USE LOADS							
LARGEST KVA MTR	43.2	52.0	43.2	52.0	54.0	65.0	80.30
TOTALS	43.2	52.0	43.2	52.0	54.0	65.0	80.30

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

TOTAL SOURCE LOAD SUMMARY

LOAD DESCRIPTION TYPE	UNITS	CONNECTED LOAD	DEMAND LOAD	DESIGN LOAD	POWER FACTOR %
=====					
GENERAL LOADS	KW	19.5	19.5	19.5	
	KVAR	12.6	12.6	12.6	
	KVA	23.2	23.2	23.2	83.92 LAGGING
KVA TYPE MTR	KW	36.4	36.4	36.4	
	KVAR	27.0	27.0	27.0	
	KVA	45.4	45.4	45.4	80.29 LAGGING
LARGEST KVA MTR	KW	204.9	204.9	256.2	
	KVAR	97.5	97.5	121.9	
	KVA	227.0	227.0	283.7	90.30 LAGGING

TOTAL LOADS	KW	260.8	260.8	312.1	
	KVAR	137.2	137.2	161.6	
	KVA	294.7	294.7	351.4	
	% PF	88.5	88.5	88.8	
		LAGGING	LAGGING	LAGGING	

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Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
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LOAD DEMAND TABLE

LOAD DESCRIPTION	LOAD TYPE	FIRST DEMAND KVA	FIRST DEMAND %	SECOND DEMAND KVA	SECOND DEMAND %	THIRD DEMAND KVA	THIRD DEMAND %	DESIGN FACT
GENERAL LOADS	Z	100.	100.	ALL	50.	ALL	50.	1.00
LIGHTING	K	ALL	100.	ALL	100.	ALL	100.	1.25
RECEPTACLES	Z	10.	100.	ALL	50.	ALL	50.	1.00
Load Not Defined	K	ALL	0.	ALL	0.	ALL	0.	1.00
HEATING	Z	ALL	100.	ALL	100.	ALL	100.	1.25
OFFICE EQUIPMENT	Z	ALL	100.	ALL	100.	ALL	100.	1.00
WATER PUMPS	K	ALL	100.	ALL	100.	ALL	100.	1.00
VAR SPEED DRIVE	K	ALL	5.	ALL	5.	ALL	5.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
HVAC MTR LOAD	K	ALL	100.	ALL	100.	ALL	100.	1.00
HVAC LGST MTR	K	ALL	100.	ALL	100.	ALL	100.	1.25
ACC MTR LOAD	K	ALL	100.	ALL	100.	ALL	100.	1.00
ACC LGST MTR	K	ALL	100.	ALL	100.	ALL	100.	1.25
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00
SPARE	K	ALL	100.	ALL	100.	ALL	100.	1.00

NOTES: LARGEST MOTOR CIRCUIT IDENTIFIED,
AND USED TO CALCULATE DEMAND LOAD BASED ON NEC ART 430
DEMAND AND DESIGN FACTORS APPLIED AT EACH LOAD BUS
AND ALL LOAD TOTALS ARE POWER FACTOR CORRECTED
DESIGN LOAD VALUES BASED ON MOTOR RUNING OR STARTING CONDITION

Attachment C

Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

DATE: 7:24:1998

TIME: 8:34:59.76

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SKM POWER*TOOLS FOR WINDOWS
FEEDER AND TRANSFORMER SIZING REPORT
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DATE 7:24:1998 TIME: 8:34:59.76
Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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FEEDER AND TRANSFORMER STUDY CRITERIA

=====

SIZE AND REPORT, DO NOT CHANGE THE DATA BASE

BRANCH VOLTAGE DROP CRITERIA 3.00 %

VOLTAGE DROP CALCULATIONS ARE PRELIMINARY
EXECUTE VOLTAGE DROP AND LOAD FLOW STUDY FOR MORE ACCURATE RESULTS

PRIMARY/SECONDARY TRANSFORMER FDRS SIZED AT 125. % OF TX FULL LOAD RATING

*** NOTICE *** FEEDER SIZED TO 125. PERCENT OF TRANSFORMER SIZE
BRANCH FROM XFMR Pri TO XFMR Sec
TX KVA: 294.7 TR FLA: 12.3
MINIMUM FEEDER AMPACITY: 15.4

*** NOTICE *** FEEDER SIZED TO 125. PERCENT OF TRANSFORMER SIZE
BRANCH FROM XFMR Pri TO XFMR Sec
TX KVA: 294.7 TR FLA: 354.5
MINIMUM FEEDER AMPACITY: 443.1

DATE 7:24:1998 TIME: 8:34:59.76

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

FEEDER SIZE REPORT

F E E D E R S C H E D U L E

FEEDER ROUTING NO NAME	FEEDER VOLTAGE	NO /PH	WIRE QTY	SIZE FDR	TYPE MAT	INSUL TYPE	GROUND WIRE	RACEWAY SIZE	TYPE
FROM Pole E1 *****	13800.								
TO XFMR Pri	EX	(1)	3	1	CU	BARE			N
FROM XFMR Sec *****	480.								
TO AY-PDP-1 800A	EX	(2)	4	350	CU	THWN		3" C	M
FROM AY-PDP-1 800A *****	480.								
TO AY102-PP1 Bus	EX	(1)	4	4	CU	THWN	8	1" C	M
TO Tap Bus Asmby	EX	(2)	4	350	CU	THWN	1/0	2 1/2" C	M
FROM Group Cntlr *****	480.								
TO Pit Chlllr Bus	EX	(1)	4	10	CU	THWN	10	1/2" C	M
FROM Tap Bus Asmby *****	480.								
TO Group Cntlr	EX	(1)	4	2/0	CU	THWN	6	1 1/2" C	M
FROM Group Cntlr *****	480.								
TO Imrs SS	EX	(1)	4	1/0	CU	THWN	6	1 1/2" C	M
TO Winch Bus	EX	(1)	4	12	CU	THWN	12	1/2" C	M
FROM Boostr VSD *****	480.								
TO P-0622 Bus	EX	(1)	4	500	CU	THWN	3	3" C	M
FROM Imrs SS *****	480.								
TO P-0621 Bus	EX	(1)	4	1/0	CU	THWN	6	1 1/2" C	M
FROM Tap Bus Asmby *****	480.								
TO Boostr VSD	EX	(1)	4	500	CU	THWN	3	3" C	M

DATE 7:24:1998 TIME: 8:34:59.76
Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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FEEDER EVALUATION

FEEDER DESIGN LOAD ANALYSIS

=====

FEEDER ROUTING NO NAME	EXTG % VD	QTY /PH	SIZE FDR	FEEDER DESCRIPTION MAT	DESIGN INSUL	DERATED AMBIENT	LOAD	CAPACITY
---------------------------	--------------	------------	-------------	---------------------------	-----------------	--------------------	------	----------

=====

FROM Pole E1 13800.

TO XFMR Pri	EX	0.00	1	CU	BARE	30.	15. A	UNKNOWN
*** WARNING *** ENGINEERING REVIEW OF FEEDER CAPACITY SUGGESTED								

FROM XFMR Sec 480.

TO AY-PDP-1 800A	EX	0.22	2	CU	THWN	30.	423. A	620. A
------------------	----	------	---	----	------	-----	--------	--------

FROM AY-PDP-1 800A 480.

TO AY102-PP1 Bus	EX	0.09	1	CU	THWN	30.	18. A	70. A
TO Tap Bus Asmbly	EX	0.21	2	CU	THWN	30.	405. A	620. A

FROM Group Cntlr 480.

TO Pit Chillr Bus	EX	0.42	1	CU	THWN	30.	10. A	30. A
-------------------	----	------	---	----	------	-----	-------	-------

FROM Tap Bus Asmbly 480.

TO Group Cntlr	EX	0.01	1	CU	THWN	30.	77. A	175. A
----------------	----	------	---	----	------	-----	-------	--------

FROM Group Cntlr 480.

TO Imrs SS	EX	0.00	1	CU	THHN	30.	65. A	150. A
TO Winch Bus	EX	0.22	1	CU	THHN	70.	3. A	12. A

FROM Boost VSD 480.

TO P-0622 Bus	EX	0.69	1	CU	THWN	30.	341. A	380. A
---------------	----	------	---	----	------	-----	--------	--------

FROM Imrs SS 480.

TO P-0621 Bus	EX	0.61	1	CU	THWN	30.	65. A	150. A
---------------	----	------	---	----	------	-----	-------	--------

FROM Tap Bus Asmbly 480.

TO Boost VSD	EX	0.06	1	CU	THWN	30.	341. A	380. A
--------------	----	------	---	----	------	-----	--------	--------

DATE 7:24:1998 TIME: 8:34:59.76

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

TRANSFORMER SIZE REPORT

T R A N S F O R M E R S C H E D U L E

LOCATION	DESCRIPTION	VOLTAGE	CONN	PCT.	TRANSFORMER DESCRIPTION
BUS NO.	NAME	LEVELS	CODE	TAP	
FROM XFMR Pri		13800.	D	-5.0	TYPE: OA SIZE: 0.0 KVA
TOr XFMR Sec		480.	YG		DESCRIPTION: XFMR C6351-3
DEMAND LOAD:	294.7 KVA		EX		4.51 %Z NOMINAL RATING 0.0 KVA

Attachment D

Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

DATE: 7:24:1998
TIME: 8:35:19.70

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AY-Farm Electrical Distribution
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*** SOLUTION COMMENTS ***

=====

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA : 3.00 %
BUS VOLTAGE CRITERIA : 5.00 %

ACCELERATION FACTOR FOR 'PV' GENERATORS : 1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS: 1.00
EXACT(ITERATIVE) SOLUTION : YES

UTILITY IMPEDANCE : YES
TRANSFORMER PHASE SHIFT : NO

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

LOAD FLOW IS BASED ON CALCULATED DEMAND LOAD RESULTS
FROM THE DEMAND LOAD ANALYSIS STUDY.
LOAD ANALYSIS INCLUDES ALL LOADS.

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

SWING GENERATORS		
SOURCE NAME	VOLTAGE	ANGLE
=====		
C8-L6 13.8Kv	1.030	0.00

LARGEST LOAD:	226.96 KVA	
CONVERGENCE CRITERIA:	0.011 KVA	
LARGEST BUS MISMATCH	P-0622 Bus	0.681 KVA
LARGEST BUS MISMATCH	P-0622 Bus	0.057 KVA
LARGEST BUS MISMATCH	P-0622 Bus	0.005 KVA

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

SOURCE	VOLTAGE	ANGLE	KW	KVAR	VD%	(UTILITY IMPEDANCE)
C8-L6 13.8Kv	1.030	0.00	274.67	164.41	0.35	0.64485+J 1.12848

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: Pole E1 DESIGN VOLTS: 13800 BUS VOLTS: 14165 %VD: -2.65

===== PU BUS VOLTAGE: 1.026 ANGLE: -0.1 DEGREES

*** SWING GENERATOR: C8-L6 13.8Kv 274.7 KW 164.4 KVAR

LOAD TO: XFMR Pri FEEDER AMPS: 13.0 VOLTAGE DROP: 0. %VD: 0.00
 PROJECTED POWER FLOW: 274.0 KW 163.3 KVAR 319.0 KVA PF: 0.86 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: XFMR Pri DESIGN VOLTS: 13800 BUS VOLTS: 14165 %VD: -2.65

===== PU BUS VOLTAGE: 1.026 ANGLE: -0.1 DEGREES

LOAD FROM: Pole E1 FEEDER AMPS: 13.0 VOLTAGE DROP: 0. %VD: 0.00
 PROJECTED POWER FLOW: 274.0 KW 163.3 KVAR 319.0 KVA PF: 0.86 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: XFMR Sec TRANSF AMPS: 13.0 VOLTAGE DROP: 256. %VD: 1.86
 PROJECTED POWER FLOW: 274.0 KW 163.3 KVAR 319.0 KVA PF: 0.86 LAGGING
 LOSSES THRU TRANSF: 11.3 KW 23.7 KVAR 26.2 KVA

==== BUS: XFMR Sec DESIGN VOLTS: 480 BUS VOLTS: 484 %VD: -0.79

===== PU BUS VOLTAGE: 1.008 ANGLE: -2.9 DEGREES

LOAD FROM: XFMR Pri TRANSF AMPS: 12.1 VOLTAGE DROP: 9. %VD: 1.86
 PROJECTED POWER FLOW: 274.0 KW 163.3 KVAR 319.0 KVA PF: 0.86 LAGGING
 LOSSES THRU TRANSF: 11.3 KW 23.7 KVAR 26.2 KVA

LOAD TO: AY-PDP-1 800A FEEDER AMPS: 355.1 VOLTAGE DROP: 1. %VD: 0.19
 PROJECTED POWER FLOW: 262.8 KW 139.7 KVAR 297.6 KVA PF: 0.88 LAGGING
 LOSSES THRU FEEDER: 0.4 KW 0.5 KVAR 0.6 KVA

==== BUS: AY-PDP-1 800A DESIGN VOLTS: 480 BUS VOLTS: 483 %VD: -0.60

===== PU BUS VOLTAGE: 1.006 ANGLE: -3.0 DEGREES

LOAD FROM: XFMR Sec FEEDER AMPS: 355.1 VOLTAGE DROP: 1. %VD: 0.19
 PROJECTED POWER FLOW: 262.4 KW 139.2 KVAR 297.0 KVA PF: 0.88 LAGGING
 LOSSES THRU FEEDER: 0.4 KW 0.5 KVAR 0.6 KVA

LOAD TO: Tap Bus Asmbly FEEDER AMPS: 337.2 VOLTAGE DROP: 1. %VD: 0.18
 PROJECTED POWER FLOW: 250.3 KW 130.1 KVAR 282.1 KVA PF: 0.89 LAGGING
 LOSSES THRU FEEDER: 0.3 KW 0.4 KVAR 0.5 KVA

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: AY102-PP1 Bus FEEDER AMPS: 18.1 VOLTAGE DROP: 0. %VD: 0.09
 PROJECTED POWER FLOW: 12.1 KW 9.1 KVAR 15.2 KVA PF: 0.80 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Tap Bus Asmbly DESIGN VOLTS: 480 BUS VOLTS: 482 %VD: -0.43
 ===== PU BUS VOLTAGE: 1.004 ANGLE: -3.0 DEGREES

LOAD FROM: AY-PDP-1 800A FEEDER AMPS: 337.2 VOLTAGE DROP: 1. %VD: 0.18
 PROJECTED POWER FLOW: 249.9 KW 129.7 KVAR 281.6 KVA PF: 0.89 LAGGING
 LOSSES THRU FEEDER: 0.3 KW 0.4 KVAR 0.5 KVA

LOAD TO: Group Cntl'r FEEDER AMPS: 64.4 VOLTAGE DROP: 0. %VD: 0.01
 PROJECTED POWER FLOW: 44.1 KW 30.8 KVAR 53.8 KVA PF: 0.82 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: Boost'r VSD FEEDER AMPS: 273.4 VOLTAGE DROP: 0. %VD: 0.05
 PROJECTED POWER FLOW: 205.8 KW 98.9 KVAR 228.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

==== BUS: Pit Chll'r Bus DESIGN VOLTS: 480 BUS VOLTS: 480 %VD: -0.01
 ===== PU BUS VOLTAGE: 1.000 ANGLE: -2.9 DEGREES
 NET BRANCH DIVERSITY LOAD: 7.5 KW 3.6 KVAR

LOAD FROM: Group Cntl'r FEEDER AMPS: 10.0 VOLTAGE DROP: 2. %VD: 0.42
 PROJECTED POWER FLOW: 7.5 KW 3.6 KVAR 8.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: Group Cntl'r DESIGN VOLTS: 480 BUS VOLTS: 482 %VD: -0.42
 ===== PU BUS VOLTAGE: 1.004 ANGLE: -3.0 DEGREES

LOAD FROM: Tap Bus Asmbly FEEDER AMPS: 64.4 VOLTAGE DROP: 0. %VD: 0.01
 PROJECTED POWER FLOW: 44.1 KW 30.8 KVAR 53.8 KVA PF: 0.82 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: Pit Chll'r Bus FEEDER AMPS: 10.0 VOLTAGE DROP: 2. %VD: 0.42
 PROJECTED POWER FLOW: 7.5 KW 3.6 KVAR 8.3 KVA PF: 0.90 LAGGING
 LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: Imrs SS	FEEDER AMPS: 52.0	VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 34.9 KW	25.8 KVAR	43.4 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: Winch Bus	FEEDER AMPS: 2.5	VOLTAGE DROP: 1. %VD: 0.17
PROJECTED POWER FLOW: 1.7 KW	1.3 KVAR	2.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

==== BUS: Imrs SS	DESIGN VOLTS: 480	BUS VOLTS: 482	%VD: -0.42
=====	PU BUS VOLTAGE: 1.004	ANGLE: -3.0	DEGREES

LOAD FROM: Group Cntl'r	FEEDER AMPS: 52.0	VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 34.9 KW	25.8 KVAR	43.4 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

LOAD TO: P-0621 Bus	FEEDER AMPS: 52.0	VOLTAGE DROP: 2. %VD: 0.48
PROJECTED POWER FLOW: 34.9 KW	25.8 KVAR	43.4 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.2 KW	0.1 KVAR	0.2 KVA

==== BUS: Winch Bus	DESIGN VOLTS: 480	BUS VOLTS: 481	%VD: -0.25
=====	PU BUS VOLTAGE: 1.002	ANGLE: -2.9	DEGREES
NET BRANCH DIVERSITY LOAD:	1.7 KW	1.3 KVAR	

LOAD FROM: Group Cntl'r	FEEDER AMPS: 2.5	VOLTAGE DROP: 1. %VD: 0.17
PROJECTED POWER FLOW: 1.7 KW	1.3 KVAR	2.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

==== BUS: AY102-PP1 Bus	DESIGN VOLTS: 480	BUS VOLTS: 482	%VD: -0.51
=====	PU BUS VOLTAGE: 1.005	ANGLE: -2.9	DEGREES
NET BRANCH DIVERSITY LOAD:	12.1 KW	9.1 KVAR	

LOAD FROM: AY-PDP-1 800A	FEEDER AMPS: 18.1	VOLTAGE DROP: 0. %VD: 0.09
PROJECTED POWER FLOW: 12.1 KW	9.1 KVAR	15.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW	0.0 KVAR	0.0 KVA

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: Boost VSD DESIGN VOLTS: 480 BUS VOLTS: 482 %VD: -0.38
===== PU BUS VOLTAGE: 1.004 ANGLE: -3.0 DEGREES

LOAD FROM: Tap Bus Asmly FEEDER AMPS: 273.4 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 205.7 KW 98.8 KVAR 228.2 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

LOAD TO: P-0622 Bus FEEDER AMPS: 273.4 VOLTAGE DROP: 3. %VD: 0.55
PROJECTED POWER FLOW: 205.7 KW 98.8 KVAR 228.2 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.8 KW 1.3 KVAR 1.5 KVA

==== BUS: P-0622 Bus DESIGN VOLTS: 480 BUS VOLTS: 479 %VD: 0.17
===== PU BUS VOLTAGE: 0.998 ANGLE: -3.2 DEGREES
NET BRANCH DIVERSITY LOAD: 204.9 KW 97.5 KVAR

LOAD FROM: Boost VSD FEEDER AMPS: 273.4 VOLTAGE DROP: 3. %VD: 0.55
PROJECTED POWER FLOW: 204.9 KW 97.5 KVAR 227.0 KVA PF: 0.90 LAGGING
LOSSES THRU FEEDER: 0.8 KW 1.3 KVAR 1.5 KVA

==== BUS: P-0621 Bus DESIGN VOLTS: 480 BUS VOLTS: 480 %VD: 0.06
===== PU BUS VOLTAGE: 0.999 ANGLE: -2.9 DEGREES
NET BRANCH DIVERSITY LOAD: 34.7 KW 25.8 KVAR

LOAD FROM: Imrs SS FEEDER AMPS: 52.0 VOLTAGE DROP: 2. %VD: 0.48
PROJECTED POWER FLOW: 34.7 KW 25.8 KVAR 43.2 KVA PF: 0.80 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

==== BUS: C8-L6 13.8kv DESIGN VOLTS: 1 BUS VOLTS: 1 %VD: -3.00
===== PU BUS VOLTAGE: 1.030 ANGLE: 0.0 DEGREES
*** SWING GENERATOR: C8-L6 13.8Kv 274.7 KW 164.4 KVAR

LOAD TO: Po1e E1 FEEDER AMPS: 174210 VOLTAGE DROP: 0. %VD: 0.35
PROJECTED POWER FLOW: 274.7 KW 164.4 KVAR 320.1 KVA PF: 0.86 LAGGING
LOSSES THRU FEEDER: 0.6 KW 1.1 KVAR 1.3 KVA

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AY-Farm Electrical Distribution

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BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY

BUS NAME	BASE VOLT	PU VOLT	BUS NAME	BASE VOLT	PU VOLT
Pole E1	13800.00	1.0265	XFMR Pri	13800.00	1.0265
XFMR Sec	480.00	1.0079	AY-PDP-1 800A	480.00	1.0060
Tap Bus Asmblly	480.00	1.0043	Pit Chillr Bus	480.00	1.0001
Group Cntl'r	480.00	1.0042	Imrs SS	480.00	1.0042
Winch Bus	480.00	1.0025	AY102-PP1 Bus	480.00	1.0051
Boostr VSD	480.00	1.0038	P-0622 Bus	480.00	0.9983
P-0621 Bus	480.00	0.9994			

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM NAME	TO NAME	TYPE	VD%	AMPS	KVA	RATING%
Pole E1	XFMR Pri	FDR	0.00	13.00	319.02	UNKNOWN
XFMR Pri	XFMR Sec	TX2	1.86	13.00	319.02	184.94
XFMR Sec	AY-PDP-1 800A	FDR	0.19	355.13	297.58	57.28
AY-PDP-1 800A	Tap Bus Asmblly	FDR	0.18	337.23	282.06	54.39
AY-PDP-1 800A	AY102-PP1 Bus	FDR	0.09	18.13	15.17	25.91
Tap Bus Asmblly	Group Cntl'r	FDR	0.01	64.44	53.80	36.82
Tap Bus Asmblly	Boostr VSD	FDR	0.05	273.46	228.33	71.96
Group Cntl'r	Pit Chillr Bus	FDR	0.42	10.00	8.35	33.34
Group Cntl'r	Imrs SS	FDR	0.00	52.01	43.42	34.67
Group Cntl'r	Winch Bus	FDR	0.17	2.58	2.16	22.26
Imrs SS	P-0621 Bus	FDR	0.48	52.01	43.42	34.67
Boostr VSD	P-0622 Bus	FDR	0.55	273.46	228.22	71.96

NOTE: FDR RATING% = % AMPS RATING BASED ON LIBRARY FLA OR BRANCH INPUT FLA
 TX2 RATING% = % KVA RATING BASED ON TRANSFORMER FL KVA

13 BUSES

*** TOTAL SYSTEM LOSSES ***

13. KW 27. KVAR

Attachment E

Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
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ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

SKM POWER*TOOLS FOR WINDOWS
SHORT CIRCUIT ANALYSIS REPORT
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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

SWING GENERATORS			
SOURCE	NAME	VOLTAGE	ANGLE
=====			
C8-L6	13.8Kv	1.03	0.00

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***** PRE - FAULT VOLTAGE PROFILE *****

BUS#	NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
	Pole E1	13800.00	1.0300	0.
	XFMR Pri	13800.00	1.0300	0.
	XFMR Sec	480.00	1.0842	-30.
	AY-PDP-1 800A	480.00	1.0842	-30.
	Tap Bus Asmbly	480.00	1.0842	-30.
	Pit Chlllr Bus	480.00	1.0842	-30.
	Group Cntl'r	480.00	1.0842	-30.
	Imrs SS	480.00	1.0842	-30.
	Winch Bus	480.00	1.0842	-30.
	AY102-PP1 Bus	480.00	1.0842	-30.
	Boostr VSD	480.00	1.0842	-30.
	P-0622 Bus	480.00	1.0842	-30.
	P-0621 Bus	480.00	1.0842	-30.

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***** FAULT ANALYSIS REPORT *****

FAULT TYPE: 3PH

MODEL INDUCTION MOTOR CONTRIBUTION: YES

MODEL TRANSFORMER TAPS: YES

MODEL TRANSFORMER PHASE SHIFT: YES

Pole E1

VOLTAGE BASE LL: 13800.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 3363.7 / -61. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 0.631 +j 1.115 (PU)

THEVENIN IMPEDANCE X/R RATIO: 1.768

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3458.5	3363.7	3363.7	3363.7	

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME =	0.5 CYCLES	
---	---	---
PHASE A---	PHASE B---	PHASE C---
3458.5	3458.5	3458.5

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XFMR Pri

VOLTAGE BASE LL: 13800.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3363.0 / -60. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 0.631 +j 1.115 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.767

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
3457.7	3363.0	3363.0	3363.0	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
3457.7		3457.7		3457.7

XFMR Sec

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 6047.5 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.304 +j 20.290 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.778

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
6647.5	6047.5	6047.5	6047.5	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	---	---	---	---
6647.5		6647.5		6647.5

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AY-PDP-1 800A VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5974.6 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.377 +j 20.543 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.785

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
6570.6	5974.6	5974.6	5974.6	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	6570.6	---PHASE B---	6570.6	---PHASE C---
				6570.6

Tap Bus Asmbly VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5905.3 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.441 +j 20.792 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.794

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
6498.7	5905.3	5905.3	5905.3	

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---	6498.7	---PHASE B---	6498.7	---PHASE C---
				6498.7

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Pit Chiller Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1964.8 / -51. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 61.944 +j 23.844 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.385

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
1964.8	1964.8	1964.8	1964.8	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1964.8 1964.8 1964.8

Group Cntlr VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5887.4 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.517 +j 20.836 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.772

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
6468.9	5887.5	5887.4	5887.4	

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 6468.9 6468.9 6468.9

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Imrs SS

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5877.7 / -100. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 7.563 +j 20.859 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.758

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
6451.9		5877.7	5877.7	5877.7

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
6451.9		6451.9		6451.9

Winch Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 1198.9 / -44. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 105.692 +j 25.724 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.243

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1198.9		1198.9	1198.9	1198.9

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
1198.9		1198.9		1198.9

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

AY102-PP1 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5037.9 / -88. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 13.888 +j 21.845 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.573

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5129.8		5037.9	5037.9	5037.9

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
5129.8		5129.8		5129.8

Boostr VSD VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5875.3 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.471 +j 20.901 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.798

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
6467.3		5875.3	5875.3	5875.3

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
6467.3		6467.3		6467.3

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

P-0622 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5554.8 / -101. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 7.760 +j 22.157 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.855

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
6139.2		5554.8	5554.8	5554.8

ASYM	RMS	FAULTED CURRENT (AMPS)		
	AT TIME =	0.5 CYCLES		
---	PHASE A---	---	PHASE B---	---
	6139.2		6139.2	6139.2

P-0621 Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 4290.3 / -87. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 16.480 +j 25.542 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.550

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
4364.1		4290.3	4290.3	4290.3

ASYM	RMS	FAULTED CURRENT (AMPS)		
	AT TIME =	0.5 CYCLES		
---	PHASE A---	---	PHASE B---	---
	4364.1		4364.1	4364.1

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

***** FAULT ANALYSIS REPORT *****

FAULT TYPE: SLG

MODEL INDUCTION MOTOR CONTRIBUTION: YES

MODEL TRANSFORMER TAPS: YES

MODEL TRANSFORMER PHASE SHIFT: YES

Pole E1

VOLTAGE BASE LL: 13800.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 1302.9 / -45. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 7.016 +j 7.017 (PU)

THEVENIN IMPEDANCE X/R RATIO: 1.000

SEQUENCE EQUIVALENT IMPEDANCE Z1: 0.631 +j 1.115 (PU)

Z2: 0.631 +j 1.115 (PU)

Z0: 5.754 +j 4.787 (PU)

ASYM RMS INTERRUPTING AMPS

1/2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES

1305.3 1302.9 1302.9 1302.9

ASYM RMS FAULTED CURRENT (AMPS)

AT TIME = 0.5 CYCLES

---PHASE A---

---PHASE B---

---PHASE C---

1305.3

0.0

0.0

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

XFMR Pri

VOLTAGE BASE LL: 13800.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1302.7 / -45. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 7.016 +j 7.018 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.000
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 0.631 +j 1.115 (PU)
 Z2: 0.631 +j 1.115 (PU)
 Z0: 5.754 +j 4.787 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1305.2		1302.7	1302.7	1302.7

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 1305.2 0.0 0.0

XFMR Sec

VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 5352.0 / -98. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 27.546 +j 67.712 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.458
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.304 +j 20.290 (PU)
 Z2: 7.304 +j 20.290 (PU)
 Z0: 12.937 +j 27.133 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5752.3		5352.0	5352.0	5352.0

ASYM RMS FAULTED CURRENT (AMPS)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 5752.3 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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AY-PDP-1 800A VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5190.9 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 29.026 +j 69.555 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.396
SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.377 +j 20.543 (PU)
Z2: 7.377 +j 20.543 (PU)
Z0: 14.271 +j 28.469 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5555.3		5190.9	5190.9	5190.9

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---	PHASE A---	---	PHASE B---	---
	5555.3		0.0	0.0

Tap Bus Asmbly VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5039.9 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 30.488 +j 71.389 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.342
SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.441 +j 20.792 (PU)
Z2: 7.441 +j 20.792 (PU)
Z0: 15.605 +j 29.805 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5373.3		5039.9	5039.9	5039.9

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---	PHASE A---	---	PHASE B---	---
	5373.3		0.0	0.0

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Project W-320 / Tank 241-C-106 Sluicing
AY-Farm Electrical Distribution
Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

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Pit Chllr Bus VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 1212.4 / -45. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 311.297 +j 85.015 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.273
SEQUENCE EQUIVALENT IMPEDANCE Z1: 61.944 +j 23.844 (PU)
Z2: 61.944 +j 23.844 (PU)
Z0: 187.409 +j 37.328 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
1212.4		1212.4	1212.4	1212.4

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
1212.4		0.0		0.0

Group Cntl'r VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5017.0 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 30.913 +j 71.592 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.316
SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.517 +j 20.836 (PU)
Z2: 7.517 +j 20.836 (PU)
Z0: 15.879 +j 29.920 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5339.4		5017.0	5017.0	5017.0

ASYM	RMS	FAULTED CURRENT (AMPS)		
		AT TIME = 0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
5339.4		0.0		0.0

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

Imrs SS

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 5004.3 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 31.169 +j 71.696 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.300
SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.563 +j 20.859 (PU)
Z2: 7.563 +j 20.859 (PU)
Z0: 16.043 +j 29.979 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
5320.2		5004.3	5004.3	5004.3

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
5320.2 0.0 0.0

Winch Bus

VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 715.9 / -39. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 539.053 +j 89.960 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.167
SEQUENCE EQUIVALENT IMPEDANCE Z1: 105.692 +j 25.724 (PU)
Z2: 105.692 +j 25.724 (PU)
Z0: 327.669 +j 38.512 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
715.9		715.9	715.9	715.9

ASYM RMS FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
715.9 0.0 0.0

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

AY102-PP1 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 3994.2 / -80. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 62.564 +j 75.366 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.205
SEQUENCE EQUIVALENT IMPEDANCE Z1: 13.888 +j 21.845 (PU)
Z2: 13.888 +j 21.845 (PU)
Z0: 34.789 +j 31.676 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
4015.8	3994.2	3994.2

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		
---PHASE A---	---PHASE B---	---PHASE C---
4015.8	0.0	0.0

Boostr VSD VOLTAGE BASE LL: 480.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 4985.2 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 30.944 +j 72.121 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.331
SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.471 +j 20.901 (PU)
Z2: 7.471 +j 20.901 (PU)
Z0: 16.002 +j 30.318 (PU)

ASYM	RMS	INTERRUPTING AMPS
1/2 CYCLES	3 CYCLES	5 CYCLES
5311.0	4985.2	4985.2

ASYM	RMS	FAULTED CURRENT (AMPS)
AT TIME = 0.5 CYCLES		
---PHASE A---	---PHASE B---	---PHASE C---
5311.0	0.0	0.0

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

P-0622 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 4417.6 / -96. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 36.283 +j 80.789 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.227
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 7.760 +j 22.157 (PU)
 Z2: 7.760 +j 22.157 (PU)
 Z0: 20.763 +j 36.474 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
4673.0		4417.6	4417.6	4417.6

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
4673.0		0.0		0.0

P-0621 Bus VOLTAGE BASE LL: 480.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 3161.7 / -79. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 81.833 +j 92.816 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 1.134
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 16.480 +j 25.542 (PU)
 Z2: 16.480 +j 25.542 (PU)
 Z0: 48.874 +j 41.732 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES		3 CYCLES	5 CYCLES	8 CYCLES
3174.1		3161.7	3161.7	3161.7

ASYM	RMS	FAULTED CURRENT (AMPS)		
AT TIME =		0.5 CYCLES		
---PHASE A---		---PHASE B---		---PHASE C---
3174.1		0.0		0.0

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Project W-320 / Tank 241-C-106 Sluicing

AY-Farm Electrical Distribution

Calc. No. W320-31-016 (Reference Drawing H-2-818693, SH 1, Rev. 1)

***** FAULT ANALYSIS SUMMARY *****

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT		X/R
		3 PHASE	X/R LINE/GRND	
Pole E1	13800.	3363.7	1.8 1302.9	1.0
XFMR Pri	13800.	3363.0	1.8 1302.7	1.0
XFMR Sec	480.	6047.5	2.8 5352.0	2.5
AY-PDP-1 800A	480.	5974.6	2.8 5190.9	2.4
AY102-PP1 Bus	480.	5037.9	1.6 3994.2	1.2
Tap Bus Asmbly	480.	5905.3	2.8 5039.9	2.3
Group Cntlr	480.	5887.4	2.8 5017.0	2.3
Pit Chllr Bus	480.	1964.8	0.4 1212.4	0.3
Imrs SS	480.	5877.7	2.8 5004.3	2.3
Winch Bus	480.	1198.9	0.2 715.9	0.2
Boostr VSD	480.	5875.3	2.8 4985.2	2.3
P-0622 Bus	480.	5554.8	2.9 4417.6	2.2
P-0621 Bus	480.	4290.3	1.5 3161.7	1.1

***** FAULT ANALYSIS REPORT COMPLETED *****

PARTIALLY FIELD VERIFIED AT REV 2

1. SYMBOLS PER ANSI Y14.15 AND/OR Y32.2.
2. 2 POLE CIRCUIT BREAKER WHERE SHOWN.
3. CONTINUOUS CURRENT RATINGS ARE SHOWN
ADJUNCT TO MCP'S (MOTOR CIRCUIT PROTECTOR).
4. MINI-POWER PANEL, SQUARE-D #M2B1540F
CONSISTING OF 120V AC, 15 AMP, 1-PHASE
PRIMARY AND SECONDARY CIRCUIT BREAKERS AND
BRANCH CIRCUIT BREAKERS AS SHOWN.
5. MOTOR MCP'S AND CB FOR MOTOR STARTERS & VSD
CONTROLLER SHALL BE CAPABLE OF BEING LOCKED
IN OPEN POSITION.
6. AT MINI POWER PANEL, BOND JUMPER NEUTRAL,
AND GROUND CONDUCTORS.
7. REFER TO H-2-B18423 NOTE 1 FOR SPECIFIC INFORMATION
CONCERNING SAFETY CLASSIFICATION OF COMPONENTS.

ESSENTIAL DRAWING

[illegible][illegible]

W320-31-017

Tank AY-102 Load Determination,
Feeder/Protection Sizing, Voltage Drop,
Lighting and Conduit Sizing Calculations

<h2 style="margin: 0;">Fluor Daniel Northwest</h2>	<h3 style="margin: 0;">CALCULATION IDENTIFICATION AND INDEX</h3>		Page i of 24
			Date

This sheet shows the status and description of the attached Design Analysis sheets.

Discipline **Electrical** WO/Job No. **Task Order N09** Calculation No. **W320-31-017**
 Project No. & Name **W320 Tank 241-C-106 Sluicing**
 Calculation Item **Tank AY-102 Load Determination, Feeder/Protection Sizing, Voltage Drop, Lighting, and Conduit Sizing Calculations**

These calculations apply to:

Dwg. No. **See Continuation Sheet** Rev. No. _____
 Dwg. No. _____ Rev. No. _____
 Other (Study, CDR) _____ Rev. No. _____

The status of these calculations is:

☐ Preliminary Calculations
☒ Final Calculations
☐ Check Calculations (On Calculation Dated)
☐ Void Calculation (Reason Voided)

Incorporated in Final Drawings? ☒ Yes ☐ No
 This calculation verified by independent "check" calculations? ☐ Yes ☒ No

Original and Revised Calculation Approvals:

	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	RH Graeber 9/13/95	<i>R. H. Graeber</i> 7/24/98	
Checked by	SA Najjar 9/13/95	<i>SA Najjar</i> 7/24/98	
Approved by	TJ Kasnick 9/15/95	<i>TJ Kasnick</i> 7/24/98	
Checked Against Approved Vendor Data	N/A	<i>TJ Kasnick</i> 7/24/98	

Design Analysis Page No.	Description
i-ii	Calculation Identification and Index, Continuation Sheet
iii	Calculation Cross Index
1	Objective; Design Inputs
2	Given Data; Assumptions; Method of Analysis
3	References
3-23	Calculations
23	Conclusions
A-1 to A-7	Attachment A: Additional Reference Materials
B-1 to B-29	Attachment B: Vendor Information Cut Sheets
C-1	Attachment C: One-Line Diagram Drawing H-2-818693

Fluor Daniel Northwest	CALCULATION IDENTIFICATION AND INDEX Continuation Sheet		Page ii of 24
			Date 7/24/98
Discipline Electrical		WO/Job No. Task Order N09	Calculation No. W320-31-017
	Rev. 0 Signature/Date	Rev. 1 Signature/Date	Rev. 2 Signature/Date
Originator	RH Graeber 9/13/95	<i>RH Graeber 7/24/98</i>	
Checked by	SA Najjar 9/13/95		

These calculations apply to:

H-2-818686 Sheet 1, Rev. 0
 H-2-818693 Sheet 1, Rev. 0
 H-2-818694 Sheet 1, Rev. 0

H-2-818695 Sheet 1, Rev. 1
 H-2-818695 Sheet 2, Rev. 1
 H-2-818695 Sheet 3, Rev. 1

H-2-818695 Sheet 4, Rev. 1
 H-2-818695 Sheet 5, Rev. 1
 H-2-818696 Sheet 3, Rev. 0

H-2-818698 Sheet 1, Rev. 0
 H-2-818698 Sheet 2, Rev. 0
 H-2-818699 Sheet 1, Rev. 0

H-2-818699 Sheet 2, Rev. 0
 H-2-818700 Sheet 1, Rev. 0
 H-2-818700 Sheet 2, Rev. 0
 H-2-818700 Sheet 3, Rev. 0

HNF-2487, Rev. 0
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CALCULATION CROSS INDEX (Typical)

Subject Calculation No.: *W320-31-017*

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Subject Calculation Revision No.	Superseded by Calculation No.	These interfacing calculation/documents provide input to the subject calculation, and if revised may require revision of the subject calculation.		Results and conclusions of the subject calculation are used in these interfacing calculations and/or documents		Does the output interface calculation/documents require revision?		Has the output interface calculation/documents been revised?		Discipline manager's signature and date indicating evaluation complete.
		Calculation/Document No.	Revision No.	Calculation/Document No.	Revision No.	Yes	No	Yes		
0	N/A	H-2-818693	0	H-2-818686	0		X		X	
				H-2-818693	0		X		X	
				H-2-818695, sh 1	1		X		X	
				H-2-818695, sh 2	1		X		X	
				H-2-818695, sh 3	1		X		X	
				H-2-818695, sh 4	1		X		X	
				H-2-818695, sh 5	1		X		X	
				H-2-818696, sh 3	0		X		X	
				H-2-818698, sh 1	0		X		X	
				H-2-818698, sh 2	0		X		X	
				H-2-818699, sh 1	0		X		X	
				H-2-818699, sh 2	0		X		X	
				H-2-818700, sh 1	0		X		X	
				H-2-818700, sh 2	0		X		X	
				H-2-818700, sh 3	0		X		X	

HNF-2487, Rev. 0
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DESIGN ANALYSIS

Client Numatec Hanford Corporation
 Subject TANK AY-102 LOAD DETERMINATION,
 FEEDER/PROTECTION SIZING, VOLTAGE DROP AND
 LIGHTING CALCULATIONS
 Location 200E, AY Farm

WO/Job No. Task Order N09
 Date 9/13/95 By RH Graeber
 Checked 9/13/95 By SA Najjar
 Revised 7/24/98 By Cris Carlson

1. OBJECTIVE

- 1.1 To determine the total connected load and estimate the maximum demand for the Tank AY-102 portion of Project W-320, Tank 241-C-106 Sluicing.
- 1.2 To size the power feeder/branch circuit conductors, circuit protection and conduits.
- 1.3 To calculate the voltages at motor terminals during normal running and starting conditions in order to ensure proper operation of pump motors.
- 1.4 To determine number of light fixtures required to provide adequate illumination levels.
- 1.5 To determine instrument and control conduit sizes.
- 1.6 Special situation equipment sizing and voltage drop checks.

2. DESIGN INPUTS

- 2.1 Functional Design Criteria, HNF-SD-W320-FDC-001, Rev. 5.
- 2.2 One-Line Diagram, Drawing (DWG) H-2-818693.
- 2.3 NFPA-70, National Electrical Code (NEC), 1993 edition.
 - a. Branch circuit conductors shall be sized to carry at least 125% of the largest load plus the sum of other loads, for multiple load circuits.
 - b. Single conductor copper wires, with 90°C XHHW, 600 VAC insulation in buried raceway and conductor ampacity per Reference 6.1, Table 310-16 for 86°F (30°C) ambient temperature, shall be used.
 - c. Minimum conduit size shall be based on Reference 6.1, NEC Chapter 9 Table 3B.
 - d. Motor rated full load currents shall be based on Reference 6.1, 1993 NEC Table 430-150, Reliance Electric motor catalog and motor data sheets in vendor file #22668. Vendor data for Booster pump motor (250 HP motor) shows full load amps is 273 amperes. See Reliance data sheet E06854-A-A009.
 - e. Motor Circuit Protector (MCP) for motor protection and motor starters shall be sized per Reference 6.4.

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- 2.4 The lockable "Service Entrance Rated" safety switch shall provide the main service disconnecting means to the AY-Farm loads supplied via the Electrical Equipment Skid (EES), building 241-AY-51.
- 2.5 Effective impedance (Z_{eff}) at 85% Power Factor (PF), shown in Reference 6.1, NEC Chapter 9 Table 9, shall be used for voltage calculations.

3. GIVEN DATA

- 3.1 The 150 KVA transformer bank installed by the Equipment Removal Phase of Project W-320 will be the source of power for these sluicing loads. Hanford Electrical Utilities Department estimates demand of the existing services is 22 KW @ 0.8 PF = 27.5 KVA $\approx$ 28 KVA.
- 3.2 Distribution transformer %Z = 2.6%.
- 3.3 Minimum allowable voltage at the motor terminals is 414 volts based on NEMA motor rating of 460 V $\pm$ 10%.
- 3.4 Pit-02E, the EES housing 241-AY-51 and Seismic Shutdown System missile shield enclosures 241-AY-51A and 51B are air conditioned.
- 3.5 Motors shown on the One-Line Diagram, Drawing H-2-818693 are induction motors rated 460 VAC, 3 ϕ , 60 Hz. Motor FLA are from the NEC, except for the 250 HP motor which is based on vendor information in CVI file #22668.
- 3.6 The Variable Speed Drive (VSD) controller for the 250 HP In-Line Booster pump motor has been furnished by pump vendor (Procurement Specification W-320-P17). VSD controller maximum input current is 325 A. (150% Torque Limit for 60 sec. maximum).
- 3.7 The 40 HP Immersible pump is started before the booster pump. The submersible pump is interlocked with the booster pump so that the booster pump can only be started after the submersible pump discharge pressure exceeds the pressure switch setpoint. A "Soft Start" unit is to be used to limit torque effect to submersible pump hoses to prevent excess twisting.
- 3.8 Pit chiller FLA is 8.1 A per Edwards Engineering Corp. Vendor data, see file #22668.

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4. ASSUMPTIONS

- 4.1 Estimated duration for this project is two years.
- 4.2 Transformer primary taps are set at 100% and secondary terminal voltage at no-load conditions is 480 V.
- 4.3 Demand factor (DF) for the booster and submersible pump and pit cooler motors is 80%; other loads at 30%.
- 4.4 "Soft-Start" unit used for 40 HP submersible pump, P-0621, is considered to have the same efficiency as a conventional motor starter. The basis for this is the description given in the Cutler Hammer document, "User's Manual Easy-Start Advantage EA Series." See Vendor Information file #22668.
- 4.5 Unless otherwise stated, PF = .95 and EFF. = 0.95

5. METHOD OF ANALYSIS

- 5.1 Hand calculations.

6. REFERENCES

- 6.1 NFPA-70, National Electrical Code (1993).
- 6.2 Drawing H-2-818693, Sheet 1, Rev. 1, Electrical AY-Farm One-Line Diagram.
- 6.3 W320-31-016, AY-102 Demand Load Analysis, Size Feeders, Voltage Drop and Fault study.
- 6.4 Westinghouse Cat. 25-000, Quick Selector 1993.
- 6.5 Additional References to Support C-Farm Demand Load Analysis:
 - a. Industrial Power Systems Handbook, Beeman, First Edition, Chapter 17 (Load and Cost Estimating Data).
 - b. Standard Handbook for Electrical Engineers, Fink and Beaty, Eleventh Edition, Chapter 18 (Demand and Diversity Factors).
- 6.6 W-320 vendor data CVI file #22668.

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7. CALCULATIONS

7.1 Connected Load Determination

a) 250HP Booster Pump Motor: 273 A
VSD with 250 HP Input @ 95% eff.
VSD maximum input: 325 A	287.4 A
b) 40 HP Immersible Pump Motor: 52 A
"Soft Start" Unit energized only during motor start.	52 A
c) 1.5 HP Winch	2.6 A
d) Package Chiller	<u>8.1 A</u>
Subtotal 480V, 3 PH Motor Connected Load ≈	350.1 A
e) Mini-Power Panel: 15 KVA, 1 PH (B-C)	<u>31.3 A</u>
Total Connected Load Phases B&C ≈	381.4 A
Phase A ≈	350.1 A
Total Connected Load ≈ 381.4 A x .480 KV x $\sqrt{3}$ ≈	<u>317.1 KVA</u>

7.2 Estimated Demand Determination

7.2.1 ICF KH "Utilities" Method:

a) Existing Loads (Ave. Demand)	28 KVA
b) 250 HP, 273 A @ 460 V,
VSD efficiency 95%, 80% DF	183.2 KVA
c) 40 HP, 52 A @ 460 V, 80% DF	33.1 KVA
d) 1.5 HP, 2.6 A @ 460 V, 30% DF	0.6 KVA
e) 15 KVA @ 95% eff, 30% DF	4.7 KVA
f) Pit Cooler @ 8.1 A x .460 kV x 1.73 x 80% DF	<u>5.2 KVA</u>
Subtotal =	254.8 KVA
Diversity Factor =	1.44
Total Estimated Demand =	<u>176.9 KVA</u>

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7.2.2 "Normal" Anticipated Method:

a) Existing Loads	28 KVA
b) 250 HP running at 90 HP, extrapolated from motor data sheet, 100% DF	97.2 KVA
c) 40 HP, 52 A @ 460 V, 100% DF	41.4 KVA
d) 1.5 HP @ zero DF	0
e) 15 KVA @ 95% eff & 30% DF	4.7 KVA
f) Pit Cooler @ 8.1 A X 460 V X 1.73 X 0.8	<u>5.2 KVA</u>

Total Anticipated Demand = 176.5 KVA**7.2.3 "Worst Case" Full Load Method:**

a) Existing Loads	28 KVA
b) 250 HP, 273 A @ 460 V, 95% VSD eff, 100% DF	229.0 KVA
c) 40 HP @ 52 A @ 460 V, 100% DF	41.4 KVA
d) 1.5 HP @ zero DF	0
e) 15 KVA @ 95% eff, 30% DF	4.7 KVA
f) Pit Cooler	<u>5.2 KVA</u>

Total "Worst Case" Demand = 308.3 KVASluicing Project "Worst Case" demand $\approx 308.3 \text{ KVA} - 28 \text{ KVA} \approx 280.3 \text{ KVA}$

Three 50 KVA, Pole Mounted, Oil Filled Transformers are installed as a part of the Equipment Removal Phase of the project.

7.2.4 Summary

- a) $176.9 \text{ KVA} \div 150 \text{ KVA} \approx 117.9\%$ of nameplate.
- b) $176.5 \text{ KVA} \div 150 \text{ KVA} \approx 117.7\%$ of nameplate.
- c) $308.3 \text{ KVA} \div 150 \text{ KVA} \approx 205.5\%$ of nameplate.

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d) Therefore, the 150 KVA transformer bank is adequate based on:

- 1) For "Normal" Operation, 130% of demand (or less) is acceptable per Electrical Utilities engineering and IEEE /ANSI C57.91 and 92.
- 2) Duration of "Worst Case" is less than 5 minutes. Project design life is only 2 years. Small losses of the transformer's 30 year design life expectancy are acceptable.

7.3 Breaker, Starter, Feeder and Conduit Sizing**7.3.1 Main feeder from AY-PDP-1 via the EES, Circuit Breaker, Seismic Contactors and Safety Switch, to the Tap Bus Assembly**

The Lockable Non-Fused Safety Switch will be the main disconnect means for 241-AY-51 (EES).

Feeder Sizing Per NEC 220-10, 240-21, 430-2, 430-22, 430-24 and 430-28 using actual loads listed in 7.1.

a) Summation of motor loads Per VSD vendor & NEC 430-24:

1) 250 HP Booster Pump (VSD)	287.4 A
2) 40 HP Immersible Pump (Soft Start)	52 A
3) 1.5 HP Winch	2.6 A
4) Pit Chiller	8.1 A
5) Plus 25% of largest motor 1)	71.9 A

Main Feeder Size Capacity = 422.0 A

600AF/600AT circuit breaker used at AY-PDP-1.

Down-stream feeder conductors shall be rated 600 A @ 75°C.

- 1) Need 2-350 kcmil per phase.
- 2) Requires 3-350 kcmil conductors and 1#1/0 copper ground, in each of two 3½" conduits.

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3) Wire runs W102-01A, 01B, 02, 02A, 03, 03A, 04, 04A, 19 and 19A.

4) Conduits AY102-3P01, 01A, 04, 04A, 22, 22A and AY102 - 1P02, 02A, 03 and 03A.

Note: Up sized 3½" conduits to 4" conduits based on constructability comment.

7.3.2 The 250 HP Booster Pump and VSD Controller (P-0622)
(VSD protective circuitry included with controller provided by booster pump vendor).

VSD Feeder:

VSD controller maximum input current = 325 A per vendor information. Per NEC 430-2, required feeder ampacity = $1.0 \times 325 = 325$ A. Per NEC Table 310-16, use 3-500 kcmil 90°C conductors with 1 #1/0 ground wire in 3½" conduit (Up sized to 4" conduit to aid in cable pulling).

Wire run W102-05; conduit AY102-3P05

Motor Feeder:

Booster Pump motor (vendor information) FLA = 273 A. Per NEC 430-22, required feeder ampacity = $1.25 \times 273 = 341$ A. Per NEC Table 310-16, use 3-500 kcmil 90°C conductors with 1 #1/0 ground wire in 3½" conduit (Up sized to 4" conduit to aid in cable pulling).

Wire run W102-08; conduit AY102-3P08.

See 7.3.9 For "In Pit" segment of motor feeder.

VSD feeder is tapped off buss at "Tap Bus Assembly". Feeder length is approximately 7 feet. Feeder meets "10 foot" Tap Rule criteria (NEC 240-21 and 430-28).

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7.3.3 40 HP Submersible Pump (P-0621)Motor Feeder: $FLA = 52A$; required feeder ampacity = $1.25 \times 52 A = 65 A$

3-#4 conductors (ampacity = 70 A) is adequate based on ampacity. Used 3-#1/0 with 1-#4 ground wire in 2" conduit.

Install 1#1/0 AWG per phase from Group Controller Power Terminal Block to "Soft Start" unit. Use 70 A MCP (mounted within Group Controller).

Wire run W102-09; conduit AY102-3P09.

Install 1#1/0 AWG per phase from "soft start" to PTBX-0621.

Wire run W102-29; conduit AY102-3P26.

Use 150 A MCP and NEMA Size 4, Full Voltage Non-Reversing (FVNR) starter (mounted within Group Controller).

See 7.3.9 for "In Pit" Segment of Motor Feeder.

See 7.3.10 for "Group Controller" feeder and jumper sizing. Per Code Authority, power terminal block ties within Group Controller are not considered as taps. See Appendix page A-1.

7.3.4 The 1.5 HP Winch (W-0621)Motor starter line and load side feeder conductors: $FLA = 2.6 A$; required feeder ampacity = $1.25 \times 2.6 A = 3.25 A$

Use 7 A MCP and NEMA Size 1, Full Voltage Reversing (FVR) starter.

Use 3-#12 with 1-#12 ground wire in 3/4" conduit (Up sized to 1" conduit for conservatism).

Wire run W102-10 & 31; conduit AY102-3P10 & 3P27.

Install 1#12 AWG per phase from top of starter to Group Controller power terminal block.

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Note: Out of PTBX on top of cover block, change to 3/C cable.
Change/upsized to 3/C #8 with ground over to winch motor
(manufacturer availability).

Wire run W102-28.

7.3.5 Packaged Pit Chiller (R-0621/FC-0621)Feeder circuit breaker "line and load side" Conductors:

Use 30 A CB, as recommended by MFR. Install in Group
Controller."

Use 3-#10 with 1-#10 ground wire in 3/4" conduit (Up sized to
1" conduit for conservatism).

Wire run W102-11; conduits AY102-3P11 & 3P17.

Install 1#10 AWG conductor per phase from circuit breaker
within "Group Controller" to safety switch and to Group
Controller power terminal blocks.

7.3.6 Mini-Power Panel (AY102-PP1)

Feed 15 KVA, 1Ø, transformer, with 480 V primary, from circuit
breaker in Power Distribution Panel.

$$I = \frac{15,000 \text{ VA}}{480 \text{ V}} = 31.25 \text{ A}$$

Unit supplied with 60 A, 2 pole primary circuit breaker by
manufacturer.

Install 150AF/70AT, 2 Pole CB in AY-PDP-1, Ckt# 7. Provide 70A, 1
phase circuit to unit.

Use 2-#4 with 1-#8 ground wire in 3/4" conduit.

Wire run W102-07; conduit AY102-3P39.

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7.3.7 Seismic Shutdown Missile Enclosure Air Conditioning and Receptacles

$$I = \frac{1320}{120} = 11A; 11A \times 1.25 = 14A \text{ capacity (from AY102-PP1)}$$

Calculation W102-31-022 requires #10 AWG due to voltage drops.

Use 2-#10 with 1-#10 ground wire in 3/4" conduit (underground conduits will be up sized to 1" conduit for conservatism).

Wire runs W102-22 & 23; conduits AY102-3P15 & 3P16 will be 1".

7.3.8 Typical 120 VAC branch circuit conductor loaded up to 1,500 VA

$I = 1500VA/120V = 12.5A; 12.5A \times 1.25 = 15.625 A$ capacity and a 20 A circuit breaker.

Use 2-#12 with 1-#12 ground wire in 3/4" conduit (underground conduits will be up sized to 1" conduit for conservatism).

Wire runs W102-12, 13, 14, 15, 16, 17, 18, 20, 21, 25, 32 & 36; conduits AY102-3P13, 18, 19, 20, 21, 23, 25A, 28, 38 & 41 will be 3/4"; conduits AY102-12, 14, 24, 25, 30 & 34 will be 1".

7.3.9 "In Pit" Cord Sizing

NEC article 40 defines the requirements for the "In-Pit" cords. NEC article 430-22 states that branch circuit conductors supplying a single motor shall have an ampacity not less than 125 percent of the motor full-load current rating.

40 HP Immersible pump motor has FLA = 52 A. The 1993 NEC Table 430-150 does not include values for motors of 250 HP. Reliance Electric information shows that the 250 HP motor FLA is 273 amps.

The cables will be in free air within the pump pit. NEC Table 400-5(B) for Type G, portable power cord will be utilized. The cable is a thermoset cable that, if assumed equivalent to Type G, will need derating for high ambient conditions using the correction factors in Table 310-16.

Per Project W-320 Motor Cooling Evaluation dated 6/7/95, the ambient temperature at the AY-102 pump pit will be maintained below 120°F (50°C) by the use of a pit cooler. Per NEC Table 310-17, a

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correction factor of 0.82 will apply. Since this is considered cord (not cable in conduit), the calculation of the desired derating factor is based on the cable manufacturer's recommendation.

Per the Rockbestos company, the following formula is used for determining an acceptable derating factor.

$$TCF = \sqrt{\frac{(Tc2 - Ta2)}{(Tc1 - Ta1)}} \times \frac{(234.5 + Tc1)}{(234.5 + Tc2)}$$

Tc1 = Maximum conductor temperature used to determine base ampacity.

Ta1 = Ambient temperature used to determine base ampacity (30°C per NEC Table 400-5(b)).

Tc2 = Maximum conductor temperature used to determine adjusted ampacity (90°C for Rockbestos Firewall III for 40 year qualified life.)

Ta2 = Ambient temperature used to determine adjusted ampacity; 0.3°C additional is used as margin.

The cords for the pumps fall under the F category, i.e. no more than 3 current carrying conductors. The 90° column is used, because of rating of the terminations in the pump terminal boxes will be defined to be 90°C.

$$TCF = \sqrt{\frac{(90 - (50 + 0.3))}{(90 - 30)}} \times \frac{(234.5 + 90)}{(234.5 + 90)} = 0.8134$$

For sizing the 40 HP Immersible Pump cord:

(52 A X 1.25) / .8134 = 79.9 A; Per NEC Table 400-5(B), use a minimum #6 conductor with ground wire.

Vendor supplied Wire Run W102-27.

For sizing the 250 HP Booster Pump cord:

(273 A X 1.25) / .8134 = 419.5 A; per NEC Table 400-5(B), use 500 kcmil conductors with ground wire.

Wire Run W102-26.

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Rockbestos Firewall III XHHW P62-3119 is a 3/C#1 AWG cable with an overall diameter of 1.16" (something similar will be vendor furnished by procurement specification W-320-P17).

Rockbestos Firewall III XHHW P62-0504 is a 500 kcmil cable with an overall diameter of 2.26".

7.3.10 Group Controller Feeder and "Jumper" (between all starters) Sizing

a) Group Controller Total Load

1) Winch (1.5 HP) 2.6 A

2) Immersible Pump (40 HP) 52 A

3) Chiller motor loads 8.1 A

4) Plus 25% of largest motor 2) 13 A

Total = 75.7 A

For 75°C rated conductors, use 3#2/0 and 1#4 ground wire in 2" conduit.

Wire run W102-06; conduit AY102-3P06.

Jumpers between power terminal blocks shall be #2/0.

NEC "10 Foot" Tap Rule applies and criteria is met.

7.4 Steady State Voltage Drop Evaluation (Worst Case Full Load Method)7.4.1 On Transformer Bank

$$I_{pu} = \frac{308.3 \text{ KVA}}{150 \text{ KVA}} = 2.06$$

[from 7.2]

$$\% VD = \%Z \times I_{pu} = 2.6 \times 2.06 = 5.3\%$$

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7.4.2 On 100' of Parallel 350 kcmil copper feeders in steel conduits (AY-PDP-1 to Tap Bus Assembly).

$$\% VD = \frac{\sqrt{3} \times I \times Z_{eff} / 1000' \times L}{4.8} ; 308.3KVA - 28KVA = 280.3KVA$$

$$\text{Where } I = \frac{280.3 \text{ KVA}}{\sqrt{3} \times .480 \text{ KV}} \approx 337.2 \text{ A} \quad [\text{from 7.2}]$$

Parallel 350 kcmil Feeders:

$$Z_{eff} = 0.06 \div 2 = 0.03, L = 0.12$$

$$\%VD \text{ 350 kcmil feeder} = \frac{\sqrt{3} \times 337.2 \times 0.03 \times .12}{4.8} = \underline{0.44\%}$$

$$\text{Total \%VD from transformer bank to Tap Buss Assembly} = 0.44 + 5.3 = \underline{5.74\%}$$

7.4.3 \%VD from VSD Controller to Motor (100' of 500 kcmil copper feeder in steel conduit)

$$\text{Motor FLA} = 273 \text{ A}; Z_{eff} = .05 \text{ ohms}, L = .1$$

$$\text{Total \%VD} = \frac{\sqrt{3} \times 273 \times .05 \times .1}{4.8} = \underline{0.49\%}$$

Summary:

$$\text{Total \%VD at motor terminals} = 5.74 + 0.49 = \underline{6.23\%}$$

$$\text{Motor terminal voltage} = 480 (1 - 0.0623) \approx 450.1 \text{ Volts}$$

$$\text{Minimum permissible voltage} = 414 \text{ volts}$$

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7.4.4 %VD on Immersible Pump Feeder (#1/0 copper feeder in steel conduit - 80' to Pump Pit and 60' #4 down into Tank AY-102)Motor FLA = 52 A; Z_{eff} for #4 AWG = .30; $L = .06$
 Z_{eff} for #1/0 = .13; $L = .08$

$$\%VD = \frac{\sqrt{3} \times 52 \times ((.13 \times .08) + (.30 \times .06))}{4.8} = 0.53\%$$

Total %VD at motor terminals = 5.74 + 0.53 = 6.27%

Motor terminal voltage = 480 (1 - .0627) $\approx$ 449.9 Volts

Minimum permissible voltage = 414 V

7.5 % Voltage Dip During Immersible Pump Startup

Initial conditions:

- a) Booster Pump is Off
- b) Winch is Off
- c) Chiller is On
- d) Normal Panelboard loads are On.

1) Chiller	8.1 A
2) Mini-Power Panel (8 KVA)	<u>17 A</u>
Total =	25.1 A

Existing Load: 28KVA $\div$ 480 $\div$ 1.73 $\approx$ 34A**7.5.1 %VD on Transformer Bank**

$$I = 25.1 + 34 + (6 \times FLA) = 25.1 + 34 + 6(52) = 25.1 + 34 + 312$$

$$= 371.1 \text{ A}$$

$$\%VD = \frac{371.1}{181} \times 2.6 \approx 5.33\% \quad [\text{from 4.4}]$$

Where 181 = transformer rated full load secondary current.

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7.5.2 %VD on Service Drop and Feeder up to "Tap Bus Assembly" with I = 25.1 + 6(52) = 337.1 A

Using direct proportionality:

$$\%VD = 1.24 \times \frac{337.1}{337.2} = 1.24\% \quad [\text{from 7.4.2}]$$

7.5.3 %VD on Submersible Pump Feeder

Z_{eff} for #1/0 = .13; Z_{eff} for #4 = .30; L = .08 for #1/0 and .06 for #4;
I = 336 A (starting)

$$\%VD = \frac{\sqrt{3} \times 312 \times ((.13 \times .08) + (.30 \times .06))}{4.8} = 3.20\%$$

Total %VD up to Immersible Pump motor terminals =
5.33 + 1.24 + 3.20 = 9.77%

Motor terminal voltage = 480 (1 - .977) $\approx$ 433.1 V

Minimum permissible voltage = 414 V

A single #1/0 feeder is adequate. Initially, the "soft start" unit was utilized to limit the torque effect of the Immersible pump as it hangs down into the tank. Additionally, the "soft start" unit will be configured to limit starting current to aid in starting the Immersible pump..

7.6 % Voltage Dip With Booster Pump Starting (Immersible Pump already running)7.6.1 %VD on Transformer Bank

With 150% current limit,

[from 4.6]

$$I = (1.5 \times 273) + 25.1 + 34 + 52 = 520.6 \text{ A}$$

[from 7.5]

$$\%VD = \frac{520.6}{181} \times 2.6 = 7.48\%$$

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By RH Graeber

Checked 9/13/95

By SA Najjar

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By Cris Carlson

7.6.2 %VD on parallel 350 kcmil Feeder

$$\%VD = .44\% \times 1.44 = 0.63\%$$

[from 7.4.2]

7.6.4 %VD on 500 Kcmil motor feeder

$$\%VD = .49\% \times 1.44 = 0.63\%$$

[from 7.4.3]

$$\text{Total \%VD} = 7.48\% + 0.63\% + 0.63\% = 8.74\%$$

$$\text{Motor terminal voltage} = 480 (1 - 0.874) = 438.1 \text{ V}$$

$$\text{Minimum permissible voltage} = 414 \text{ V}$$

7.7 Outdoor Lighting Calculations

Entrance lighting needs 3 footcandles. Total area that needs to be lit is approximately $6' \times 3' = 18\text{ft}^2$

The fixture selected for outdoor use is the Voigt SOX-35 Wall-Most. The manufacture's data may be used to determine whether this fixture is adequate for our needs. The Footcandle Isolux diagram shows the footcandles available from Voigt SOX-55 at a height of 15 ft. This must be adjusted to obtain values for the SOX-35 at 10 feet.

To adjust for the lower lamp output, the footcandles will be multiplied by 0.6. This is obtained from the ratio of the lumen output of the lamps. The Westinghouse Lighting Handbook provides guidance for adjusting for the height difference. The following is quoted from page 2-14 of the 1969 Westinghouse Lighting Handbook, "Footcandles for other mounting heights than the one shown are obtained by multiplying the values given on the curves by the ratio of the square of the present mounting height to the square of the new mounting height."

$$\text{This adjustment factor will be } (15^2 / 10^2) = 2.25$$

We will consider an area 3 ft out from the wall. The chart shows this as approximately 7 footcandles.

$$\text{Using the adjustment factors: } 7 \text{ footcandles} \times 2.25 \times .6 = 9.5 \text{ footcandles}$$

Outdoor fixture selected will give adequate light over doorway.

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7.8 Indoor Lighting Calculations - AY Electrical Equipment Skid

Per IES, average of 50 (approximately) footcandles is adequate. The Zonal-Cavity Method will be used to determine the number of fixtures.

$$\text{Room Cavity Ratio (RCR)} = [5 \times h \times (L + W)] / (L \times W)$$

$$\begin{aligned}\text{Where } h &= \text{height of light} = 8' \\ L &= \text{room length} = 13' \\ W &= \text{room width} = 7'\end{aligned}$$

$$\text{RCR} = [5 \times 8 \times (13 + 7)] / (13 \times 7) = 8.8$$

Using the Crouse-Hinds photometric data (see Appendix B), with an assumed ceiling reflectance of 80% and an assumed wall reflectance of 50%, the coefficient of utilization is 0.25.

$$\text{Number of fixtures} = (\text{FC} \times \text{AREA}) / (\text{number of lamps} \times \text{lumens/lamp} \times \text{CU} \times \text{MF})$$

$$\text{Number of fixtures} = (50 \times 13 \times 7) / (2 \times 3200 \times .25 \times .9) = 3.16 \text{ fixtures}$$

Use three fixtures.

7.9 Conduit Sizing for Control Wire Runs

Wire runs W102-42, 85, 86, 86A, 87, 88, 90, 91, 94, 95 & 104 are included.

Wire runs with largest cross sections are W102-86 with 8#14 and W102-87 with 4#12 and #104 with 20#14. Per NEC Table 3B, the first Wire Runs will "fit" into $\frac{3}{4}$ " conduits and the last wire run will fit into a $1\frac{1}{2}$ " conduit which is 3C11.

AY102-3C01, 3C03, 3C04, 3C05, 3C08, 3C09 and 3C10 will be $\frac{3}{4}$ " conduits.

The following underground conduit runs will be Up sized to 1" conduit for conservatism:

AY102-3C02 with wire run W102-86 and W102-86A

AY102-3C06 with wire run W102-87

AY102-3C07 with wire run W102-88

Conduit AY102-3C11 with wire run W102-104 will be $1\frac{1}{2}$ " conduit for to be conservative.

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7.10 Conduit Sizing for Instrumentation (Signal) Wire Runs

Instrument wiring used for W-320 (AY-Farm) is of the following sizes and types:

Type 1 - 3#16 triad, diameter $\leq .34"$
 Type 2 - same as Type 1 (in pit)
 Type 3 - 2 pair # 16, diameter $\leq .63"$
 Type 4 - same as Type 3 (in pit)
 Type 5 - 1 pair #16, diameter $\leq .34"$
 Type 13 - Vendor furnished wire with PE-0621/0622
 Type 16 - 8c/#14, diameter $\leq .48"$

7.10.1 Conduit AY102-3S01

This conduit is a 1" installed spare.

7.10.2 Wire Runs W102-48A, 48B, 48C, 49A, 49B, 50, 51, 105, 106, 107 & 109 In Conduit AY102-3S02

Ten Type 1, one Type 13 and one Vendor Wire Run (Nominal diameter .6").

Type 1: $(10)(3.14 \times (0.34 \div 2)^2) =$	0.91 in ²
Type 13: $(1)(3.14 \times (0.63 \div 2)^2) =$	0.16 in ²
Type 17 (vendor): $(1)(3.14 \times (0.6 \div 2)^2) =$	0.28 in ²
	<hr/>
	1.35 in ²

40% fill: $1.35 \div 0.4 = 3.38 \text{ in}^2$

2½" conduit cross-section area = 4.87 in²

The minimum size needed for AY102-3S02 is 2½" conduit (Up sized to 3" conduit for conservatism and because there is no other 2½" conduit needed for the AY-102 installation).

7.10.3 Wire Runs W102-59, 61, 62, 63, & 82 In Conduit AY102-3S03

Five Type 1 and one Type 13.

Type 1: $(4)(3.14 \times (0.17^2)) =$	0.36
Type 13: $(1)(3.14 \times (0.315^2)) =$	0.31
	<hr/>
	0.67 in ²

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$$40\% \text{ fill: } 0.67 \div .4 = 1.68 \text{ in}^2$$

$$1\frac{1}{2}" \text{ conduit area} = 2.07 \text{ in}^2 \text{ from NEC Chapter 9 Table 4}$$

AY102-3S03 Up sized to 2" conduit for conservatism.

7.10.4 Wire Runs W102-37A, 37B, 37C, 38A, 38B, 40, 41, 43, 115, 116, 117, 118
in Conduit AY102-3S19

Five Type 1, six Type 5, one Type 16

$$\text{Types 1 \& 5: } (11)(3.14 \times .17^2) = 1.00 \text{ in}^2$$

$$\text{Type 16: } (1)(3.14 \times .24^2) = .18 \text{ in}^2$$

$$\underline{1.18 \text{ in}^2}$$

$$40\% \text{ fill: } 1.18/0.4 = 2.95 \text{ in}^2$$

$$2" \text{ conduit cross sectional area} = 3.41 \text{ in}^2 \text{ from NEC Chapter 9 Table 4}$$

Use a 2" conduit

7.10.5 Wire Runs W102-68, 69, 70, 71, 72, 73 \& 103 Routed Through Conduits
AY102-3S08, 3S08A \& 3S10

All seven wire runs are Type 5.

$$(7) \times (3.14 \times 0.17^2) = 0.64 \text{ in}^2$$

$$40\% \text{ fill: } 0.64 \div 0.4 = 1.60 \text{ in}^2$$

 $1\frac{1}{2}"$ conduit required (AY102-3S08, 3S08A, and 3S10 Up sized to 2" conduit for conservatism).

7.10.6 Wire Run W102-80 In Conduit AY102-3S14

Both are Type 3 => 0.63" diameter, radius = .315"

$$(3.14) \times 0.315^2 = 0.31 \text{ in}^2$$

$$53\% \text{ fill: } 0.31 \div 0.53 = .59 \text{ in}^2$$

1" conduit needed (AY102-3S14 Up sized to 2" conduit for conservatism).

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7.10.7 Wire Runs W102-64, & 67

Both are Type 5.

Conduits AY102-3S04, & 3S13 each contain only one of the above wire runs, i.e. one Type 5.

$$(1) \times (3.14 \times 0.17^2) = 0.09 \text{ in}^2$$

$$53\% \text{ fill applies: } 0.09 \div 0.53 = 0.17 \text{ in}^2$$

Minimum size of conduit required is $\frac{3}{4}$ ". AY102-3S04 & -3S13 to be $\frac{3}{4}$ " conduit for conservatism.

7.10.8 Four Type 7 Wire Runs Per Conduit

W102-100 & 101

AY102-3S16 & 3S17

Per NEC Table 3B, either wire run fits into a $\frac{1}{2}$ " conduit.

$$(1) \times (3.14 \times 0.315^2) \div 0.53 = 0.5879 \text{ in}^2$$

$$1" \text{ conduit area} = (3.14 \times (1.049 \div 2)^2) = 0.8638 \text{ in}^2$$

AY102-3S16 & -3S17 to be 1" conduit for conservatism.

7.10.9 Wire Run W102-79, Type 14 2/C #16 Belden In Conduit AY102-3S09

Type 5 - diameter .34," Cross-sectional area = .091 sq"

1" conduit is acceptable.

7.10.10 Wire Run W102-74, Belden 9953 (0.264" Diameter) in Conduit AY102-3S15

$$(3.14 \times (0.264 \div 2)^2) = 0.05 \text{ in}^2$$

53% fill: $0.05 \div 53 = 0.10 \text{ in}^2$. Need minimum $\frac{3}{4}$ " conduit for AY102-3S15 (Up sized to 1" conduit for conservatism).

7.10.11 Wire Run W102-39, SE-0621 In Conduit AY102-3S07

1" installed spare.

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7.10.12 Wire Runs W102-65, 65A & 66 In Conduits AY102-3S11 & 3S12

3 or 4 #14 Type 7

Use $\frac{3}{4}$ " conduit (Up sized to 1" conduit for conservatism).

7.10.13 Miscellaneous Wire Runs W102-32 & W102-33 ?? temperature ??

a) W102-32, Type 7, in conduit AY102-3P30, 3#12, vendor furnished:

Minimum conduit size for AY102-3P30 is $\frac{1}{2}$ ", used 1".

b) W102-33, 3#8, Type 7, in conduit AY102-3P31:

Interfarm Cathodic Protection Rectifier to be fed from a 120 VAC, 20 A circuit. The 20 A circuit breaker will serve a 16 A circuit. Maximum rectifier input current is 4 Amps. Size circuit for 120VAC, 4 A minimum.

Circuit length is estimated at $225 \text{ LF} \times 2 = 450 \text{ ft}$.

1) 20 A circuit breaker dictates a #12 conductor size (minimum).

$$R_{95^{\circ}\text{C}} = 1.72 \times 1.115 = 1.92 \text{ ohm}/1000\text{LF}$$

$$\%VD_{\text{max}} = (4)(1.92 \times 0.45) = 3.46 \text{ volt} = 2.9\%$$

3% voltage drop is maximum allowable for branch circuit; the 2.9% is considered to be too high.

2) Try #10 AWG: $R_{95^{\circ}\text{C}} = 1.1 \times 1.115 = 1.23 \text{ ohms}/100\text{LF}$

$$\%VD_{\text{max}} = 4(1.23 \times 0.45) = 2.21 \text{ volt} = 1.8\%$$

This voltage drop is acceptable.

3) Since power is from an existing Panelboard, decided to upsize again to #8 AWG (2#8 with 1#8 ground wire).

$$R_{95^{\circ}\text{C}} = 0.7 \times 1.115 = 0.78 \text{ ohms}/1000\text{LF}$$

$$\%VD = (4A)(0.78 \times 0.45) = 1.4 \text{ V} = 1.2\%$$

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3#8 AWG requires a $\frac{1}{2}$ " conduit; Up sized AY102-3P31 to 1" conduit for conservatism because it is a long underground run.

7.11 Special Situations7.11.1 P-0621 Motor Starter Control Power Transformer Sizing

The Control Power Transformers are an integral part of seller supplied equipment. They are sized by the providers of the motor control equipment. No evaluation is needed here.

7.11.2 Winch (W-0621) Limit Switch - 120VAC Circuit
Conductor Sizing (Wire Run Nos #-86, #-86A, & #-95)

Circuit limited to maximum of 0.8 A by CPT fuses,
therefore #14 AWG, Type 7, is acceptable.

Checking voltage drop during starting:

Size 1 starter inrush = 160 VA with minimum
pickup voltage @ 85% (120 Vac x 0.85 = 102 V).

CPT %Z = 6.5% (cold); 7.8% (hot). (typical values)

#14 AWG R @ 55°C = 2.73×1.115
= 3.04 ohm/1000 LF

Circuit Length: 80' x 2 = 160 LF

$$\begin{aligned} \text{a) VD \#14} &= (160\text{VA}/120\text{V}) \times (3.04 \times 0.16) \\ &= 0.648 \text{ Volt} = 0.5\% \end{aligned}$$

$$\begin{aligned} \text{b) VD XFMR} &= (6.5) (160\text{VA}/120\text{V}) = 8.7\% \\ &\quad (\text{cold}) \\ &= (7.8) (1.333) = 10.4\% (\text{hot}) \end{aligned}$$

$$\begin{aligned} \text{Total VD} &= 0.5 + 8.7 = 9.2\% (\text{cold}) \text{ and} \\ &\quad \underline{.5 + 10.4 = 10.9\% (\text{hot})} \end{aligned}$$

Hot is worst case: (120V) (1 - 0.109) = 107 V

Minimal allowable voltage = 102 V

Will use #14 AWG, Type 7 Wire.

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7.11.3 Seismic Safety System "Emergency Trip"/Remote Trip Circuit Conductor Sizing

Normally would use 14 AWG - Due to FU3 secondary CPT
 fuse size of 3 AMPS

Checking voltage drops during contactor pick up:

Size 6 Contactor In-Rush VA = 2900
 Pickup Volts = 70% (120V x 0.7= 84V)
 Coil Voltage = 120 VAC

750 VA CPT
 CPT %Z = 4.44

Circuit Length 55' x 2 = 110LF

#14 AWG R @ 55°C = 2.73 x 1.115
 = 3.04 ohm/1000LF

a) %VD #14 (inrush) = (2900VA/120V) (3.04ohm/1000LF x 110ft)
 = 8.08 V = 6.73%

b) %VD CPT (inrush) = (I inrush / I base)(%Z)

I (inrush) = 2900VA/120V = 24.17 A

I base = 750VA/120V = 6.25 A

%VD CPT = 24.17/6.25 (4.44) = 17.17%

c) #14 AWG combination: VD #14 + VD CPT =
 6.74 + 17.17 = 23.91%

120 V x (1 - 0.2391) = 91.3 V

Minimum allowable for pick-up = 84 V

d) VD #12 (inrush) where R @ 55°C =
 1.72ohms/1000LF x 1.115 = 1.92ohm/1000ft

VD #12 (inrush) = (2900VA/120A) (1.92 x .011)=
 51 V = .43%

e) #12 AWG combination:

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$$VD \#12 + VD \text{ CPT} = .43 + 17.17 = 17.6\%$$

$$(120 \text{ V}) \times (1 - 0.176) = 98.9 \text{ V}$$

Minimum allowable for pick-up = 84 V

Elected to use #12 AWG, Type 7 Wire for WI02-87 & 88.

8. CONCLUSIONS

8.1 Total connected load is 317.1 KVA. [from 7.1]

Maximum estimated demand for sluicing project = 176.9 KVA. [from 7.2]

Estimated total non-coincident demand on transformer bank = 308.3 KVA. [from 7.2.3]

8.2 The existing parallel 350 kcmil service entrance and feeder to AY-PDP-1 is adequate for the additional AY-102 Sluicing demand.

8.3 500 kcmil feeder for the 250 HP VSD motor is adequate to maintain proper terminal voltage level during motor starting.

8.4 To maintain adequate motor terminal voltage level for the 40 HP Immersible Pump motor (using the #1/0 feeder size indicated), the existing "soft start" will be adequate.

8.5 A single outdoor light fixture is adequate over the door. Three "two-tube" fixtures are required inside the Electrical Equipment skid.

8.6 Control and instrumentation conduit runs and misc. equipment are properly sized.

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