ATTACHMENT 1
Design Analysis Major Revision Cover Sheet
Page 1 of 1

Design Analysis (Major Revision)			**Last Page No.** 14.0-7 and S118
Analysis No.:	9389-46-19-3	**Revision:** 004	
Title:	Diesel Generator 2/3 Loading Under Design Bases Accident Condition		
EC/ECR No.:	EC 364066	**Revision:** 000	

Station(s):	Dresden	**Components(s)**	
Unit No.:	2 and 3	Various	
Discipline:	E		
Description Code/Keyword:	E15		
Safety/QA Class:	SR		
System Code:	66		
Structure:	N/A		

CONTROLLED DOCUMENT REFERENCES

Document No.	From/To	Document No.	From/To
See Section XIV			

Is this Design Analysis Safeguards Information? Yes ☐ No ☒ If yes, see SY-AA-101-106
Does this Design Analysis Contain Unverified Assumptions? Yes ☐ No ☒ If yes, ATI/AR#
This Design Analysis SUPERSEDES: N/A in its entirety

Description of Revision (list affected pages for partials):
See Page 1.0-4 for a description of this revision and a list of affected pages.

Preparer Scott Shephard (Print Name) — [signature] (Sign Name) — 4/4/07 (Date)

Method of Review **Detailed Review** ☒ **Alternate Calculations (attached)** ☐ **Testing** ☐
Reviewer Glenn McCarthy (Print Name) — [signature] (Sign Name) — 4-4-2007 (Date)
Review Notes: Independent Review ☒ Peer Review ☐

(For External Analyses Only)
External Approver Richard H. Low (Print Name) — Richard H Low (Sign Name) — 4-4-2007 (Date)
Exelon Reviewer J.G. Kovach (Print Name) — J.G. Kovach (Sign Name) — 04/04/07 (Date)

Independent 3rd Party Review Required? Yes ☐ No ☒ If yes, complete Attachment 3
Exelon Reviewer Louis Mallavarapu (Print Name) — Louis Mallavarapu (Sign Name) — 4/5/07 (Date)

Sargent & Lundy LLC ORIGINAL	Calculation For Diesel Generator 2/3 Loading Under			Calc. No. 9389-46-19-3	
	Design Bases Accident Condition			Rev. 2	Date 10/17/96
	X	Safety-Related	Non-Safety-Related	Page 1.0-1 of	

Client Com Ed		Prepared by	JECardona V	Date 10/11/96
Project Dresden Station		Reviewed by	[signature]	Date 10/11/96
Proj. No. 9389-46	Equip. No.	Approved by	[signature]	Date 10/17/96

QA COPY MADE

DIVISION: EPED FILE: 15B SYSTEM CODE: 6600

~~INFORMATION ONLY~~ 10/21/04

NOTE: FOR THE PURPOSE OF MICROFILMING THE PROJ. NO. FOR THE ENTIRE CALC. IS "9389-46"

I. REVISION SUMMARY AND REVIEW METHOD

A. Revision 0

Revision 0, Initial issue, all pages.

This calculation supersedes the Calculation for Diesel-Generator Loading Under Design Basis Accident Condition , Calculation Number 7317-33-19-3 . The major differences between Calculation 7317-33-19-3 and this calculation are as follows:

1) Dresden Diesel Generator (DG) surveillance test strip charts (Reference 23) show that the first LPCI pump starts almost 3.5 seconds after the closure of the DG output breaker. This is due to the under voltage (UV) relay disk resetting time. This revision shows that the 480V auxiliaries start as soon as the DG output breaker closes to the bus and the first LPCI pump starts approximately 3.5 seconds after the closure of the DG output breaker during Loss Of Offsite Power (LOOP) concurrent with Loss Of Coolant Accident (LOCA).

2) Created new ELMS-AC PLUS files for the DG for both Units 2 & 3 based on the latest base ELMS modified files D2A4.M24 and D3A4.M21, including all modifications included in Revisions 0 through 15 of Calculation Number 7317-43-19-1 for Unit 2 and all modifications included in Revisions 0 through 14 of Calculation 7317-43-19-2 for Unit 3. Utilization of the ELMS-AC PLUS program in this calculation is to maintain the loading data base and totaling the running KVA for each step.

3) Created Tables 1B & 2B for Unit 3. These tables did not previously exist.

4) Created Table 4A for Unit 2 and Table 4B for Unit 3 for totaling 480V loads starting KW/KVAR for determining starting voltage dip from the DG Dead Load Pickup Curve.

Revision 1:

Revised pages 1.0-1, 1.0-3, 2.0-1, 2.0-2, 2.0-3, 2.0-4, 4.0-7, 10.0-7 through 10.0-10, 10.0-12, 10.0-13, 10.0-20, 10.0-21, 10.0-23, 10.0-24, 11.0-1, 12.0-1, 14.0-6, F116, P2 and S94 as

REVISION SUMMARY (Cont'd)

Revision 1 (Cont'd)

indicated by the revision bar, no revision bar was used to identify the information shifted due to addition and respacing of the text. Added pages 1.0-2, 4.0-8, 14.0-7, F117 through F232, P3, P4 and S95 through S101.

This revision analyzes the effect on the DG loading (both continuous and transient) due to the replacement of the existing LPCI Pump Motor 2B (700 HP) with a new 800 HP motor from Reliance Electric (see attachment 56) per Exempt Change Request E 12-2-95-200 and Work Order No. D222021. LPCI Pump 2B is powered by 4KV Switchgear bus 23-1. This pump (i.e. second LPCI pump) will start automatically 5 seconds after LPCI pump 2A (i.e. first LPCI Pump) during a LOOP concurrent with LOCA. This revision also determine the accelerting time of the new LPCI pump motor 2B.

Revision 2

In this revision, the following pages were revised:

1.0-1, 1.0-2, 2.0-1 through 2.0-4, 4.0-7, 4.0-8, 10.0-1 through 10.0-12, 11.0-1 through 11.0-4, 12.0-1, 13.0-1, 14.0-1, 14.0-4, 14.0-6, 14.0-7, C1, C4, Attachment F (Pages F0 through F112), J1, J5, Attachment M (Pages M0 through M112), P1

the following pages were added:

R2

1.0-3, 1.0-4, Section 10.1 (10.1-0 through 10.1-26), Section 10.2 (10.2-0 through 10.2-26), Section 15.0 (15.0-0 through 15.0-66)

the following pages were deleted:

10.0-13 through 10.0-49, F113 through F232, M113 through M120, P2 through P4

However, for completeness, all text pages are being reissued to correct various typographical errors throughout the text. *Revision bars have not been employed to indicate these types of changes.*

This revision incorporates load parameter changes determined in Revision 18 of Calculation 7317-43-19-1 (Ref. 26), and Revision 16 of Calculation 7317-43-19-2 (Ref. 27) into the ELMS-AC datafile models used in this calculation to model diesel generator operation. The most critical of these changes is the CCSW Pump BHP change from 450 HP to 575 HP. These load parameter changes normalize the DG datafiles so that file updates can be made easily and accurately with the file comparison program ELMSCOMP. In addition to the

Revision Summary (cont'd)

Revision 2 (Cont'd)

load/file changes, the text portion of the calculation dealing with determining starting kVA and motor start time for the 4.16 kV motors has been encoded into the MATHCAD Program. This will simplify any future changes, and decrease the possibility of calculation errors.

ELMSCOMP reports showing data transfers and so forth will be added in a new Section.

Please note: The BHP of CCSW Pump Motors is based on the nameplate rating of 500 HP with a 575 HP @ 90°C Rise. This assumption of CCSW Pump Motor BHP loading requires further verification per References 26 and 27.

Revision 3

EC 364066 was created for Operability Evaluation # 05-005. This operability evaluation concluded that the diesel generator load calculation trips one Low Pressure Coolant Injection (LPCI) pump before the first CCSW pump is loaded onto the diesel, at which point the diesel is supplying one Core Spray pump, one LPCI and one CCSW pump. In contrast, station procedure DGA-12, which implements the manual load additions for LOCA/LOOP scenarios, instruct operators to load the first CCSW pump without tripping a LPCI pump. The procedure directs removal of a LPCI pump from the EDG only before loading of the second CCSW pump. In accordance with Corrective Action #2 of the Operability Evaluation, Calculations 9389-46-19-1,2,3 "Diesel Generator 3,2,2/3 Loading Under Design Basis Accident Condition" require revision to document the capability of the EDGs to support the start of the first CCSW pump without first tripping a LPCI pump.

This revision incorporates the changes resulting from EC 364066, Rev. 000. In addition, this revision replaces the ELMS-AC portions of the calculation with ETAP PowerStation (ETAP). All outstanding minor revisions were also incorporated. The parameters for valves 2-1501-22A/B and 3-1501-22A/B were also revised in the ETAP model to reflect the latest installed motors. Section 10 calculations previously performed using MathCad were replaced with MS Excel spreadsheets.

In this revision the following pages were revised:

2.0-4, A10, A12, B14, B15, E2, O1, O2, S16-S19, S101

In this revision the following pages were added:

Design Analysis Cover Sheet, 2.0-5, G1-G61, N1-N61, S102-S113

In this revision the following pages were deleted:

1.0-4, Section XV, Attachment P

In this revision the following pages were replaced:

1.0-3, 2.0-1, 2.0-2, 2.0-3, 3.0-1, 3.0-2, 4.0-1, 4.0-6, 4.0-7, 5.0-1, 7.0-1, 8.0-2, 8.0-4, 8.0-5, 9.0-1 through 9.0-5, 10.0-1 through 10.0-12, 10.1-1 through 10.1-26, 10.2-1 through 10.2-26, 11.0-1 through 11.0-4, 12.0-1, 14.0-1, 14.0-6, 14.0-7, C1 through C5, F1-F112 replaced by F1-F113, J1 through J5, M1-M112 replaced by M1-M113,

CALCULATION REVISION SUMMARY

Revision 4

This revision incorporates various changes to the EDG loading. Major changes include CS, LPCI and CCSW BHP values. Other changes include a decrease in the RPS MG Set bhp during a LOCA and replacement of the DG cooling water pump. New study cases and loading categories were generated in ETAP to model loading of the 4kV pumps after 10 minutes into the event. The scope was expanded to include a comparison of the DG loading at 102% of rated frequency to the 2000hr rating of the diesel. This revision incorporates changes associated with References XIV.64 through 69. 71 and 72.

In this revision the following pages were revised:

S113

In this revision the following pages were added: R4

1.0-4, 2.0-6, 4.0-8, S114-S118

In this revision the following pages were replaced:

1.0.0, 1.0-3, 2.0-1, 2.0-2, 2.0-3, 2.0.5, 3.0-1, 3.0-2, 4.0-7, 5.0-1, 7.0-1, 9.0-1 through 9.0 3, 9.0-5, 10.0-1, 10.0-9 – 10.0-12, 10.1-1, 10.1-3, 10.1-4, 10.1-10, 10.1-11, 10.1-17 through 10.1-20, 10.1-22, 10.1-24 through 10.1-25, 10.2-1, 10.2-3 through 10.2-6, 10.2-8, 10.2-10, 10.2-11, 10.2-17 through 10.2-20, 10.2-22, 10.2-24 through 10.2-26, 11.0-1, 11.0-3, 12.0-1, 13.0-1,14.0-1, 14.0-7, C1, F1-F113, G1-G61 with G1-G57, J1, M1-M113, N1-N61

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XII. CONCLUSIONS	12.0-1	
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Sargent & Lundy

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Client Com Ed	Prepared by	Date
Project Dresden Station	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

File Descriptions

Revision 2

File Name	Date	Time	File Description
D2A4DGS.G02	10/11/96	9:45:18a	General File - Original Issue
D2A4DGSR.G02	10/11/96	9:47:26a	General File - Original Issue - Reduced Voltage
D2A4DGS.I02	9/18/96	3:23:34p	Initial File - Original Issue
D2A4DGSR.I02	9/18/96	4:11:14p	Initial File - Original Issue - Reduced Voltage
D2EXCEL.XLS	10/11/96	1:08:46p	Tables 1A, 2A, 4A and Time vs. Load Graph - Excel File
DG23_2.MCD	10/11/96	11:11:08a	Voltage Dip and Recovery Voltage Calculations - MathCad File
DG23_2.PPT	10/11/96	11:34:58p	Figure 1A - PowerPoint File
D3A4DGS.G01	10/11/96	9:49:16a	General File - Original Issue
D3A4DGSR.G01	10/11/96	9:51:58a	General File - Original Issue - Reduced Voltage
D3A4DGS.I01	10/11/96	9:31:36a	Initial File - Original Issue
D3A4DGSR.I01	10/11/96	9:34:04a	Initial File - Original Issue - Reduced Voltage
D3EXCEL.XLS	10/11/96	1:43:08p	Tables 1B, 2B, 4B and Time vs. Load Graph - Excel File
DG23_3.MCD	10/11/96	11:19:02a	Voltage Dip and Recovery Voltage Calculations - MathCad File
DG23_3.PPT	10/11/96	11:42:38a	Figure 1B - PowerPoint File
DRESDG23.00	11/22/94	3:25:40p	Flow Chart 1
DRDGSR2.WP	10/11/96	3:53p	Calculation Text - Wordperfect

R2

File Descriptions (cont'd)

Revision 3

File Name	Size	Date	Time	File Description
9389-46-19-3 Rev. 3.doc	599040 bytes	8/9/06	9:32:57am	Text document
9389-46-19-3 Rev. 3 (section 10.1).xls	532992 bytes	8/01/06	12:54:26pm	Section 10.1 (Unit 2 Starting Calc)
9389-46-19-3 Rev. 3 (section 10.2).xls	532480 bytes	8/09/06	8:38:47am	Section 10.2 (Unit 3 Starting Calc)
9389-46-19-3 Rev. 3 (table 4).xls	80896 bytes	4/24/06	9:07:09am	Table 4
DRE_Unit2_0003.mdb	17,977,344 bytes	8/01/06	1:22:49pm	Unit 2 ETAP database
DRE_Unit2_0003.macros.xml	10595 bytes	8/01/06	10:17:20am	Unit 2 ETAP macros
DRE_Unit2_0003.scenarios.xml	11572 bytes	7/31/06	10:20:30pm	Unit 2 ETAP Scenarios
DRE_Unit2_0003.oti	9728 bytes	8/01/06	1:22:48pm	Unit 2 ETAP "OTI" file
DRE_Unit3_0004.mdb	18,509,824 bytes	8/03/06	1:41:09pm	Unit 3 ETAP database
DRE_Unit3_0004.macros.xml	10568 bytes	8/03/06	11:12:31am	Unit 3 ETAP macros
DRE_Unit3_0004.scenarios.xml	12388 bytes	2/28/06	11:18:23am	Unit 3 ETAP Scenarios
DRE_Unit3_0004.oti	16384 bytes	8/03/06	1:41:08pm	Unit 3 ETAP "OTI" file

CALCULATION PAGE

File Descriptions (cont'd)

Revision 4

File Name	Size	Date	Time	File Description
9389-46-19-3 Rev. 4.doc	553,984 bytes	3/29/07	6:10:13 pm	Text document
9389-46-19-3 Rev. 4 (section 10.1).xls	531456 bytes	3/21/07	3:31:53pm	Section 10.1 (Unit 2 Starting Calc)
9389-46-19-3 Rev. 4 (section 10.2).xls	528384 bytes	3/29/07	7:34:57am	Section 10.2 (Unit 3 Starting Calc)
9389-46-19-3 Rev. 4 (table 4).xls	79360 bytes	3/1/07	6:51:32pm	Table 4
DRE_Unit2_0004.mdb	18,911,232 bytes	3/20/07	11:34:56pm	Unit 2 ETAP database
DRE_Unit2_0004.macros.xml	11206 bytes	3/20/07	9:46:37pm	Unit 2 ETAP macros
DRE_Unit2_0004.scenarios.xml	12862 bytes	2/12/07	3:49:12pm	Unit 2 ETAP Scenarios
DRE_Unit2_0004.oti	4/4/07 ~~15306~~ 15360 bytes	3/21/07	9:37:49pm	Unit 2 ETAP "OTI" file
DRE_Unit3_0005.mdb	19,559,360 bytes	3/29/07	8:17:29am	Unit 3 ETAP database
DRE_Unit3_0005.macros.xml	11293 bytes	3/21/07	2:47:02pm	Unit 3 ETAP macros
DRE_Unit3_0005.scenarios.xml	15500 bytes	2/26/07	7:50:53pm	Unit 3 ETAP Scenarios
DRE_Unit3_0005.oti	16384 bytes	3/29/07	8:32:57am	Unit 3 ETAP "OTI" file

R4

III PURPOSE/SCOPE

A. Purpose

The purpose of this calculation is to ensure that the Dresden Diesel Generator has sufficient capacity to support the required loading during the maximum loading profile as determined in the Calculation Results section.

The purpose of this calculation includes the following (these apply when DG 2/3 is powering either Unit 2 or Unit 3):

1) Determine automatically actuated devices and their starting KVA at each step for the ac electrical load when the DG is powering the safety related buses.

2) Develop a Time versus Load profile for the DG when the DG is powering the safety related buses.

3) Compare the maximum loading in ETAP for the DG load profile against the capacity of the DG.

4) Determine the starting voltage dip and one second recovery voltage at the DG terminals for initial loading and each 4000V motor starting step.

5) Evaluate the control circuits during the starting transient voltage dip.

6) Evaluate the protective device responses to ensure they do not inadvertently actuate or dropout during the starting transient voltage dip.

7) Evaluate the travel time of MOVs to ensure they are not unacceptably lengthened by the starting transient voltage dips.

8) Determine the starting duration of the automatically starting 4kV pump motors.

9) Ensure the loading on the EDG is within the 2000hr rating should the frequency on the machine increase to its maximum allowable value. R4

10) Determine the minimum power factor for the long term loading on the EDG.

B. Scope

The scope of this calculation is limited to determining the capability of the DG to start the sequential load (with or without the presence of the previous running load as applicable), without degrading the safe operating limits of the DG or the powered equipment & services. The minimum voltage recovery after 1 second following each sequential start will be taken from the DG dead load pickup characteristics and compared to the minimum recovery required to successfully start the motors and continue operation of all services.

CALCULATION PAGE

PURPOSE/SCOPE (cont'd)

The total running load of the DG will also be compared against the rating of the DG at the selected loading step to confirm the loading is within the DG capacity.

The EDG has a minimum and maximum allowable frequency range. Operating the EDG at a frequency above its nominal value results in additional loading on the EDG. The percent increase in load due to the increase in frequency will be quantified and compared to the EDG 2000 hr rating to ensure the limits of the EDG are not exceeded. The minimum power factor for EDG long term loading will be quantified. R4

The scope will also include an evaluation based on review of identified drawings to determine the effects on control functionality during the transient voltage dips.

The scope will also include an evaluation of protective devices which are subject to transient voltage dips.

The scope does not include loads fed through the cross-tie breakers between Unit 2 and 3 Buses of the same Division. Although DGA-12, Rev. 16 allows its use, loading is performed manually at Operations' discretion and is verified to be within allowable limits during manual loading. Therefore, this operation is not included in the scope of this calculation.

IV **INPUT DATA**

The input data extracted from the references is summarized below:

A. Abbreviations

ADS	Automatic Depressurization System
AO	Air Operated
CC	Containment Cooling
CCSW	Containment Cooling Service Water
Clg	Cooling
Clnup	Clean up
Cnmt	Containment
Comp	Compressor
Compt	Compartment
Diff	Differential
DIT	Design Information Transmittal
DG	Diesel Generator
DW	Drywell
EFF	Efficiency
EHC	Electro Hydraulic Control
ELMS	Electrical Load Monitoring System
ETAP	Electrical Transient Analyzer Program R3
Emerg	Emergency

Input Data (cont'd):

ECCS	-	Emergency Core Cooling System
FSAR	-	Final Safety Analysis System
gpm	-	Gallons Per Minute
GE	-	General Electric
Gen	-	Generator
Hndlg	-	Handling
HPCI	-	High Pressure Coolant Injection
HVAC	-	Heating Ventilation & Air Conditioning
Inbd	-	Inboard
Inst	-	Instrument
Isoln	-	Isolation
LOCA	-	Loss Of Coolant Accident
LOOP	-	Loss Of Offsite Power
LPCI	-	Low Pressure Coolant Injection
LRC	-	Locked Rotor Current
Mon	-	Monitoring
MCC	-	Motor Control Center
M-G	-	Motor Generator
MOV	-	Motor Operated Valve

Input Data (cont'd):

Outbd	-	Outboard
PF	-	Power Factor
Press	-	Pressure
Prot	-	Protection
Recirc	-	Recirculation
Rm	-	Room
Rx Bldg	-	Reactor Building
SBGT	-	Standby Gas Treatment System
Ser	-	Service
SWGR	-	Switchgear
Stm	-	Steam
Suct	-	Suction
TB	-	Turbine Building
Turb	-	Turbine
UPS	-	Uninterruptible Power Supply
Vlv	-	Valve
Wtr	-	Water
Xfmr	-	Transformer

Input Data (cont'd):

B. Emergency Diesel Generator Nameplate data for the Dresden Unit 2/3 is as follows (Reference 24):

Manufacturer	Electro - Motive Division (GM)
Model	A - 20 -C1
Serial No.	68 - B1 - 1011
Volts	2400 / 4160 v
Currents	782 / 452 Amps
Phase	3
Power Factor	0.8
RPM	900
Frequency	60
KVA	3250
Temperature Rise	85°C Stator - Therm 60°C Rotor - Res
KVA Peak Rating	3575 KVA For 2000 HR / YR
Temperature Rise	105°C Stator - Therm 70°C Rotor - Res
Insulation Class	Stator - H Rotor - F
Excitation	Volts - 144 Amps - 100
Diesel Engine Manufacturer	Electro - Motive Division (GM)
Model No.	S20E4GW
Serial No.	1158

Input Data (cont'd)

C. Dead Load Pickup Capability (Locked Rotor Current) - Generator Reactive Load Vs % Voltage Graph #SC - 5056 by Electro - Motive Division (EMD) [Reference 13].

This reference describes the dead load pickup capability of the MP45 Generating Unit. The curve indicates that even under locked rotor conditions an MP45, 2750 kw generating unit will recover to 70% of nominal voltage in 1 second when a load with 12,500 KVA inrush at rated voltage is applied. This indicates that the full range of the curve is usable. Also, page 8 of the purchase specification K-2183 (Reference 12) requires that the Generator be capable of starting a 1250 hp motor (starting current equal to 6 times full load current). The vertical line labelled as "Inherent capability" on the Dead Load Pickup curve is not applicable for the Dresden Diesel Generators because they have a boost system associated with the exciter. Per Reference 40 of this calculation, Graph #SC-5056 is applicable for Dresden Diesel Generators.

D. Speed Torque Current Curve (297HA945-2) for Core Spray Pump by GE (Reference 14).

E. Speed Torque Current Curve (#257HA264) for LPCI Pump by GE (Reference 15).

F. Dresden Re-baselined Updated FSAR Table 8.3-3, DG loading due to loss of offsite ac power (Reference 30)

G. Table 1A: Automatically ON and OFF devices during LOOP Concurrent with LOCA when the DG 2/3 is powering the Unit 2 Division I loads (Attachment A).

H. Table 2A: Affects of Voltage Dip on the Control Circuits during the Start of Each Large Motor when DG 2/3 is powering Unit 2, Division I loads (Attachment B).

I. Table 4A: KW/KVAR/ KVA loading tables for total and individual starting load at each step when DG 2/3 is powering Unit 2, Division I loads (Attachment C).

J. Table 1B: Automatically ON and OFF devices during LOOP Concurrent with LOCA when the DG 2/3 is powering the Unit 3 Division I loads (Attachment H)

K. Table 2B: Affects of Voltage Dip on the Control Circuits during the Start of Each Large Motor when DG 2/3 is powering Unit 3, Division I loads (Attachment I).

L. Table 4B: KW/KVAR/ KVA loading tables for total and individual starting load at each step when DG 2/3 is powering Unit 3, Division I loads (Attachment J).

Input Data (cont'd)

M. CECO letter dated March 11, 1988 from Bruce B. Palagi to W. Fancher / M. Reed regarding the post LOCA ECCS Equipment requirements for the Dresden and Quad Cities Station (Reference 35).

N. Dresden Re-baselined Updated FSAR Figure 8.3-6, DG loading under accident and during loss of offsite ac power (Reference 31).

O. Dresden Appendix R Table 3.1-1, DG loading for safe shutdown (Reference 32).

P. Flow Chart No. 1, showing the source of data and establishing which load is ON when the DG is powering the safety buses during LOOP concurrent with LOCA (Attachment 0).

Q. Single Line diagram showing the breaker position when the DG output breaker closes to 4-kv bus 23-1 during LOOP concurrent with LOCA (Attachment D).

R. ETAP Loadflow Report for comparing loading and calculated KVA input of running loads at each step to DG capacity for both Units 2 & 3 (Attachment F, G, M & N). R3

S. S&L Standard ESA - 102, Revision 04-14-93 - Electrical and Physical Characteristics of Class B Electrical Cables (Reference 11).

T. S&L Standard ESC - 165, Revision 11-03-92 - Power Plant Auxiliary Power System Design (Reference 41).

U. S&L Standard ESI-167, Revision 4-16-84, Instruction for Computer Programs (Reference 1).

V. S&L Standard ESC-193, Revision 9-2-86, Page 5 for Determining Motor Starting Power Factor (Reference 39).

W. S&L Standard ESA-104a, Revision 1-5-87, Current Carrying Capacities of Copper Cables (Reference 10).

X. S&L Standard ESC-307, Revision 1-2-64, for checking voltage drop in starting ac motors (Reference 21).

Y S&L Standard ESI-253, Revision 12-6-91, Electrical Department instruction for preparation, review, and approval of electrical design calculations (Reference 20).

Input Data (cont'd)

Z. Unit 2 ETAP file from Calculation DRE05-0038, Rev. 000 and 000A (Ref. 58). See Section 2.0 for the latest ETAP file.

R4

AA Unit 3 ETAP file from Calculation DRE04-0019, Rev. 000 and 000B (Ref. 59). See Section 2.0 for the latest ETAP file.

AB. 125Vdc and 250Vdc Battery Charger, and 250Vdc UPS Models Calculations 9198-18-19-1 and 9198-18-19-3 used in ETAP (Reference 25, 54 & 55).

AC. Single Line diagram showing the breaker position when the DG output breaker closes to 4-kv bus 33-1 during LOOP concurrent with LOCA (Attachment K).

AD. DIT DR-EPED-0860-00; Loading change for Dresden Unit 2 - Division 1.

AE. DIT DR-EPED-0862-00; Loading change for Dresden Unit 3 - Division 1.

AF. Speed - Torque Curve (#257HA266) for Core Spray Pump by GE (Attached)

AG. Speed - Torque - Current Curve (#257HA265) for Core Spray Pump by GE (Attached)

AH. Memorandum from R.M. Dahlgren to C.A. Tobias dated December 30, 1994 regarding the measured stroke times of various MOVs (Reference 46).

AI. CHRON Letter 0302643 to Mr. T. Rieck from E.J. Rowley and J.D. Williams dated June 21, 1994 regarding the measured stroke times and acceptable limits for various MOVs (Reference 47).

AJ. DOS 1600-18, Revision 15; Cold Shutdown Valve Testing (Reference 48).

AK. DOS 1600-05, Revision 4; Unit 3 Quarterly Valve Timing (Reference 49).

AL. DOS 7500-02, Revision 11; SBGT System Monthly Surveillance and Operating Test (Reference 50).

AM. DOS 1600-03, Revision 4; Unit 2 Quarterly Valve Timing (Reference 51).

AN. Paper Titled "Safety Classification of the Motor Operated Valves for the Reactor Recirculation System" dated 12-23-91 (Reference 52).

AO. Comparison table of MOV measured stroke times vs. their acceptable limits (Reference 53).

AP. The maximum allowable time to start each LPCI Pump and Core Spray Pump is 5 Seconds (Reference 60)

AQ. The BHP values for the CS, LPCI and CCSW pumps after 10 minutes into a LOCA event are provided below (Ref. 64, 65, 66).

Core Spray Pump 2A	870.0 hp
LPCI Pump 2A	622.2 hp
LPCI Pump 2B	631.8 hp
CCSW Pump 2A	575.0 hp with 1 pump running, 465 hp with both pumps running
CCSW Pump 2B	575.0 hp with 1 pump running, 465 hp with both pumps running
Core Spray Pump 3A	893.8 hp
LPCI Pump 3A	619.9 hp
LPCI Pump 3B	633.8 hp
CCSW Pump 3A	575.0 hp with 1 pump running, 465 hp with both pumps running
CCSW Pump 3B	575.0 hp with 1 pump running, 465 hp with both pumps running

R4

AR. The 2/3 EDG Cooling Water Pump has a BHP of 65.97kW with a power factor of 83.0. The efficiency, LRC and starting power factor are 100%, 400% and 31.5% respectively (Ref. 67 & 68)

AS. The RPS MG Sets have a BHP of 3.9kW when unloaded with a power factor of 12.2%. This is based on a 5% tolerance in the data acquisition equipment (Ref. 69)

AT. For centrifugal pumps, the break horsepower varies as the cube of the speed (Ref. 70).

AU. Dresden Technical Specification Section 3.8.1.16 allows a +2% tolerance on the nominal 60HZ EDG frequency (Ref. 73)

AV. The continuous rating of the EDG is 2600kW at a 0.8 pf (Ref. 74)

V ASSUMPTIONS

1) MCC control transformers (approximately 150VA – 200VA each) generally have only a small portion of their rating as actual load and can be neglected.

2) The Diesel Fuel Oil Transfer Pump is shown in this calculation as operating as soon as voltage is available on the MCC bus, but this is not the actual case as the pump responds to low day tank level which is normally full prior to DG starting. This is conservative and compensates for Assumption 1.

3) Individual load on buses downstream of 480/120V transformer have not been discretely analyzed to determine transformer loading. This transformer load on the 480V bus is assumed to be the rating of the distribution transformer or an equivalent three-phase loading for single phase transformers, which is conservative.

4) When Locked Rotor Currents are not available, it is considered 6.25 times the full load current. This is from S&L Standard ESC-165 and is reasonable and conservative.

5) For large motors (>250HP), the starting power factor is considered to be 20%. This is typical for large HP motors and does not require verification.

6) The load on the diesel generator is assumed to increase by 6% when the frequency of the machine is 2% above its nominal value. A majority of the load consists of large centrifugal pumps. The break horsepower of these pumps varies as the cube of the speed. Thus, a 2% increase in speed corresponds to a 6% increase in load (1.02^3) (Ref. 70). Note that these pumps will operate on a different point on the performance curve and the BHP may actually increase less than 6%. Therefore, a 6% increase is conservative. R4

7) For determining starting time for the large motors, the starting current is assumed to be constant throughout the evaluation. Although the speed-torque curve shows a decrease in current with speed as is expected, using a constant current will simplify the starting time evaluation. Motor starting time would be somewhat less if the speed-current characteristics were included. This assumption of CCSW Pump Motor starting current is conservative.

The above assumptions 1, 2, 3, 4, 5, 6 and 7 do not require verification.

VI. ENGINEERING JUDGEMENT

1.) Based on engineering judgement an efficiency of 90% is to be used to convert the cummulative HP to an equivalent KW for Table 8.3-3 of the Dresden Re-baselined Updated FSAR, Revision 0. This is considered conservative because the majority of this load consists of 1-4kV motor. Also, this result is only to be used for a comparison.

2.) The swing bus transfer circuits for MCC 28/29-7 and MCC 38/39-7 have a time delay relay with a setting of 20s (Reference 7). Based on engineering judgment a tolerance of ±5 seconds will be used for this time delay relay. The LPCI Swing MCC 28/29-7 (38/39-7) is normally fed from Switchgear 29 (39). However, on failure of the dedicated DG to start, this MCC will transfer to Switchgear 28 (38) approximately 15-25 seconds (i.e. 5-15 seconds after diesel breaker closes) after loss of Switchgear 29 (39) voltage. This is conservative because the loads starting on MCC 28/29-7 or MCC 38/39-7 can be shown starting at the most conservative time between 5s and 15s after DG breaker closure.

3.) For the purposes of this calculation, a LOCA is defined as a large line break event. This is a bounding case, as in this event, the large AC powered ECCS-related loads will be required to operate in the minutes of the event. This is conservative, as in the event of a small or intermediate line break scenario, there will be more time between the LOCA event and the low pressure (i.e. AC) ECCS system initiation.

VII ACCEPTANCE CRITERIA

The following are used for the acceptance criteria:

1) Continuous loading of the Diesel Generator.

- The total running load of the DG must not exceed its peak rating of 3575kVA @ 0.8 pf (Ref. 24) or 2860 KW for 2000 hr/yr operation.

  Note: The load refinements performed under Revision 004 of this calculation showed that the running load is within the 2600 KW continuous rating of the DG. Should a future calculation revision show that the loading is greater than the 2600KW continuous rating; a 50.59 safety evaluation should be performed to assess the impact on the current Dresden design/licensing basis.

- The total running load of the DG must not exceed its nameplate rating of 3575 KVA @ 0.8 pf (Ref. 24) or 2860 kW for 2000 hr/yr operation when considering the maximum frequency tolerance. If the EDG is at 102% of its nominal frequency, the EDG load is expected to be 1.02^3 or 1.06 times larger since a centrifugal pump input BHP varies as the cube of the speed (Ref. 70). R4

- EDG Power Factor during Time Sequence Steps DG2/3_T=10+m, DG2/3_T=10++m, and DG2/3_T=CRHVAC must be ≥88% (Ref. 75 and 76)

  Note: Should a future calculation revision show that the criterion for reactive power during the above noted DG time sequence steps can no longer be met; a review should be performed to assess the impact on the current Dresden design/licensing basis.

2) Transient loading of the Diesel Generator.

- Voltage recovery after 1 second following each start must be greater than or equal to 80% of the DG bus rated voltage (Ref. 12). This 80% voltage assures motor acceleration.
- The transient voltage dip will not cause any significant adverse affects on control circuits.
- The transient voltage dip will not cause any protective device to inadvertently actuate or dropout as appropriate.
- The transient voltage dip will not cause the travel time of any MOV to be longer than allowable.
- The starting durations of the automatically starting 4kV pump motors are less than or equal to the following times (see Section IV.AP):

Service	Allowable-Starting Time (sec.)
LPCI Pump 2A	5
LPCI Pump 2B	5
Core Spray Pump 2A	5
LPCI Pump 3A	5
LPCI Pump 3B	5
Core Spray Pump 3A	5

VIII. LOAD SEQUENCING OPERATION

A. Load Sequencing During LOOP/LOCA

By reviewing the Table 1 schematic drawings, it was determined that there are three automatic load starting steps, which start the two LPCI Pumps sequentially, followed by the Core Spray Pump. Also, there is another inherent step which delays the large pumps from starting by 3 seconds. This delay is due to the undervoltage relay recovery time, which is interlocked with the timers for the large pumps.

This calculation considers that all the devices auto start from an initiating signal (pressure, level, etc.) or from a common relay start at the same time (unless a timer is in the circuit). It considers all devices are in normal position as shown on the P&ID. It was found from discussion with ComEd Tech. Staff and the Control Room Operators that valves always remain in the position as shown on the design document.

For long term cooling, manual operation is required to start a Containment Cooling Service Water pump.

1) Automatic Initiation of DG during LOOP concurrent with LOCA

The DG will automatically start with any one of the signals below:

- 2 psig drywell pressure, or
- -59" Reactor water level, or
- Primary Under voltage on Bus 23-1 (33-1), or
- Breaker from Bus 23 (33) to Bus 23-1 (33-1) opens, or
- Backup undervoltage on Bus 23-1 (33-1) with a 7 second time delay, with an additional 5 minute time delay if there is a LOCA.

Upon loss of all normal power sources, DG starts automatically and is ready for loading within 10 seconds (Reference 7, page 8.3-14). When the safety-related 4160V bus is de-energized, the DG automatically starts and the DG output breaker closes to energize the bus when the DG voltage and frequency are above the minimum required. Closure of the output breaker, interlocks ECCS loads from automatically reclosing to the emergency bus, and then the loads are started sequentially with their timers. This prevents overloading of the DG during the auto-starting sequence.

LOAD SEQUENCING OPERATION (cont'd)

The LPCI Swing MCC 28/29-7 (38/39-7) is normally fed from Switchgear 29 (39). However, on failure of the dedicated DG to start, this MCC will transfer to Switchgear 28 (38) approximately 15 - 25 seconds after loss of Switchgear 29 (39) voltage (Reference 7, page 8.3-13 and engineering judgement). For conservatism, this calculation uses the time range of the transfer delay and applies it to coincide with the greatest transient voltage dip caused by the automatically starting 4000V motors.

Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1A & 1B.

2) Automatic Load Sequence Operation for LOOP with LOCA

- When the DG automatically starts and its output breaker (at Bus 23-1 or 33-1) closes to Switchgear 40, the diesel auxiliaries and certain MOVs start operating, and the UV relay starts its reset recovery timing.
- As soon as UV relays (IAV 69B) complete their reset, the first LPCI pump starts.
- 5 seconds after UV relays (IAV 69B) reset, the second LPCI pump starts. At the same time, associated valves and equipment with the LPCI pump start operating.
- 10 seconds after the UV relays (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating.

3) Manual actuation required for long term cooling

After 10 minutes of continued automatic operation of the LPCI Pumps and Core Spray system, the operator has to do the following actions to initiate long term cooling (see References 56 and 57):

- Shed and lock out appropriate loads on Bus 23 (or 33). R3
- At this point the operator can manually close the breaker to the switchgear bus and start one of the CC Service Water pumps, and also opens the CC Heat Exchanger Service Water Discharge Valve.
- Turn off one of the LPCI pumps. R3
- After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump.

B. Description of sequencing for various major systems with large loads

1) LPCI/CC - LPCI Mode

LPCI/CC

LPCI/CC is used to prevent a failure of fuel cladding as a result of various postulated LOCAs for break sizes ranging from those for which the core is adequately cooled by HPCI system alone, up to and including a DBA (Reference 6).

LPCI Mode

The LPCI mode of the LPCI/CC is to restore and maintain the water level in the reactor vessel to at least two-thirds of core height after a LOCA (Ref. 6).

i) Initiation of LPCI occurs at low-low water level (-59"), low reactor pressure (<350 psig), or high drywell pressure (+2 psig).

- CC Service Water pumps are tripped and interlocked off.
- The Heat Exchanger Bypass Valve 1501-11A receives an open signal and is interlocked open for 30 seconds and then remains open.
- Containment Cooling valves 1501-18A, 19A, 20A, 27A, 28A, and 38A are interlocked closed.
- An injection signal closes the Recirculation Pump Discharge Valve 202-5A.
- When reactor pressure decreases to 350 psig or less, the following occurs:

  1.) LPCI pumps will start. Under LOOP concurrent with LOCA, LPCI Pump 2A (3A) will start after the closure of the DG output breaker following the UV relay (IAV 69B) reset time. Five (5) seconds following the UV relay (IAV 69B) reset, LPCI Pump 2B (3B) will auto start. If the initiation signal was low-low water level, the pumps will not start until the reactor pressure reaches <350 psig or they receive a start signal from ADS showing low water level for 8.5 minutes continuous.

ii) The following valves respond to initiation of LPCI/CC - LPCI mode of operation:

- LPCI injection valves (1501-21A, 21B, 22A & 22B) - LOOP selection circuitry will sense a damaged loop and will close one of the LPCI outboard valves

(1501-21A or 21B) which are open during normal plant operation, and permit water injection through the undamaged loop. The undamaged loop LPCI inboard valve (1501-22A or 22B) which is normally closed will open upon LPCI initiation. Only one valve in each loop operates. In both loops, there are only two valves operating (one inboard and one outboard) at a given time. R3

- LPCI pump suction valves (1501-5A and 5B) - To prevent main system pump damage caused by overheating with no flow, these valves are lined up automatically upon system initiation.

- LPCI pumps minimum bypass valve (1501-13A) - To prevent the LPCI pumps from overheating at low flow rates, a minimum flow bypass line, which routes water from pump discharge to the suppression chamber is provided for each pump. A single valve for both LPCI pumps controls the minimum flow bypass line. The valve opens automatically upon sensing low flow in the discharge lines from the pump. The valve also auto-closes when flow is above the low flow setting.

2) Core Spray

The function of the Core Spray system is to provide the core with cooling water spray to maintain sufficient core cooling on a LOCA or other condition, which causes low reactor water, enough to potentially uncover the core.

i) The core spray pump starts automatically on any of the following signal:

- High Drywell Pressure (2 psig) or,

- Low -Low reactor water level (-59") and low reactor pressure (<350 psig), or

- Low Low reactor water level (-59") for 8.5 minutes.

ii) The following valves respond to initiation of core spray:

- Minimum Flow Bypass Valve 1402-38A - This valve is a N.O. valve, which remains open to allow enough flow to be recirculated to the torus to prevent overheating of Core Spray Pump when pumping against a closed discharge valve. When sufficient flow is sensed, it will close automatically

- Outboard Injection Valve 1402-24A - This valve is normally open and interlocks open automatically when reactor pressure is less than 350 psig.
- Inboard Injection Valve 1402-25A - This valve is normally closed, but will open automatically when reactor pressure is less than 350 psig.
- Test Bypass Valve 1402-4A - This is a normally closed valve and interlocks closed with Core Spray initiation.
- Core Spray Pump Suction Valve 1402-3A - This is a normally open valve and interlocks open with the initiation of Core Spray.

3) CC Service Water (CCSW) Pump

The CC Service Water pump provides river water at a pressure of 20 psig over the LPCI water pressure for removing the heat from the LPCI heat exchanger. One CC Service Water pump is sized to assure sufficient cooling in the secondary cooling loop of the CC heat exchanger for LPCI operation, even though there are two CC Service Water pumps per heat exchanger. The pump flow required is 3500 gpm. Each CCSW pump has the flow rate of 3500gpm, so at this rate, one pump is enough for adequate cooling.

i) The CCSW pump trips when it senses UV, overcurrent, or a LPCI initiation signal on Bus 23 (33) and will not auto start when the proper voltage is back on Bus 23 (33).

ii) According to Dresden FSAR Section 8, Table 8.2.5 two CC Service Water pumps are required during LOOP concurrent with LOCA. After 10 minutes of running both LPCI pumps and the Core Spray pump, the operator manually turns on the CCSW pumps, but is required for DG loading capacity to turn off one of the LPCI pumps [e.g. pump 2B (3B) for this calculation] before the second CCSW pump is turned on (see References 56 and 57). Dresden Updated FSAR section 5.2.3.3 analyzed the recovery portion of LOCA for the equipment availability and concluded that one LPCI, one Core Spray, and two CCSW pumps are adequate for recovery beyond 10 minutes after LOCA. R3 R3

iii) After the CC Service Water Pump is turned on, the operator has to open the CC 2A (3A) Heat Exchanger Service Water Discharge Control Valve 1501-3A to provide CCSW flow through the CC heat exchanger. The operator at some point during the event will manually close the CC 2A (3A) Heat Exchanger Bypass Valve 1501-11A to establish LPCI flow through the heat exchanger. R3

IX METHODOLOGY

A. Loading Scenarios:

There are three different abnormal conditions on which the Emergency Diesel Generator can be operating:

1) Loss of AC Offsite Power
2) Safe Shutdown Due to Fire
3) LOOP concurrent with LOCA

The above scenarios will be compared for total loading and heaviest sequential loading to determine worst case scenario and why the scenario was chosen.

B. Continuous Loading Evaluation

The following Attachments are used to determine and develop the continuous loading of the DG:

- Table 1
- ETAP for the load summary of the loading of the DG at selected steps of automatically and manually started loads.

The loading based on the maximum loading scenario, including cumulative proposed modifications to the loading, will be tracked in the ETAP data file. In all of the cases that will be analyzed, the proposed loading will be greater than that of the existing loading, since all modified load reductions will remain at previous loads until installed and changed to existing. Thus the capability of the DG to pickup the modified loading and operate within the safe operating limit of the DG will envelope the existing loading.

For all of the various steps in the DG load profile, the ETAP total load will be the summation of the steady state load of all running and starting services for the starting step being analyzed.

The ETAP model was revised to mimic the ELMS-AC data files that were part of the calculation prior to Revision 003. Scenarios were created in ETAP to model the various loading steps in the DG load profile as loads are energized and de-energized.

The scenarios used to model the DG loading in ETAP are listed in the table below. The scenarios use one of three loading categories named "DG Ld 0 CCSW", DG Ld 1 CCSW" and "DG Ld 2 CCSW". These loading categories were created by duplicating loading category "Condition 3". In cases where a load was identified in loading category "Condition 3" as zero and the load is energized during the diesel loading scenario, the loads were modeled as 100% in the "DG Loading" category. If the bhp for a given load in the previous DG data files was different than that in load condition 3, it was revised to match the bhp value in the previous ELMS-AC data files for this calculation. Breakers were added for various loads that change state as part of the DG load profile. No specific breaker data was entered as these breakers are only used as switches. The breakers were opened and closed as required creating configurations which duplicate the loading on the DG for each load step (load condition) previously captured in the ELMS-AC program. The three loading categories are identical except the BHP values associated with the CS, LPCI and CCSW pumps are varied. "DG Ld 0 CCSW" represents the first 10 minutes of the accident where no CCSW pumps are operating. "DG Ld 1 CCSW" reflects reduced CS and LPCI loading values after 10 minutes and a 115% bhp loading value for a single CCSW pump in operation. "DG Ld 2 CCSW" is the same as "DG Ld 1 CCSW" except CCSW bhp values are reduced to reflect operation of both pumps. R4 R4

Four study cases were created for use with this calculation: DG_0_CCSW, DG_1_CCSW, DG_2_CCSW and DG_Vreduced. The first three study cases use the corresponding similarly named loading categories and the DG_Vreduced case uses the DG_0_CCSW loading category as all runs correspond to less than 10 minutes into the event. The generating category was set to "Nominal" and "Gen Min" for the first three study cases and DG_Vreduced study cases respectively. The "2/3" diesel voltage was set to 100% and 54% for the "Nominal" and "Gen Min" generation categories respectively. 54% was chosen as it envelopes the lowest expected DG terminal voltage. This value is supported by the calculations performed in Section 10. In each of these study cases, the Newton Raphson method of load flow was selected with the maximum number of iterations set at 99 and the precision set to 0.000001. Only the initial bus voltages were chosen to be updated as a result of execution of the load flow. No diversity factors or global tolerances were used. R4

The scenario wizard in ETAP was used to set up the configuration, study case, and output report for each time step in the DG load profile. The study wizard was used to group and run all of the scenarios. Each scenario was run three times in a row as part of each study macro. The results can vary depending upon the order that the study cases are run as certain calculations within ETAP are run using the initial bus voltages in the bus editor. The multiple runs assure a unique solution is reached regardless of the bus voltages in the bus editors prior to each load flow run. The precision for each study case is not accurate enough to guarantee a unique solution. The scenarios used to calculate the loading on the DG during each time step are listed below along with the relevant ETAP settings, configurations, etc. Note that these same scenarios are used in both the Unit 2 and Unit 3 ETAP files as the 2/3 EDG is modeled in each file.

Unit 2/3 Diesel Generator

Scenario	Configuration	Study Case	DG Voltage	Output Report	Study Macro	Description
DG2/3_Bkr_Cl	DG2/3_Bkr_Cl	DG_0_CCSW	4160V	DG23_Bkr_Close	DG23_Vnormal	Initial loading on DG due to 480V loads when DG breaker closes
DG2/3_UV_Rst	DG2/3_UV_Rst	DG_0_CCSW	4160V	DG23_UV_Reset	DG23_Vnormal	Scenario DG2/3_Bkr_Cl plus 1st LPCI pump and auxiliaries
DG2/3_T=5sec	DG2/3_T=5sec	DG_0_CCSW	4160V	DG23_T=5sec	DG23_Vnormal	Scenario DG2/3_UV_Rst plus 2nd LPCI pump
DG2/3_T=10s	DG2/3_T=10s	DG_0_CCSW	4160V	DG23_T=10sec	DG23_Vnormal	Scenario DG2/3_T=5sec plus Core Spray Pump and Auxiliaries
DG2/3_T=10-m	DG2/3_T=10-m	DG_0_CCSW	4160V	DG23_T=10-min	DG23_Vnormal	Scenario DG2/3_T=10s minus MOV that have completed stroke
DG2/3_T=10+m	DG2/3_T=10+m	DG_1_CCSW	4160V	DG23_T=10+min	DG23_Vnormal	Scenario DG2/3_T=10-m plus 1st CCSW pump and Auxiliaries
DG2/3_T10++m	DG2/3_T10++m	DG_2_CCSW	4160V	DG23_T=10++min	DG23_Vnormal	Scenario DG2/3_T=10+m plus 2nd CCSW pump and Auxiliaries minus 1 LPCI pump.
DG2/3_CRHVAC	DG2/3_CRHVAC	DG_2_CCSW	4160V	DG23_CR_HVAC	DG23_Vnormal	Scenario DG2/3_T10++m plus all long term loads
DG23_Bkr_Vlo	DG2/3_Bkr_Cl	DG_Vreduced	2246V	DG23_Bkr_Vred	DG23_Vreduce	Scenario DG2_Bkr_Cl run at lowest expected voltage
DG23_UV_Vlow	DG2/3_UV_Rst	DG_Vreduced	2246V	DG23_UV_Vred	DG23_Vreduce	Scenario DG2_UV_Reset run at lowest expected voltage
DG23_T=5sVlo	DG2/3_T=5sec	DG_Vreduced	2246V	DG23_T=5sVred	DG23_Vreduce	Scenario DG2_T=5sec run at lowest expected voltage
DG23_T10-mVl	DG2/3_T=10-m	DG_Vreduced	2246V	DG23_T=10-mVred	DG23_Vreduce	Scenario DG2_T=10-min run at lowest expected voltage

R4

METHODOLOGY (cont'd)

C. Transient Loading Evaluation. R3

The following attachments are used to determine and develop the transient loading of the DG:

- Tables 1A & 1B
- Table 4A & 4B
- Flow Chart 1
- Use of Dead Load Pickup Curve.

The following formulas will be used to determine the starting KVA on the DG at each step from the motor data provided and the ETAP reduced voltage scenarios. R3

Calculating starting KVA ($SKVA_R$) at the machine's rated voltage (V_R)

$$SKVAR = \sqrt{3}\ V_R\ I_{LRC}$$

where, I_{LRC} is the machine's Locked Rotor Current

Calculating starting KVA (SKVA) at a different voltage (V_2)

$$SKVA\ @\ V_2 = (V_2)^2 / (V_R)^2 \times SKVA_R$$

METHODOLOGY (cont'd)

The starting kW/kVAR for the starting loads in each step will be calculated and tabulated separately in Tables 4A & 4B.

The reduced voltage ETAP files are run for each timeframe immediately preceeding a large motor start with the exception of the last CCSW pump which is bounded by a start of the 1st CCSW pump. The reduced DG terminal voltage is equal to or lower than the voltage dip during the most severe starting step. The reduced terminal voltage will be used to determine an incremental increase in current caused by the running loads operating at lower than rated voltage.

The difference in current will be reflected as the equivalent kw/kvar at full voltage (at the power factor of the running loads) and added to the total starting kw/kvar of the starting loads to determine the net starting KVA.

The power factor of the running load is taken from ETAP.

Calculating the incremental KVA for previously running loads is done as follows:

$I_{Curr@100\%}$ = Taken from ETAP output report from study cases run at nominal voltage R4

$I_{Curr@reduced\ voltage}$ = Taken from ETAP output report from DG_Vreduced study cases

$\Delta I = I_{Curr@reduced\ voltage} - I_{Curr@100\%}$

$\Delta KVA = \Delta I \times \sqrt{3} \times 4.16KV$

Conservatively, the worst voltage dip case due to the presence of running load will be applied to all large motor starting cases. The previous calculation revisions show that the largest voltage dip occurs when the Core Spray Pump starts. Revision 10 of Calculation 7317-33-19-3 shows that the voltage dip is 54.3% of bus rated voltage for Unit 2 and 54.5% of bus rated voltage for Unit 3 when the first LPCI Pump is starting. For conservatism, 54.0% (i.e. 2246V) of bus rated voltage will be used for all running load conditions.

The voltage dip and one second recovery at the DG for the initial start at breaker closing is determined from the EMD's Dead Load Pickup Curve #SSC-5056 (Ref. 13) by using the total starting KVA value from Table 4. Following the initial start, the total KVA is determined by vectorially adding the step starting load KW/KVAR from Table 4, the ΔKVA changed to KW/KVAR of the running load of the previous scenario in the ETAP file, and the starting KW/KVAR of the 4000V motor

that is starting to determine the total starting KVA, which is then used to determine the voltage dip and one second recovery at the DG terminals.

The Dead Load Pickup Curve provides initial voltage dip and recovery after 1 second following a start based on the DG transient starting load. The curve includes the combined effect of the exciter and the governor in order to provide recovery voltages. The voltage dip and recovery analysis utilizes the results of dynamic DG characteristics reflected in the manufacturer's curve. Though the curve shows voltage recovery up to 1 second, the voltage will continue to improve after 1 second due to exciter and governor operation. The DG Strip Chart for the surveillance test (Ref. 23) shows the voltage improvement past I second.

METHODOLOGY (Cont'd)

that is starting to determine the total starting KVA, which is then used to determine the voltage dip and one second recovery at the DG terminals.

The Dead Load Pickup Curve provides initial voltage dip and recovery after 1 second following a start based on the DG transient starting load. The curve includes the combined effect of the exciter and the governor in order to provide recovery voltages. The voltage dip and recovery analysis utilizes the results of dynamic DG characteristics reflected in the manufacturer's curve. Though the curve shows voltage recovery up to 1 second, the voltage will continue to improve after 1 second due to exciter and governor operation. The DG Strip Chart for the surveillance test (Ref. 23) shows the voltage improvement past 1 second.

To determine motor starting terminal voltage, the cable voltage drop is calculated using the locked rotor current at rated voltage. This is conservative since the locked rotor current is directly proportional to applied voltage.

D. Analysis of control circuits during motor starting transient voltage dip.

When the DG starts a large motor, the momentary voltage dip can be below 70% of generator rated voltage. There is a concern whether momentary low voltage could cause certain control circuits to drop-out. Table 2 of this calculation analyzes the effect of an ac momentary voltage dip on the operation of the mechanical equipment. This table analyzes the momentary voltage dip at 5 seconds & 10 seconds after UV reset; and 10 minutes and after for its effect on the operation of mechanical equipment.

E. Protective device evaluation and MOV operating time effects during motor starting transient voltage dip

The voltage recovery after one second will be evaluated for net effect on the protective devices The duration of starting current is expected to be shorter than operation from offsite power source because of better DG voltage recovery. Because protective devices are set to allow adequate starting time at motor rated voltage and during operation from offsite power, protective device operation due to overcurrent or longer operating time is not expected to be a concern when operating from the DG power during LOOP concurrent with LOCA.

METHODOLOGY (Cont'd)

F. **Methodology for Determining Starting Time of Large Motors.** (Ref. 42)

To determine large motor starting times, the time needed for the motor to accelerate through an increment of motor speed will be found. This will be accomplished by determining from motor and load speed-torque curves net accelerating torque (i.e. the difference between the torque produced by the motor and the torque required by the load) for each increment of speed. Using the combined motor and load inertia, the time needed to accelerate through the increment of speed can be calculated. All the time intervals will be summed to obtain a total motor starting time. Since motor torque is directly proportional to the square of applied terminal voltage, values obtained from the 100% rated voltage speed-torque curve will be adjusted downward for lower than rated applied terminal voltage. And, since this calculation determines for each motor start an initial voltage and a recovery voltage after 1 second, these two values will be used when adjusting motor torque for applied terminal voltage (i.e. *For the initial speed increment and all subsequent increments occuring 1 second or less from the beginning of the motor start period, the initial voltage value will be used to determine motor torque. All later increments will use the 1 second recovery voltage value.*) The time for each speed increment will be found using the following process:

1) At each speed increment, the motor torque will be found at the initial or 1 second recovery motor terminal voltage, as appropriate this will be done using the equation:

   $T = [(Vterm)^2 / (Vrated)^2] \times$ Motor Base Torque x 100% Voltage Motor Torque from speed-torque curve

2) At each speed increment, load torque will be obtained *from the load speed-torque curve.*

3) *The torque of the load is subtracted from the determined motor torque to obtain the net accelerating torque.*

4) Finally the time fo accelerate through an RPM increment is found using the following equation:

   $t = [WK^2(\text{pump + motor}) \times \text{RPM increment}] / (307.5 \times \text{Net Accelerating Torque})$

5) All the time increments are summed to obtain the total motor starting time.

X CALCULATIONS AND RESULTS

The following set of Calculations and Results are for the condition when DG 2/3 is powering the Unit 2 buses.

A. Loading Scenarios:

Dresden Re-baselined Updated FSAR, Rev. 0, loading table 8.3-3 shows that the maximum DG 2/3 loading during LOOP is only **1552 kW**.

Dresden Station Fire Protection Reports - Safe Shutdown Report dated July 1993, Table 3.1-1, shows that the maximum loading on DG 2/3 is **1541 kW**, (Note: Note 3 of Table 3.1-1 was considered when calculating this loading).

Also, the Dresden Re-baselined Updated FSAR, Rev. 0, Figure 8.3-6 shows that the maximum loading on DG 2/3 during LOOP concurrent with LOCA is **2328 kW**

By comparing all three conditions, it is concluded that the combination of LOOP concurrent with LOCA is the worst case of DG loading. Therefore, LOOP concurrent with LOCA scenario was analyzed in detail in this calculation.

The load values for the three conditions stated above are historical values and are used only for comparison of load magnitudes to determine the worst-case loading scenario for the Diesel Generator. For currently predicted loading values on the diesel generator, see Section XI, Subsection A, "Continuous Loading of the Diesel Generator".

B. Continuous Loading

Table 1A was developed to show loads powered by the DG and the loads that will be automatically activated when the Bus 23-1 (DG output) breaker closes to 4-kV Bus 40 following LOOP concurrent with LOCA. The ETAP model was then set up using the "DG Ld 0 CCSW", DG Ld 1 CCSW" and "DG Ld 2 CCSW" loading categories and the configurations to model the loads as described in the methodology section. The 2nd CCSW Pump is manually started and a LPCI Pump is turned off to stay within the DG capacity. R4

Also, for conservatism the Diesel Fuel Oil Transfer Pumps are shown as operating from 0 seconds, even though these pumps will not operate for the first few hours because the Day Tank has fuel supply for approximately four hours.

C. DG Terminal Voltages under Different Loading Steps

Figure 2A Load vs Time profile of starting loads for the DG was developed from Table 1A showing loads operating at each different time sequence. The values for the running loads in kW/kVAR/kVA were taken from the appropriate ETAP output report, and the starting values for 480V loads are calculated in Table 4A. The following is a sample calculation for LPCI Pump 2A showing the determination of motor starting kVA and starting time. It is shown for demonstrative *purposes only (based on Rev. 3). Actual calculations for the Unit 2 4.16 kV motors is contained* in Section 10.1. This sample calculation is based on use of the ETAP program. R4

X **CALCULATIONS AND RESULTS** (cont'd)

Starting LPCI Pump 2A (700HP) **(FOR DEMONSTRATION ONLY)**

i) Starting KVA of LPCI Pump 2A

Base Voltage (Motor rated voltage)	4000V (4.0kV)
Operating voltage	4160V (4.16kV)
Base current (FLC)	90A
LRC	7 Times FLC
Starting Power Factor (SPF%)	20%

Calculating the starting KVA at base voltage

$SKVA_1 = \sqrt{3} \times 4.0kV \times (90A \times 7.00) = 4365$ KVA

Starting KVA @ Operating voltage = $(4160V)^2/(4000V)^2 \times 4365KVA = 4721KVA$ @20%PF

The starting KVA is converted at starting power factor to the following KW and KVAR values:

Starting KW = 4721KVA x 0.20PF = 944.2KW

Starting KVAR = 4721KVA x $(\sin[\cos^{-1} 0.20PF])$ = 4625.6KVAR

The initial voltage dip (Based on 4721KVA) due to starting the first LPCI Pump alone from the Dead Load Pickup Curve #SC-5056 and multiplying by 0.97 to account for -3% curve tolerance is

= (69.8% X 0.97) = 67.7% of 4160V

ii) When LPCI Pump starts, the LPCI Core Spray Area Cooling Unit 2A, and MOV 2-1501-13A will also start operating. The starting load is summarized in Table 4A, with the results as follows:

Starting auxiliary load = 20.6 + j28.4

iii) When the first LPCI Pump starts, at that time there are running loads on DG powered buses. Therefore, the actual voltage drop on the bus is assumed to be more than the starting of the LPCI Pump alone. The running KVA from ETAP supplied by the Unit 2/3 EDG is 513 KVA (398kW and 323kVAR). R3

X. CALCULATIONS AND RESULTS (cont'd)

The current at 100% voltage (i.e. at 4160 volts) from ETAP is

$I_{run@100\%}$ = 71.2 amps

The kVAR & kW from ETAP scenario DG23_Bkr_Vlo at reduced voltage are 221 kVAR & 339 kW.

The power factor from the same ETAP scenario at the reduced voltage running load is R3

PF = 0.838 PF

The calculated current at the reduced voltage dip for this KVA load from ETAP is

$I_{run@reduced\ voltage}$ = 104.0 amps

The incremental difference of current is

ΔI = 104.0 amps – 71.2 amps = 32.80 amps R3

The incremental KVA (ΔKVA) used to determine additional starting KVA is

$\Delta KVA = \sqrt{3} \times 4.160\ kV \times 32.8\ amps = 236.3\ KVA$ R3

The incremental running load equivalent is converted to an equivalent kW/kVAR from the incremental KVA previously determined.

Incremental running load KW = 236.3 kVA x 0.838 PF = 198.05 kW

Incremental running load KVAR
= 236.3 kVA x (sin[$\cos^{-1}$ 0.838 PF]) = 128.96 kVAR R3

X. CALCULATIONS AND RESULTS (cont'd)

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

Starting Auxiliary Load	20.6+j28.4
Incremental running load equivalent	198.05 + j128.96
LPCI Pump 2C Starting load	944.19 + j4625.55
Total Starting KVA equivalent	1162.84 + j4782.91

R3

Vector starting KVA = $\sqrt{[(1162.84)^2 + (4782.91)^2]}$ = 4922.24 kVA

R3

From Dead Load Pickup Curve (SC-5056) the initial starting voltage and 1 second recovery voltage (Based on 4922.24 kVA) and multiplying by 0.97 to account for - 3% curve tolerance (For Demonstration Only)

Initial Voltage drop = (68.9% x 0.97) = 66.83% of 4160V

Voltage recovery after 1 second = (95.3% x 0.97) = 92.44% of 4160V

R3

v) The feed cable of LPCI Pump 2A is 3/C - #1/0 - 5 kV, and the cable number is 20900. The length of the cable is 241 feet and this length is taken from ETAP. R3

The impedance of the cable (Ref. S&L Standard ESA-102) is:

Z_{cable} = 241 ft. x [(0.0128 + j0.00384 ohms)/100ft p.u. imp.]

Z_{cable} = 0.03085 + j0.00925 ohms

$|Z_{cable}| = \sqrt{[(0.03085)^2 + (0.00925)^2]}$ = 0.032207 ohms

R3

The maximum motor terminal line-to-line voltage drop which may occur on this cable where 630 amps is the LRC is:

ΔVcable = $\sqrt{3}$ x 630 amps x 0.032207 ohm = 35.14 volts (0.84% of 4160V) R3

X. **CALCULATIONS AND RESULTS (cont'd)**

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminal, the initial starting voltage at the motor terminals is

66.83% - 0.84% = 65.99% of 4160V R3

The voltage after 1 second at the motor terminals is

92.44% - 0.84% = 91.60% of 4160V R3

The process as demonstrated above determines the initial starting voltage and voltage after 1 second. See Section 10.1 for actual numbers corresponding to Unit 2, and Section 10.2 for actual numbers corresponding to Unit 3.

X. **CALCULATIONS AND RESULTS (cont'd)**

Starting Time Calculations (FOR DEMONSTRATION ONLY)

1) LPCI Pump 2A

Initial (Starting) Voltage (@ motor) 65.99% of 4160v = 2745.18 volts
Voltage at 1 second (@ motor) 91.60% of 4160v = 3810.56 volts R3

Motor Base Torque - 1030 ft-lb

WK2 Pump (wet)	- 18.1 $lb\text{-}ft^2$
WK2 Motor	- 190.0 $lb\text{-}ft^2$
Total WK2	- 208.1 $lb\text{-}ft^2$

Motor Torque at 2745.18 volts

$$T = [(2745.18V)^2 / (4000V)^2] \times 1030 \text{ ft-lb} \times 100\% \text{ voltage} \times \text{Motor Torque from speed-torque curve}$$ R3

$$= 485.13 \times 100\% \text{ voltage} \times \text{Motor Torque from speed-torque curve (Ref. 42)}$$

Motor Torque at 3810.56 volts R3

$$T = [(3810.56)^2 / (4000)^2] \times 1030 \text{ ft-lb} \times 100\% \text{ voltage} \times \text{Motor Torque from speed-torque curve}$$

$$= 934.75 \times 100\% \text{ voltage} \times \text{Motor Torque from speed-torque curve}$$ R3

CALCULATION PAGE

X. CALCULATIONS AND RESULTS (cont'd)

FOR DEMONSTRATION ONLY)

% RPM	RPM	Voltage %	Motor Torque From Curve	Motor Torque lb - ft	Pump Torque From Curve	Pump Torque lb - ft	Net Torque lb - ft	Time in Seconds
0 - 10	360	65.99	0.80	388.08	0.0	0.00	388.08	0.63
10 - 20	360	65.99	0.80	388.08	0.02	20.60	367.48	0.66
20 - 30	360	91.60	0.81	757.08	0.05	51.50	705.58	0.35
30 - 40	360	91.60	0.82	766.43	0.06	61.80	704.63	0.35
40 - 50	360	91.60	0.83	775.78	0.10	103.00	672.78	0.36
50 - 60	360	91.60	0.85	794.47	0.15	154.50	639.97	0.38
60 - 70	360	91.60	0.92	859.90	0.19	195.70	664.20	0.37
70 - 80	360	91.60	1.07	1000.10	0.25	257.50	742.60	0.33
80 - 90	360	91.60	1.50	1402.01	0.32	329.60	1072.41	0.23
90 - 95	180	91.60	2.20	2056.28	0.38	391.40	1664.88	0.07
95 - 99	144	91.60	2.35	2196.48	0.43	442.90	1753.58	0.06
							TOTAL	3.78

R3

Notes for the table above:

1. Motor Torque in above table is from GE drawing 257HA264 (Reference 15).
2. Motor Torque in above table is read from mid-point of applicable speed range.
3. Motor Torque in lb-ft is obtained by multiplying the torque from the curve by motor at applicable voltage.
4. Pump torques are from GE Curve 257HA264 (3% bypass) (Reference 15) and then multiplied by base torque of motor.
5. Net Torque is motor torque minus pump torque, both in lb-ft.
6. Time in Seconds to accelerate through an RPM Increment =

$$\frac{[WK^2(\text{Pump + Motor}) \times \text{RPM Increment}]}{(307.5 \times \text{Net Torque})}$$

X. CALCULATIONS AND RESULTS (cont'd)

The following table summarizes the motor starting times from Section 10.1.

Device	Total Starting Time (Seconds)	Starting Time Allowed (Seconds) (See IV.AP)
LPCI Pump 2A	3.78	5
LPCI Pump 2B	3.90	5
Core Spray Pump 2A	4.09	5

R3

D. Control Circuit Evaluation for Voltage Dips

R3

The voltage recovery is more than 87% after one second following the Core Spray motor start. The voltage will continue to improve after one second due to the exciter and the governor characteristics. These voltages during motor starting period (after the initial dip) are much better than the voltages expected during the operation from the offsite source. Table 2A has evaluated the effects on the control circuits of all services on the DG and has determined any transient effect during the short initial voltage dip and no lasting effects have been identified.

E. Protective Device Operation during Voltage Dips

R3

The voltage recovery is more than 87% after one second following the Core Spray motor start. The voltage will continue to improve after one second due to the exciter and the governor characteristics. These voltages during motor starting period (after the initial dip) are much better than the voltages expected during the operation from the offsite source. Therefore, the duration of starting current is shorter than operation from offsite power source. Because protective devices are set to allow adequate starting time at motor rated voltage and during operation from offsite power, protective device operation due to overcurrent is not a concern when operating from the DG power during LOOP concurrent with LOCA.

X. CALCULATIONS AND RESULTS (cont'd)

F. Results of calculations

The results of the calculation included in Section 10.1 show that the minimum voltage drop to the DG powered buses occur when the Core Spray Pump starts. The table below shows the starting (at 0.1 sec.) voltages and recovery voltages after 1 second following the start at Bus 23-1.

Equipment Description	Starting KVA	Voltage Drop @ 0.1 Second	Voltage Recovery after 1 second
LPCI Pump 2A	4924.1	66.83% of 4160V	92.44% of 4160V
LPCI Pump 2B	5230.4	65.57% of 4160V	91.37% of 4160V
Core Spray Pump	6570.3	60.72% of 4160V	87.11% of 4160V
CCSW Pump 2B	4477.1	68.97% of 4160V	93.90 % of 4160V

R4

During LOOP concurrent with LOCA there is a 5 second time delay from the start of the first LPCI Pump to the start of the second LPCI Pump. Starting time calculations for the LPCI Pumps show that both the pumps accelerate to full speed in under 4 seconds. Therefore by the time the second LPCI Pump starts, the first LPCI Pump is at full speed (i.e. running load). There is also a 5 second time delay from the start of the second LPCI Pump to the start of the Core Spray Pump. Therefore, by the time the Core Spray pump starts, the second LPCI Pump is at full speed.

X. CALCULATIONS AND RESULTS (cont'd)

The following set of Calculations and Results are for the condition when DG 2/3 is powering the Unit 3 buses.

A. Loading Scenarios:

Dresden Re-baselined Updated FSAR, Rev. 0, loading table 8.3-3 shows that the maximum DG 2/3 loading during LOOP is only **1552 kW**.

Dresden Station Fire Protection Reports - Safe Shutdown Report dated July 1993, Table 3.1-1, shows that the maximum loading on DG 2/3 is **1541 kW**, (Note: Note 3 of Table 3.1-1 was considered when calculating this loading).

Also, the Dresden Re-baselined Updated FSAR, Rev. 0, Figure 8.3-7 shows that the maximum loading on DG 2/3 during LOOP concurrent with LOCA is **2343 kW**.

By comparing all three conditions, it is concluded that the combination of LOOP concurrent with LOCA is the worst case of DG loading. Therefore, LOOP concurrent with LOCA scenario was analyzed in detail in this calculation.

The load values for the three conditions stated above are historical values and are used only for comparison of load magnitudes to determine the worst-case loading scenario for the Diesel Generator. For currently predicted loading values on the diesel generator, see Section XI, Subsection A, "Continuous Loading of the Diesel Generator".

B. Continuous Loading

Table 1B was developed to show loads powered by the DG and the loads that will be automatically activated when the Bus 33-1 (DG output) breaker closes to 4-kV Bus 40 following LOOP concurrent with LOCA. The ETAP model was then set up using the "DG Ld 0 CCSW", "DG Ld 1 CCSW" and "DG Ld 2 CCSW" loading categories and the configurations to model the loads as described in the methodology section. The 2nd CCSW Pump is manually started and a LPCI Pump is turned off to stay within the DG capacity. R4

Also, for conservatism the Diesel Fuel Oil Transfer Pumps are shown as operating from 0 seconds, even though these pumps will not operate for the first few hours because the Day Tank has fuel supply for approximately four hours.

C. DG Terminal Voltages under Different Loading Steps

Figure 2B Load vs Time profile of starting loads for the DG was developed from Table 1B showing loads operating at each different time sequence. The values for the running loads in kW/kVAR/kVA were taken from the appropriate ETAP output report, and the starting values for 480V loads are calculated in Table 4B. The calculations included in Section 10.2 show the determination of the motor starting kVA and starting time for Unit 3, 4 kV motors. Calculations performed in Section 10.2 follow the sample calculation presented for a Unit 2 LPCI Pump motor.

X. CALCULATIONS AND RESULTS (cont'd)

The following table summarizes the motor starting times from Section 10.2.

Device	Total Starting Time (Seconds)	Starting Time Allowed (Seconds) (See IV.AP)
LPCI Pump 3A	3.79	5
LPCI Pump 3B	3.92	5
Core Spray Pump 3A	4.10	5

R4

R4

E. Control Circuit Evaluation for Voltage Dips

The voltage recovery is at least 87% after one second following the Core Spray motor start. The voltage will continue to improve after one second due to the exciter and the governor characteristics. These voltages during motor starting period (after the initial dip) are much better than the voltages expected during the operation from the offsite source. Table 2B has evaluated the effects on the control circuits of all services on the DG and has determined any transient effect during the short initial voltage dip and no lasting effects have been identified.

F. Protective Device Operation during Voltage Dips

The voltage recovery is at least 87% after one second following the Core Spray motor start. The voltage will continue to improve after one second due to the exciter and the governor characteristics. These voltages during motor starting period (after the initial dip) are much better than the voltages expected during the operation from the offsite source. Therefore, the duration of starting current is shorter than operation from offsite power source. Because protective devices are set to allow adequate starting time at motor rated voltage and during operation from offsite power, protective device operation due to overcurrent is not a concern when operating from the DG power during LOOP concurrent with LOCA.

X. CALCULATIONS AND RESULTS (cont'd)

G. **Results of calculations**

The results of the calculation show that the minimum voltage drop to the DG powered buses occur when the Core Spray Pump starts. The table below shows the starting (at 0.1 sec.) voltages and recovery voltages after 1 second following the start at Bus 33-1.

Equipment Description	Starting KVA	Voltage Drop @ 0.1 Second	Voltage Recovery after 1 second
LPCI Pump 3A	4937.2	66.74% of 4160V	92.25% of 4160V
LPCI Pump 3B	5241.7	65.48% of 4160V	91.37% of 4160V
Core Spray Pump	6550.1	60.72% of 4160V	87.11% of 4160V
CCSW Pump 3A	4502.8	67.80% of 4160V	93.80 % of 4160V

R4

During LOOP concurrent with LOCA there is a 5 second time delay from the start of the first LPCI Pump to the start of the second LPCI Pump. Starting time calculations for the LPCI Pumps show that both the pumps accelerate to full speed in under 4 seconds. Therefore by the time the second LPCI Pump starts, the first LPCI Pump is at full speed (i.e. running load). There is also a 5 second time delay from the start of the second LPCI Pump to the start of the Core Spray Pump. Therefore, by the time the Core Spray pump starts, the second LPCI Pump is at full speed.

X. **CALCULATION AND RESULTS** (Cont.)

SECTION 10.1

Calculation of Inital Voltage and Recovery Voltage after 1 Second following the start of each 4 kV Motor, and Calculation of Motor Starting Times, when DG2/3 is powering Unit 2 Buses

1) Starting kVA of the DG auxiliaries after the closure of the DG output breaker (Page C1 & C2 Calculation)

Aggregate $SKW = 856.1$ (Ref. Table 4A)
Aggregate $SKVAR = 1338.2$ (Ref. Table 4A) R4
Aggregate $SKVA = SKW + j\,SKVAR$
$SKVA = 856.1 + j1338.2$
$|SKVA| = 1588.61$ R4

$$\text{Angle} = \tan^{-1}(SKVAR/SKW)$$

Angle = 57.39 Degrees R4

To determine the initial starting voltage (V_{curve_i}) and 1 second recovery voltage (V_{curve_1}), use the Dead Load Pickup Curve (SC-5056) and SKVA (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_i} = 88.1\%$ of 4160V R4
$V_{dip} = V_{curve\_i} \times 0.97$
$V_{dip} = 85.5\%$ of 4160V R4

Voltage recovery after 1 second:

$V_{curve\_1} = 100.0\%$ of 4160V
$V_{recovery} = V_{curve\_1} \times 0.97$
$V_{recovery} = 97.0\%$ of 4160V

2) Starting of First LPCI Pump 2A (700HP)

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 18)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 90	Amps	(Ref. 18)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 18)
	I_{LRC} = 630.0		
Starting Power factor	PF_{start} = 0.20		(Ref. 18)

Motor Cable data

Conductor Size	3/C - #1/0 -5kV		
Cable Number	20900		
Cable Length (feet)	L = 241	(ETAP)	R2
Cable Impedance (ohms)	$Z_{cable} = 0.03085 + j0.00925$	(ETAP)	R2

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated}$ = 1030	ft-lb	(Ref. 15)
WK^2 Pump (wet)	WK_{pump} = 18.1	lb-ft^2	(Ref. 15)
WK^2 Motor	WK_{motor} = 190.0	lb-ft^2	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of LPCI Pump 2A

Calculating the starting kVA at base voltage

$SKVA_1 = \sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\qquad SKVA_1 = 4364.8$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\qquad KVA_{start1} = 4720.9$ $\qquad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$LPCI_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$

$LPCI_{start} = 944.19 + j4625.55$ kVA

ii) When the LPCI Pump starts, the LPCI Core Spray Pump Area Cooling Unit 2A, and MOV 2-1501-13A will also start operating. The starting load is summarized in Table 4A, with the results as follows:

Additional Starting auxiliary load: $Load_{start} = 20.6 + j28.4$ kVA

iii) When the first LPCI Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the first LPCI Pump alone. The running kW & kVA from the ETAP DG2/3_Bkr_CI scenario is:

$KW_{ETAP\_100\%} = 388$

$KVAR_{ETAP\_100\%} = 337$ R4

$KVA_{ETAP\_100\%} = 514$

The current at 100% voltage (i.e. at 4.16kV) is:

$I_{run\_100\%} = 71.2$ Amps R4

The KVA & KW from the special ETAP scenario DG2/3_Bkr_VI for the reduced voltage condition are:

$V_{reduced} = 2246$ Volts

$KW_{reduced} = 327$

$KVAR_{reduced} = 233$ R4

$KVA_{reduced} = 402$

The power factor from the same ETAP scenario at reduced voltage running load is:

$PF_{reduced} = 0.814$ R4

The calculated current at the reduced voltage for this kVA load is:

$I_{reduced} = 103.1$ Amps R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$I_{delta} = 31.90$ Amps | R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000$ $KVA_{delta} = 229.9$ | R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\mathrm{acos}(PF_{reduced})))]$$

$KVA_{increment} = 187.1 + j133.51$ kVA | R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

LPCI Pump 2A starting load:	$LPCI_{start} = 944.19 + j4625.55$	kVA	
Additional starting load:	$Load_{start} = 20.6 + j28.4$	kVA	
Incremental running load equiv.:	$KVA_{increment} = 187.1 + j133.51$	kVA	R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + LPCI_{start}$$

$Total_{start} = 1151.88 + j4787.46$ kVA | R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$Vector_{start} = 4924.09$ kVA | R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial}$ = 68.9% of 4160V R2

$V_{drop} = V_{curve\_initial} \times 0.97$

V_{drop} = 66.83% of 4160V R2

Voltage recovery after 1 second:

V_{curve_1sec} = 95.3% of 4160V R2

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

V_{drop_1sec} = 92.44% of 4160V

v) The impedance of the pump feed cable, as defined earlier: R2

$Z_{cable} = 0.03085 + j0.00925$ ohms

$|Z_{cable}| = 0.0322$ ohms

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

$I_{LRC} = 630.0$ Amps

$V_{delta\_max} = (\sqrt{3} \times I_{LRC} \times |Z_{cable}|)$ $V_{delta\_max} = 35.14$ Volts R2

$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$ $V_{delta\_\%} = 0.84\%$ of 4160V

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$V_{initial.LPCI2A} = V_{drop} - V_{delta\_\%}$

$V_{initial.LPCI2A} = 65.99\%$ of 4160V | R2

The voltage after 1 second at the motor terminals is:

$V_{1second.LPCI2A} = V_{drop\_1sec} - V_{delta\_\%}$

$V_{1second.LPCI2A} = 91.60\%$ of 4160V | R2

<u>Calculation of Motor Starting Time:</u>

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.LPCI2A} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.LPCI2A} /100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 190.0$ lb-ft^2

$WK2 = WK_{pump} + WK_{motor}$

$WK2 = 208.10$ lb-ft^2

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (i.e. Vi until 1 second, V1 after that).

R2

%rpm$_o$	%rpm$_f$	%Torque$_{Motor}$	%Torque$_{Pump}$	%Volt
0	10	0.80	0.00	Vi
10	20	0.80	0.02	Vi
20	30	0.81	0.05	V1
30	40	0.82	0.06	V1
40	50	0.83	0.10	V1
50	60	0.85	0.15	V1
60	70	0.92	0.19	V1
70	80	1.07	0.25	V1
80	90	1.50	0.32	V1
90	95	2.20	0.38	V1
95	99	2.35	0.43	V1

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

$$V_{OP} = 4160 \quad \text{Volts}$$

$$V_{base} = 4000 \quad \text{Volts}$$

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = \overrightarrow{(\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{Net})} \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

Time_{cumul} = Total Cumulative Start Time

R2

Calculations:

$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	$\%Torque_{Net}$	Time	$Time_{cumul}$
10	388.08	0.00	388.08	0.63	0.63
20	388.08	20.60	367.48	0.66	1.29
30	757.08	51.50	705.58	0.35	1.64
40	766.43	61.80	704.63	0.35	1.98
50	775.78	103.00	672.78	0.36	2.34
60	794.47	154.50	639.97	0.38	2.72
70	859.90	195.70	664.20	0.37	3.09
80	1000.10	257.50	742.60	0.33	3.42
90	1402.01	329.60	1072.41	0.23	3.65
95	2056.28	391.40	1664.88	0.07	3.72
99	2196.48	442.90	1753.58	0.06	3.78

R2

Therefore, the total time for this pump to accelerate is: $\text{Time}_{cumul10}$ = 3.78 seconds

3) <u>Starting LPCI Pump 2B (700HP)</u>

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 56)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 90	Amps	(Ref. 56)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 56)
	I_{LRC} = 630.0		
Starting Power factor	PF_{start} = 0.20		(Ref. 39)

Motor Cable data

Conductor Size	3/C - #1/0 -5kV		
Cable Number	20906		
Cable Length (feet)	L = 237	(ETAP)	R2
Cable Impedance (ohms)	Z_{cable} = 0.03034 + j0.0091	(ETAP)	

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated}$ = 1030	ft-lb	(Ref. 15)
WK^2 Pump (wet)	WK_{pump} = 18.1	$lb\text{-}ft^2$	(Ref. 15)
WK^2 Motor	WK_{motor} = 190.0	$lb\text{-}ft^2$	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of LPCI Pump 2B

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\quad SKVA_1 = 4364.8$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\quad KVA_{start1} = 4720.93$ $\quad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$LPCI_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$

$LPCI_{start} = 944.19 + j4625.55$ kVA

ii) There are no additional loads starting with this pump:

Additional Starting auxiliary load: $Load_{start} = 0 + j0$ kVA

iii) When the second LPCI Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the second LPCI Pump alone. The running kW & kVA from the ETAP DG2/3_UV_Rst scenario is:

$KW_{ETAP\_100\%} = 901$
$KVAR_{ETAP\_100\%} = 587$
$KVA_{ETAP\_100\%} = 1075$ R4

The current at 100% voltage (i.e. at 4.16kV) in ETAP is:

$I_{run\_100\%} = 149.2$ Amps R4

The KVA & KW from the special ETAP scenario DG2/3_UV_Vlo for the reduced voltage condition are:

$V_{reduced} = 2246$ Volts
$KW_{reduced} = 843$
$KVAR_{reduced} = 485$
$KVA_{reduced} = 973$ R4

The power factor from the same ETAP scenario at reduced voltage running load is:

$PF_{reduced} = 0.866$ R4

The calculated current at the reduced voltage for this kVA load in ETAP is:

$I_{reduced} = 249.9$ Amps R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$$I_{delta} = 100.70 \quad \text{Amps}$$ R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000 \qquad KVA_{delta} = 725.6$$ R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\operatorname{acos}(PF_{reduced})))]$$

$$KVA_{increment} = 628.35 + j362.82 \quad \text{kVA}$$ R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

LPCI Pump 2B starting load:	$LPCI_{start} = 944.19 + j4625.55$	kVA
Additional starting load:	$Load_{start} = 0 + j0$	kVA
Incremental running load equiv.:	$KVA_{increment} = 628.35 + j362.82$	kVA R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + LPCI_{start}$$

$$Total_{start} = 1572.54 + j4988.37 \quad \text{kVA}$$ R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$$Vector_{start} = 5230.36 \quad \text{kVA}$$ R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial}$ = 67.6% of 4160V R2

$V_{drop} = V_{curve\_initial} \times 0.97$

V_{drop} = 65.57% of 4160V R2

Voltage recovery after 1 second:

V_{curve_1sec} = 94.2% of 4160V R2

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

V_{drop_1sec} = 91.37% of 4160V

v) The impedance of the pump feed cable, as defined earlier:

$Z_{cable} = 0.03034 + j0.0091$ ohms R2

$|Z_{cable}| = 0.0317$ ohms

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

I_{LRC} = 630.0 Amps

$V_{delta\_max} = \sqrt{3} \times I_{LRC} \times \lvert Z_{cable}\rvert$	V_{delta_max} = 34.56	Volts	R2
$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$	$V_{delta\_\%}$ = 0.83%	of 4160V	

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$$V_{initial.LPCI2B} = V_{drop} - V_{delta\_\%}$$

$$V_{initial.LPCI2B} = 64.74\% \quad \text{of } 4160V$$ R2

The voltage after 1 second at the motor terminals is:

$$V_{1second.LPCI2B} = V_{drop\_1sec} - V_{delta\_\%}$$

$$V_{1second.LPCI2B} = 90.54\% \quad \text{of } 4160V$$ R2

Calculation of Motor Starting Time:

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.LPCI2B} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.LPCI2B} /100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 190.0$ lb-ft^2

$$WK2 = WK_{pump} + WK_{motor}$$

$$WK2 = 208.10 \quad \text{lb-ft}^2$$

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (i.e. Vi until 1 second, V1 after that).

$\%rpm_o$	$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	%Volt
0	10	0.80	0.00	Vi
10	20	0.80	0.02	Vi
20	30	0.81	0.05	V1
30	40	0.82	0.06	V1
40	50	0.83	0.10	V1
50	60	0.85	0.15	V1
60	70	0.92	0.19	V1
70	80	1.07	0.25	V1
80	90	1.50	0.32	V1
90	95	2.20	0.38	V1
95	99	2.35	0.43	V1

R2

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

V_{OP} = 4160 Volts

V_{base} = 4000 Volts

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{Pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = (\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{Net}) \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

Time_{cumul} = Total Cumulative Start Time R2

Calculations:

$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	$\%Torque_{Net}$	Time	$Time_{cumul}$
10	373.55	0.00	373.55	0.65	0.65
20	373.55	20.60	352.95	0.69	1.34
30	739.78	51.50	688.28	0.35	1.70
40	748.91	61.80	687.11	0.35	2.05
50	758.04	103.00	655.04	0.37	2.42
60	776.31	154.50	621.81	0.39	2.81
70	840.24	195.70	644.54	0.38	3.19
80	977.23	257.50	719.73	0.34	3.53
90	1369.95	329.60	1040.35	0.23	3.77
95	2009.27	391.40	1617.87	0.08	3.84
99	2146.26	442.90	1703.36	0.06	3.90

R2

Therefore, the total time for this pump to accelerate is: $\text{Time}_{cumul10}$ = 3.90 seconds

4) Starting Core Spray Pump (800HP)

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 17)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 102	Amps	(Ref. 17)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 17)
	I_{LRC} = 714.0		
Starting Power factor	PF_{start} = 0.20		(Ref. 17)

Motor Cable data

Conductor Size	3/C - #4/0 -5kV		
Cable Number	20876		
Cable Length (feet)	L = 184	(ETAP)	R2
Cable Impedance (ohms)	Z_{cable} = 0.01176 + j0.00659	(ETAP)	

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated}$ = 1180	ft-lb	(Ref. 15)
WK^2 Pump (wet)	WK_{pump} = 18.1	lb-ft^2	(Ref. 15)
WK^2 Motor	WK_{motor} = 220.0	lb-ft^2	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of Core Spray Pump

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\qquad$ $SKVA_1 = 4946.7$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\qquad$ $KVA_{start1} = 5350.39$ $\qquad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$CoreSpray_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$

$CoreSpray_{start} = 1070.08 + j5242.29$ kVA

ii) When the Core Spray Pump starts, MOVs 1402-38A, 1402-25A, 1501-22A, 1502-21B, 202-9A, & 202-5A; and RX Building Emergency Lighting will also start operating. The starting load is summarized in Table 4A, with the results as follows:

Additional Starting auxiliary load: $Load_{start} = 185.5 + j320.1$ kVA

iii) When the Core Spray Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the Core Spray Pump alone. The running kW & kVA from the ETAP DG2/3_T=5sec scenario is:

$KW_{ETAP\_100\%} = 1414$

$KVAR_{ETAP\_100\%} = 835$ R4

$KVA_{ETAP\_100\%} = 1642$

The current at 100% voltage (i.e. at 4.16kV) from ETAP is:

$I_{run\_100\%} = 227.9$ Amps R4

The KVA & KW from the special ETAP scenario DG2/3_T=5sVI output at reduced voltage are:

$V_{reduced} = 2246$ Volts

$KW_{reduced} = 1358$

$KVAR_{reduced} = 737$ R4

$KVA_{reduced} = 1545$

The power factor from the same ETAP scenario at reduced voltage running load is:

$PF_{reduced} = 0.879$ R4

The calculated current at the reduced voltage for this kVA load in ETAP is:

$I_{reduced} = 397.2$ Amps R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$I_{delta} = 169.30$ Amps | R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000$ $\quad$ $KVA_{delta} = 1219.9$ | R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\operatorname{acos}(PF_{reduced})))]$$

$KVA_{increment} = 1072.26 + j581.66$ kVA | R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

Core Spray Pump starting load:	$CoreSpray_{start} = 1070.08 + j5242.29$	kVA	
Additional starting load:	$Load_{start} = 185.5 + j320.1$	kVA	
Incremental running load equiv.:	$KVA_{increment} = 1072.26 + j581.66$	kVA	R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + CoreSpray_{start}$$

$Total_{start} = 2327.84 + j6144.05$ kVA | R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$Vector_{start} = 6570.25$ kVA | R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial} = 62.6\%$ of 4160V R2

$V_{drop} = V_{curve\_initial} \times 0.97$

$V_{drop} = 60.72\%$ of 4160V R2

Voltage recovery after 1 second:

$V_{curve\_1sec} = 89.8\%$ of 4160V R2

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

$V_{drop\_1sec} = 87.11\%$ of 4160V

v) The impedance of the pump feed cable, as defined earlier: R2

$Z_{cable} = 0.01176 + j0.00659$ ohms

$|Z_{cable}| = 0.0135$ ohms

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

$I_{LRC} = 714.0$ Amps

$V_{delta\_max} = \sqrt{3} \times I_{LRC} \times |Z_{cable}|$ $V_{delta\_max} = 16.67$ Volts R2

$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$ $V_{delta\_\%} = 0.40\%$ of 4160V

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$V_{initial.CSP} = V_{drop} - V_{delta\_\%}$

$V_{initial.CSP} = 60.32\%$ of 4160V

The voltage after 1 second at the motor terminals is:

$V_{1second.CSP} = V_{drop\_1sec} - V_{delta\_\%}$

$V_{1second.CSP} = 86.71\%$ of 4160V | R4

Calculation of Motor Starting Time:

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.CSP} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.CSP} / 100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 220.0$ lb-ft^2

$WK2 = WK_{pump} + WK_{motor}$

$WK2 = 238.10$ lb-ft^2

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (i.e. Vi until 1 second, V1 after that).

$\%rpm_o$	$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	%Volt
0	10	0.89	0.00	Vi
10	20	0.90	0.00	Vi
20	30	0.90	0.02	V1
30	40	0.90	0.06	V1
40	50	0.90	0.13	V1
50	60	0.94	0.20	V1
60	70	1.02	0.26	V1
70	80	1.18	0.35	V1
80	90	1.61	0.46	V1
90	95	2.25	0.58	V1
95	99	2.35	0.65	V1

R2

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

$V_{OP} = 4160$ Volts

$V_{base} = 4000$ Volts

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{Pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = (\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{Net}) \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

Time_{cumul} = Total Cumulative Start Time

Calculations:

$\%rpm_{I}$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	$\%Torque_{Net}$	Time	$Time_{cumul}$
10	413.31	0.00	413.31	0.67	0.67
20	417.96	0.00	417.96	0.67	1.34
30	863.54	23.60	839.94	0.33	1.67
40	863.54	70.80	792.74	0.35	2.02
50	863.54	153.40	710.14	0.39	2.42
60	901.92	236.00	665.92	0.42	2.84
70	978.68	306.80	671.88	0.41	3.25
80	1132.20	413.00	719.20	0.39	3.64
90	1544.78	542.80	1001.98	0.28	3.92
95	2158.85	684.40	1474.45	0.09	4.01
99	2254.80	767.00	1487.80	0.07	4.09

R4

Therefore, the total time for this pump to accelerate is: $\text{Time}_{cumul10}$ = 4.09 seconds

5) <u>Starting of Containment Cooling Service Water Pump 2A (500HP)</u> R2

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 40)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 67	Amps	(Ref. 40)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 5.91$		(Ref. 40 & 43)
	I_{LRC} = 395.97		
Starting Power factor	PF_{start} = 0.20		(Ref. 41)

i) Starting kVA of CCSW Pump

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\qquad SKVA_1 = 2743.4$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\qquad KVA_{start1} = 2967.2$ $\qquad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

$CCSW_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$

$CCSW_{start} = 593.44 + j2907.27$ kVA

ii) The CCSW Pumps are turned on manually between 10 minutes and 2 hours depending on the situation. For the purpose of this calculation the CCSW Pump 2A is turned on by the operator after 10 minutes into the event and CCSW Pump 2B is turned on shortly after CCSW Pump 2A.

The CC Heat exchanger Discharge Valve is required to operate to exchange CC residual heat with the CCSW system. When CCSW Pump 2A starts, the Containment Cooling Heat Exchanger Discharge Valve also starts. When CCSW Pump 2B starts, the CC Heat Exchanger Discharge Valve is considered to be in operation (i.e. running load), however, at this time the CCSW Pump Cubical Cooler Fans (total 4) are also starting.

This calculation will only calculate the voltage dip due to the starting of CCSW Pump 2A (the first CCSW pump) instead of CCSW Pump 2B because starting kVA (due to the voltage dip) for the load already on the diesel when the 2A pump starts is the largest. However the 2A pump is evaluated with the starting kVA of the loads that start concurrently with the 2B CCSW pump as it is conservative. The starting load is summarized in Table 4A, with the results as follows: R2

Additional Starting auxiliary load: $Load_{start} = 56 + j60.3$ kVA

iii) When the CCSW Pump 2A starts, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the CCSW Pump 2A alone.

All of the valves which are initiated by LOOP/LOCA have completed their operations and have stopped operating before CCSW Pump 2A was started. Therefore, these valve loads are taken off from the initial running load.

The running kW & kVA from the ETAP scenario DG2/3_T=10-m is:

$$KW_{ETAP\_100\%} = 2151$$
$$KVAR_{ETAP\_100\%} = 1154$$
$$KVA_{ETAP\_100\%} = 2441$$

R4

The current at 100% voltage (i.e. at 4.16kV) from ETAP is:

$$I_{run\_100\%} = 338.7 \quad \text{Amps}$$

R4

The KVA & KW from the special ETAP scenario DG2/3_T10-ml for the reduced voltage condition is:

$$V_{reduced} = 2246 \quad \text{Volts}$$
$$KW_{reduced} = 2085$$
$$KVAR_{reduced} = 1058$$
$$KVA_{reduced} = 2338$$

R4

The power factor from the same ETAP scenario at reduced voltage running load is:

$$PF_{reduced} = 0.892$$

R4

The calculated current at the reduced voltage for this kVA load from ETAP is:

$$I_{reduced} = 600.7 \quad \text{Amps}$$

R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$I_{delta} = 262.00$ Amps | R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000$ $KVA_{delta} = 1887.8$ | R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(a\cos(PF_{reduced})))]$$

$KVA_{increment} = 1683.91 + j853.35$ kVA | R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

CCSW Pump 2B starting load:	$CCSW_{start} = 593.44 + j2907.27$	kVA	R4
Additional starting load:	$Load_{start} = 56 + j60.3$	kVA	
Incremental running load equiv.:	$KVA_{increment} = 1683.91 + j853.35$	kVA	

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + CCSW_{start}$$

$Total_{start} = 2333.36 + j3820.92$ kVA | R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$Vector_{start} = 4477.05$ kVA | R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial} = 71.1\%$ of 4160V | R2

$V_{drop} = V_{curve\_initial} \times 0.97$

$V_{drop} = 68.97\%$ of 4160V | R2

Voltage recovery after 1 second:

$V_{curve\_1sec} = 96.8\%$ of 4160V | R2

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

$V_{drop\_1sec} = 93.90\%$ of 4160V | R2

X. **CALCULATION AND RESULTS** (Cont.)

SECTION 10.2

Calculation of Inital Voltage and Recovery Voltage after 1 Second following the start of each 4 kV Motor, and Calculation of Motor Starting Times, when DG2/3 is powering Unit 3 Buses

1) <u>Starting kVA of the DG auxiliaries after the closure of the DG output breaker (Page C1 & C2 Calculation)</u>

Aggregate	SKW =	896.90	(Ref. Table 4B)	R4
Aggregate	SKVAR =	1369.40	(Ref. Table 4B)	
Aggregate	SKVA =	SKW + j SKVAR		
	SKVA =	896.9 + j1369.4		R4
	|SKVA| =	1636.97		

Angle = $\tan^{-1}$(SKVAR/SKW)

Angle = 56.78 Degrees R4

To determine the initial starting voltage (V_{curve_i}) and 1 second recovery voltage (V_{curve_1}), use the Dead Load Pickup Curve (SC-5056) and SKVA (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

V_{curve_i} = 87.7% of 4160V R4

$V_{dip} = V_{curve\_i} \times 0.97$

V_{dip} = 85.1% of 4160V R4

Voltage recovery after 1 second:

V_{curve_1} = 100.0% of 4160V

$V_{recovery} = V_{curve\_1} \times 0.97$

$V_{recovery}$ = 97.0% of 4160V

2) Starting of First LPCI Pump 3A (700HP)

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 18)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 90	Amps	(Ref. 18)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 18)
	I_{LRC} = 630.0		
Starting Power factor	PF_{start} = 0.20		(Ref. 18)

Motor Cable data

Conductor Size	3/C - #1/0 -5kV		
Cable Number	30900		
Cable Length (feet)	L = 236	(ETAP)	R3
Cable Impedance (ohms)	Z_{cable} = 0.03021 + j0.00906	(ETAP)	

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated}$ = 1030	ft-lb	(Ref. 15)
WK^2 Pump (wet)	WK_{pump} = 18.1	lb-ft^2	(Ref. 15)
WK^2 Motor	WK_{motor} = 190.0	lb-ft^2	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of LPCI Pump 2A

Calculating the starting kVA at base voltage

$SKVA_1 = \sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\quad SKVA_1 = 4364.8$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\quad KVA_{start1} = 4720.93$ $\quad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$$LPCI_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$$

$$LPCI_{start} = 944.19 + j4625.55 \quad kVA$$

ii) When the LPCI Pump starts, the LPCI Core Spray Pump Area Cooling Unit 3A, and MOV 3-1501-13A will also start operating. The starting load is summarized in Table 4B, with the results as follows:

Additional Starting auxiliary load: $Load_{start} = 20.6 + j28.4 \quad kVA$

iii) When the first LPCI Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the first LPCI Pump alone. The running kW & kVA from the ETAP DG2/3_Bkr_CI scenario is:

$$KW_{ETAP\_100\%} = 421$$
$$KVAR_{ETAP\_100\%} = 351$$
$$KVA_{ETAP\_100\%} = 548$$

R4

The current at 100% voltage (i.e. at 4.16kV) is:

$$I_{run\_100\%} = 76.1 \quad Amps$$

R4

The KVA & KW from the special ETAP scenario DG2/3_Bkr_VI for the reduced voltage condition is::

$$V_{reduced} = 2246 \quad Volts$$
$$KW_{reduced} = 338$$
$$KVAR_{reduced} = 259$$
$$KVA_{reduced} = 426$$

R4

The power factor from the same ETAP scenario at reduced voltage running load is:

$$PF_{reduced} = 0.793$$

R4

The calculated current at the reduced voltage for this kVA load from ETAP is:

$$I_{reduced} = 109.4 \quad Amps$$

R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$$I_{delta} = 33.30 \quad \text{Amps}$$ R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000 \qquad KVA_{delta} = 239.9$$ R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\mathrm{acos}(PF_{reduced})))]$$

$$KVA_{increment} = 190.27 + j146.18 \quad \text{kVA}$$ R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

LPCI Pump 3A starting load:	$LPCI_{start} = 944.19 + j4625.55$	kVA
Additional starting load:	$Load_{start} = 20.6 + j28.4$	kVA
Incremental running load equiv.:	$KVA_{increment} = 190.27 + j146.18$	kVA R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + LPCI_{start}$$

$$Total_{start} = 1155.06 + j4800.13 \quad \text{kVA}$$ R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$$Vector_{start} = 4937.14 \quad \text{kVA}$$ R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial} = 68.8\%$ of 4160V | R4

$V_{drop} = V_{curve\_initial} \times 0.97$

$V_{drop} = 66.74\%$ of 4160V | R4

Voltage recovery after 1 second:

$V_{curve\_1sec} = 95.1\%$ of 4160V | R4

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

$V_{drop\_1sec} = 92.25\%$ of 4160V | R4

v) The impedance of the pump feed cable, as defined earlier:

$Z_{cable} = 0.03021 + j0.00906$ ohms

$|Z_{cable}| = 0.0315$ ohms

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

$I_{LRC} = 630.0$ Amps

$V_{delta\_max} = (\sqrt{3} \times I_{LRC} \times |Z_{cable}|)$ $V_{delta\_max} = 34.42$ Volts

$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$ $V_{delta\_\%} = 0.83\%$ of 4160V

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$V_{initial.LPCI3A} = V_{drop} - V_{delta\_\%}$

$V_{initial.LPCI3A} = 65.91\%$ of 4160V R4

The voltage after 1 second at the motor terminals is:

$V_{1second.LPCI3A} = V_{drop\_1sec} - V_{delta\_\%}$

$V_{1second.LPCI3A} = 91.42\%$ of 4160V R4

Calculation of Motor Starting Time:

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.LPCI3A} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.LPCI3A} / 100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 190.0$ lb-ft^2

$WK2 = WK_{pump} + WK_{motor}$

$WK2 = 208.10$ lb-ft^2

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (i.e. Vi until 1 second, V1 after that).

R3

$\%rpm_o$	$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	%Volt
0	10	0.80	0.00	Vi
10	20	0.80	0.02	Vi
20	30	0.81	0.05	V1
30	40	0.82	0.06	V1
40	50	0.83	0.10	V1
50	60	0.85	0.15	V1
60	70	0.92	0.19	V1
70	80	1.07	0.25	V1
80	90	1.50	0.32	V1
90	95	2.20	0.38	V1
95	99	2.35	0.43	V1

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

$V_{OP} = 4160$ Volts

$V_{base} = 4000$ Volts

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = (\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{\text{Net}}) \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

$\text{Time}_{\text{cumul}}$ = Total Cumulative Start Time

Calculations:

$\%\text{rpm}_f$	$\%\text{Torque}_{\text{Motor}}$	$\%\text{Torque}_{\text{Pump}}$	$\%\text{Torque}_{\text{Net}}$	Time	$\text{Time}_{\text{cumul}}$
10	387.15	0.00	387.15	0.63	0.63
20	387.15	20.60	366.55	0.66	1.29
30	754.17	51.50	702.67	0.35	1.64
40	763.48	61.80	701.68	0.35	1.99
50	772.79	103.00	669.79	0.36	2.35
60	791.41	154.50	636.91	0.38	2.73
70	856.59	195.70	660.89	0.37	3.10
80	996.25	257.50	738.75	0.33	3.43
90	1396.61	329.60	1067.01	0.23	3.66
95	2048.36	391.40	1656.96	0.07	3.73
99	2188.02	442.90	1745.12	0.06	3.79

R4

Therefore, the total time for this pump to accelerate is: $\text{Time}_{\text{cumul10}}$ = 3.79 seconds

3) Starting LPCI Pump 3B (700HP)

Motor parameters (LPCI Pumps 3A and 3B are identical pumps)

Base Voltage (motor rated voltage)	$V_{base} = 4000$	Volts	(Ref. 18)
Operating Voltage	$V_{OP} = 4160$	Volts	
Base Current (full load)	$I_{FL} = 90$	Amps	(Ref. 18)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 18)
	$I_{LRC} = 630.0$		
Starting Power factor	$PF_{start} = 0.20$		(Ref. 18)

Motor Cable data

Conductor Size	3/C - #1/0 -5kV		
Cable Number	30906		
Cable Length (feet)	L = 276	(ETAP)	R3
Cable Impedance (ohms)	$Z_{cable} = 0.03533 + j0.0106$	(ETAP)	

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated} = 1030$	ft-lb	(Ref. 15)
WK^2 Pump (wet)	$WK_{pump} = 18.1$	$lb\text{-}ft^2$	(Ref. 15)
WK^2 Motor	$WK_{motor} = 190.0$	$lb\text{-}ft^2$	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of LPCI Pump 3B

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $SKVA_1 = 4364.8$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $KVA_{start1} = 4720.9$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$LPCI_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\mathrm{acos}(PF_{start})))]$

$LPCI_{start} = 944.19 + j4625.55$ kVA

ii) There are no additional loads starting with this pump:

Additional Starting auxiliary load: $Load_{start} = 0 + j0$ kVA.

iii) When the second LPCI Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the second LPCI Pump alone. The running kW & kVA from the ETAP DG2/3_UV_Rst scenario is:

$KW_{ETAP\_100\%} = 931$

$KVAR_{ETAP\_100\%} = 600$ R4

$KVA_{ETAP\_100\%} = 1108$

The current at 100% voltage (i.e. at 4.16kV) from ETAP is:

$I_{run\_100\%} = 153.7$ Amps R4

The KVA & KW from the special ETAP scenario DG2/3_UV_VI for the reduced voltage condition are:

$V_{reduced} = 2246$ Volts

$KW_{reduced} = 850$

$KVAR_{reduced} = 510$ R4

$KVA_{reduced} = 991$

The power factor from the same ELMS-AC file at reduced voltage running load is:

$PF_{reduced} = 0.857$ R4

The calculated current at the reduced voltage for this kVA load is:

$I_{reduced} = 254.9$ Amps R4

Therefore, the incremental difference of current is:

$I_{delta} = I_{reduced} - I_{run\_100\%}$

$I_{delta} = 101.20$ Amps | R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000$ $KVA_{delta} = 729.2$ | R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\operatorname{acos}(PF_{reduced})))]$

$KVA_{increment} = 624.91 + j375.76$ kVA | R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

LPCI Pump 2B starting load:	$LPCI_{start} = 944.19 + j4625.55$	kVA	
Additional starting load:	$Load_{start} = 0 + j0$	kVA	
Incremental running load equiv.:	$KVA_{increment} = 624.91 + j375.76$	kVA	R4

Total Starting kVA equivalent:

$Total_{start} = Load_{start} + KVA_{increment} + LPCI_{start}$

$Total_{start} = 1569.09 + j5001.31$ kVA | R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$Vector_{start} = 5241.67$ kVA | R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial}$ = 67.5% of 4160V | R3

$V_{drop} = V_{curve\_initial} \times 0.97$

V_{drop} = 65.48% of 4160V | R3

Voltage recovery after 1 second:

V_{curve_1sec} = 94.2% of 4160V | R3

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

V_{drop_1sec} = 91.37% of 4160V

v) The impedance of the pump feed cable, as defined earlier:

$Z_{cable} = 0.03533 + j0.0106$ ohms

$|Z_{cable}| = 0.0369$ ohms

R3

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

I_{LRC} = 630.0 Amps

$V_{delta\_max} = \sqrt{3} \times I_{LRC} \times |Z_{cable}|$ V_{delta_max} = 40.25 Volts

$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$ $V_{delta\_\%}$ = 0.97% of 4160V

R3

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$$V_{initial.LPCI3B} = V_{drop} - V_{delta\_\%}$$
$$V_{initial.LPCI3B} = 64.51\% \quad \text{of } 4160V$$ R3

The voltage after 1 second at the motor terminals is:

$$V_{1second.LPCI3B} = V_{drop\_1sec} - V_{delta\_\%}$$
$$V_{1second.LPCI3B} = 90.41\% \quad \text{of } 4160V$$ R3

Calculation of Motor Starting Time:

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.LPCI3B} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.LPCI3B} / 100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 190.0$ lb-ft^2

$$WK2 = WK_{pump} + WK_{motor}$$

$$WK2 = 208.10 \quad \text{lb-ft}^2$$

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (*i.e. Vi until 1 second, V1 after that*).

R3

$\%rpm_o$	$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	%Volt
0	10	0.80	0.00	Vi
10	20	0.80	0.02	Vi
20	30	0.81	0.05	V1
30	40	0.82	0.06	V1
40	50	0.83	0.10	V1
50	60	0.85	0.15	V1
60	70	0.92	0.19	V1
70	80	1.07	0.25	V1
80	90	1.50	0.32	V1
90	95	2.20	0.38	V1
95	99	2.35	0.43	V1

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

V_{OP} = 4160 Volts

V_{base} = 4000 Volts

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{Pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = \overrightarrow{(\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{Net})} \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

Time_{cumul} = Total Cumulative Start Time R3

Calculations:

%rpm	$\%\text{Torque}_{Motor}$	$\%\text{Torque}_{Pump}$	$\%\text{Torque}_{Net}$	Time	Time_{cumul}
10	370.86	0.00	370.86	0.66	0.66
20	370.86	20.60	350.26	0.70	1.35
30	737.54	51.50	686.04	0.36	1.71
40	746.65	61.80	684.85	0.36	2.06
50	755.75	103.00	652.75	0.37	2.44
60	773.97	154.50	619.47	0.39	2.83
70	837.70	195.70	642.00	0.38	3.21
80	974.29	257.50	716.79	0.34	3.55
90	1365.82	329.60	1036.22	0.24	3.78
95	2003.21	391.40	1611.81	0.08	3.86
99	2139.79	442.90	1696.89	0.06	3.92

R3

Therefore, the total time for this pump to accelerate is: $\text{Time}_{cumul10}$ = 3.92 seconds

4) <u>Starting Core Spray Pump (800HP)</u>

Motor parameters

Base Voltage (motor rated voltage)	$V_{base} = 4000$	Volts	(Ref. 17)
Operating Voltage	$V_{OP} = 4160$	Volts	
Base Current (full load)	$I_{FL} = 102$	Amps	(Ref. 17)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 7.00$		(Ref. 17)
	$I_{LRC} = 714.0$		
Starting Power factor	$PF_{start} = 0.20$		(Ref. 17)

Motor Cable data

Conductor Size	3/C - #4/0 -5kV	
Cable Number	30876	
Cable Length (feet)	L = 233	(ETAP)
Cable Impedance (ohms)	$Z_{cable} = 0.01489 + j0.00834$	(ETAP)

R3

Motor parameters to be used to determine starting time of the pump.

Motor Base Torque	$Torque_{rated} = 1180$	ft-lb	(Ref. 15)
WK^2 Pump (wet)	$WK_{pump} = 18.1$	$lb\text{-}ft^2$	(Ref. 15)
WK^2 Motor	$WK_{motor} = 220.0$	$lb\text{-}ft^2$	(Ref. 15)
Motor rated RPM	RPM = 3600		(Ref. 15)

2) Starting kVA of Core Spray Pump

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\quad$ $SKVA_1 = 4946.7$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\quad$ $KVA_{start1} = 5350.4$ $\quad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

Motor parameters

$CoreSpray_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\operatorname{acos}(PF_{start})))]$

$CoreSpray_{start} = 1070.08 + j5242.29$ kVA

ii) When the Core Spray Pump starts, MOVs 1402-38A, 1402-25A, 1501-22A, 1501-21B, 202-5A will also start operating. The starting load is summarized in Table 4B, with the results as follows:

Additional Starting auxiliary load: $Load_{start} = 163.2 + j294.1$ kVA

iii) When the Core Spray Pump starts, at that time, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the Core Spray Pump alone. The running kW & kVA from the ETAP DG2/3_T=5sec scenario is:

$KW_{ETAP\_100\%} = 1448$
$KVAR_{ETAP\_100\%} = 850$
$KVA_{ETAP\_100\%} = 1679$ R4

The current at 100% voltage (i.e. at 4.16kV) from ETAP is:

$I_{run\_100\%} = 232.9$ Amps R4

The KVA & KW from the special ETAP scenario DG2/3_T=5sVI output at reduced voltage are:

$V_{reduced} = 2246$ Volts
$KW_{reduced} = 1369$
$KVAR_{reduced} = 763$
$KVA_{reduced} = 1567$ R4

The power factor from the same ETAP scenario at reduced voltage running load is:

$PF_{reduced} = 0.874$ R4

The calculated current at the reduced voltage for this kVA load is:

$I_{reduced} = 402.9$ Amps R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

$$I_{delta} = 170.00 \quad \text{Amps}$$ R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000 \qquad KVA_{delta} = 1224.9$$ R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\operatorname{acos}(PF_{reduced})))]$$

$$KVA_{increment} = 1070.57 + j595.21 \quad \text{kVA}$$ R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

Core Spray Pump starting load:	$CoreSpray_{start} = 1070.08 + j5242.29$	kVA
Additional starting load:	$Load_{start} = 163.2 + j294.1$	kVA
Incremental running load equiv.:	$KVA_{increment} = 1070.57 + j595.21$	kVA R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + CoreSpray_{start}$$

$$Total_{start} = 2303.85 + j6131.6 \quad \text{kVA}$$ R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$$Vector_{start} = 6550.14 \quad \text{kVA}$$ R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial} = 62.6\%$ of 4160V | R4

$V_{drop} = V_{curve\_initial} \times 0.97$

$V_{drop} = 60.72\%$ of 4160V | R4

Voltage recovery after 1 second:

$V_{curve\_1sec} = 89.8\%$ of 4160V | R4

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

$V_{drop\_1sec} = 87.11\%$ of 4160V | R4

v) The impedance of the pump feed cable, as defined earlier:

$Z_{cable} = 0.01489 + j0.00834$ ohms

$|Z_{cable}| = 0.0171$ ohms

The maximum motor terminal line-to-line voltage drop which may occur on this cable given the LRC is:

$I_{LRC} = 714.0$ Amps

$V_{delta\_max} = \sqrt{3} \times I_{LRC} \times |Z_{cable}|$ $V_{delta\_max} = 21.11$ Volts

$V_{delta\_\%} = V_{delta\_max} / V_{op} \times 100$ $V_{delta\_\%} = 0.51\%$ of 4160V

Deducting the voltage drop due to motor feed cable to determine the actual voltage at the motor terminals, the initial starting voltage at the motor terminals is:

$V_{initial.CSP} = V_{drop} - V_{delta\_\%}$

$V_{initial.CSP} = 60.21\%$ of 4160V | R4

The voltage after 1 second at the motor terminals is:

$V_{1second.CSP} = V_{drop\_1sec} - V_{delta\_\%}$

$V_{1second.CSP} = 86.60\%$ of 4160V | R4

Calculation of Motor Starting Time:

Initial Starting Voltage (converted to decimal) $Vi = V_{initial.CSP} / 100$

Voltage at 1 second (converted to decimal) $V1 = V_{1second.CSP} / 100$

Total inertia of the motor and pump together from above (WK^2):

$WK_{pump} = 18.1$ lb-ft^2 $WK_{motor} = 220.0$ lb-ft^2

$WK2 = WK_{pump} + WK_{motor}$

$WK2 = 238.10$ lb-ft^2

The folowing variables define the speed intervals and corresponding motor and pump torque increments necessary to compute the starting time of the pump.

$\%RPM_o$ - initial RPM of increment as a percentage of rated RPM

$\%RPM_f$ - final RPM of increment as a percentage of rated RPM

$\%Torque_{Motor}$ - motor torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

$\%Torque_{Pump}$ - pump torque value from pump torque-speed curve read from the midpoint of the applicable speed range.

%Volt - either the initial voltage (Vi) or the voltage at 1 second (V1).

Note that the determination of which voltage (%Volt) to use is made when the motor acceleration time exceeds 1 second, and that can only be determined by looking at the calculated cumulative time below (i.e. Vi until 1 second, V1 after that).

R3

%rpm$_o$	%rpm$_f$	%Torque$_{Motor}$	%Torque$_{Pump}$	%Volt
0	10	0.89	0.00	Vi
10	20	0.90	0.00	Vi
20	30	0.90	0.02	V1
30	40	0.90	0.06	V1
40	50	0.90	0.13	V1
50	60	0.94	0.20	V1
60	70	1.02	0.26	V1
70	80	1.18	0.35	V1
80	90	1.61	0.46	V1
90	95	2.25	0.58	V1
95	99	2.35	0.65	V1

Compute the motor torque at the initial voltage (Vi) and at 1 second (V1) using the motor torque at motor rated voltage (Ref 15).

V_{OP} = 4160 Volts

V_{base} = 4000 Volts

$$Torque_{Motor.at.voltage} = \overrightarrow{[Torque_{rated} \times (\%Volt \times V_{op})^2 / V_{base}^2]} \quad \text{ft-lb}$$

Convert the percentage of motor torque from the curve to motor torque by using the applicable motor torque computed at Vi and V1 above.

$$Torque_{Motor} = \overrightarrow{(Torque_{motor} \times Torque_{Motor.at.voltage})} \quad \text{ft-lb}$$

Torque of the pump is determined by multiplying the pump torque from Ref. 15 by the base torque of the motor.

$$Torque_{Pump} = Torque_{rated} \times \%Torque_{Pump} \quad \text{ft-lb}$$

Net torque is the motor torque minus the pump torque:

$$Torque_{Net} = Torque_{Motor} - Torque_{Pump} \quad \text{ft-lb}$$

Speed increment (% of rated RPM):

$$\%\Delta_{rpm} = \%rpm_f - \%rpm_o$$

Time in seconds to accelerate through an RPM increment is calculated by the following:

$$\text{Time} = \overrightarrow{(\text{WK2} \times \text{RPM} \times \%\Delta\text{rpm} / 100) / (307.5 \times \text{Torque}_{Net})} \quad \text{seconds}$$

Cumulative time from 0% to full speed at $\%\Delta_{rpm}$ increments.

Time_{cumul} = Total Cumulative Start Time

Calculations:

$\%rpm_f$	$\%Torque_{Motor}$	$\%Torque_{Pump}$	$\%Torque_{Net}$	Time	$Time_{cumul}$	
10	411.85	0.00	411.85	0.68	0.68	
20	416.48	0.00	416.48	0.67	1.35	
30	861.42	23.60	837.82	0.33	1.68	
40	861.42	70.80	790.62	0.35	2.03	
50	861.42	153.40	708.02	0.39	2.43	
60	899.70	236.00	663.70	0.42	2.85	R4
70	976.27	306.80	669.47	0.42	3.26	
80	1129.41	413.00	716.41	0.39	3.65	
90	1540.98	542.80	998.18	0.28	3.93	
95	2153.54	684.40	1469.14	0.09	4.02	
99	2249.26	767.00	1482.26	0.08	4.10	

Therefore, the total time for this pump to accelerate is: $Time_{cumul10}$ = 4.10 seconds

5) Starting of Containment Cooling Service Water Pump 3A (500HP) R2

Motor parameters

Base Voltage (motor rated voltage)	V_{base} = 4000	Volts	(Ref. 40)
Operating Voltage	V_{OP} = 4160	Volts	
Base Current (full load)	I_{FL} = 67	Amps	(Ref. 40)
Locked Rotor Current	$I_{LRC} = I_{FL} \times 5.91$		(Ref. 40 & 43)
	I_{LRC} = 395.97		
Starting Power factor	PF_{start} = 0.20		(Ref. 41)

i) Starting kVA of CCSW Pump

Calculating the starting kVA at base voltage

$SKVA_1 = (\sqrt{3} \times V_{base} \times I_{LRC})/1000$ $\qquad SKVA_1 = 2743.4$

Calculating starting kVA at operating voltage

$KVA_{start1} = (V_{op}^2/V_{base}^2) \times SKVA_1$ $\qquad KVA_{start1} = 2967.2$ $\qquad$ at $Pf_{start} = 0.20$

The starting kVA is converted at starting power factor to the following KW and KVAR values:

$CCSW_{start} = (KVA_{start1} \times PF_{start}) + j \times [KVA_{start1} \times (\sin(\operatorname{acos}(PF_{start})))]$

$CCSW_{start} = 593.44 + j2907.27$ kVA

ii) The CCSW Pumps are turned on manually between 10 minutes and 2 hours depending on the situation. For the purpose of this calculation the CCSW Pump 3A is turned on by the operator after 10 minutes into the event and CCSW Pump 3B is turned on shortly after CCSW Pump 3A.

The CC Heat exchanger Discharge Valve is required to operate to exchange CC residual heat with the CCSW system. When CCSW Pump 3A starts, the Containment Cooling Heat Exchanger Discharge Valve also starts. When CCSW Pump 3B starts, the CC Heat Exchanger Discharge Valve is considered to be in operation (i.e. running load), however, at this time the CCSW Pump Cubical Cooler Fans (total 4) are also starting.

This calculation will only calculate the voltage dip due to the starting of CCSW Pump 3A (the first CCSW pump) instead of CCSW Pump 3B because the starting kVA (due to the voltage dip) for the load already on the diesel when the 3A pump starts is the largest. However, the 3A pump is conservatively evaluated with the starting kVA of the loads that start concurrently with the 3B CCSW pump. The starting load is summarized in Table 4B, with the results as follows: R3

Additional Starting auxiliary load: $Load_{start} = 62.7 + j60$ kVA

iii) When the CCSW Pump 3A starts, there are running loads on DG powered Buses. Therefore, the actual voltage drop on the bus will be more than that of the starting of the CCSW Pump 3A alone.

All of the valves which are initiated by LOOP/LOCA have completed their operations and have stopped operating before CCSW Pump 3A was started. Therefore, these valve loads are taken off from the initial running load.

The running kW & kVA from the ETAP scenario DG2/3_T=10-m is:

$$KW_{ETAP\_100\%} = 2181$$
$$KVAR_{ETAP\_100\%} = 1153$$
$$KVA_{ETAP\_100\%} = 2467$$

R4

The current at 100% voltage (i.e. at 4.16kV) from ETAP is:

$I_{run\_100\%} = 342.4$ Amps

The KVA & KW from the special ETAP scenario DG2/3_T10-ml output at reduced voltage is:

$V_{reduced} = 2246$ Volts

$$KW_{reduced} = 2107$$
$$KVAR_{reduced} = 1074$$
$$KVA_{reduced} = 2365$$

R4

The power factor from the same ETAP scenario at reduced voltage running load is:

$PF_{reduced} = 0.891$ R4

The calculated current at the reduced voltage for this kVA load from ETAP is:

$I_{reduced} = 607.7$ Amps R4

Therefore, the incremental difference of current is:

$$I_{delta} = I_{reduced} - I_{run\_100\%}$$

I_{delta} = 265.30 Amps | R4

The incremental KVA (KVA_{delta}) used to determine additional starting kVA is

$KVA_{delta} = (\sqrt{3} \times V_{op} \times I_{delta}) / 1000$ KVA_{delta} = 1911.6 | R4

The incremental running load equivalent is converted to an equivalent KW and KVA from the incremental kVA previously determined

$$KVA_{increment} = (KVA_{delta} \times PF_{reduced}) + j \times [KVA_{delta} \times (\sin(\operatorname{acos}(PF_{reduced})))]$$

$KVA_{increment}$ = 1703.21 + j867.86 kVA | R4

iv) The starting KVA equivalent as seen by the DG is calculated as follows:

CCSW Pump 3A starting load:	$CCSW_{start}$ = 593.44 + j2907.27	kVA	
Additional starting load:	$Load_{start}$ = 62.7 + j60	kVA	
Incremental running load equiv.:	$KVA_{increment}$ = 1703.21 + j867.86	kVA	R4

Total Starting kVA equivalent:

$$Total_{start} = Load_{start} + KVA_{increment} + CCSW_{start}$$

$Total_{start}$ = 2359.36 + j3835.13 kVA | R4

$$Vector_{start} = \sqrt{Re(Total_{start})^2 + Im(Total_{start})^2}$$

$Vector_{start}$ = 4502.75 kVA | R4

To determine the initial starting voltage ($V_{curve\_initial}$) and 1 second recovery voltage (V_{curve_1sec}), use the Dead Load Pickup Curve (SC-5056) and $Vector_{start}$ (calculated above) as "Generator Reactive Load MVA". Multiply the initial and 1 second curve values by 0.97 to account for a -3% curve tolerance.

Initial Voltage Dip:

$V_{curve\_initial} = 69.9\%$ of 4160V R4

$V_{drop} = V_{curve\_initial} \times 0.97$

$V_{drop} = 67.80\%$ of 4160V R4

Voltage recovery after 1 second:

$V_{curve\_1sec} = 96.7\%$ of 4160V R4

$V_{drop\_1sec} = V_{curve\_1sec} \times 0.97$

$V_{drop\_1sec} = 93.80\%$ of 4160V R4

XI COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA

Comparison of results with Acceptance Criteria when DG2/3 power Unit 2 loads

A. Continuous loading of the Diesel Generator

The results of the calculation show that the maximum continuous load on the Diesel Generator is 2609 kW (ETAP Scenario DG2/3_T=10+m), which is slightly above the 2600 kW continous rating of the Diesel Generator. However, this loading value is well within the 2860kW 2000hr rating of the DG. This loading value occurs only while the 1st CCSW pump is energized and prior to de-energizing one of the two LPCI pumps. The maximum long term DG loading is 2491 kW when both CCSW pumps are in operation (ETAP Scenario DG2/3_CRHVAC). Therefore, from a continuous loading point of view the DG 2/3 has adequate capacity to accept the emergency load under LOOP concurrent with LOCA in accordance with the acceptance criteria. R4

If the EDG is at 102% of its nominal frequency, the EDG load is expected to be 1.02^3 or 1.06 times larger since input power is proportional to the speed cubed (Section V.5). This results in a maximum loading of 2609kW x 1.02^3 = 2769kW which is within the 2000 hr 2860kW rating of the diesel. R4

The lowest power factor for the EDG load during the DG2/3_T=10+m, DG2/3_T=10++m and DG2/3_CRHVAC is 87.7%. This value is below the 88% acceptance criteria.

B. Transient loading of the Diesel Generator

Results of this calculation show that the minimum recovery voltage after 1 second following the start of any large 4-kv motors is 87% of 4160V which is above the 80% recovery requirement in the acceptance criteria.

This calculation shows that when the Core Spray Pump starts, the initial voltage dips below 61% of operating voltage (i.e. 4160v). However, within 1 second after the start, voltage recovers to above 87% of 4160v. This voltage dip and recovery analysis utilizes the results of dynamic DG characteristics reflected in the manufacturer's curve. The curve includes the combined effect of exciter and governor in order to provide recovery voltages.

In this calculation, the voltage dip was conservatively calculated from the Dead Load Pick up curve utilizing the total KVA loading on the DG bus. The Dead Load Pickup curve indicates that reactive load (KVAR) should be used to determine the voltage dip when using this curve. Even with that conservatism, the minimum voltage recovery after 1 second following the start is 87% of 4160v. After one second, the voltage will continue to improve due to exciter and governor operation. These recovery voltages during the motor starting period (after the first second) are much better than the voltage expected during operation from the offsite power source under degraded voltage condition.

Due to momentary sharp voltage drops below 61% during large motor starting, certain contactors or relays may drop out, and that could cause some control circuits to de-energize. Table 2A of this calculation shows that none of the 480V DG powered loads have a seal-in circuit, and therefore these loads will restart as soon as the adequate voltage returns. The calculation shows that the voltage will recover to more than 87% within 1 second following the start and will continue recover to 100% voltage due to

XI **COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA (cont'd)**

exciter and governor operation. Strip chart (Ref. 23) of the DG surveillance tests show that the DG recover to 100% of rated voltage within 3 to 4 seconds. The 480v loads which may drop out will experience recovery voltages sufficient to pick up at different times due to variations in the network impedances (such as cable size and length) and variations in loading in each bus. This diverse restarting of 480v loads will have minimum impact on the DG performance.

Due to this momentary sharp drop, operating valves may stop momentarily. However, Table 2A of this calculation shows that these valves would start operating again as soon as the sufficient operating voltage is back. The analysis in Table 2A shows that the momentary voltage drop will not cause any unacceptable effect on the valve operation. The momentary drop may cause the operating time of those valves to increase by 2 seconds. Even with that pause, the increased operating time is below the time limit set by various Dresden Operating Procedures (see References 46 through 53).

For LOOP concurrent with LOCA the minimum voltage recovery is more than 87% after one second R3 following the Core Spray motor start. The voltage will continue to improve after one second due to the excitor and governor characteristics. Due to the momentary nature of this dips the duration of starting current at reduced voltage is shorter. Because protective devices are set to allow adequate starting time at motor rated voltage and during operation from offsite power (voltages from offsite power will be much worse than the voltages when powered by the DG), the protective device operation due to over current is not a concern when operating from the DG power during LOOP concurrent with LOCA.

Starting times for large automatically starting motors during LOOP concurrent with LOCA were calculated to ensure the starting times of LPCI Pumps and Core Spray Pump do not-exceed 5 seconds Therefore, during the starting sequence, the pumps start within the allowable time and the previous motor is at full speed before the next motor starts.

XI COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA (cont'd)

Comparison of results with Acceptance Criteria when DG2/3 powers Unit 3 loads

A. Continuous loading of the Diesel Generator

The results of the calculation show that the maximum continuous load on the Diesel Generator is 2638 kW (ETAP Scenario DG2/3_T=10+m), which is above the 2600kW continuous rating of the Diesel Generator. However, this loading value is well within the 2860kW 2000hr rating of the DG. This loading value occurs only while the 1st CCSW pump is energized and prior to de-energizing one of the two LPCI pumps. The maximum long term DG loading is 2518 kW when both CCSW pumps are in operation (ETAP Scenario DG2/3_CRHVAC). Therefore, from a continuous loading point of view the DG2/3 has adequate capacity to accept the emergency load under LOOP concurrent with LOCA in accordance with the acceptance criteria. R4

If the EDG is at 102% of its nominal frequency, the EDG load is expected to be 1.02^3 or 1.06 times larger since input power is proportional to the speed cubed (Section V.5). This results in a maximum loading of 2638kW x 1.02^3 = 2800kW which is within the 2000 hr 2860kW rating of the diesel. R4

The lowest power factor for the EDG load during the DG2/3_T=10+m, DG2/3_T=10++m and DG2/3_CRHVAC is 87.9%. This value is below the 88% acceptance criteria.

B. Transient loading of the Diesel Generator

Results of this calculation show that the minimum recovery voltage after 1 second following the start of any large 4-kv motors is 87% of 4160V which is above the 80% recovery requirement in the acceptance criteria.

This calculation shows that when the Core Spray Pump starts, the initial voltage dips below 61% of operating voltage (i.e. 4160v). However, within 1 second after the start, voltage recovers to at least 87% of 4160v. This voltage dip and recovery analysis utilizes the results of dynamic DG characteristics reflected in the manufacturer's curve. The curve includes the combined effect of exciter and governor in order to provide recovery voltages.

In this calculation, the voltage dip was conservatively calculated from the Dead Load Pick up curve utilizing the total KVA loading on the DG bus. The Dead Load Pickup curve indicates that reactive load (KVAR) should be used to determine the voltage dip when using this curve. Even with that conservatism, the minimum voltage recovery after 1 second following the start is 87% of 4160v. After one second, the voltage will continue to improve due to exciter and governor operation. These recovery voltages during the motor starting period (after the first second) are much better than the voltage expected during operation from the offsite power source under degraded voltage condition.

Due to momentary sharp voltage drops below 61% during large motor starting, certain contactors or relays may drop out, and that could cause some control circuits to de-energize. Table 2B of this calculation shows that none of the 480V DG powered loads have a seal-in circuit, and therefore these loads will restart as soon as the adequate voltage returns. The calculation shows that the voltage will recover to more than 87%

XI **COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA (cont'd)**

within 1 second following the start and will continue recover to 100% voltage due to exciter and governor operation. Strip Chart (Ref. 23) of the DG surveillance tests show that the DG recover to 100% of rated voltage within 3 to 4 seconds. The 480v loads which may drop out will experience recovery voltages sufficient to pick up at different times due to variations in the network impedances (such as cable size and length) and variations in loading in each bus. This diverse restarting of 480v loads will have minimum impact on the DG performance.

Due to this momentary sharp drop, operating valves may stop momentarily. However, Table 2B of this calculation shows that these valves would start operating again as soon as the sufficient operating voltage is back. The analysis in Table 2B shows that the momentary voltage drop will not cause any unacceptable effect on the valve operation. The momentary drop may cause the operating time of those valves to increase by 2 seconds. Even with that pause, the increased operating time is below the time limit set by various Dresden Operating Procedures (see References 46 through 53).

For LOOP concurrent with LOCA the minimum voltage recovery is more than 87% after one second following the Core Spray motor start. The voltage will continue to improve after one second due to the exciter and governor charecteristics. Due to the momentary nature of this dip the duration of starting current at reduced voltage is shorter. Because protective devices are set to allow adequate starting time at motor rated voltage and during operation from offsite power (voltages from offsite power will be much worse than the voltages when powered by the DG), the protective device operation due to over current is not a concern when operating from the DG power during LOOP concurrent with LOCA. R3

Starting times for large automatically starting 4kV motors during LOOP concurrent with LOCA were calculated to ensure the starting times of LPCI Pumps and Core Spray Pump do not exceed 5 seconds. Therefore, during-the starting sequence, the pumps start within the allowable time and the previous motor is at full speed before the next motor starts.

XII CONCLUSIONS

The results of the calculation show that the maximum continuous running load under the maximum loading scenario is less than the 2860 kW 2000hr rating of the Diesel Generator. The loading of the DG at maximum frequency of 102% is within the 2000 hr nameplate rating. Also, the worst voltage recovery after one second following the start of large 4kv motor (Core Spray Pump motor) is above 87% of DG terminal rated voltage. This 87% voltage recovery is above the minimum voltage recovery of 80% per the DG specification K-2183 requirement. The worst case power factor for the 10 minute and beyond time period is 87.7 which is below the acceptance criteria. The DG surveillance procedures and Technical Specification Bases should be revises accordingly. R4 R4

The starting times for LPCI Pumps 2A, 2B, 3A, and 3B are less than 4 seconds, and the starting time for Core Spray Pumps 2A and 3A are less than 5 seconds. All of these pump starting times are below the maximum allowable starting time of 5 seconds, and therefore, are acceptable.

Also, the analysis in Tables 2A & 2B for Unit 2 and Unit 3, respectively, and the detailed explanation under the Calculation and Results section show that while some of the control circuits may dropout during the lowest portion of the voltage dip, no adverse effects are identified and no protective devices are expected to operate. This calculation also shows that momentary voltage dip will not cause the travel time of any MOV to increase any longer than allowable.

XIII RECOMMENDATIONS

The worst case power factor for the 10 minute and beyond time period is 87.7 which is below the acceptance criteria. The Dresden Design/Licensing basis should be assessed to determine the impact due to this result. R4

XIV REFERENCES

1) S & L Standard ESI-167, Revision 4-16-84, Instruction for Computer Programs.

2) Operation Technology Software, ETAP PowerStation & Users Manual, Version 5.5.0N. R4

3) Unused

4) Dresden DG 2/3 Calculation 7317-33-19-3, Revision 10.

5) Quad Cities DG 1 Calculation 7318-33-19-1, Revision 0.

6) Dresden Units 2 & 3, Equipment Manual from GE, Number GEK-786.

7) Dresden Re-baselined Updated FSAR, Revision O.

8) Guidelines for Estimating Data (Used by Electrical Analytical Division in Various Projects like Clinton, Byron & Braidwood), which is used for determining % PF and efficiency (Attached).

9) ANSI / IEEE C37.010-1979 for Determining X/R Range for Power Transformers, and 3-phase Inductor Motor,

10) S & L Standard ESA-104a, Revision 1-5-87, Current Carrying Capacities of Copper Cables.

11) S & L Standard ESA-102, Revision 4-14-93, Electrical & Physical Characteristics of Electrical Cables.

12) Specification for Diesel Engine Generator Sets K-2183, Pages 3 and 8 (Attached).

13) Dead Load Pickup Capability (Locked Rotor Condition) - Generator Reactive Load vs. % Voltage Graph (#SC-5056) by Electro-Motive Division (EMD) (Attached).

14) Speed - Torque - Current Curve (#297HA945-2) for Core Spray Pump by GE (Attached).

15) Speed - Torque - Current Curve (#857HA264) for RHR/LPCI Pump by GE (Attached).

16.)

Drawing No.	Rev.	Drawing No.	Rev.
12E-2301	Z	12E-2389A	B
12E-2302	J	12E-2389D	C
12E-2302A	L	12E-2393	N
12E-2302B	W	12E-2397	H
12E-2303, Sh. 1, 2	K	12E-2398	D
12E-2304	S	12E-2399A	K
12E-2305	Y	12E-2400A	S
12E-2306	W	12E-2400B	M
12E-2307	Y	12E-2400C, Sh. 1	AA
12E-2308	T	12E-2400C, Sh. 2	AA
12E-2311	AD	12E-2416	N
12E-2312	V	12E-2420A	P
12E-2318	AK	12E-2420B	M
12E-2320	AA	12E-2420C	D
12E-2328	D	12E-2429, Sh. 1	X
12E-2344, Sh. 1	P	12E-2429, Sh. 2	X
12E-2344, Sh. 2	P	12E-2430, Sh. 1, 2	AW
12E-2344, Sh. 3	P	12E-2431, Sh. 1	X
12E-2344, Sh. 4	P	12E-2432	Y
12E-2345, Sh. 1	AH	12E-2433	M
12E-2349, Sh. 1	W		
12E-2349, Sh. 2	W	12E-2435, Sh. 1	X
12E-2349, Sh. 3	W	12E-2436, Sh. 1	W
12E-2350B, Sh. 2	V	12E-2436, Sh. 3	W
		12E-2437, Sh. 1	AH
12E-2351B, Sh. 1	AA	12E-2437, Sh. 2	AJ

Drawing No.	Rev.	Drawing No.	Rev.
12E-2351B, Sh. 2	AC	12E-2437A	X
12E-2362	M	12E-2438, Sh. 1, 2	AL
12E-2363	K	12E-2438A	Y
12E-2364	K	12E-2439	S
12E-2365	M	12E-2440, Sh. 1	Z
12E-2370	S	12E-2440, Sh. 2	Z
12E-2372B	M	12E-2440, Sh. 3	Z
12E-2373	P		
12E-2374	T	12E-2441, Sh. 1	W
12E-2387B	G		
12E-2441, Sh. 2	W	12E-2674A	AG
12E-2441, Sh. 3	W	12E-2674C	X
12E-2441, Sh. 4	W	12E-2674D	S
12E-2450	D	12E-2674G	S
12E-2460, Sh. 1, 2	W	12E-2675A	AE
12E-2501, Sh. 1	AC	12E-2675B	R
12E-2501, Sh. 2	AC	12E-2675C	S
12E-2506, Sh. 1	AC	12E-2676B	W
12E-2506, Sh. 2	AC	12E-2677C	V
12E-2507B	F	12E-3345, Sh. 1	AF
12E-2508	M	12E-3345, Sh. 2	Z
12E-2508A	F	12E-3507A	N
12E-2509, Sh. 1, 2	AG	12E-3507B	F
12E-2509A	L	12E-6628	C
12E-2516	G	12E-6629	C
12E-2517	H	12E-6631	D

Drawing No.	Rev.	Drawing No.	Rev.
12E-2520	Q	12E-6552, Sh. 2	P
12E-2548	R	12E-6554A	F
12E-2592	J	12E-3312	AD
12E-3304	Q	12E-3318, Sh. 1	X
12E-3306	Q	12E-3318, Sh. 2	Z
12E-3311	AD	12E-3320	U

In addition to the above listed drawings, the draw the drawings listed in any Table 1 or Table 2 are also considered as references for this calculation.

17.) GE Drawing 992C510AB, Dresden Core Spray Pump Motor (Attached).

18.) GE Drawing 992C510, Dresden LPCI Pump Motor (Attached).

19.) IEEE Standard 399-1980, Chapter 8, for determining motor starting voltage drop at the source when some running load is is already present

20.) S & L Standard, ESI-253, Revision 12-6-91, Electrical Department instruction for preparation, review, and approval of electrical design calculations

21.) S & L Standard ESC-307, Revision 1-2-64, for checking voltage drop in starting ac motors

22.) Western Engine letter dated 1/19/87 to Mr. Wayne Hoan identifying the voltage dip curve applicable to Dresden and Quad Cities (Attached).

23.) Strip Chart for Diesel Generator 2/3 Surveilence Test: Dated March 7, 1992 (Attached).

24.) Walkdown Data for Diesel Generator 2/3 dated April 15, 1994 (Attached).

25.) DIT DR-EAD-0001-00 regarding the Battery Charger and UPS Models (Attached).

R2 26.) Dresden Unit 2 Electrical Load Monitoring System (ELMS) - AC, Calculation Number 7317-43-19-1, Revision 18.

R2 27.) Dresden Unit 3 Electrical Load Monitoring System (ELMS) - AC, Calculation Number 7317-43-19-2, Revision 16.

28.) DIT DR-EPED-0860-00; Loading Change for Dresden Unit 2 - Division 1 (Attached).

29.) CIS-2: Tabulation for cables lengths (Attached).

30.) Dresden Re-baselined Updated FSAR, Revision 0, Table 8.3-3; DG loading due to Loss of Offsite AC Power (Attached).

31.) Dresden Re-baselined Updated FSAR, Revision 0, Figure 8.3-6 and 8.3-7, DG loading under Accident Condition (Attached).

32.) Dresden Station Fire Protection Reports -- Safe Shutdown Report dated July 1993, Table 3.1-1, DG Loading for Safe Shutdown (Attached).

33.) DIT DR-EPED-0862-00; Loading Change for Dresden Unit 3 - Division 1 (Attached).

34.) DOP 0202-01, Revision 13; Unit 2 Reactor Recirculation System Startup (Attached).

35.) DELETED

36.) Calculation for Evaluation of 3HP, 460V CCSW Motor Minimum Voltage Starting Requirements; Calculation Number 9215-99-19-1, Revision 1.

37.) 4160 Volt Switchgeart Specification K-3141 (page 3-5 attached)

38.) Calculation for Single Line Impedance Diagrams for ELMS-AC; Calculation 7317-38-19-1, Revision 1.

39.) S & L Standard ESC-193, Revision 9-2-86, Page 5 for Determining Motor Starting Power Factor.

40.) Walkdown data for CCSW Pumps 2A, 2B, 2C, and 2D dated December 14, 1994; and walkdown data for CCSW Pumps 3A, 3B, 3C, and 3D dated December 15, 1994 (Attached).

41.) S & L Standard ESC-165, Revision 11-3-92, Electrical Engineering Standard for Power Plant Auxiliary Power System Design.

42.) Letter addressed to E. Guse from G.C. Mulick dated March 8, 1967 regarding EMD Inquiry No. 66-708 (attached).

43.) Hand calculation to determine LRC for CCSW Pumps (Attached).

44) Speed - Torque Curve (#257HA266) for Core Spray Pump by GE (Attached)

45) Speed - Torque - Current Curve (#257HA265) for Core Spray Pump by GE (Attached)

46) Memorandum from R.M. Dahlgren to C.A. Tobias dated December 30, 1994 regarding the measured stroke times of various MOVs (Attached).

47) CHRON Letter 0302643 to Mr. T. Rieck from E.J. Rowley and J.D. Williams dated June 21, 1994 regarding the measured stroke times and acceptable limits for various MOVs (Attached).

48) DOS 1600-18, Revision 15; Cold Shutdown Valve Testing (pgs 1, 18, 21 & 23 attached)

49) DOS 1600-05, Revision 4; Unit 3 Quarterly Valve Timing (pgs 1, 39 & 44 attached).

50) DOS 7500-02, Revision 11; SBGT System Monthly Surveillance and Operating Test (pgs 1 & 15 attached).

51) DOS 1600-03, Revision 4; Unit 2 Quarterly Valve Timing (pgs 1, 40, 45 &46 attached).

52) Paper Titled "Safety Classification of the Motor Operated Valves for the Reactor Recirculation System" dated 12-23-91 (Attached).

53) Comparison table of MOV measured stroke times vs. their acceptable limits (Attached).

54) Calculation for Dresden 2/I Safety-Related Continuous Load Running/Starting Voltages; Calculation Number 9198-18-19-1, Revision 003, 003A R3

55) Calculation for Dresden 3/I Safety-Related Continuous Load Running/Starting Voltages; Calculation Number 9198-18-19-3, Revision 003, 003A.

56) EC 358579, Rev 000, Controlled Document Changes Required to Support Closure of Operability Evaluation 05-005. R3

57) Procedure DGA-12, Revision 55, "Partial or Complete Loss of Offsite Power"

58) Calculation DRE05-0038, Rev. 000A, "Auxiliary Power Analysis for Dresden Unit 2"

59) Calculation DRE04-0019, Rev. 000B, "Auxiliary Power Analysis for Dresden Unit 3"

60) OPL-4, Rev. 003, GE LOCA Analysis Inputs for Dresden 2 & 3 and Quad Cities 1 & 2.

61) MOV 2-1501-22A & 22B Field Data Sheet dated 3/13/03, (Attachment S)

62) MOV 3-1501-22A & 22B Field Data Sheet dated 3/13/03, (Attachment S)

63) GE Correspondence, Containment Cooling Service Water Pumps – Motor Ratings, dated February 25, 1971 (Attachment S)

64) Calculation DRE07-0003, Rev. 000, "EDG Loading for CCSW Pump – LOCA Long Term Cooling"

65) Calculation DRE07-0002, Rev. 000, "EDG Loading for LPCI Pump – LOCA Long Term Cooling"

66) Calculation DRE07-0001, Rev. 000, "EDG Loading for CS Pump – LOCA Long Term Cooling"

67) Calculation 8982-13-19-4, Rev. 001A, "Evaluation of 460V Diesel Generator Cooling Water Pump Minimum Starting Voltage:

68) EC 347745, Rev. 001, "Replace Diesel Generator Cooling Water Pump and Motor with New Pump and Motor – U2/3"

69) TODI-07-003, Dated 2/1/07, "EDG Design Input Loading – RPS MG Set Unloaded" (Attachment S) R4

70) Cameron Hydraulic Data, Copyright 1995 by Ingersoll-Dresser Pump Co (Attachment S).

71) A/R No. 00583950, "UFSAR Figures 8.3-4, -5, -6, -7 EDG Load Profile Discrepancies"

72) A/R No. 00578451, "DG Frequency Tolerance Band not Reflected in Calculations"

73) Technical Specification Section SR 3.8.1.12, SR 3.8.1.16 and SR 3.8.1.19, Amendment 185/180.

74) UFSAR Table 8.3.1, Rev. 5

75) Technical Specification Section SR 3.8.1.15, Amendment 185/180

76) EC 364072, Rev. 000, "Evaluate and Determine Power Factor and KVAR Range for Emergency Diesel Generator 24-Hour Endurance Test."

Table 1A

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
23-1 2321	RX Shutdown Cooling Pump 2C (2-1002-C)	Yes	Tripped on bus UV, and has no auto start.		12E-2516 12E-2517	G H	
23-1 2322	RX. Building Cooling Water Pump 2A (2-3701-A)	Yes	Tripped on LOCA.		12E-2397	H	
23-1 2323	RX Shutdown Cooling Pump 2A (2-1002-A)	Yes	Tripped on bus UV, and has no auto start		12E-2516 12E-2517	G H	
23-1 2325	LPCI Pump 2B (2-1502-B)	No	Will operate in auto (starts 5 seconds after UV relay resets).	Assume in auto.	12E-2436 Sh. 1 & 2 12E-2437 Sh. 1	W AH	
23-1 2326	RX Cleanup Recirc. Pump 2A (2-1205-A)	Yes	Tripped on bus UV, and has no auto start.		12E-2520	L	
23-1 2327	Feed to 480V SWGR 28 (2-7328-28)	No	N.C. Does not trip and remains closed.		12E-2349, Sh. 1	AC	
23-1 2329	Main Feed from SWGR 23	No	Trips on Bus 23 UV, and is manually closed before starting the CCSW Pumps (10+ minutes).		12E-2344, Sh. 2	V	
23-1 2330	Core Spray Pump 2A (2-1401-A)	No	Will operate in auto (starts 10 seconds after UV relay resets).	Assume in auto.	12E-2429 Sh. 1 12E-2430	X AF	
23-1 2331	LPCI Pump 2A (2-1502-A)	No	Will operate in auto (starts 0 seconds after UV relay resets).	Assume in auto.	12E-2436 Sh. 1 & 2 12E-2437 Sh. 1	W AH	
23-1 2332	Bus Tie to 33-1	No	N.O. breaker with no auto close.		12E-2345	B	
40	Aux. Pt. Indicating Lights, Meter, and Relay Comb.	No	Will continue to operate (0 seconds)		12E-6628	B	
28 2B	Main Feed (2-6723-27)	No	N.C. Does not trip and remains closed.		12E-2349, Sh. 2	AD	

Table 1A

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28 2C	Bus 28-29 Tie (2-7328-2-7329)	No	N.O. and remains open.		12E-2349, Sh. 3	AC	
28 3A	Fuel Pool Cooling Water Pump 2A (2-1902-A)	Yes	Tripped on bus UV, and has no auto start.		12E-2548	R	
28 3B	RX Building Vent Fan 2A (2A-5703)	Yes	Tripped on SBGT initiation.		12E-2399A	K	
28 3C	RX Building Vent Fan 2C (2C-5703)	Yes	Tripped on SBGT initiation.		12E-2399A	K	
28 3D	RX Cleanup Demin. Auxiliary Pump (2-1206)	Yes	Tripped on bus UV, and has no auto start.		12E-2520	N	
28 4A	480 MCC 28-1 (2-7828-1P1)	No	N.C. Does not trip and remains closed.		12E-2374	AB	
28 4B	480 MCC 28-2 (2-7828-2A)	No	N.C. Does not trip and remains closed.		12E-2374	AB	
28 4C	RX Building Exhaust Fan 2A (2A-5704)	Yes	Tripped on SBGT initiation.		12E-2399A	K	
28 4D	480 MCC 28-3 (2-7828-3A1)	No	N.C. Does not trip and remains closed.		12E-2374	AB	
28 5A	480 MCC 28-7 (2-7828-7A1)	No	N.C. Does not trip and remains closed.		12E-2374	AB	
28 5C	South Turbine Room Vent Fan 2A (2A-5702)	Yes	Tripped on LOCA.		12E-2387B	G	
28 5D	Recirc M-G Set Vent Fan 2A (2A-5701)	Yes	Tripped on LOCA.		12E-2420C	D	
28 6A-6D	Drywell Cooler Blower 2A, 2B, 2F, and 2G (2A,B,F,G-5734)	Yes	Tripped on LOCA.		12E-2393	N	
28-1 A1	Diesel Gen Starting Air Compressor 2/3A (2/3-6600-A)	No	Will operate in auto as long as pressure is below 230 psi (0 seconds).	Assume in auto.	12E-2351B Sh. 1	AA	M173
28-1 A3	120/208V Distr Xfmr 28-1	No	Will continue to operate (0 seconds)		12E-2674A	AC	

Table 1A
Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-1 B1	Safety System Jockey Pump (2-1401-4)	Yes	Trips on loss of voltage and does not auto start.		12E-2674A	AG	
28-1 B2	Drywell and Torus Purge Exhaust Fan 2A (2A-5708)	Yes	Tripped on SBGT initiation.		12E-2393	K	
28-1 B3	Closed Cooling Water Drywell Return Valve 2B (2-3706)	No	NO and remains open.		12E-2398	D	M20
28-1 B4	Shutdown Cooling Return Isolation Valve 2B (2-1001-5B)	No	NC and interlocked closed.		12E-2508E 12E-2508 12E-2501 Sh. 1 & 2	J M AC	M32
28-1 C1	Cleanup System Return Isolation Valve (2-1201-7)	No	NO and interlocked closed (0 seconds).		12E-2509A 12E-2509 12E-2501 Sh. 1 & 2	L AC AC	M30
28-1 C2	Cleanup System Inlet Isolation Valve (2-1201-1)	No	NO and interlocked closed (0 seconds).		12E-2509A 12E-2509 12E-2501 Sh. 1 & 2	L AC AC	M30
28-1 C3	Shutdown Cooling Return Isolation Valve 2A (2-1001-5A)	No	NC and interlocked closed.		12E-2508E 12E-2508 12E-2501 Sh. 1 & 2	J M AC	M32
28-1 C4	Shutdown Cooling Inlet Isolation Valve 2A (2-1001-1A)	No	NC and interlocked closed.		12E-2508A 12E-2508 12E-2501 Sh. 1 & 2	F M AC	M32
28-1 D1	CRD Hydraulic System Pressure Cont. Valve 2A (2-302-8)	No	NO and remains open.		12E-2416	L	M34
28-1 D2	Torus/Drywell Air Compressor 2A (2-8549-A)	Yes	Trips on loss of voltage and does not auto start.		12E-2372B	L	

Table 1A

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-1 E2	Shutdown Cooling Inlet Isolation Valve 2B (2-1001-1B)	No	NC and interlocked closed.		12E-2508A 12E-2508 12E-2501 Sh. 1 & 2	F M AC	M32
28-1 E3	RWCU Isolation Valve Bypass (2-1201-1A)	No	NC and remains closed.		12E-6816D	F	
28-1 E4	Core Spray Pump Recirc. Isolation Valve 2A (2-1402-38A)	No	NO and interlocked open, but when flow is over low flow level, valve will close (10 seconds after UV reset).		12E-2433	M	M27
28-1 F1	Diesel Transfer Pump 2/3 (2/3-5203)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2351B Sh. 1	AA	M41/2
28-1 F2	RX Building Emergency Lighting (2-7902)	No	Has 1 minute time delay; enter in calculation 10 seconds after UV relay resets.		12E-2674C	U	
28-1 F3	LPCI Core Spray Pump Area Cooling Unit 2A (2-5746-A)	No	Controlled by thermostat.	Assume cooler starts at 0 seconds after UV reset.	12E-2393	K	
28-1 F4	Standby Liquid Control Pump 2A (2-1102A)	No	Will not operate with switch in OFF position.	Assume switch is in OFF position.	12E-2460	T	
28-1 G3	Diesel Gen 2/3 Vent Fan (2/3-5790) (Normal Feed)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2351B Sh. 2 12E-2674D	AA S	M1297
28-1 H1	Core Spray Outboard Isolation Valve 2A (2-1402-24A)	No	NO and interlocked open.		12E-2431 Sh. 1	X	M27
28-1 H2	Core Spray Inboard Isolation Valve 2A (2-1402-25A)	No	NC and interlocked open.	For conservatism, assume low pressure permissives coincide with Core Spray Pump start (10 seconds after UV relay reset).	12E-2431 Sh. 1 12E-2430	X AF	M27

Table 1A
Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-1 H3	Contain. Cooling Heat Exchanger Discharge Valve 2A (2-1501-3A)	No	NC and interlocked closed when CCSW Pump is not in service. Auto opens when CCSW Pump is started (10+ minutes).		12E-2440 Sh. 1 12E-2437 Sh. 1	Z AH	M29/1
28-1 H4	Core Spray Pump Suction Valve 2A (2-1402-3A)	No	NO and interlocked open.		12E-2432 12E-2430	Y AF	M27
28-1 J1	Core Spray Test Bypass Valve 2A (2-1402-4A)	No	NC and interlocked closed.		12E-2433 12E-2430	M AF	M27
28-1 J3	Inbd Cond Return Vlv (2-1301-4)	No	NO and interlocked closed (0 seconds).		12E-2507B 12E-2506 Sh. 1 & 2	F AC	M28
28-1 J4	Steam Line Isol Vlv (2-1301-1)	No	NO and interlocked closed (0 seconds).		12E-2507B 12E-2506 Sh. 1 & 2	F AC	M28
28-1 K1	LPCI Pump 2A Suction Valve (2-1501-5A)	No	NO and interlocked open.		12E-2440 Sh. 1 12E-2437 Sh. 1	Z AH	M29/1
28-1 K2	LPCI Pump 2B Suction Valve (2-1501-5B)	No	NO and interlocked open.		12E-2440 Sh. 1 12E-2437 Sh. 1	Z AH	M29/1
28-1 K3	LPCI Pumps Drywell Spray Discharge Valve 2A (2-1501-27A)	No	NC and interlocked closed.		12E-2440 Sh. 3 12E-2437 Sh. 1 & 2	Z AH	M29/1
28-1 K4	Stm/Iso Inbd Cond Vlv (3-1301-1 and -4)(alternate feed)	No	Manual operation only.	Assumed off.	12E-3507B	F	

Table 1A
Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-1 L1	Torus Spray Valve 2A (2-1501-38A)	No	NC and interlocked closed.		12E-2441 Sh. 1 12E-2437 Sh. 1 & 2	W AH	M29/1
28-1 L2	Torus Spray Valve 2B (2-1501-20A)	No	NC and interlocked closed.		12E-2441 Sh. 2 12E-2437 Sh. 1 & 2	W AH	M29/1
28-1 L3	Torus Ring Spray Valve 2A (2-1501-18A).	No	NC and interlocked closed.		12E-2441 Sh. 1 12E-2437 Sh. 1 & 2	W AH	M29/1
28-1 L4	Torus Ring Spray Valve 2B (2-1501-19A)	No	NC and interlocked closed.		12E-2441 Sh. 2 12E-2437 Sh. 1 & 2	W AH	M29/1
28-1 M2	LPCI Pumps Drywell Spray Discharge Valve 2B (2-1501-28A)	No	NC and interlocked closed.		12E-2441 Sh. 3 12E-2347 Sh. 1 & 2	W AH	M29/1
28-1 M3	LPCI Header Crosstie Isolation Valve 2A (2-1501-32A)	No	NO and remains open.		12E-2440 Sh. 3	Z	M29/1
28-1 N1	LPCI Pump Flow Bypass Valve 2A (2-1501-13A)	No	NO and interlocked open but when flow is over low flow level, valve will close (0 seconds after UV relay reset).		12E-2440 Sh. 2 12E-2437 Sh. 2	Z AH	M29/1
28-1 N2	LPCI Heat Exchanger Bypass Valve 2A (2-1501-11A)	No	NO and interlocked open.		12E-2440 Sh. 2 12E-2437A 12E-2437 Sh. 1	Z X AH	M29/1

Table 1A

Automatically Turn On and Off Devices Under the Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-1 N3	West LPCI/Core Spray Room Sump Pump 2B (2-2001-511B)	Yes		It is not expected that the water level in Core Spray Room will go up.	12E-2674G 12E-2677C	R U	
28-1 N4	Post LOCA H2 & O2 Monitoring Sample Pump 2A (2-2252-81A)	No	Load will operate at 0 seconds.		12E-6554A 12E-6552 Sh. 2	F P	
28-1 N5	East LPCI/Core Spray Room Sump Pump 2A (2-2001-510A)	No		It is not expected that the water level in Core Spray Room will go up.	12E-2674G 12E-2677C	R U	
28-1 P4	Closed Cooling Water Drywell Supply Valve (2-3702)	No	NO and remains open.		12E-2398	D	M20
28-1 P5	Closed Cooling Water Header Isolation Valve (2-3701)	No	NO and remains open.		12E-2398	D	M20
28-2 A2	Main Steam Line Drain Valves 2-220-90 A, B, C, and D	No	NC and remains closed.		12E-2450	D	M12/2
28-2 A4	120/240V Distr Xfmr 28-2	No	Will continue to operate (0 seconds)		12E-2326A	AG	
28-2 B1	Condensate Transfer Jockey Pump (2-4321)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2373	M	
28-2 B2	Contain. Cool. Serv. Water Pump Cub. Cooler A, Fan 1 (2-5700-30A)	No	Turns on by operating CCSW Pump 2B (starts at 10++ minutes).		12E-2675A 12E-2435 SH. 1	AE X	M274
28-2 B3	RX Protection System M-G Set 2A (2-8001-A)	No	Will operate when voltage is restored to MCC 28-2.		12E-2592	K	
28-2 C1	RX Building Vent to Standby Gas Treatment Damper 2/3A (2-7503)	No	NO and remains open.		12E-2400A 12E-2400C Sh. 1 & 2	S B	M49
28-2 C2	120/240V Essential Service Bus (Reserve Feed)	No	Will not operate.		12E-2675B	Q	
28-2 C3	120/240V Instrument Bus (Normal Feed)	No	Will continue to operate (0seconds)		12E-2675B	Q	

Table 1A

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-2 C4	120/240V Distr Xfmr Inst 2B	No	Will continue to operate (0 seconds).		12E-2675B	Q	
28-2 D1	H2 Seal Oil Pump (2-5350-MSOP)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2365	L	
28-2 D3	125 Volt Battery Charger 2A (2-8300-2A)	No	Will continue to operate (0 seconds).		12E-2389D	A	
28-2 D4	H2 Seal Oil Vacuum Pump (2-5350-SOVP)	No	Will operate in auto (0 seconds)	Assume in auto.	12E-2365	L	
28-2 D5	Condensate Transfer Pump 2A (2A-4301)	Yes	Trips on loss of voltage, and does not auto start.	Assume in auto.	12E-2370	Q	
28-2 E2	Contain. Cool. Serv. Water Pump Cub. Cooler A, Fan 2 (2-5700-30A)	No	Turns on by operating CCSW Pump 2B (starts at 10++ minutes).		12E-2675C 12E-2435 SH. 1	S X	M274
28-2 E3	Diesel Starting Air Compressor 2A (2-4611-A)	No	Will operate in auto as long as pressure is below 230 psi (0 seconds).	Assume in auto.	12E-2350B Sh. 1	U	M173
28-2 E5	Turbine Vacuum Breaker Valve (2-4901)	No	NC and remains closed.	Assume in auto.	12E-2363	F	
28-2 F1	Contain. Cool. Serv. Water Pump Cub. Cooler B Fan 1 (2-5700-30B)	No	Turns on by operating CCSW Pump 2B (starts at 10++ minutes).		12E-2675C 12E-2435 Sh. 1	S X	
28-2 F2	Submersible Sewage Pump (2/3-2001-260)	No		Presume that pump is not in area of LOCA	12E-2675C	S	
28-2 F3	Contain. Cool. Serv. Water Pump Cub. Cooler B Fan 2 (2-5700-30B)	No	Turns on by operating CCSW Pump 2B (starts at 10++ minutes).		12E-2675C 12E-2435 Sh. 1	S X	
28-2 F4	Main Steam Isolation Valve Unit Coolers (2-5758 A thru H)	No		Considering the worst case that the manual starter has no UV, the coolers will start to operate at 0 seconds.	12E-2675C 12E-2435 Sh. 1	S X	
28-2 F5	120/240V Distr Xfmr Inst 2A	No	Will continue to operate (0 seconds).		12E-2675B	Q	

Table 1A

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-3 2C3	120/208V Distr Xfmr FP-2	No	Will always operate (0seconds).		12E-2676B	V	
28-3 A2	Diesel Circ. Water Heater 2	No	When DG 2 gets up to the speed the contacts will open.	Assume DG 2 failed to start.	12E-2350B Sh. 2	U	
28-3 A2	DG Lube Oil Circulating Pump Motor 1HP (2-6657)	No	Will remain on (0 seconds)		12E-2350B Sheet 2	V	
28-3 A2	DG Lube Oil Circulating Pump Motor 3/4HP (2-6660)	No	Will remain on (0 seconds)		12E-2350B Sheet 2	V	
28-3 A3	Turning Gear Oil Pump (2-5600-TGOP)	No	Will operate in auto (starts after Core Spray Pump but before CCSWP). Shown as a running load at 10- minutes.	Assume in auto.	12E-2362	M	
28-3 A4	Turbine Turning Gear (2-5601-TGM)	No	Motor will start when the turbine speed has decreased to a set point.	Show in calculation in the final loading condition.	12E-2362	M	
28-3 B1	Turning Gear Piggyback Motor (2-5601-TGM-PBM)	No	Will operate in auto. This load is shown to have operated (i.e. the Turbine Turning Gear Motor is engaged and shown as the operating load in ELMS).	Assume in auto.	12E-2362	M	
28-3 B2-B6	Turbine Bearing Lift Pump 2A, 2B, 2C, 2D, and 2E (2-5620-A,B,C,D,E)	No	Manual operation only.	These are manually started prior to the Turning Gear operation (shown in final loading).	12E-2364	K	
28-3 C2	250 Volt Battery Charger #2	No	Will always operate (0 seconds).		12E-2389A	B	
28-3 D1	Diesel Cooling Water Pump 2/3 (2/3-3903)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2676B 12E-2351B Sh. 1	V AA	

Table 1A

Automatically Turn On and Off Devices Under the Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-7 B3	LPCI Inbd. Isolation Valve 2A (2-1501-22A)	No	NC and interlocked open (10 seconds after UV relay reset).	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2441 Sh. 4 12E-2437A 12E-2438A	W X Y	M29/1
~~28-7 B4~~	~~Recirc. Loop Bypass Valve 2A (2-202-9A)~~	~~No~~	~~NO and closes on LPCI initiation (10seconds after UV relay reset).~~	~~Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.~~ ~~Shown as operating when 28/29-7 is re-energized. This is conservative.~~	~~12E-2420A 12E-2437A 12E-2438A~~	~~P X Y~~	~~M26/2~~
28-7 C1	Recirc. Pump 2A Suction Valve (2-202-4A)	No	NO and remain open.		12E-2420	P	M26/2
28-7 C2	Recirc. Pump 2A Discharge Valve (2-202-5A)	No	NO and interlock closed (10 seconds after UV relay reset).	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2420 12E-2437A 12E-2438A	P X Y	M26/2
28-7 C3	Recirc. Pump 2A Discharge Bypass Valve (2-202-7A)	No	NC and interlocked closed.		12E-2420A 12E-2437A 12E-2438A	P X Y	M26/2

R3

Table 1A

Automatically Turn On and Off Devices Under the Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
28-7 C4	Recirc. Loop Equalizing Valve 2A (2-202-6A)	Yes	Disconnected at MCC 28-7		12E-2662B	N	M26/2
28-7 D2	LPCI Outbd. Isolation Valve 2A (2-1501-21A)	No	NO and interlocked open.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2441 Sh. 3 12E-2437A 12E-2438A	W X Y	M29/1
29-7 A3	LPCI Outboard Isolation Valve 2B (2-1501-21B)	No	NO and interlocked closed (10 seconds after UV relay reset).	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2441A 12E-2437A 12E-2438A	W X Y	M29/1
29-7 B1	Recirc. Pump 2B Discharge Bypass Valve (2-202-7B)	No	NC and remains closed.		12E-2420B 12E-2437A 12E-2438A	M X Y	M26/2
29-7 B2	Recirc. Pump 2B Discharge Valve (2-202-5B)	No	NO and remains open.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2420B 12E-2437A 12E-2438A	M X Y	M26/2
29-7 B3	Recirc. Loop Equalizing Valve 2B (2-202-6B)	Yes	Disconnected at MCC 29-7.		12E-2662C	S	M26/2

Table 1A
Automatically Turn On and Off Devices Under the Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 2

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
~~29-7 B4~~	~~Recirc. Equal. Bypass Valve 2B (2-202-9B)~~	~~No~~	~~NC and remains closed. MOV 2-202-9A is shown as the normally open by-pass valve.~~	~~Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.~~	~~12E-2420B 12E-2437A 12E-2438A~~	~~M X Y~~	~~M26/2~~
29-7 C2	Recirc. Pump 2B Suction Valve (2-202-4B)	No	NO and remains open.		12E-2420B	M	M26/2
29-7 C3	LPCI Inboard Isolation Valve 2B (2-1501-22B)	No	NC and interlocked closed.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 28/29-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-2441A 12E-2437A 12E-2438A	W X Y	M29/1

R3

N.O. - Normally Open
N.C. - Normally Closed
N/A - Not Available
Note: All loads that are tripped off and interlocked off or require manual action to restart are considered Load Shed.
Operating loads and loads with auto start capabilities that have power available and do not operate (i.e. an MOV that is N.O. and remains open) is considered NOT load shed.

TABLE 2A

AFFECTS OF VOLTAGE DIP

PURPOSE

The purpose of Table 2 is to determine the affects of an AC voltage dip, that is low enough to de-energize control circuits ie., contactors, relays, etc., has on the operation of the mechanical equipment.

METHOD

Table 2 shows the results of the review. The conclusion of Table 2 is shown in the analysis of data section. Below is the explanation for each column in Table 2.

Table 2 Column Description	Explanation of What is Shown in the Column
Equipment Description/No.	This column lists all of the loads connected to the DG buses. It is the same list as shown in Table 1.
Load Shed	All loads that are tripped off and interlocked off or require manual action to restart are considered load shed. Operating loads and loads with auto start capabilities that have power available that do not operate (i.e. an MOV that is N.O. and remains open) is considered not load shed.
Will the voltage dip at 5 seconds, 10 seconds, and 10 minutes affect the equipments' operation (Question 1)	The "affect" looked for is that the control circuit per the referenced schematics is de-energized or energized by a voltage dip. If the circuit was not energized before the dip and/or the energized state of the circuit did not change due to a dip, the answer is no. If the energized state of the circuit changed, the answer is yes.

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..E 2A

AFFECTS OF A VOLTAGE DIP

Table 2 Column Description	Explanation of What is Shown in the Column
Will the equipment restart after the voltage recovery (Question 2)	This question is to verify that equipment required is restarted automatically after a voltage dip. Only AC control circuits need to be considered. DC control circuits will be unaffected by an AC voltage dip. Circuits that have seal-in contacts are types that would not restart.
Will the equipment operate in an adverse mode due to a voltage dip (Question 3)	If the answer to Question 1 is yes, and to Question 2 is yes, then Question 3 has to be answered. The "adverse modes" looked for are items like, valves moving in the wrong direction, time delay relays being reset by the dip causing equipment to operate for shorter or longer periods than required, etc.
Will the time delay in operation cause any adverse affect (Question 4)	If the answer to Question 1 is yes, and 2 is yes, Question 4 has to be answered. The time delay referred to is the one second it takes the DG to recover ~~to~~ above 80% after the start of a large motor. The adverse affects looked for are items like, could within one second the room temperature rise excessively if a cooler is de-energized, if a valve travel requires one more second to operate will its total travel time exceed design limits, etc.

The "no" answers to this question are based on the following engineering judgements:

a. Some valves may require two seconds more to complete its travel. Valves operate normally less than a minute. The allowable total time is 120 seconds. Therefore with a voltage dip, the design allowable is not exceeded.

b. Two-second time delays in room coolers, pumps, etc. would not cause rooms, equipment, etc. to overheat, etc.

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TABLE 2A

AFFECTS OF A VOLTAGE DIP

Table 2 Column Description	Explanation of What is Shown in the Column
	c. Instrument bus loads may give erroneous readings for a fraction of a second due to momentary sharp voltage drop. But the instrument bus is designed with transfer switch, which takes about one second to transfer the loads. Therefore, the operators are familiar with the behavior of these loads during abnormal condition. This will not require any special attention of the operators.
Drawing Reference	This drawing shows the main schematic or wiring diagram for the control circuit reviewed.
Revision	This is the revision number of the drawing referenced above.
Other Reference	Other references used to understand the operation of control circuit may be listed here or see the main reference section of this calculation.

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TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
23-1 2321	RX Shutdown Cooling Pump 2C	Yes	N/A	N/A	N/A	N/A	12E-2516 12E-2517	G H	
23-1 2322	RX Building Cooling Water Pump 2A	Yes	N/A	N/A	N/A	N/A	12E-2397	H	
23-1 2323	RX Shutdown Cooling Pump 2A	Yes	N/A	N/A	N/A	N/A	12E-2516 12E-2517	G H	
23-1 2325	LPCI Pump 2B	No	Yes, pump will slow down momentarily.	Yes, 125Vdc control.	No	No	12E-2436 Sh. 1 & 3 12E-2437 Sh.1	W AH	
23-1 2326	RX Cleanup Recirc. Pump 2A	Yes	N/A	N/A	N/A	N/A	12E-2520	L	
23-1 2327	Feed to 480V SWGR 28 (2-7328-28)	No	No. Note 1.	N/A	N/A	N/A	12E-2349, Sh. 1	AC	
23-1 2329	Main Feed from SWGR 23	No	No. Note 1.	N/A	N/A	N/A	12E-2344, Sh. 2	V	
23-1 2330	Core Spray Pump 2A	No	Yes, pump will slow down momentarily.	Yes, 125Vdc control.	No	No	12E-2429 Sh. 1 12E-2430	X AF	
23-1 2331	LPCI Pump 2A	No	Yes, pump will slow down momentarily.	Yes, 125Vdc control.	No	No	12E-2436 Sh. 1 & 3 12E-2437 Sh.1	W AH	
23-1 2332	Bus Tie to 33-1	No	No. Note 1.	N/A	N/A	N/A	12E-2345	B	
40	Aux. Pt. Indicating Light, Meter, and Relay Comb.	No	No	Yes	No	No	12E-6628	B	
28 2B	Main Feed (2-6723-27)	No	No. Note 1.	N/A	N/A	N/A	12E-2349, Sh. 2	AD	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28 2C	Bus 28-29 Tie (2-7328-2-7329)	No	No. Note 1.	N/A	N/A	N/A	12E-2349, Sh. 3	AC	
28 3A	Fuel Pool Cooling Water Pump 2A	Yes	N/A	N/A	N/A	N/A	12E-2548	R	
28 3B	RX Building Vent Fan 2A	Yes	N/A	N/A	N/A	N/A	12E-2399A	K	
28 3C	RX Building Vent Fan 2C	Yes	N/A	N/A	N/A	N/A	12E-2399A	K	
28 3D	RX Cleanup Demin. Aux. Pump	Yes	N/A	N/A	N/A	N/A	12E-2520	N	
28 4A	480 MCC 28-1 (2-7828-1P1)	No	No. Note 1.	N/A	N/A	N/A	12E-2374	AB	
28 4B	480 MCC 28-2 (2-7828-2A)	No	No. Note 1.	N/A	N/A	N/A	12E-2374	AB	
28 4C	RX Building Exhaust Fan 2A	Yes	N/A	N/A	N/A	N/A	12E-2399A	K	
28 4D	480 MCC 28-3 (2-7828-3A1)	No	No. Note 1.	N/A	N/A	N/A	12E-2374	AB	
28 5A	480 MCC 28-7 (2-7828-7A1)	No	No. Note 1.	N/A	N/A	N/A	12E-2374	AB	
28 5C	South Turbine Room Vent Fan 2A	Yes	N/A	N/A	N/A	N/A	12E-2387B	G	
28 5D	Recirc. M-G Set Vent Fan 2A	Yes	N/A	N/A	N/A	N/A	12E-2420C	D	
28 6A-6D	Drywell Cooler Blower 2A, 2B, 2F, and 2G	Yes	N/A	N/A	N/A	N/A	12E-2393	N	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 A1	Diesel Gen Starting Air Compressor 2/3A	No	Yes. Air compressor will slow down momentarily.	Yes	No	N/A	12E-2351B Sh. 1	AA	M-173
28-1 A3	120/208V Distr Xfmr 28-1	No	Yes. Voltage will decrease momentarily.	Yes	No	N/A	12E-2326A	AG	
28-1 B1	Safety System Jockey Pump	Yes	N/A	N/A	N/A	N/A	12E-2674A	AG	
28-1 B2	Drywell & Torus Purge Exhaust Fan 2A (2A-5708)	Yes	N/A	N/A	N/A	N/A	12E-2393	K	
28-1 B3	Closed Cooling Water Drywell Return Valve 2B (2-3706)	No	No. Note 1.	N/A	N/A	N/A	12E-2398	D	M-20
28-1 B4	Shutdown Cooling Outlet Isolation Valve 2B (2-1001-5B)	No	No. Note 1.	N/A	N/A	N/A	12E-2508E 12E-2508 12E-2501 Sh. 1 & 2	J M AC	
28-1 C1	Cleanup System Outlet Isolation Valve (2-1201-7)	No	Yes. Valve will stop momentarily.	Yes	No. N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2509A 12E-2509 12E-2501 Sh. 1 & 2	L AC AC	M-30
28-1 C2	Cleanup System Inlet Isolation Valve (2-1201-1)	No	Yes. Valve will stop momentarily.	Yes	No. N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2509A 12E-2509 12E-2501 Sh. 1 & 2	L AC AC	M-30
28-1 C3	Shutdown Cooling Outlet Isolation Valve 2A (2-1001-5A)	No	No. Note 1.	N/A	N/A	N/A	12E-2508E 12E-2508 12E-2501 Sh. 1 & 2	J M AC	M-32

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 C4	Shutdown Cooling Inlet Isolation Valve 2A (2-1001-1A)	No	No. Note 1.	N/A	N/A	N/A	12E-2508A 12E-2508 12E-2501 Sh. 1 & 2	F M AC	
28-1 D1	CRD Hydraulic System Pressure Cont. Valve 2A (2-302-8)	No	No. Note 1.	N/A	N/A	N/A	12E-2416	L	M-34
28-1 D2	Torus/Drywell Air Compressor 2A	Yes	N/A	N/A	N/A	N/A	12E-2372B	L	
28-1 E2	Shutdown Cooling Inlet Isolation Valve 2B (2-1001-1B)	No	No. Note 1.	N/A	N/A	N/A	12E-2508A 12E-2508 12E-2501 Sh. 1 & 2	F M AC	
28-1 E3	RWCU Isolation Valve Bypass 2-1201-1A	No	No. Note 1.	N/A	N/A	N/A	12E-6816D	F	
28-1 E4	Core Spray Pump Recirc. Isolation Valve 2A (2-1402-38A)	No	No	Does not operate until after Core Spray Pump is started and completes its operation before the CCSW Pump is started.	N/A	N/A	12E-2433	M	M27
28-1 F1	Diesel Transfer Pump 2/3 (2/3-5203)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2351B Sh. 1	AA	M-41 Sh. 2
28-1 F2	RX Building Emergency Lighting	No	Yes. Light will dim momentarily.	Yes	No	N/A	12E-2674C	U	
28-1 F3	LPCI Core Spray Pump Area Cool. Unit 2A	No	Yes. Unit slows down momentarily.	Yes	No	N/A	12E-2393	K	
28-1 F4	Standby Liquid Control Pump 2A (2-1102A)	No	No. Note 1.	N/A	N/A	N/A	12E-2460	T	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 G3	Diesel 2/3 Vent Fan (2/3-5790)	No	Yes. Fan will slow down momentarily.	Yes	No	N/A	12E-2351B Sh. 2 12E-2674D	AA S	M-1297
28-1 H1	Core Spray Outboard Isolation Valve 2A (2-1402-24A)	No	No. Note 1.	N/A	N/A	N/A	12E-2431 Sh. 1	X	M-27
28-1 H2	Core Spray Inboard Isolation Valve 2A (2-1402-25A)	No	Yes. Valve will stop operating momentarily.	Yes	No. N.C. and interlocked open.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2431 Sh. 1 12E-2430	X AF	M-27
28-1 H3	Containment Cool. Heat Exchanger Discharge Valve 2A (2-1501-3A)	No	No	No (not required until CCSW Pump is started)	No. N.C. and interlocked closed until CCSW Pump is started.	No	12E2440 Sh. 1 12E-2437 Sh. 1	Z AA	M-29 Sh.1
28-1 H4	Core Spray Pump Suction Valve 2A (2-1402-3A)	No	No. Note 1.	N/A	N/A	N/A	12E-2432 12E-2430	Y AF	M-27
28-1 J1	Core Spray Test Bypass Valve 2A (2-1402-4A)	No	No. Note 1.	N/A	N/A	N/A	12E-2433 12E-2430	M AF	M-27

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 J3	Indb Cond Return Vlv (2-1301-4)	No	Yes. Valve will stop operating momentarily.	Yes	No. N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2507B 12E-2506 Sh. 1 & 2	F AC	M-28
28-1 J4	Steam Line Isol Vlv (2-1301-1)	No	Yes. Valve will stop momentarily.	Yes	No. N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2507B 12E-2506 Sh. 1 & 2	F AC	M-28
28-1 K1	LPCI Pump 2A Suction Valve (2-1501-5A)	No	No. Note 1.	N/A	N/A	N/A	12E-2440 Sh. 1 12E-2437 Sh. 1	Z AH	M-29 Sh. 1
28-1 K2	LPCI Pump 2B Suction Valve (2-1501-5B)	No	No. Note 1.	N/A	N/A	N/A	12E-2440 Sh. 1 12E-2437 Sh. 1	Z AH	M-29 Sh. 1
28-1 K3	LPCI Pumps Drywell Spray Discharge Valve 2A (2-1501-27A)	No	No. Note 1.	N/A	N/A	N/A	12E-2440 Sh. 3 12E-2437 Sh. 1 & 2	Z AH	M-29 Sh. 1
28-1 K4	Stm/Iso Inbd Cond Vlv (3-1301-1 & 3-1301-4)(alternate feed)	No	No. Note 1.	N/A	N/A	N/A	12E-3507B	F	
28-1 L1	Torus Spray Valve 2A (2-1501-38A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 1 12E-2437 Sh. 1 & 2	W AH	M29, Sh. 1

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 L2	Torus Spray Valve 2A (2-1501-20A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 2 12E-2437 Sh. 1 & 2	W AH	M-29 Sh. 1
28-1 L3	Torus Ring Spray Valve 2A (2-1501-18A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 1 12E-2437 Sh. 1 & 2	W AH	M-29 Sh. 1
28-1 L4	LPCI Torus Ring Spray Valve 2A (2-1501-19A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 2 12E-2437 Sh. 1 & 2	W AH	M-29 Sh. 1
28-1 M2	LPCI Pumps Drywell Spray Discharge Valve 2A (2-1501-28A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 3 12E-2437 Sh. 1 & 2	W AH	M-29 Sh.1
28-1 M3	LPCI Header Crosstie Isolation Valve 2A (2-1501-32A)	No	No. Note 1.	N/A	N/A	N/A	12E-2440 Sh. 3	Z	M-29 Sh.1
28-1 N1	LPCI Pump Flow Bypass Valve 2A (2-1501-13A)	No	Yes. Valve will stop operating momentarily.	Yes	No.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2440 Sh. 2 12E-2437 Sh. 2	Z AH	M-29 Sh.1
28-1 N2	LPCI Heat Exchanger Bypass Valve 2A (2-1501-11A)	No	No. Note 1.	N/A	N/A	N/A	12E-2440 Sh. 2 12E-2437A 12E-2437 Sh. 1	Z X AH	M-29 Sh.1
28-1 N3	West LPCI/Core Spray Room Sump Pump 2B (2-2001-511B)	No	No. Note 1.	N/A	N/A	N/A	12E-2674G 12E-2677C	R U	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-1 N4	Post LOCA H2 & O2 Monitor Sample Pump 2A	No	Yes. Pump will slow down momentarily.	Yes. Interlocked with LOCA.	No	N/A	12E-6554A 12E-6552 Sh. 2	F P	
28-1 N5	East LPCI/Core Spray Room Sump Pump 2A (2001-510A)	No	No. Note 1.	N/A	N/A	N/A	12E-2674G 12E-2674C	R U	
28-1 P4	Closed Cooling Water Supply Valve (2-3702)	No	No. Note 1.	N/A	N/A	N/A	12E-2398	D	M-20
28-1 P5	Closed Cooling Water Header Isolation Valve (2-3701)	No	No. Note 1.	N/A	N/A	N/A	12E-2398	D	M20
28-2 A2	Main Steam Line Drain Valves (2-220-90A,B,C,D)	No	No. Note 1.	N/A	N/A	N/A	12E-2450	D	
28-2 A4	120/240V Distr Xfmr 28-2	No	Yes. Voltage will decrease momentarily.	Yes	No	No	12E-2326A	AG	
28-2 B1	Condensate Transfer Jockey Pump (2-4321)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2373	M	
28-2 B2	Containment Cooling Service Water Pump Cubicle Cooler A Fan 1	No	No. Fan will operate after the CCSW Pump is operating (starts at 10++ minutes)	N/A	No	N/A	12E-2675A 12E-2435 Sh. 1	AE X	M-274
28-2 B3	RX Protection System M-G Set 2A	No	Yes. Motor will slow down momentarily.	Yes.	No.	N/A	12E-2592	K	
28-2 C1	RX Building Vent to Standby Gas Treatment Damper 2/3A (2/3-7503)	No	No. Note 1.	N/A	N/A	N/A	12E-2400A 12E-2400C Sh. 1 & 2	S B	M-49
28-2 C2	120/240V Essential Service Bus (Reserve Feed)	No	No. Note 1.	N/A	N/A	N/A	12E-2675B	P	
28-2 C3	120/240V Instrument Bus (Normal Feed)	No	Yes. Voltage will decrease momentarily (see pages B15-B18).	—	—	—	12E-2675B	Q	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-2 C4	120/240V Distr Xfmr Inst 2B	No	Yes. Voltage will decrease momentarily (see Cubicles C2 & C3).	—	—	—	12E-2675B	Q	
28-2 D1	H2 Seal Oil Pump	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2365	L	
28-2 D3	125V Battery Charger 2A	No	Yes. Charger output might decrease	Yes	No	N/A	12E-2389D	A	
28-2 D4	H2 Seal Oil Vacuum Pump	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2365	L	
28-2 D5	Condensate Transfer Pump 2A (2A-4301)	Yes	N/A	N/A	N/A	N/A	12E-2370	Q	
28-2 E2	Containment Cooling Service Water Pump Cubicle Cooler A Fan 2	No	No. Fan will operate after the CCSW Pump is operating (starts at 10++ minutes)	N/A	No	N/A	12E-2675C 12E-2435 Sh. 1	S X	M-274
28-2 E3	Diesel Starting Air Compressor 2A	No	Yes. Compresor will slow down momentarily.	Yes. When pressure is below 230 psi.	No	N/A	12E-2350B Sh. 1	U	M-173
28-2 E5	Turbine Vacuum Breaker Valve (2-4901)	No	No. Note 1.	N/A	N/A	N/A	12E-2363	F	
28-2 F1	Containment Cooling Service Water Pump Cubicle Cooler B Fan 1	No	No. Fan will operate after the CCSW Pump is operating (starts at 10++ minutes)	N/A	No	N/A	12E-2675C 12E-2435 Sh. 1	S X	
28-2 F2	Submersible Sewage Pump (2/3-2001-260)	No	No. Note 1.	N/A	N/A	N/A	12E-2675C	S	
28-2 F3	Containment Cooling Service Water Pump Cubicle Cooler B Fan 2	No	No. Fan will operate after the CCSW Pump is operating (starts at 10++ minutes)	N/A	No	N/A	12E-2675C 12E-2435 Sh. 1	S X	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-2 F4	Main Steam Isolation Valves Unit Coolers (2-5758A thru H)	No	Yes. Coolers will slow down momentarily.	Yes	No	N/A	12E-2675C	S	
28-2 F5	120/240V Distr Xfmr Inst 2A	No	Yes. Voltage will decrease momentarily (see Cubicles C2 & C3).	----	----	----	12E-2675B	Q	
28-3 2C3	120/208V Distr Xfmr FP-2	No	No	Yes	No	N/A	12E-2676B	V	
28-3 A2	Diesel Circ. Water Heater 2	No	Yes. Heater output will decrease momentarily.	Yes	No	N/A	12E-2350B Sh. 2	V	
28-3 A2	DG Lube Oil Circulating Pump Motor 1HP (2-6657)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2350B Sheet 2	V	
28-3 A2	DG Lube Oil Circulating Pump Motor 3/4HP (2-6660)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2350B Sheet 2	V	
28-3 A3	Turning Gear Oil Pump (2-5600-TGOP)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2362	M	
28-3 A4	Turbine Turning Gear (2-5601-TGM)	No	No. Not started until after second CCSW Pump is running.	N/A	N/A	N/A	12E-2362	M	
28-3 B1	Turbine Turning Gear Piggyback Motor (2-5601-TGM-PBM)	No	No. Not started until after second CCSW Pump is running.	N/A	N/A	N/A	12E-2362	M	
28-3 B2-B6	Turbine Bearing Lift Pump 2A, 2B, 2C, 2D, and 2E	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2364	K	
28-3 C2	250V Battery Charger #2	No	Yes. Charger output will decrease momentarily.	Yes	No	N/A	12E-2389A	B	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
28-3 D1	Diesel Cooling Water Pump 2/3 (2/3-3903)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2676B 12E-2351B Sh. 1	V AA	
28-7 B3	LPCI Inboard Isolation Valve 2A (2-1501-22A)	No	Yes, valve will stop momentarily.	Yes	No, N.C. and interlocked open.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2441 Sh. 4 12E-2437A 12E-2438A	W X Y	M-29 Sh. 1
~~28-7 B4~~	~~Recirc. Loop Bypass Valve 2A (2-202-9A)~~	~~No~~	~~Yes. Valve will slow down momentarily.~~	~~Yes~~	~~No~~	~~Yes. Will increase operating time. However, increased time will be within acceptable limits.~~	~~12E-2420A 12E-2437A 12E-2438A~~	~~P X Y~~	~~M-26 Sh.2~~
28-7 C1	Recirc. Pump 2A Suction Valve (2-202-4A)	No	No. Note 1.	N/A	N/A	N/A	12E-2420A	P	M-26 Sh.2
28-7 C2	Recirc. Pump 2A Discharge Valve (2-202-5A)	No	Yes, valve will stop momentarily.	Yes	No, N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2420A 12E-2437A 12E-2438A	P X Y	M-26 Sh.2
28-7 C3	Recirc. Pump 2A Bypass Discharge Valve (2-202-7A)	No	No. Note 1.	N/A	N/A	N/A	12E-2420A 12E-2437A 12E-2438A	P X Y	M-26 Sh.2
28-7 C4	Recirc. Loop Equalizing Valve 2A (2-202-8A)	Yes	N/A	N/A	N/A	N/A	12E-2662B	N	M-26 Sh.2
28-7 D2	LPCI Outboard Isolation Valve 2A (2-1501-21A)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 Sh. 4 12E-2437A 12E-2438A	W X Y	M-29 Sh. 1

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TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
29-7 A3	LPCI Outboard Isolation Valve 2B (2-1501-21B)	No	Yes. Valve will stop momentarily.	Yes	No, N.O. and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-2441A 12E-2437A 12E-2438A	W X Y	M-29 Sh. 1
29-7 B1	Recirc. Pump 2B Bypass Discharge Valve (2-202-7B)	No	No. Note 1.	N/A	N/A	N/A	12E-2420B 12E-2437A 12E-2438A	M X Y	M-26 Sh.2
29-7 B2	Recirc. Pump 2B Discharge Valve (2-202-5B)	No	No. Note 1.	N/A	N/A	N/A	12E-2420B 12E-2437A 12E-2438A	M X Y	M-26 Sh.2
29-7 B3	Recirc. Loop Equalizing Valve 2B (2-202-6B)	Yes	N/A	N/A	N/A	N/A	12E-2662C	S	M-26 Sh.2
~~29-7~~ B4	~~Recirc. Loop Bypass Valve 2B~~ (2-202-9B)	No	No. Note 1.	N/A	N/A	~~N/A~~	~~12E-2420B~~ 12E-2437A ~~12E-2438A~~	~~M~~ X Y	~~M-26~~ Sh.2
29-7 C2	Recirc. Pump 2B Suction Valve (2-202-4B)	No	No. Note 1.	N/A	N/A	N/A	12E-2420B	M	M-26 Sh.2
29-7 C3	LPCI Inboard Isolation Valve 2B (2-1501-22B)	No	No. Note 1.	N/A	N/A	N/A	12E-2441 12E-2437A 12E-2438A	W X Y	M-29 Sh. 1
Inst. Bus Ckt 1	Power Distribution Rod Manual Control Alarm Circuits	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2410 12E-2755C 12E2755D	E Z D	
Inst. Bus Ckt 2	Voltage Regulator AC Control Circuit & MCB Generator 2 Wattage Recorder	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2614 12E-2737 12E-2613 12E-2379	K W R AB	

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TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
Inst. Bus Ckt 3	MCB Process Radiation Monitor System, Reheat Seal-Trough Valve Control & Condensor Seal Trough Drain Valve	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2489 12E-2369 12E-2731 12E-2728 12E-2729 12E-2733	AP K P AB T Q	
Inst. Bus Ckt 4	ATWS Recirc. Pump Trip System & Annunciator Failure Indication	No	Yes. Will lose power temporarily.	Yes	No	No	12E-6583C 12E-2576 12E-6583A 12E-2815J	L D R F	
Inst. Bus Ckt 5	Reactor Water Cleanup System Process	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2492 12E-2751	P T	
Inst. Bus Ckt 6	Reactor Recirc. Pump Seal Water Pressure	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2491 12E-2750A	S AH	
Inst. Bus Ckt 7	Annunciator Feed	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2745	K	
Inst. Bus Ckt 8	Battery Charger Control	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2685B	AA	
Inst. Bus Ckt 9	Feedwater Control System & Instrument Isolators	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2417 12E-2750B 12E-2750A 12E-6818AA	R AC AH K	
Inst. Bus Ckt 10	CRD Hydraulic System	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2496 12E-2751	G T	
Inst. Bus Ckt 11	Reactor Protection Scram	No	Yes. Will lose power temporarily.	No. Will not be in use during an emergency condition	No	No	12E-2468 Sh. 2 12E-2781A	R J	
Inst. Bus Ckt 12	HPCI Valve Indicating Lights	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2528 12E-2699	AL BD	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
Inst. Bus Ckt 13	Reactor Protection Scram	No	Yes. Will lose power temporarily.	No. Will not be in use during an emergency condition	No	No	12E-2468 Sh.1 12E-2779A	R H	
Inst. Bus Ckt 14	24Vdc Battery Charger 2A for Nuetron Monitor - Reactor Protection System #1	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2798C	E	
Inst. Bus Ckt 15	24Vdc Battery Charger 2B for Nuetron Monitor - Reactor Protection System #2	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2798D	E	
Inst. Bus Ckt 16	Thrust Bearing Wear Detector Sw./on the Electro-Hydraulic Cont. Cab.	No	Yes. Will lose power temporarily.	No. Manually operated.	No	No	12E-2638C 12E-2636	D K	
Inst. Bus Ckt 17	Neutron Monitoring System, SRM & IRM Drive Control	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2477 12E-2478 12E-2777	L L G	
Inst. Bus Ckt 18	Activate Standby Gas Treat & Close Reactor Building Vent System (Outboard)	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2488 12E-2764B	AR T	
Inst. Bus Ckt 19	Off-gas Sample Control Switches	No	Yes. Will lose power temporarily.	No. Not in use during an emergency condition.	No	No	12E-6225 12E-6251 12E-6253	G AC S	
Inst. Bus Ckt 20	Switch Light Transfer	No	Yes. Will lose power temporarily.	Yes	No	No	12E-5205 12E-5204	G K	
Inst. Bus Ckt 21	Signal Convertor (Signal originates at the radiation monitor in the Radwaste Room and ends at the recorder in the Main Control Board)	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2744A 12E-2744B	AB AF	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
Inst. Bus Ckt 22	Jet Pumps Process Instr. & LPCI Containment Cooling System 1	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2490 12E-2495 12E-2761 12E-2751	F T G T	
Inst. Bus Ckt 23	Auto Blowdown (Electromatic Relief Valve, Controller)	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2462 Sh. 2 12E-2757D 12E-2757B	AT AN AQ	
Inst. Bus Ckt 24	High-Low Level Alarm on Standby Liquid Control	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2460 12E-2720 12E-2719	T AA AS	
Inst. Bus Ckt 25	Totalizing Relay at Relay and Meter Panel	No	Yes. Will lose power temporarily.	Yes	No	N/A	12E-2690D	P	
Inst. Bus Ckt 26	Main Steam Valves Inboard, Isolation Condenser Steam Line Break Outboard, Inboard & Outboard Recirc. Loop Sample Valves	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2504 Sh. 2 12E-2506 12E-2505 12E-2695 12E-2696 12E-2697 12E-2698 12E-2711 12E-2710 12E-2708	Q AB W CS BD BJ AB AX AC BG	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
Inst. Bus Ckt 27	Tip Control on the Primary Containment Isolation System & Torus Vacuum Relief Valves, RX Vessel Vent Valves	No.	Yes. Will lose power temporarily.	Yes	No	No	12E-2502 Sh. 1 12E-2449 12E-2695 12E-2696 12E-2706 12E-2709	AB E CS BD BL Q	
Inst. Bus Ckt 28	L.P. Feed Heaters and Flash Tank Level Controls & H.P. Feed Heater Level Controls	No	Yes. Will lose power temporarily.	Yes	No	No	12E-2379 12E-2380 12E-2809A 12E-2809B 12E-2810B 12E-2810C 12E-2810D 12E-2810E	G K H J J F H C	
MCC 28-2 Dist. Pnl Ckt 1	L.P. Service Water Strainer Cont. Cab.	Yes	No	N/A	No	N/A	12E-2391	H	
MCC 28-2 Dist. Pnl Ckt 2	East Turb. Room Vent Panel 2252-27	Yes	No	N/A	No	N/A			
MCC 28-2 Dist. Pnl Ckt 3	Cont. Room & Office Heating & Vent Panel 2223-35	No	No	Yes	No	No	12E-2375	M	
MCC 28-2 Dist. Pnl Ckt 4	Feed Cont. Room Aux. Elect. Equip. Rm. HVAC Sys. Panel 2223-89	No	No	Yes	No	No			

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
MCC 28-2 Dist. Pnl Ckt 5	Rollamatic Filter 2-5744 R.F. Pump Motors Vent Sys. Panel 2252-25	Yes	No	N/A	No	N/A	12E-2394 12E-2395	U S	
MCC 28-2 Dist. Pnl Ckt 6	Diesel Ganerator 2 Relay & Meter Panel 2252-10	No	No	Yes	No	No	12E-2336	M	
MCC 28-2 Dist. Pnl Ckt 7	Area Rad. Mon. System STA 2A	No	No	Yes	No	No	12E-2480	M	
MCC 28-2 Dist. Pnl Ckt 8	Power Supply & Indicating Lights Panel 2252-25	No	No	Yes	No	No	12E-2494 12E-2395	Q S	
MCC 28-2 Dist. Pnl Ckt 9	Junction Box TB-2, Turb. Stand. #2	Yes	No	N/A	No	N/A			
MCC 28-2 Dist. Pnl Ckt 10	Turbine Building Entry Doors #16,51,52	Yes	No	N/A	No	N/A	12E-2844E	J	
MCC 28-2 Dist. Pnl Ckt 11	Turbine Building Entry Doors #47, 48	Yes	No	N/A	No	N/A	12E-2844E	J	
MCC 28-2 Dist. Pnl Ckt 12	Drywell Cooling System Panel 2252-26	No	No	Yes	No	No	12E-2393	K	
MCC 28-2 Dist. Pnl Ckt 13	Turbine Building Entry Doors #74, 75	Yes	No	N/A	No	N/A	12E-2844E	J	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
MCC 28-2 Dist. Pnl Ckt 14	Diesel Generator 2 Vent Panel 2252-47	No	No	Yes	No	No	12E-2350B	T	
MCC 28-2 Dist. Pnl Ckt 15	Control Cooling Service Water Pump Room Floor Drain Valves	Yes	No	N/A	No	N/A	12E-2400C	B	
MCC 28-2 Dist. Pnl Ckt 16	Main Steam Tunnel Access Door Interlocks #55, 185	Yes	No	N/A	No	N/A	12E-2844E	J	
MCC 28-2 Dist. Pnl Ckt 17	Feed Com. Sys. A Panel 902-55	Yes	No	N/A	No	N/A			
MCC 28-2 Dist. Pnl Ckt 18	Instrument Air Comp. Panel 2202-51	No	No	Yes	No	No	12E-6716B	A	
MCC 28-2 Dist. Pnl Ckt 19	Standby Liquid Cont. Area Panel 2202-48	No	No	Yes	No	No	12E-6574H	J	
MCC 28-2 Dist. Pnl Ckt 21	Turbine Building 480V SWGR Area Panel 2202-46 Fire Det. Panel	Yes	No	N/A	No	N/A	12E-6730H		
MCC 28-2 Dist. Pnl Ckt 23	Feed Battery Area Panel 2202-47	Yes	No	N/A	No	N/A	12E-6730G		
MCC 28-1 Dist. Pnl Ckt 1	RX Head Seal Inst. Shutoff Valve 2A & 2B	Yes	No	N/A	No	N/A	12E-2449	E	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
MCC 28-1 Dist. Pnl Ckt 2	Core Spray Pump 2A & LPCI Pump 2A Motor Heater	No	No	Yes	No	No	12E-2436 12E-2439	S S	
MCC 28-1 Dist. Pnl Ckt 3	RX Head Cool Drain Valve 2A	No	No	Yes	No	No	12E-2449	E	
MCC 28-1 Dist. Pnl Ckt 4	Diesel Gen 2/3 Vent	No	No	Yes	No	No	12E-2830		
MCC 28-1 Dist. Pnl Ckt 5	Press. Suppr. Sys. Torus Vac. Bkr. Valve	Yes	No	N/A	No	N/A			
MCC 28-1 Dist. Pnl Ckt 6	H2 & O2 Monitor Sys. Heat Tracing	No	No	Yes	No	No	12E-6554P	E	
MCC 28-1 Dist. Pnl Ckt 7	RX Shutdown Cooling Pump 2A Motor Heater & Post LOCA H2 & O2 Panel	No	No	Yes	No	No	12E-2516 12E-6554A	G F	
MCC 28-1 Dist. Pnl Ckt 8	Diesel Gen 2/3 Relay & Meter Panel	No	No	Yes	No	No	12E-2337	M	
MCC 28-1 Dist. Pnl Ckt 9	RX Shutdown Cooling Pump 2B Motor Heater	No	No	Yes	No	No	12E-2516	G	
MCC 28-1 Dist. Pnl Ckt 10	RX Water Cleanup Panel	No	Yes. Panel will be at 0 volts momentarily	Yes	No	No	12E-6862	B	

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
MCC 28-1 Dist. Pnl Ckt 11	RX Shutdown Cooling Pump 2C & LPCI Pump 2B Motor Space Heaters	No	No	Yes	No	No	12E-2516 12E-2436	G V	
MCC 28-1 Dist. Pnl Ckt 12,13,14	Area Radiation Monitoring System Local Alarm Stations #1, 4, & 7 Recept	No	No	Yes	No	No	12E-2480	M	
MCC 28-1 Dist. Pnl Ckt 15	Analog Trip Cabinet	No	No	Yes	No	No	12E-6822	L	
MCC 28-1 Dist. Pnl Ckt 16	Switchgear 28 & MCC 28-7 Heaters	No	No	Yes	No	No			
MCC 28-1 Dist. Pnl Ckt 17	MCC 28-1 Space Heater & Feed Fire Protection Panel	No	No	Yes	No	No			
MCC 28-1 Dist. Pnl Ckt 18	Cont. Standby Liquid System Pipes Heat Trace Pump 2A-1102	Yes	No	N/A	No	N/A			

TABLE 2A
AFFECTS OF VOLTAGE DIP

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
MCC 28-1 Dist. Pnl Ckt 19,21,23	Local Starter Panel 28-1-1	No	No	Yes	No	No			
MCC 28-1 Dist. Pnl Ckt 20,22,24	SRM-IRM Drive System Motor Control Instrument Rack 2202-14	No	No	Yes	No	No	12E-2477	L	

NC - Normally Closed
NO - Normally Open
For further explanation of this table see Flow Chart No. 2.
Note 1: These loads have power available, however they do not operate.

Table 4A

DG Auxiliaries and Other 480V Loads Starting 0 Seconds after Closing of DG Breaker

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
	Aux. Pt. Indicating Lights, Meter, and relay Comb	40	0.4	KVA	480	85	85	0.6	100	85	0.4	0.2
2/3-6600-A	Diesel Starting Air Compressor 2/3A	28-1	5	HP	460	85	80	6.9	625	58	19.9	27.9
	120/208V Distr Xfmr 28-1	28-1	9	HP	480	75	100	10.8	100	75	6.7	5.9
2-1201-7	Cleanup System Return Isolation Valve	28-1	2.6	HP	440	85	80	3.7	680	68	13.2	14.2
2-1201-1	Cleanup System Inlet Isolation Valve	28-1	5.2	HP	460	60	70	11.6	545.5	78	39.3	31.5
2/3-5203	Diesel Transfer Pump 2/3	28-1	1.5	HP	460	80	75	2.3	625	75	8.7	7.7
2/3-5790	Diesel 2/3 Vent Fan	28-1	30	HP	440	85	85	40.6	625	42	81.3	175.7
2-1301-4	Inbd Cond Return Vlv	28-1	5.2	HP	460	82	70	8.5	850	56	32.2	47.6
2-1301-1	Steam Line Isol Vlv	28-1	9.5	HP	460	82	70	15.5	650	54	43.3	67.5
2-2252-81A	Post LOCA H2 & O2 Monitoring Sample	28-1	1	HP	460	80	75	1.6	625	79	6.1	4.8
	120/240V Distr Xfmr 28-1	28-2	17.32	KVA	480	75	100	20.8	100	75	13.0	11.5
2-4321	Condensate Transfer Jockey Pump	28-2	7.5	HP	460	85	80	10.3	625	56	28.8	42.6
	120/240V Distr Xfmr Inst 2A & 2B	28-2	86.6	KVA	480	75	100	104.2	100	75	65.0	57.3
2-5350-MSOP	Main H2 Seal Oil Pump	28-2	15	HP	440	85	85	20.3	625	49	47.4	84.4
2-8300-2A	125V Battery Charger 2A	28-2	From ETAP								34.1	30.6
2-5350-SOVP	H2 Seal Oil Vacuum Pump	28-2	2	HP	440	85	80	2.9	625	75	10.3	9.1
2-4611-A	Diesel Starting Air Compressor 2A	28-2	5	HP	460	85	80	6.9	625	58	19.9	27.9
2-5758A	Main Steam Isolation Valve Unit Cooler A	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758B	Main Steam Isolation Valve Unit Cooler B	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758C	Main Steam Isolation Valve Unit Cooler C	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758D	Main Steam Isolation Valve Unit Cooler D	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758E	Main Steam Isolation Valve Unit Cooler E	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758F	Main Steam Isolation Valve Unit Cooler F	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758G	Main Steam Isolation Valve Unit Cooler G	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-5758H	Main Steam Isolation Valve Unit Cooler H	28-2	2	HP	460	85	80	2.8	625	75	10.3	9.1
2-8001-A	RX Protection System M-G Set 2A	28-2	25	HP	440	85	85	33.9	625	43	69.4	145.7
	120/208V Distr Xfmr FP-2	28-3	15	KVA	480	75	100	18.0	100	75	11.3	9.9
	Diesel Circulation Water Heater 2	28-3	15	KW	480	100	100	18.0	100	100	15.0	0.0
2-6657	Engine Lube Oil Circulating Pump Motor	28-3	1	HP	460	80	75	1.6	625	79	6.1	4.8
2-6660	Engine Lube Oil Circulating Pump Motor	28-3	0.75	HP	460	80	75	1.2	546	83	4.2	2.8
	250V Battery Charger #2	28-3	From ETAP								66.1	58.0
2/3-3903	Diesel Cooling Water Pump 2/3	28-3	87	KW	460	83	100	131.6	400	31.5	132.1	397.9
										TOTAL STARTING KW & KVAR	856.1	1338.2

R4

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF))

Table 4A

DG Auxiliaries and Other 480V Loads Starting 0 Seconds after UV Relay Resets

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
2-1501-13A	LPCI Pump Flow Bypass Valve 2A	28-1	0.13	HP	440	80	75	0.2	527	83	0.7	0.5
2-5746A	LPCI Core Spray Pump Area Cooling Unit 2A	28-1	5	HP	460	85	80	6.9	625	58	19.9	27.9
								TOTAL STARTING KW & KVAR			20.6	28.4

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF))

R3

Table 4A

DG Auxiliaries and Other 480V Loads Starting 10 Seconds after UV Relay Resets

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR	
2-7902	RX Building Emergency Lighting	28-1	21.54	KW	480	90	100	28.8	100	90	21.5	10.4	
2-1401-38A	Core Spray Pump Recirculation Isolation Valve 2A	28-1	0.13	HP	440	80	75	0.2	527	85	0.7	0.4	
2-1402-25A	Core Spray Inboard Isolation Valve 2A	28-1	3.9	HP	440	85	80	5.6	830	58	20.6	28.9	
2-1501-22A	LPCI Inboard Isolation Valve 2A	28-7	10.5	HP	460	85	83.78	13.8	826	43	39.1	82.0	R3
2-202-5A	Recirc. Pump 2A Discharge Valve	28-7	13	HP	460	85	85	16.8	766	49	50.4	89.6	R3
2-1501-21B	LPCI Outboard Isolation Valve 2B	29-7	16.2	HP	460	85	85	21.0	723	44	53.2	108.6	
									TOTAL STARTING KW & KVAR		185.5	320.1	R3

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF)) R3

Table 4A

DG Auxiliaries and Other 480V Loads Starting at 10+ Minutes

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
2-1501-3A	Containment Cooling Heat Exchanger Discharge Valve 3A	28-1	0.33	HP	460	80	75	0.5	273	85	1.0	0.6
									TOTAL STARTING KW & KVAR		1.0	0.6

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

R3

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF))

Table 4A

DG Auxiliaries and Other 480V Loads Starting at 10++ Minutes

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
2-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 1	28-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 2	28-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 1	28-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 2	28-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
									TOTAL STARTING KW & KVAR		56.0	60.3

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF)) R3

DRESDEN DIESEL GEN 2/3 LOAD BUS (LOOP AND LOCA CONDITION)

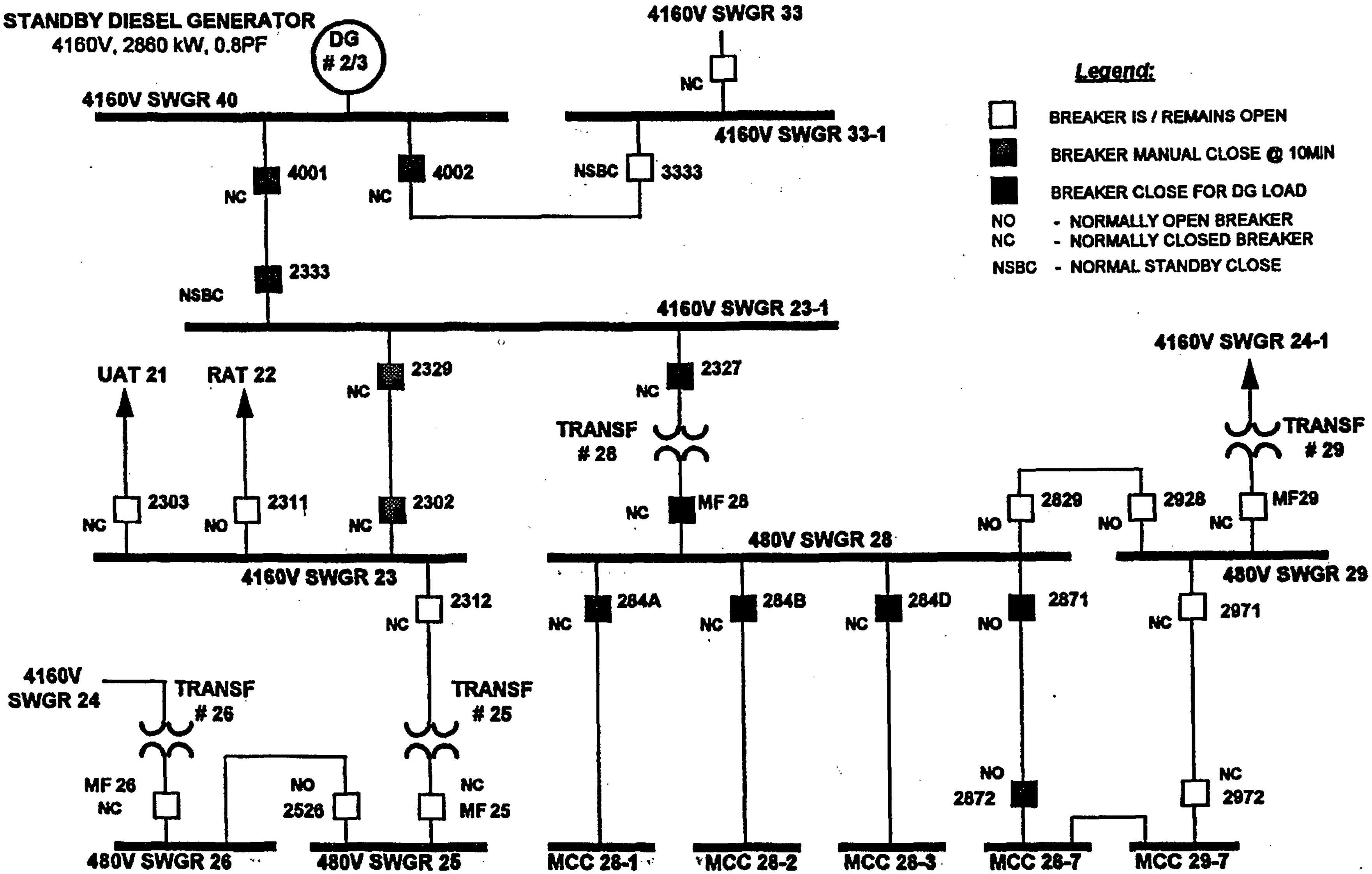

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Figure 1A

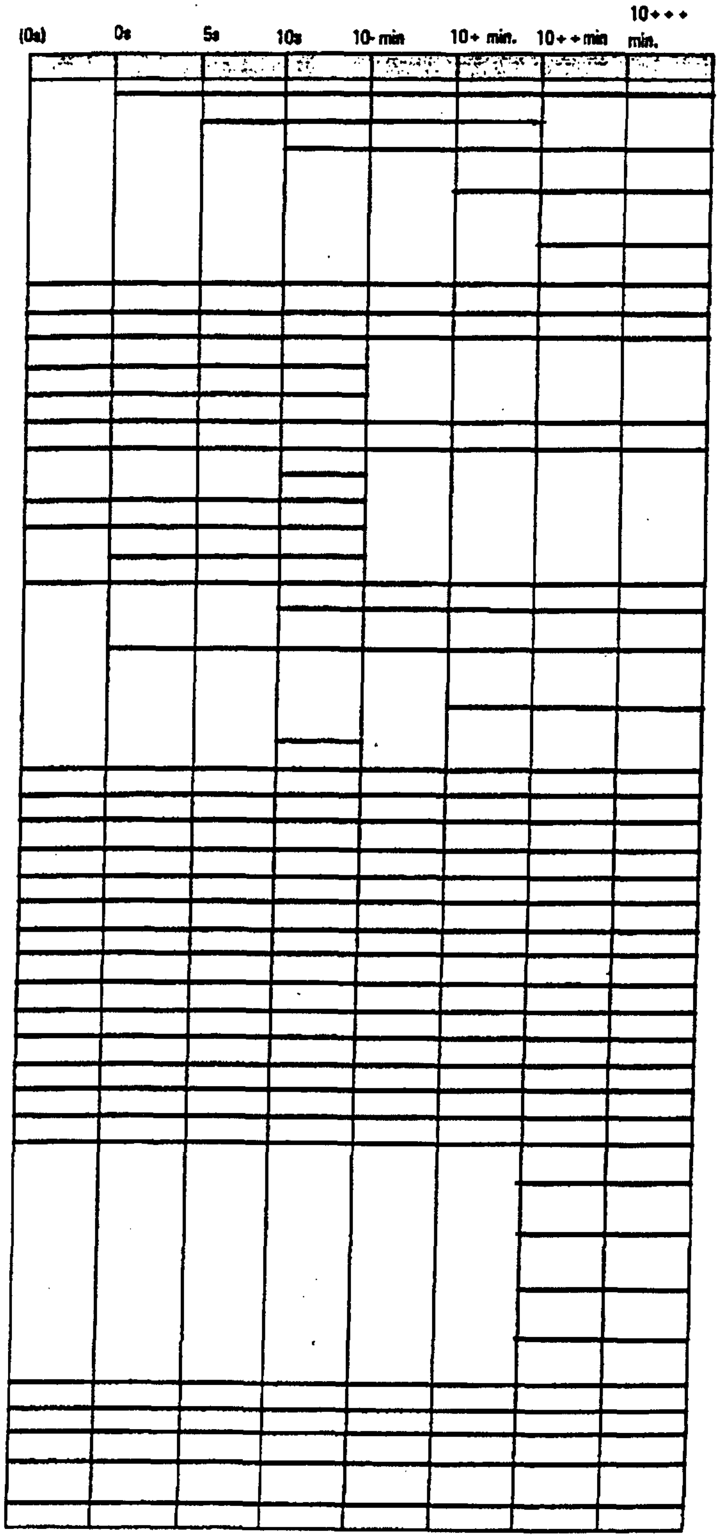
Calc. No. 9389-46-19-3, Rev. 2
Page D1/Final Proj. No. 10014-012

FIGURE 2A - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

Calc.No. 9389-46-19-3, Rev.3 Page No. E1 , Proj.No. 10014-012

Emergency Diesel 2/3 - Powering Unit 2 Loads

Load No.	Load Description	Bus No.
2-1502-A	LPCI Pump 2A	23-1
2-1502-B	LPCI Pump 2B	23-1
2-1401-A	Core Spray Pump 2A	23-1
	Containment Cooling Service Water Pump 2A	23
	Containment Cooling Service Water Pump 2B	23
	Aux. Pt. Indicating Lights, Meter, and Relay	40
2/3-6600-A	Diesel Gen Starting Air Compressor 2/3A	28-1
	120/208V Distr Xfmr 28-1	28-1
2-1201-7	Cleanup System Return Isolation Valve	28-1
2-1201-1	Cleanup System Inlet Isolation Valve	28-1
2/3-5203	Diesel Transfer Pump 2/3	28-1
2/3-5790	Diesel Gen 2/3 Vent Fan	28-1
2-1402-25A	Core Spray Inboard Isolation Valve 2A	28-1
2-1301-4	Inbd Cond Return Vlv	28-1
2-1301-1	Steam Line Isol Vlv	28-1
2-1501-13A	LPCI Pump Flow Bypass Valve 2A	28-1
2-2252-81A	Post LOCA H2 & O2 Monitoring Sample	28-1
2-7902	RX Building Emergency Lighting	28-1
2-5746-A	LPCI Core Spray Pump Area Cooling Unit 2A	28-1
2-1501-3A	Containment Cooling Heat Exchanger Discharge Valve 2A	28-1
2-1402-38A	Core Spray Pump Recirc. Isolation Valve 2A	28-1
	120/240V Distr Xfmr 28-2	28-2
2-4321	Condensate Transfer Jockey Pump	28-2
	120/240V Distr Xfmr Inst 2A & 2B	28-2
2-5350-MSOP	Main H2 Seal Oil Pump	28-2
2-8300-2A	125V Battery Charger 2A	28-2
2-5350-SOVP	H2 Seal Oil Vacuum Pump	28-2
2-4611-A	Diesel Gen Starting Air Compressor 2A	28-2
2-5758A	Main Steam Isolation Valve Unit Cooler A	28-2
2-5758B	Main Steam Isolation Valve Unit Cooler B	28-2
2-5758C	Main Steam Isolation Valve Unit Cooler C	28-2
2-5758D	Main Steam Isolation Valve Unit Cooler D	28-2
2-5758E	Main Steam Isolation Valve Unit Cooler E	28-2
2-5758F	Main Steam Isolation Valve Unit Cooler F	28-2
2-5758G	Main Steam Isolation Valve Unit Cooler G	28-2
2-5758H	Main Steam Isolation Valve Unit Cooler H	28-2
2-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 1	28-2
2-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 2	28-2
2-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 1	28-2
2-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 2	28-2
2-8001-A	RX Protection System M-G Set 2A	28-2
	120/208V Distr Xfmr FP-2	28-3
	Diesel Circulation Water Heater 2	28-3
2-6657	Engine Lube Oil Circulating Pump Motor 1HP	28-3
2-6660	Engine Lube Oil Circulating Pump Motor 3/4HP	28-3



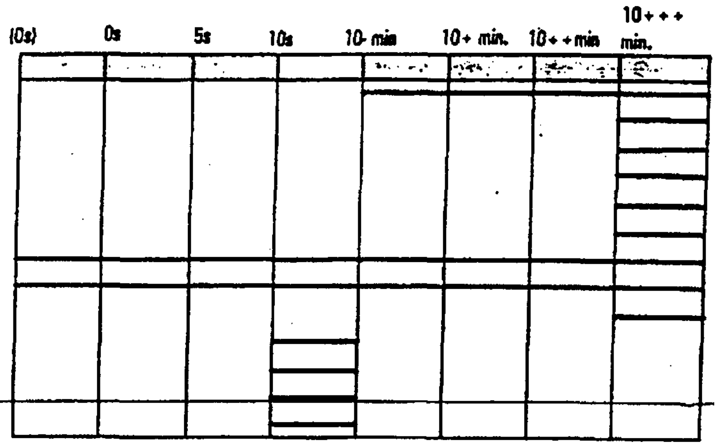
/R3

FIGURE 2A - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

Calc.No. 9389-46-19-3, Rev. 3, Page No. E 2/FINAL, Proj.No. 10014-012

Emergency Diesel 2/3 - Powering Unit 2 Loads

Load No.	Load Description	Bus No.
2-5600-TGOP	Turning Gear Oil Pump	28-3
2-5620-A	Turbine Bearing Lift Pump 2A	28-3
2-5620-B	Turbine Bearing Lift Pump 2B	28-3
2-5620-C	Turbine Bearing Lift Pump 2C	28-3
2-5620-D	Turbine Bearing Lift Pump 2D	28-3
2-5620-E	Turbine Bearing Lift Pump 2E	28-3
	250V Battery Charger #2	28-3
2/3-3903	Diesel Gen Cooling Water Pump 2/3	28-3
2-5601-TGM	Turbine Turning Gear	28-3
2-1501-22A	LPCI Inboard Isolation Valve 2A	28-7
2-202-5A	Recirc. Pump 2A Discharge Valve	28-7
~~2-202-9A~~	~~Recirc. Loop By-pass Valve 2A~~	~~28-7~~
2-1501-21B	LPCI Outboard Isolation Valve 2B	29-7



1R3

(0s) - 0 seconds after closing of DG Breaker
0s - 0 seconds after UV reset
5s - 5 seconds after UV reset
10s - 10 seconds after UV reset

10-min - All loads that automatically stop before 10 minutes are shown off.
10+min - CCSW Pump 2A is started.
10++min - CCSW Pump 2B is started with its auxiliaries.
10+++min. - Both CCSW Pumps are running and other loads starting after 10 minutes are shown here.

Attachment F

DG Unit 2 Division I ETAP Output Reports – Nominal Voltage

Scenario	**Page #'s**
DG2/3_Bkr_Cl	F2-F15
DG2/3_UV_Rst	F16-F29
DG2/3_T=5sec	F30-F43
DG2/3_T=10s	F44-F57
DG2/3_T=10-m	F58-F71
DG2/3_T=10+m	F72-F85
DG2/3_T=10++m	F86-F99
DG2/3_CRHVAC	F100-F113

Only the Load Flow Report (Page 8) of these Scenarios have been included JDN 4/26/07

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23-1	4.160	4.158	0.0	0	0	0	0	HIGH SIDE OF XFMR 28	0.387	0.337	71.2	75.5	
								4KV SWING BUS 40	-0.387	-0.337	71.2	75.5	
* 4KV SWING BUS 40	4.160	4.160	0.0	0.388	0.337	0	0	4KV SWGR 23-1	0.387	0.337	71.2	75.5	
28-1 ALTF 3-1301-1&4	0.480	0.477	-1.4	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.464	-0.8	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.1	
250V DC CHGR 2	0.480	0.469	-1.3	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.1	76.7	
480V MCC 28-1	0.480	0.477	-1.4	0	0	0.065	0.047	480V SWGR 28	-0.065	-0.047	96.7	81.2	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.472	-1.5	0	0	0.119	0.128	480V SWGR 28	-0.154	-0.156	268.0	70.3	
								125V DC CHGR 2A	0.035	0.028	55.0	77.9	
480V MCC 28-3	0.480	0.473	-1.5	0	0	0.095	0.056	480V SWGR 28	-0.162	-0.111	239.7	82.3	
								250V DC CHGR 2	0.067	0.055	106.1	77.0	
480V MCC 28-7	0.480	0.479	-1.4	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.479	-1.4	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.479	-1.4	0	0	0	0	480V MCC 28-1	0.065	0.047	96.7	81.2	
								480V MCC 28-2	0.156	0.158	268.0	70.2	
								480V MCC 28-3	0.164	0.113	239.7	82.2	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.385	-0.318	601.9	77.0	
HIGH SIDE OF XFMR 28	4.160	4.158	0.0	0	0	0	0	4KV SWGR 23-1	-0.387	-0.337	71.2	75.5	
								480V SWGR 28	0.387	0.337	71.2	75.5	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23-1	4.160	4.157	0.0	0	0	0.509	0.246	HIGH SIDE OF XFMR 28	0.392	0.340	72.0	75.6	
								4KV SWING BUS 40	-0.900	-0.586	149.2	83.8	
* 4KV SWING BUS 40	4.160	4.160	0.0	0.901	0.587	0	0	4KV SWGR 23-1	0.901	0.587	149.2	83.8	
28-1 ALTF 3-1301-1&4	0.480	0.477	-1.4	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.463	-0.8	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 2	0.480	0.469	-1.3	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.1	76.7	
480V MCC 28-1	0.480	0.477	-1.4	0	0	0.069	0.049	480V SWGR 28	-0.069	-0.049	103.1	81.4	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.472	-1.6	0	0	0.119	0.128	480V SWGR 28	-0.154	-0.156	268.0	70.3	
								125V DC CHGR 2A	0.035	0.028	55.0	78.0	
480V MCC 28-3	0.480	0.473	-1.5	0	0	0.095	0.056	480V SWGR 28	-0.162	-0.111	239.8	82.4	
								250V DC CHGR 2	0.067	0.055	106.1	77.0	
480V MCC 28-7	0.480	0.479	-1.4	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.479	-1.4	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.479	-1.4	0	0	0	0	480V MCC 28-1	0.070	0.050	103.1	81.5	
								480V MCC 28-2	0.156	0.158	268.0	70.2	
								480V MCC 28-3	0.164	0.113	239.8	82.2	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.389	-0.321	608.3	77.1	
HIGH SIDE OF XFMR 28	4.160	4.156	0.0	0	0	0	0	4KV SWGR 23-1	-0.392	-0.339	72.0	75.6	
								480V SWGR 28	0.392	0.339	72.0	75.6	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23-1	4.160	4.156	0.0	0	0	1.021	0.494	HIGH SIDE OF XFMR 28	0.392	0.339	72.0	75.6	
								4KV SWING BUS 40	-1.413	-0.834	227.9	86.1	
*4KV SWING BUS 40	4.160	4.160	0.0	1.414	0.835	0	0	4KV SWGR 23-1	1.414	0.835	227.9	86.1	
28-1 ALTF 3-1301-1&4	0.480	0.476	-1.4	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.463	-0.8	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 2	0.480	0.469	-1.3	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.1	76.8	
480V MCC 28-1	0.480	0.476	-1.4	0	0	0.069	0.049	480V SWGR 28	-0.069	-0.049	103.1	81.4	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.472	-1.6	0	0	0.119	0.127	480V SWGR 28	-0.154	-0.156	268.0	70.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.0	
480V MCC 28-3	0.480	0.473	-1.6	0	0	0.095	0.056	480V SWGR 28	-0.162	-0.111	239.8	82.4	
								250V DC CHGR 2	0.067	0.055	106.1	77.1	
480V MCC 28-7	0.480	0.479	-1.5	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.479	-1.5	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.479	-1.5	0	0	0	0	480V MCC 28-1	0.070	0.050	103.1	81.5	
								480V MCC 28-2	0.156	0.158	268.0	70.2	
								480V MCC 28-3	0.164	0.113	239.8	82.3	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.389	-0.321	608.3	77.2	
HIGH SIDE OF XFMR 28	4.160	4.155	0.0	0	0	0	0	4KV SWGR 23-1	-0.391	-0.339	72.0	75.6	
								480V SWGR 28	0.391	0.339	72.0	75.6	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Project: Dresden Unit2	ETAP	Page:	8
Location: OTI	5.5.0N	Date:	03-20-2007
Contract:		SN:	WASHTNGRPN
Engineer: OTI		Revision:	Base
Filename: DRE_Unit2_0004	Study Case: DG_0_CCSW	Config.:	DG2/3_T=10s

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	% Tap
4KV SWGR 23-1	4.160	4.153	-0.1	0	0	1.721	0.794	HIGH SIDE OF XFMR 28	0.452	0.378	81.9	76.7	
								4KV SWING BUS 40	-2.174	-1.172	343.3	88.0	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.176	1.176	0	0	4KV SWGR 23-1	2.176	1.176	343.3	88.0	
28-1 ALTF 3-1301-1&4	0.480	0.474	-1.7	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.461	-1.1	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.5	
250V DC CHGR 2	0.480	0.467	-1.6	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.1	77.0	
480V MCC 28-1	0.480	0.474	-1.7	0	0	0.094	0.062	480V SWGR 28	-0.094	-0.062	137.1	83.5	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.470	-1.8	0	0	0.118	0.127	480V SWGR 28	-0.153	-0.155	267.8	70.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.3	
480V MCC 28-3	0.480	0.471	-1.8	0	0	0.095	0.056	480V SWGR 28	-0.162	-0.111	240.2	82.5	
								250V DC CHGR 2	0.067	0.055	106.1	77.3	
480V MCC 28-7	0.480	0.475	-1.7	0	0	0.021	0.013	480V SWGR 28	-0.036	-0.022	50.7	85.4	
								480V MCC 29-7	0.014	0.009	20.4	85.1	
480V MCC 29-7	0.480	0.475	-1.7	0	0	0.014	0.009	480V MCC 28-7	-0.014	-0.009	20.4	85.1	
480V SWGR 28	0.480	0.477	-1.7	0	0	0	0	480V MCC 28-1	0.095	0.062	137.1	83.6	
								480V MCC 28-2	0.155	0.157	267.8	70.2	
								480V MCC 28-3	0.163	0.113	240.2	82.3	
								480V MCC 28-7	0.036	0.022	50.7	85.4	
								HIGH SIDE OF XFMR 28	-0.449	-0.354	692.3	78.5	
HIGH SIDE OF XFMR 28	4.160	4.153	-0.1	0	0	0	0	4KV SWGR 23-1	-0.452	-0.378	81.9	76.7	
								480V SWGR 28	0.452	0.378	81.9	76.7	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23-1	4.160	4.154	-0.1	0	0	1.721	0.794	HIGH SIDE OF XFMR 28	0.427	0.355	77.2	76.8	
								4KV SWING BUS 40	-2.148	-1.150	338.7	88.2	
*4KV SWING BUS 40	4.160	4.160	0.0	2.151	1.154	0	0	4KV SWGR 23-1	2.150	1.154	338.7	88.1	
28-1 ALTF 3-1301-1&4	0.480	0.476	-1.6	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.462	-1.0	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.3	
250V DC CHGR 2	0.480	0.466	-1.5	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.2	77.1	
480V MCC 28-1	0.480	0.476	-1.6	0	0	0.066	0.040	480V SWGR 28	-0.066	-0.040	93.9	85.8	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.471	-1.7	0	0	0.119	0.127	480V SWGR 28	-0.154	-0.155	267.9	70.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.1	
480V MCC 28-3	0.480	0.471	-1.8	0	0	0.132	0.079	480V SWGR 28	-0.199	-0.134	294.0	83.0	
								250V DC CHGR 2	0.067	0.055	106.2	77.4	
480V MCC 28-7	0.480	0.478	-1.6	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.478	-1.6	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.478	-1.6	0	0	0	0	480V MCC 28-1	0.067	0.040	93.9	85.9	
								480V MCC 28-2	0.156	0.158	267.9	70.2	
								480V MCC 28-3	0.202	0.136	294.0	82.8	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.424	-0.334	652.2	78.5	
HIGH SIDE OF XFMR 28	4.160	4.153	-0.1	0	0	0	0	4KV SWGR 23-1	-0.427	-0.355	77.2	76.8	
								480V SWGR 28	0.427	0.355	77.2	76.8	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 2 LPCI Pump, 1 CCSW, This time period is 10+ min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23	4.160	4.150	-0.1	0	0	0.477	0.212	4KV SWGR 23-1	-0.477	-0.212	72.6	91.3	
4KV SWGR 23-1	4.160	4.152	-0.1	0	0	1.701	0.788	HIGH SIDE OF XFMR 28	0.427	0.356	77.2	76.8	
								4KV SWGR 23	0.477	0.213	72.6	91.3	
								4KV SWING BUS 40	-2.605	-1.356	408.4	88.7	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.609	1.361	0	0	4KV SWGR 23-1	2.609	1.361	408.4	88.7	
28-1 ALTF 3-1301-1&4	0.480	0.475	-1.6	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.462	-1.0	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.4	
250V DC CHGR 2	0.480	0.466	-1.5	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.2	77.1	
480V MCC 28-1	0.480	0.475	-1.6	0	0	0.067	0.040	480V SWGR 28	-0.067	-0.040	94.4	85.8	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.471	-1.8	0	0	0.119	0.127	480V SWGR 28	-0.154	-0.155	267.9	70.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.2	
480V MCC 28-3	0.480	0.470	-1.8	0	0	0.132	0.079	480V SWGR 28	-0.199	-0.134	294.1	83.0	
								250V DC CHGR 2	0.067	0.055	106.2	77.4	
480V MCC 28-7	0.480	0.478	-1.6	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.478	-1.6	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.478	-1.6	0	0	0	0	480V MCC 28-1	0.067	0.040	94.4	85.8	
								480V MCC 28-2	0.156	0.158	267.9	70.2	
								480V MCC 28-3	0.202	0.136	294.1	82.8	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.424	-0.334	652.7	78.5	
HIGH SIDE OF XFMR 28	4.160	4.152	-0.1	0	0	0	0	4KV SWGR 23-1	-0.427	-0.355	77.2	76.8	
								480V SWGR 28	0.427	0.355	77.2	76.8	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 1 LPCI Pump, 2 CCSW, This time period is 10+ min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23	4.160	4.150	-0.1	0	0	0.771	0.395	4KV SWGR 23-1	-0.771	-0.395	120.5	89.0	
4KV SWGR 23-1	4.160	4.153	-0.1	0	0	1.194	0.542	HIGH SIDE OF XFMR 28	0.438	0.364	79.2	77.0	
								4KV SWGR 23	0.771	0.396	120.5	89.0	
								4KV SWING BUS 40	-2.404	-1.301	380.0	87.9	
*4KV SWING BUS 40	4.160	4.160	0.0	2.407	1.306	0	0	4KV SWGR 23-1	2.407	1.306	380.0	87.9	
28-1 ALTF 3-1301-1&4	0.480	0.475	-1.6	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.461	-1.1	0	0	0.034	0.028	480V MCC 28-2	-0.034	-0.028	55.0	77.5	
250V DC CHGR 2	0.480	0.466	-1.6	0	0	0.066	0.055	480V MCC 28-3	-0.066	-0.055	106.2	77.1	
480V MCC 28-1	0.480	0.475	-1.6	0	0	0.067	0.040	480V SWGR 28	-0.067	-0.040	94.4	85.8	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.470	-1.8	0	0	0.130	0.134	480V SWGR 28	-0.165	-0.162	283.8	71.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.3	
480V MCC 28-3	0.480	0.470	-1.8	0	0	0.132	0.079	480V SWGR 28	-0.199	-0.134	294.2	83.0	
								250V DC CHGR 2	0.067	0.055	106.2	77.4	
480V MCC 28-7	0.480	0.477	-1.7	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.477	-1.7	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.477	-1.7	0	0	0	0	480V MCC 28-1	0.067	0.040	94.4	85.8	
								480V MCC 28-2	0.167	0.165	283.8	71.2	
								480V MCC 28-3	0.201	0.136	294.2	82.8	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.436	-0.341	669.1	78.7	
HIGH SIDE OF XFMR 28	4.160	4.152	-0.1	0	0	0	0	4KV SWGR 23-1	-0.438	-0.363	79.2	77.0	
								480V SWGR 28	0.438	0.363	79.2	77.0	-2.500

* *Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)*

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, 1 LPCI Pump, 2 CCSW, This time period is 10+ min into event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 23	4.160	4.149	-0.1	0	0	0.771	0.395	4KV SWGR 23-1	-0.771	-0.395	120.6	89.0	
4KV SWGR 23-1	4.160	4.152	-0.1	0	0	1.194	0.542	HIGH SIDE OF XFMR 28	0.522	0.423	93.5	77.7	
								4KV SWGR 23	0.771	0.396	120.6	89.0	
								4KV SWING BUS 40	-2.488	-1.361	394.3	87.7	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.491	1.366	0	0	4KV SWGR 23-1	2.491	1.366	394.3	87.7	
28-1 ALTF 3-1301-1&4	0.480	0.473	-2.0	0	0	0	0	480V MCC 28-1	0.000	0.000	0.0	0.0	
125V DC CHGR 2A	0.480	0.459	-1.4	0	0	0.034	0.027	480V MCC 28-2	-0.034	-0.027	55.0	77.8	
250V DC CHGR 2	0.480	0.461	-2.0	0	0	0.066	0.053	480V MCC 28-3	-0.066	-0.053	106.3	77.9	
480V MCC 28-1	0.480	0.473	-2.0	0	0	0.066	0.040	480V SWGR 28	-0.066	-0.040	94.5	85.8	
								28-1 ALTF 3-1301-1&4	0.000	0.000	0.0	0.0	
480V MCC 28-2	0.480	0.468	-2.1	0	0	0.129	0.133	480V SWGR 28	-0.164	-0.161	283.7	71.4	
								125V DC CHGR 2A	0.035	0.028	55.0	78.7	
480V MCC 28-3	0.480	0.465	-2.2	0	0	0.213	0.129	480V SWGR 28	-0.280	-0.183	415.3	83.7	
								250V DC CHGR 2	0.067	0.053	106.3	78.2	
480V MCC 28-7	0.480	0.475	-2.0	0	0	0	0	480V SWGR 28	0.000	0.000	0.0	0.0	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-7	0.480	0.475	-2.0	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
480V SWGR 28	0.480	0.475	-2.0	0	0	0	0	480V MCC 28-1	0.067	0.040	94.5	85.8	
								480V MCC 28-2	0.166	0.164	283.7	71.3	
								480V MCC 28-3	0.285	0.188	415.3	83.5	
								480V MCC 28-7	0.000	0.000	0.0	0.0	
								HIGH SIDE OF XFMR 28	-0.519	-0.392	789.7	79.8	
HIGH SIDE OF XFMR 28	4.160	4.152	-0.1	0	0	0	0	4KV SWGR 23-1	-0.522	-0.423	93.5	77.7	
								480V SWGR 28	0.522	0.423	93.5	77.7	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
33-1 3321	Bus Tie to 23-1	No	N.O. breaker with no auto close.		12E-3445, Sh. 3	A	
33-1 3322	RX. Building Cooling Water Pump 3A (3-3701-A)	Yes	Tripped on LOCA.		12E-3397	M	
33-1 3323	Main Feed from SWGR 33 (3-6733-10)	No	Trips on bus UV, and is manually closed before starting the CCSW Pump (10+ minutes).		12E-3344, Sh.1 &2	V, W	
33-1 3324	RX Cleanup Recirc. Pump 3A (3-1205-A)	Yes	Tripped on bus UV, and has no auto start.		12E-3520	V	
33-1 3325	480V SWGR 38 Feed (3-7338-2B)	No	N.C. Does not trip and remains closed.		12E-3349	S	
33-1 3327	LPCI Pump 3A (3-1502-A)	No	Will operate in auto (starts 0 seconds after UV relay resets).	Assume in auto.	12E-3436 Sh. 1 & 2 12E-3437 Sh. 1	P,P AD	
33-1 3329	RX Shutdown Cooling Pump 3A (3-1002-A)	Yes	Tripped on bus UV, and has no auto start.		12E-3516 12E-3517	F E	
33-1 3330	LPCI Pump 3B (3-1502-B)	No	Will operate in auto (starts 5 seconds after UV relay resets).	Assume in auto.	12E-3436 Sh. 1 & 2 12E-3437 Sh. 1	P,P AD	
33-1 3331	Core Spray Pump 3A (3-1401-A)	No	Will operate in auto (starts 10 seconds after UV relay resets).	Assume in auto.	12E-3429 Sh. 1 12E-3430 Sh. 1	U AP	
33-1 3332	I.L.R.T. Air Compressor	Yes	Compressor trips on LOCA.		12E-3397	M	
40	Aux. Pt. Indicating Lights, Meter, and Relay Comb.	No	Will continue to operate (0 seconds)		12E-6628	C	
38 2B	Main Feed from SWGR 33-1 (3-6733-25)	No	N.C. Does not trip and remains closed.		12E-3349	S	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38 2C	Bus 38-39 Tie (3-7339-2C)	No	N.O. and remains open.		12E-3349	S	
38 3A	Fuel Pool Cooling Water Pump 3A (3-1902-A)	Yes	Tripped on bus UV, and has no auto start.		12E-3548	L	
38 3B	RX Building Vent Fan 3A (3A-5703)	Yes	Tripped on SBGT initiation.		12E-3399A	L	
38 3C	RX Building Vent Fan 3C (3C-5703)	Yes	Tripped on SBGT initiation.		12E-3399A	L	
38 3D	RX Cleanup Demin. Auxiliary Pump (3-1206)	Yes	Tripped on bus UV, and has no auto start.		12E-3520	V	
38 4A	480V MCCs 38-1 & 38-4 (3-7838-1A & 3-7838-4E1)	No	N.C. Does not trip and remains closed.		12E-3374	U	
38 4B	480V MCC 38-2 (3-7838-2A1)	No	N.C. Does not trip and remains closed.		12E-3374	U	
38 4C	RX Building Exhaust Fan 3A (3A-5704)	Yes	Tripped on SBGT initiation.		12E-3399A	L	
38 4D	480V MCC 38-3 (3-7838-3A1)	No	N.C. Does not trip and remains closed.		12E-3374	U	
38 5A	480V MCC 38-7 (3-7838-7A1)	No	N.C. Does not trip and remains closed.		12E-3374	U	
38 5C	South Turbine Room Vent Fan 3A (3A-5702)	Yes	Tripped on LOCA		12E-3387B	L	
38 5D	Recirc M-G Set Vent Fan 3A (3A-5701)	Yes	Tripped on LOCA		12E-3420C	J	
38 6A-6D	Drywell Cooler Blower 3A, 3B, 3F, and 3G (3A,B,F,G-5734)	Yes	Tripped on LOCA		12E-3393	N	
38-1 A2	Drywell Air Compressor (3-4710-A)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-3514	B	
38-1 A4	120/208V Distr Xfmr 38-1	No	Will continue to operate (0 seconds)		12E-3674A	AF	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-1 B1	West LPCI/Core Spray Room Sump Pump 3B (3-2001-511B)	No		It is not expected that the water level in Core Spray Room will go up.	12E-3674A	AF	
38-1 B1A	Primary Containment Fans	No	Switch is N.O., therefore these will not run.		12E-3674A	AF	
38-1 B2	Standby Liquid Control Tank Heater (3-1103)	No	Will continue to operate (0 seconds).		12E-3460 Sh. 1 12E-3674A	AD AF	
38-1 B3	Standby Liquid Control Pump 3A (3-1102A)	No	Will not operate with switch in OFF position.	Assume switch is in OFF position.	12E-3460 Sh. 1	AD	
38-1 C1	LPCI/Core Spray Pump Area Cooling Unit 3A (3-5746A)	No	Controlled by thermostat.	Assume the the cooler starts at 0 seconds after UV relay reset.	12E-3393	N	
38-1 C2	Diesel Oil Transfer Pump 2/3 (2/3-5203) (alternate feed)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2351B Sh. 1	AF	
38-1 C3	Drywell and Torus Purge Exhaust Fan 3A (3-5708A)	Yes	Tripped on SBGT initiation.		12E-3393	M	
38-1 C4	Diesel 2/3 Vent Fan (2/3-5790) (alternate feed)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-2351B Sh. 2 12E-3674B	AL Y	
38-1 D1	Stm Iso/Inbd Con Vlv Alt Fd 2-1301-1 and 2-1301-4 (alternate feed)	No	Manually operated only.	Assumed off.	12E-2507B	M	
38-1 D2	Torus Drywell Compressor 3A (3-8551-A)	Yes	Trip on loss of voltage, and has no auto start.		12E-3372	R	
38-1 D3	Shutdown Cooling Inlet Isolation Valve 3B (3-1001-1B)	No	NC and interlocked closed.		12E-3508A 12E-3508 12E-3501 Sh. 1 & 2	L E AD,AD	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-1 D4	Shutdown Cooling Return Isolation Valve 3B (3-1001-5B)	No	NC and interlocked closed.		12E-3508E 12E-3508 12E-3501 Sh. 1 & 2	N E AD,AD	
38-1 E1	Core Spray Outboard Isolation Valve 3A (3-1402-24A)	No	NO and interlocked open.		12E-3431 Sh. 1 12E-3430 Sh. 1	 V AP	
38-1 E2	Core Spray Inboard Isolation Valve 3A (3-1402-25A)	No	NC and interlocked open.	Assume for conservatism, the low pressure permissive coincides with Core Spray Pump start (10 seconds after UV relay reset).	12E-3431 Sh. 1 12E-3430 Sh. 1 & 2	 V AP,AN	
38-1 E3	Contain. Cooling Heat Exchanger Discharge Valve 3A (3-1501-3A)	No	NC and interlocked closed when CCSW Pump is not in service. Auto opens when CCSW Pump is started (10+ minutes)		12E-3440 Sh. 1 12E-3437 Sh. 2	 Y AC	
38-1 E4	Cleanup System Inlet Isolation Valve (3-1201-1)	No	NO and interlocked closed (0 seconds).		12E-3509A 12E-3509 Sh.2 12E-3501 Sh. 1 & 2	R AA AD,AD	
38-1 F1	Cleanup System Return Isolation Valve (3-1201-7)	No	NO and interlocked closed (0 seconds).		12E-3509A 12E-3509 Sh.2 12E-3501 Sh. 1 & 2	R AA AD,AD	

Table 1B

Automatically Turn On and Off Devices Under the Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-1 F3	RWCU Isolation Valve Bypass (3-1201-1A)	No	NC and interlocked closed.		12E-7816D 12E-3509 Sh. 2	J AA	M-361
38-1 F4	East LPCI/Core Spray Room Sump Pump 3A (3-2001-510A)	No		It is not expected that the water level in Core Spray Room will go up.	12E-3674C	AG	
38-1 F4A	Post LOCA H2 & O2 Sample Pump 3A (3-2400-A)	No	Load will operate at 0 seconds.		12E-7554A 12E-7552 Sh. 2	J T	
38-1 G1	Closed Cooling Water Isolation Valve (3-3704)	No	NO and remains open.		12E-3674D	AA	
38-1 G2	Shutdown Cooling Return Isolation Valve 3A (3-1001-5A)	No	NC and interlocked closed.		12E-3508E 12E-3508 12E-3501 Sh. 1 & 2	N E AD,AD	
38-1 G3	Closed Cooling Water Drywell Return Valve 3A (3-3703)	No	NO and remains open.		12E-3398	D	
38-1 G4	Shutdown Cooling Inlet Isolation Valve 3A (3-1001-1A)	No	NC and interlocked closed.		12E-3508A 12E-3508 12E-3501 Sh. 1 & 2	L E AD,AD	
38-1 H1	Inbd Cond Return Vlv (3-1301-4) (normal feed)	No	NO and interlocked closed (0 seconds).		12E-3507B 12E-3506 Sh. 1 & 2	M Z,AA	
38-1 H2	Steam Line Isol Vlv (3-1301-1) (normal feed)	No	NO and interlocked closed (0 seconds).		12E-3507B 12E-3506 Sh. 1 & 2	M Z,AA	
38-1 H3	LPCI Pumps Drywell Discharge Valve 3A (3-1501-27A)	No	NC and interlocked closed.		12E-3440 Sh. 3 12E-3437 Sh. 1 & 2	 W AD,AC	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-1 H4	LPCI Pumps Drywell Discharge Valve 3B (3-1501-28A)	No	NC and interlocked closed.		12E-3441 Sh. 3 12E-3437 Sh. 1 & 2	S AD,AC	
38-2 A4	120/240V Distr Xfmr 38-2	No	Will continue to operate (0 seconds)		12E-3675A	AK	
38-2 B1	Condensate Transfer Jockey Pump (3-4321)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-3373	K	
38-2 B2	Main Steam Isolation Valve Unit Coolers (3-5758 A thru F)	No		Considering the worst case that the manual starter has no UV, the coolers will start to operate at 0 seconds.	12E-3675A 12E-3435 Sh. 1	AK S	
38-2 B3	Turbine Vacuum Breaker Valve (3-4901)	No	N.C. and remains closed.		12E-3363	L	
38-2 B4	125Vdc Alternate Battery Electric Heaters #1, 2, 3	No	Will continue to operate (0 seconds)		12E-3675A	AK	
38-2 B5	Main Steam Line Drain Valves 220-90 A, B, C, and D	No	NC and remains closed.		12E-3450	B	
38-2 B6	H2 Seal Oil Vacuum Pump (3-5350-SOVP)	No	Will operate in auto (0 seconds)	Assume in auto.	12E-3365	M	
38-2 C1	125 Volt Battery Charger 3A (3-8300-3A)	No	Will continue to operate (0 seconds).		12E-3675B	L	
38-2 C2	Essential Bus Transformer Feed (Reserve Feed)	No	Will not operate. The 250Vdc Battery Charger will be feeding this load.		12E-3675B	L	
38-2 C3	120/240V Distr Xfmr Instr	No	Will continue to operate (0 seconds).		12E-3675B	L	
38-2 C4	Instrument Buses Transformer Feeds (Bifurcated to Cubicles C2 & C3)	No	Will remain energized.		12E-3675B	L	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-2 D1	Main H2 Seal Oil Pump (3-5350-MSOP)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-3365	M	
38-2 D2	250 Volt Battery Charger #3 (3-8350-3)	No	Will always operate (0 seconds).		12E-3675B	L	
38-2 D3	Condensate Transfer Pump 3A (3A-4301)	Yes	Trips on loss of voltage, and has no auto start.		12E-3370	Q	
38-2 D4	Welder Receptacle (3-7901)	No	Will remain energized.	Assume there is no load being powered by this receptacle.	12E-3675B	L	
38-2 D5	Diesel Gen Starting Air Compressor 3A (3-4611A)	No	Will operate in auto as long as pressure is below 230 psi (0 seconds).	Assume in auto.	12E-3350B	AK	
38-3 A2	Diesel Circ. Water Heater 3	No	When Diesel Generator 3 gets up to the speed the contacts will open.	Assume Diesel Generator 3 failed to start.	12E-3350B	AK	
38-3 A2	DG Lube Oil Circulating Pump Motor 1HP (3-6657)	No	Will remain on (0 seconds)		12E-3350B	AK	
38-3 A2	DG Lube Oil Circulating Pump Motor 3/4HP (3-6660)	No	Will remain on (0 seconds)		12E-3350B	AK	
38-3 A3	Turning Gear Oil Pump (3-5600-TGOP)	No	Will operate in auto (starts after Core Spray Pump but before CCSW Pump). Shown as a running load at 10+ minutes.	Assume in auto.	12E-3362	M	
38-3 A4	Turbine Turning Gear (3-5601-TGM)	No	Motor will start when the turbine speed has decreased to a set point.	Show in calculation in the final loading condition.	12E-3362A	D	
38-3 B1	Turning Gear Piggyback Motor (3-5601-TGM-PBM)	No	Will operate in auto. This load is shown to have operated (i.e. the Turbine Turning Gear Motor is engaged and shown as the operating load in ELMS).	Assume in auto.	12E-3362A	D	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-3 B2-B6	Turbine Bearing Lift Pump 3A, 3B, 3C, 3D, and 3E (3-5620-A, B, C, D, E)	No	Manual operation only.	These are manually started prior to the Turning Gear operation (shown in final loading).	12E-3364	K	
38-3 C2	RX Protection System M-G Set 3A (3-8001-A)	No	Will start operating when voltage recovers at MCC 38-3.		12E-3592	K	
38-3 C4	Diesel Cooling Water Pump 2/3 (2/3-3903) (Alternate Feed)	No	Will operate in auto (0 seconds).	Assume in auto.	12E-3676B 12E-2351B Sh. 1	U AF	
38-3 D1	Contain. Cool. Serv. Water Pump Cub. Cooler A Fan 1 3-5700-30A	No	Turns on by operating CCSW Pump 3B (starts at 10++ minutes).		12E-3676B 12E-3435 Sh. 1	U S	
38-3 D2	Contain. Cool. Serv. Water Pump Cub. Cooler A Fan 2 3-5700-30A	No	Turns on by operating CCSW Pump 3B (starts at 10++ minutes).		12E-3676B 12E-3435 Sh. 1	U S	
38-3 D3	Contain. Cool. Serv. Water Pump Cub. Cooler B Fan 1 3-5700-30B	No	Turns on by operating CCSW Pump 3B (starts at 10++ minutes).		12E-3676B 12E-3435 Sh. 1	U S	
38-3 D4	Contain. Cool. Serv. Water Pump Cub. Cooler B Fan 2 3-5700-30B	No	Turns on by operating CCSW Pump 3B (starts at 10++ minutes).		12E-3676B 12E-3435 Sh. 1	U S	
38-3 D5	120/208V Distr Xfmr 38-3	No	Will continue to operate (0 seconds).		12E-3676B	U	
38-3 D6	120/208V Distr Xfmr FP-3	No	Will always operate (0seconds).		12E-3676B	U	
38-4 A1	Core Spray Suction Valve 3A (3-1402-3A)	No	NO and interlocked open.		12E-3432 12E-3430 Sh. 1	T AP	
38-4 A2	Core Spray Test Bypass Valve 3A (3-1402-4A)	No	NC and interlocked closed.		12E-3433 12E-3430 Sh. 1	P AP	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-4 A3	LPCI Pump 3A Suction Valve (3-1501-5A)	No	NO and interlocked open.		12E-3440 Sh. 1 12E-3437 Sh. 1	Y AD	
38-4 A4	LPCI Pump 3B Suction Valve (3-1501-5B)	No	NO and interlocked open.		12E-3440 Sh. 1 12E-3437 Sh. 1	Y AD	
38-4 B1	LPCI Torus Spray Valve 3A (3-1501-38A)	No	NC and interlocked closed.		12E-3441 Sh. 1 12E-3437 Sh. 1 & 2	Q AD,AC	
38-4 B2	LPCI Torus Spray Valve 3B (3-1501-20A)	No	NC and interlocked closed.		12E-3441 Sh. 2 12E-3437 Sh. 1 & 2	R AD,AC	
38-4 B3	LPCI Torus Ring Spray Valve [redacted] (3-1501-18A).	No	NC and interlocked closed.		12E-3441 Sh. 1 12E-3437 Sh. 1 & 2	Q AD,AC	
38-4 B4	LPCI Torus Ring Spray Valve [redacted] (3-1501-19A)	No	NC and interlocked closed.		12E-3441 Sh. 2 12E-3437 Sh. 1 & 2	R AD,AC	
38-4 C1	Temporary Hyd. Power Unit for Rod Oscillator Tests	No	Field to disconnect various points in the control circuit, thus disabling the equipment.		12E-3680B	J	
38-4 C1A	Welder Receptacle	No	Will remian energized.	Assume there is no load powered by this receptacle.	12E-3680B	J	
38-4 C2	Diesel Starting Air Compressor 2/3B (2/3-6600-B)	No	Will operate in auto as long as pressure is below 230 psi (0 seconds).	Assume in auto.	12E-2351B Sh. 1	AA	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-4 C3	LPCI Header Crosstie Isolation Valve [redacted] (3-1501-32A)	No	NO and remains open.		12E-3440 Sh. 3	W	
38-4 E2	LPCI Pump Flow Bypass Valve 3A (3-1501-13A)	No	NO and interlocked open but when fluid is over low flow level, valve will close (0 seconds after UV relay reset).		12E-3440 Sh. 2 12E-3437 Sh. 2	X AC	
38-4 E3	Core Spray Pump Recirc. Isolation Valve 3A (3-1402-38A)	No	NO and interlocked open, but when flow is over low flow level, valve will close (10 seconds after UV relay reset).		12E-3433	P	
38-4 E4	LPCI Heat Exchanger Bypass Valve 3A (3-1501-11A)	No	NO and interlocked open.		12E-3440 Sh. 2 12E-3437A 12E-3437 Sh. 1	X R AD	
38-4 E5	HPCI Floor Drain Sump Pump (3-2301-250)	No	Turns on & off by a level switch.	Water level in the sump pump is not expected to go up, thus the pump will not operate.	12E-3533	Q	
38-7 A2	LPCI Inbd. Isolation Valve 3A (3-1501-22A)	No	NC and interlocked open (10 seconds after UV reset)	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3441 Sh. 4 12E-3437A 12E-3438A	T S S	
38-7 B1	Recirc. Pump 3A Suction Valve (3-0202-4A)	Yes	NO and remain open.		12E-3420A	T	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
38-7 B2	Recirc. Pump 3A Discharge Valve (3-0202-5A)	No	NO and interlock closed (10 seconds after UV reset)	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3420A 12E-3437A 12E-3438A	T S S	
38-7 C3	LPCI Outboard Isolation Valve 3A (3-1501-21A)	No	NO and interlocked open.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3441 Sh. 3 12E-3437A 12E-3438A	S S S	
39-7 A2	Refueling Floor Jib Crane (3-5813)	No		Not operating.	12E-3662C	U	
39-7 A3	LPCI Outboard Isolation Valve 3B (3-1501-21B)	No	NO and interlocked closed (10 seconds after UV reset).	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3441A 12E-3437A 12E-3438A	U S S	
39-7 B1	Recirc. Pump 3B Suction Valve (3-0202-4B)	No	NO and remains open.		12E-3420B	V	

Table 1B

Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev.	Other Ref. (P & ID)
39-7 B2	Recirc. Pump 3B Discharge Valve (3-0202-5B)	No	NO and remains open.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3420B 12E-3437A 12E-3438A	V S S	
39-7 C2	LPCI Inboard Isolation Valve 3B (3-1501-22B)	No	NC and interlocked closed.	Since the break could occur on either side, assume that Loop B has the break, so Loop A is selected by the loop selection logic. The loads on 38/39-7 that auto start will be started at the worst case time between 5s and 15s after DG breaker closure.	12E-3441A 12E-3437A 12E-3438A	U S S	

N.O. - Normally Open
N.C. - Normally Closed
N/A - Not Available
Note: All loads that are tripped off and interlocked off or require manual action to restart are considered Load Shed.
Operating loads and loads with auto start capabilities that have power available and do not operate (i.e. an MOV that is N.O. and remains open) is considered NOT load shed.

TABLE 2B

AFFECTS OF VOLTAGE DIP

PURPOSE

The purpose of Table 2 is to determine the affects of an AC voltage dip, that is low enough to de-energize control circuits ie., contactors, relays, etc., has on the operation of the mechanical equipment.

METHOD

Table 2 shows the results of the review. The conclusion of Table 2 is shown in the analysis of data section. Below is the explanation for each column in Table 2.

Table 2 Column Description	Explanation of What is Shown in the Column
Equipment Description/No.	This column lists all of the loads connected to the DG buses. It is the same list as shown in Table 1.
Load Shed	This column answers the question "when a LOOP/LOCA occurs, does this load automatically de-energize to shed load on the bus?" It is the same list as shown in Table 1. It is shown again because any load de-energized will not be affected by a voltage dip. If there is a yes in this column, the answer to the other questions will be "no" or "N/A" (not applicable).
Will the voltage dip at 5 seconds, 10 seconds, and 10 minutes affect the equipments' operation (Question 1)	The "affect" looked for is that the control circuit per the referenced schematics is de-energized or energized by a voltage dip. If the circuit was not energized before the dip and/or the energized state of the circuit did not change due to a dip, the answer is no. If the energized state of the circuit changed, the answer is yes.

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TABLE 2B

AFFECTS OF A VOLTAGE DIP

Table 2 Column Description	Explanation of What is Shown in the Column
Will the equipment restart after the voltage recovery (Question 2)	This question is to verify that equipment required is restarted automatically after a voltage dip. Only AC control circuits need to be considered. DC control circuits will be unaffected by an AC voltage dip. Circuits that have seal-in contacts are types that would not restart.
Will the equipment operate in an adverse mode due to a voltage dip (Question 3)	If the answer to Question 1 is yes, and to Question 2 is yes, then Question 3 has to be answered. The "adverse modes" looked for are items like, valves moving in the wrong direction, time delay relays being reset by the dip causing equipment to operate for shorter or longer periods than required, etc.
Will the time delay in operation cause any adverse affect (Question 4)	If the answer to Question 1 is yes, and 2 is yes, Question 4 has to be answered. The time delay referred to is the one second it takes the DG to recover above 80% after the start of a large motor. The adverse affects looked for are items like, could within one second the room temperature rise excessively if a cooler is de-energized, if a valve travel requires one more second to operate will its total travel time exceed design limits, etc. The "no" answers to this question are based on the following engineering judgements: a. Some valves may require two seconds more to complete its travel. Valves operate normally less than a minute. The allowable total time is 120 seconds. Therefore with a voltage dip, the design allowable is not exceeded. b. Two-second time delays in room coolers, pumps, etc. would not cause rooms, equipment, etc. to overheat, etc.

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TABLE 2B

AFFECTS OF A VOLTAGE DIP

Table 2 Column Description	Explanation of What is Shown in the Column
	c. Instrument bus loads may give erroneous readings for a fraction of a second due to momentary sharp voltage drop. But the instrument bus is designed with transfer switch, which takes about one second to transfer the loads. Therefore, the operators are familiar with the behavior of these loads during abnormal condition. This will not require any special attention of the operators.
Drawing Reference	This drawing shows the main schematic or wiring diagram for the control circuit reviewed.
Revision	This is the revision number of the drawing referenced above.
Other Reference	Other references used to understand the operation of control circuit may be listed here or see the main reference section of this calculation.

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TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
33-1 3321	Bus Tie to 23-1	No	No. Note 1.	N/A	N/A	N/A	12E-3345, Sh. 3	A	
33-1 3322	RX. Building Cooling Water Pump 3A (3-3701-A)	Yes	N/A	N/A	N/A	N/A	12E-3397	M	
33-1 3323	Main Feed from SWGR 33 (3-6733-10)	No	No. Note 1.	N/A	N/A	N/A	12E-3344, Sh.1 &2	V, W	
33-1 3324	RX Cleanup Recirc. Pump 3A	Yes	N/A	N/A	N/A	N/A	12E-3520	V	
33-1 3325	480V SWGR 38 Feed (3-7338-2B)	No	No. Note 1.	N/A	N/A	N/A	12E-3349	S	
33-1 3327	LPCI Pump 3A (3-1502-A)	No	Yes. Pump will slow down momentarily.	Yes. 125Vdc control circuit.	No	No	12E-3436 Sh. 1 & 2 12E-3437 Sh. 1	P,P AD	
33-1 3329	RX Shutdown Cooling Pump 3A	Yes	N/A	N/A	N/A	N/A	12E-3516 12E-3517	F E	
33-1 3330	LPCI Pump 3B (3-1502-B)	No	Yes. Pump will slow down momentarily.	Yes. 125Vdc control circuit.	No	No	12E-3436 Sh. 1 & 2 12E-3437 Sh. 1	P,P AD	
33-1 3331	Core Spray Pump 3A (3-1401-A)	No	Yes. Pump will slow down momentarily.	Yes. 125Vdc control circuit.	No	No	12E-3429 Sh. 1 12E-3430 Sh. 1	U AP	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
33-1 3332	I.L.R.T. Air Compressor	Yes	N/A	N/A	N/A	N/A	12E-3397	M	
40	Aux. Pt. Indicating Lights, Meter, and Relay Comb.	No	No	Yes	No	No	12E-6628	C	
38 2B	Main Feed from SWGR 33-1 (3-6733-25)	No	No. Note 1.	N/A	N/A	N/A	12E-3349	S	
38 2C	Bus 38-39 Tie (3-7339-2C)	No	No. Note 1.	N/A	N/A	N/A	12E-3349	S	
38 3A	Fuel Pool Cooling Water Pump 3A (3-1902-A)	Yes	N/A	N/A	N/A	N/A	12E-3548	L	
38 3B	RX Building Vent Fan 3A (3A-5703)	Yes	N/A	N/A	N/A	N/A	12E-3399A	L	
38 3C	RX Building Vent Fan 3C (3C-5703)	Yes	N/A	N/A	N/A	N/A	12E-3399A	L	
38 3D	RX Cleanup Demin. Auxiliary Pump (3-1206)	Yes	N/A	N/A	N/A	N/A	12E-3520	V	
38 4A	480V MCCs 38-1 & 38-4 (3-7838-1A & 3-7838-4E1)	No	No. Note 1.	N/A	N/A	N/A	12E-3374	U	
38 4B	480V MCC 38-2 (3-7838-2A1)	No	No. Note 1.	N/A	N/A	N/A	12E-3374	U	
38 4C	RX Building Exhaust Fan 3A (3A-5704)	Yes	N/A	N/A	N/A	N/A	12E-3399A	L	

TABLE 2B
AFFECTS OF VOLTAGE DIP
Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38 4D	480V MCC 38-3 (3-7838-3A1)	No	No. Note 1.	N/A	N/A	N/A	12E-3374	U	
38 5A	480V MCC 38-7 (3-7838-7A1)	No	No. Note 1.	N/A	N/A	N/A	12E-3374	U	
38 5C	South Turbine Room Vent Fan 3A (3A-5702)	Yes	N/A	N/A	N/A	N/A	12E-3387B	L	
38 5D	Recirc M-G Set Vent Fan 3A (3A-5701)	Yes	N/A	N/A	N/A	N/A	12E-3420C	J	
38 6A-6D	Drywell Cooler Blower 3A, 3B, 3F, and 3G (3A,B,F,G-5734)	Yes	N/A	N/A	N/A	N/A	12E-3393	N	
38-1 A2	Drywell Air Compressor (3-4710-A)	No	Yes. Compressor will slow down momentarily.	Yes	No	N/A	12E-3514	B	
38-1 A4	120/208V Distr Xfmr 38-1	No	Yes. Voltage will decrease temporarily.	Yes	No	N/A	12E-3674A	AF	
38-1 B1	West LPCI/Core Spray Room Sump Pump 3B (3-2001-511B)	No	No. Note 1.	N/A	N/A	N/A	12E-3674A	AF	
38-1 B1A	Primary Containment Fans	No	No. Note 1.	N/A	N/A	N/A	12E-3674A	AF	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-1 B2	Standby Liquid Control Tank Heater (3-1103)	No	No	Yes	No	N/A	12E-3460 Sh. 1 12E-3674A	AD AF	
38-1 B3	Standby Liquid Control Pump 3A (3-1102A)	No	No. Note 1.	N/A	N/A	N/A	12E-3460 Sh. 1	AD	
38-1 C1	LPCI/Core Spray Pump Area Cooling Unit 3A (3-5746A)	No	Yes. Fan slows down momentarily.	Yes	No	N/A	12E-3393	N	
38-1 C2	Diesel Oil Transfer Pump 2/3 (2/3-5203) (alternate feed)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-2351B Sh. 1	AF	
38-1 C3	Drywell and Torus Purge Exhaust Fan 3A (3-5708A)	Yes	N/A	N/A	N/A	N/A	12E-3393	M	
38-1 C4	Diesel 2/3 Vent Fan (2/3-5790) (alternate feed)	No	Yes. Fan slows down momentarily.	Yes	No	N/A	12E-2351B Sh. 2 12E-3674B	AL Y	
38-1 D1	Stm Iso/Inbd Con Vlv Alt Fd 2-1301-1 and 2-1301-4 (alternate feed)	No	No. Note 1.	N/A	N/A	N/A	12E-2507B	M	
38-1 D2	Torus Drywell Compressor 3A (3-8551-A)	Yes	N/A	N/A	N/A	N/A	12E-3372	R	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-1 D3	Shutdown Cooling Inlet Isolation Valve 3B (3-1001-1B)	No	No. Note 1.	N/A	N/A	N/A	12E-3508A 12E-3508 12E-3501 Sh. 1 & 2	L E AD,AD	
38-1 D4	Shutdown Cooling Return Isolation Valve 3B (3-1001-5B)	No	No. Note 1.	N/A	N/A	N/A	12E-3508E 12E-3508 12E-3501 Sh. 1 & 2	N E AD,AD	
38-1 E1	Core Spray Outboard Isolation Valve 3A (3-1402-24A)	No	No. Note 1.	N/A	N/A	N/A	12E-3431 Sh. 1 12E-3430 Sh. 1	V AP	
38-1 E2	Core Spray Inboard Isolation Valve 3A (3-1402-25A)	No	Yes. Valve will stop momentarily.	Yes	No. NC and interlocked open.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3431 Sh. 1 12E-3430 Sh. 1 & 2	V AP,AN	
38-1 E3	Contain. Cooling Heat Exchanger Discharge Valve 3A (3-1501-3A)	No	No	No (not required until CCSW Pump is started)	No. NC and interlocked closed until the CCSW Pump is started.	No	12E-3440 Sh. 1 12E-3437 Sh. 2	Y AC	
38-1 E4	Cleanup System Inlet Isolation Valve (3-1201-1)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3509A 12E-3509 Sh.2 12E-3501 Sh. 1 & 2	R AA AD,AD	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-1 F1	Cleanup System Return Isolation Valve (3-1201-7)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3509A 12E-3509 Sh.2 12E-3501 Sh. 1 & 2	R AA AD,AD	
38-1 F3	RWCU Isolation Valve Bypass (3-1201-1A)	No	No. Note 1.	N/A	N/A	N/A	12E-7816D 12E-3509 Sh. 2	J AA	
38-1 F4	East LPCI/Core Spray Room Sump Pump 3A (3-2001-510A)	No	No. Note 1.	N/A	N/A	N/A	12E-3674C	AG	
38-1 F4A	Post LOCA H2 & O2 ~~Monitoring~~ Sample Pump 3A (3-2400-A)	No	Yes. Pump will slow down momentarily.	Yes. Interlocked with LOCA signal.	No	N/A	12E-7554A 12E-7552 Sh. 2	J T	
38-1 G1	Closed Cooling Water Isolation Valve (3-3704)	No	No. Note 1.	N/A	N/A	N/A	12E-3674D	AA	
38-1 G2	Shutdown Cooling Return Isolation Valve 3A (3-1001-5A)	No	No. Note 1.	N/A	N/A	N/A	12E-3508E 12E-3508 12E-3501 Sh. 1 & 2	N E AD,AD	
38-1 G3	Closed Cooling Water Drywell Return Valve 3A (3-3703)	No	No. Note 1.	N/A	N/A	N/A	12E-3398	D	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-1 G4	Shutdown Cooling Inlet Isolation Valve 3A (3-1001-1A)	No	No. Note 1.	N/A	N/A	N/A	12E-3508A 12E-3508 12E-3501 Sh. 1 & 2	L E AD,AD	
38-1 H1	Inbd Cond Return Valve (3-1301-4) (normal feed)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3507B 12E-3506 Sh. 1 & 2	M Z,AA	
38-1 H2	Steam Line Isol Valve (3-1301-1) (normal feed)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3507B 12E-3506 Sh. 1 & 2	M Z,AA	
38-1 H3	LPCI Pumps Drywell Discharge Valve 3A (3-1501-27A)	No	No. Note 1.	N/A	N/A	N/A	12E-3440 Sh. 3 12E-3437 Sh. 1 & 2	 W AD,AC	
38-1 H4	LPCI Pumps Drywell Discharge Valve 3B (3-1501-28A)	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 3 12E-3437 Sh. 1 & 2	S AD,AC	
38-2 A4	120/240V Distr Xfmr 38-2	No	Yes. Voltage will decrease temporarily.	Yes	No	N/A	12E-3675A	AK	
38-2 B1	Condensate Transfer Jockey Pump (3-4321)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3373	K	

TABLE 2B
AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-2 B2	Main Steam Isolation Valve Unit Coolers (3-5758 A thru F)	No	Yes. Coolers will slow down momentarily.	Yes	No	N/A	12E-3675A 12E-3435 Sh. 1	AK S	
38-2 B3	Turbine Vacuum Breaker Valve (3-4901)	No	No. Note 1.	N/A	N/A	N/A	12E-3363	L	
38-2 B4	125V Alternate Battey Electric Heaters #1, 2, 3	No	No	Yes	No	N/A	12E-3675A	AK	
38-2 B5	Main Steam Line Drain Valves 220-90 A, B, C, and D	No	No. Note 1.	N/A	N/A	N/A	12E-3450	B	
38-2 B6	H2 Seal Oil Vacuum Pump (3-5350-SOVP)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3365	M	
38-2 C1	125 Volt Battery Charger 3A (3-8300-3A)	No	Yes. Charger output will decrease momentarily.	Yes	No	N/A	12E-3675B	L	
38-2 C2	Essential Bus Transformer Feed (Reserve Feed)	No	No. Note 1.	N/A	N/A	N/A	12E-3675B	L	
38-2 C3	120/240V Distr Xfmr Inst	No	Yes. Voltage will decrease temporarily.	Yes	No	No	12E-3675B	L	
38-2 C4	Instrument Buses Transformer Feeds (Bifurcated to Cubicles C2 & C3)	No	Yes. Voltage will decrease momentarily (see Cubicles C2 & C3).	—	—	—	12E-3675B	L	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-2 D1	Main H2 Seal Oil Pump (3-5350-MSOP)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3365	M	
38-2 D2	250 Volt Battery Charger #3 (3-8350-3)	No	Yes. Charger output will decrease momentarily.	Yes	No	N/A	12E-3675B	L	
38-2 D3	Condensate Transfer Pump 3A (3A-4301)	Yes	N/A	N/A	N/A	N/A	12E-3370	Q	
38-2 D4	Welder Receptacle (3-7901)	No	No. Note 1.	N/A	N/A	N/A	12E-3675B	L	
38-2 D5	Diesel Gen Starting Air Compressor 3A (3-4611A)	No	Yes. Compressor will slow down momentarily.	Yes. Will start when pressure is below 230 psi.	No	N/A	12E-3350B	AK	
38-3 A2	Diesel Circ. Water Heater 3	No	Yes. Heater output will decrease momentarily.	Yes	No	N/A	12E-3350B	AK	
38-3 A2	DG Turbo Charger Lube Oil Circulating Pump #2	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3350B	AK	
38-3 A2	DG Turbo Charger Lube Oil Circulating Pump #2	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3350B	AK	
38-3 A3	Turning Gear Oil Pump (3-5600-TGOP)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3362	M	
38-3 A4	Turbine Turning Gear (3-5601-TGM)	No	No. Not started until after the second CCSW Pump is running.	N/A	N/A	N/A	12E-3362A	D	

TABLE 2B
AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-3 B1	Turning Gear Piggyback Motor (3-5601-TGM-PBM)	No	No. Not started until after the second CCSW Pump is running.	N/A	N/A	N/A	12E-3362A	D	
38-3 B2-B6	Turbine Bearing Lift Pump 3A, 3B, 3C, 3D, and 3E (3-5620-A, B, C, D, E)	No	N/A. Starts after 10 minutes.	Yes	N/A	N/A	12E-3364	K	
38-3 C2	RX Protection System M-G Set 3A (3-8001-A)	No.	Yes. The motor might slow down momentarily.	Yes.	No.	N/A	12E-3592	K	
38-3 C4	Diesel Cooling Water Pump 2/3 (2/3-3903) (Alternate Feed)	No	Yes. Pump will slow down momentarily.	Yes	No	N/A	12E-3676B 12E-2351B, Sh. 1	U AF	
38-3 D1	Contain. Cool. Serv. Water Pump Cub. Cooler A, Fan 1, 3-5700-30A	No	No. Fan will operate after the second CCSW Pump is operating (starts at 10++ minutes).	N/A	No	N/A	12E-3676B 12E-3435 Sh. 1	U S	
38-3 D2	Contain. Cool. Serv. Water Pump Cub. Cooler A Fan 2, 3-5700-30A	No	No. Fan will operate after the second CCSW Pump is operating (starts at 10++ minutes).	N/A	No	N/A	12E-3676B 12E-3435 Sh. 1	U S	
38-3 D3	Contain. Cool. Serv. Water Pump Cub. Cooler B, Fan 1, 3-5700-30B	No	No. Fan will operate after the second CCSW Pump is operating (starts at 10++ minutes).	N/A	No	N/A	12E-3676B 12E-3435 Sh. 1	U S	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-3 D4	Contain. Cool. Serv. Water Pump Cub. Cooler B, Fan 2, 3-5700-30B	No	No. Fan will operate after the second CCSW Pump is operating (starts at 10++ minutes).	N/A	No	N/A	12E-3676B 12E-3435 Sh. 1	U S	
38-3 D5	120/208V Distr Xfmr 38-3	No	Yes. Voltage will decrease momentarily.	Yes	No	N/A	12E-3676B	U	
38-3 D6	120/208V Distr Xfmr FP-3	No	No	Yes	No	N/A	12E-3676B	U	
38-4 A1	Core Spray Suction Valve 3A (3-1402-3A)	No	No. Note 1.	N/A	N/A	N/A	12E-3432 12E-3430 Sh. 1	T AP	
38-4 A2	Core Spray Test Bypass Valve 3A (3-1402-4A)	No	No. Note 1.	N/A	N/A	N/A	12E-3433 12E-3430 Sh. 1	P AP	
38-4 A3	LPCI Pump 3A Suction Valve (3-1501-5A)	No	No. Note 1.	N/A	N/A	N/A	12E-3440 Sh. 1 12E-3437 Sh. 1 12E-3438 Sh. 1	Y AD	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-4 A4	LPCI Pump 3B Suction Valve (3-1501-5B)	No	No. Note 1..	N/A	N/A	N/A	12E-3440 Sh. 1 12E-3437 Sh. 1	Y AD	
38-4 B1	LPCI Torus Spray Valve 3A (3-1501-38A)	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 1 12E-3437 Sh. 1 & 2	Q AD,AC	
38-4 B2	LPCI Torus Spray Valve 3B (3-1501-20A)	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 2 12E-3437 Sh. 1 & 2 12E-3438 Sh. 1 & 2	R AD,AC	
38-4 B3	LPCI Torus Ring Spray Valve 3A (3-1501-18A).	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 1 12E-3437 Sh. 1 & 2	Q AD,AC	
38-4 B4	LPCI Torus Ring Spray Valve 3B (3-1501-19A)	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 2 12E-3437 Sh. 1 & 2 12E-3438 Sh. 1 & 2	R AD,AC	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)

EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-4 C1	Temporary Hyd. Power Unit for Rod OSC Tests	No	No. Note 1.	N/A	N/A	N/A	12E-3680B	J	
38-4 C1A	Welder Receptacle	No	No. Note 1.	N/A	N/A	N/A	12E-3680B	J	
38-4 C2	Diesel Starting Air Compressor 2/3B (2/3-6600-B)	No	Yes. Compressor will slow down momentarily.	Yes	No	N/A	12E-2351B Sh. 1	AA	
38-4 C3	LPCI Header Crosstie Isolation Valve [illegible] (3-1501-32A)	No	No. Note 1.	N/A	N/A	N/A	12E-3440 Sh. 3	W	
38-4 E2	LPCI Pump Flow Bypass Valve 3A (3-1501-13A)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked open, but will close on high level	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3440 Sh. 2 12E-3437 Sh. 2	X AC	
38-4 E3	Core Spray Pump Recirc. Isolation Valve 3A (3-1402-38A)	No	Yes. Valve will stop operating momentarily.	Yes	No	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3433	P	

TABLE 2B
AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
38-4 E4	LPCI Heat Exchanger Bypass Valve 3A (3-1501-11A)	No	No. Note 1.	N/A	N/A	N/A	12E-3440 Sh. 2 12E-3437A 12E-3437 Sh. 1	X R AD	
38-4 E5	HPCI Floor Drain Sump Pump (3-2301-250)	No	No. Note 1.	N/A	N/A	N/A	12E-3533	Q	
38-7 A2	LPCI Inbd. Isolation Valve 3A (3-1501-22A)	No	Yes. Valve will stop operating momentarily.	Yes	No. NC and interlocked open.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3441 Sh. 4 12E-3437A 12E-3438A	T S S	
38-7 B1	Recirc. Pump 3A Suction Valve (3-0202-4A)	No	No. Note 1.	N/A	N/A	N/A	12E-3420A	T	
38-7 B2	Recirc. Pump 3A Discharge Valve (3-0202-5A)	No	Yes. Valve will stop momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3420A 12E-3437A 12E-3438A	T S S	
38-7 C3	LPCI Outboard Isolation Valve 3A (3-1501-21A)	No	No. Note 1.	N/A	N/A	N/A	12E-3441 Sh. 3 12E-3437A 12E-3438A	S S S	
39-7 A2	Refueling Floor Jib Crane (3-5813)	No	No. Note 1.	N/A	N/A	N/A	12E-3662C	U	

TABLE 2B

AFFECTS OF VOLTAGE DIP

Dresden Station - Unit 2/3 (Swing Diesel)
EDG 2/3 Powering Unit 3

Bus No.	Equipment Description/No.	Load Shed	Will the voltage dips @ 5s, 10s, & 10min. affect the equipment's operation ?	Will the equipment start after voltage recovery ?	Will the equipt. operate in adverse mode due to the voltage dips ?	Will the time delay in operation cause any adverse affect ?	Dwg. Ref.	Rev	Other Ref.
39-7 A3	LPCI Outboard Isolation Valve 3B (3-1501-21B)	No	Yes. Valve will stop operating momentarily.	Yes	No. NO and interlocked closed.	Yes. Will increase operating time. However, increased time will be within acceptable limits.	12E-3441A 12E-3437A 12E-3438A	U S S	
39-7 B1	Recirc. Pump 3B Suction Valve (3-0202-4B)	No	No. Note 1.	N/A	N/A	N/A	12E-3420B	V	
39-7 B2	Recirc. Pump 3B Discharge Valve (3-0202-5B)	No	No. Note 1.	N/A	N/A	N/A	12E-3420B 12E-3437A 12E-3438A	V S S	
39-7 C2	LPCI Inboard Isolation Valve 3B (3-1501-22B)	No	No. Note 1.	N/A	N/A	N/A	12E-3441A 12E-3437A 12E-3438A	U S S	

NC - Normally Closed
NO - Normally Open
For further explanation of this table see Flow Chart No. 2.
Note 1: These loads have power, however they do not operate.

Table 4B

DG Auxiliaries and Other 480V Loads Starting 0 Seconds after Closing of DG Breaker

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR	
	Aux. Pt. Indicating Lights, Meter, and relay Comb	40	0.4	KVA	480	85	85	0.6	100	85	0.4	0.2	
	120/208V Distr Xfmr 38-1	38-1	9	KVA	480	75	100	10.8	100	75	6.8	6.0	
3-1201-7	Cleanup System Return Isolation	38-1	2.6	HP	440	85	80	3.7	680	68	13.2	14.2	
3-1201-1	Cleanup System Inlet Isolation Valve	38-1	3.9	HP	460	78	70	6.7	750	58	23.2	32.6	
2/3-5203	Diesel Transfer Pump 2/3	38-1	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
2/3-5790	Diesel 2/3 Vent Fan	38-1	30	HP	440	85	85	40.6	625	42	81.3	175.7	
3-1301-4	Inbd Cond Return Vlv	38-1	6.4	HP	460	63	70	13.6	844	56	51.2	75.7	
3-1301-1	Steam Line Isol Vlv	38-1	9.5	HP	460	74	70	17.2	666	54	49.2	76.7	
3-2400-A	Post LOCA H2 & O2 Monitoring Sample	38-1	1	HP	460	80	75	1.6	625	79	6.1	4.8	
3-4710-A	Drywell Air Compressor	38-1	4.6	HP	460	80	75	7.2	625	75	26.8	23.6	
3-1103	Standby Liquid Control Tank Heater	38-1	25	KW	440	100	100	32.8	100	100	25.0	0.0	
	120/240V Distr Xfmr 38-2	38-2	17.32	KVA	480	75	100	20.8	100	75	13.0	11.5	
3-4321	Condensate Transfer Jockey Pump	38-2	7.5	HP	460	85	80	10.3	625	56	28.8	42.6	
	120/240V Distr Xfmr Inst	38-2	64.95	KVA	480	75	100	78.1	100	75	48.7	43.0	
3-5350-MSOP	Main H2 Seal Oil Pump	38-2	15	HP	460	85	85	19.4	625	49	47.4	84.4	
3-8300-2A	125V Battery Charger 3A	38-2	From ETAP								34.1	30.6	
3-5350-SOVP	H2 Seal Oil Vacuum Pump	38-2	2	HP	460	85	80	2.8	625	75	10.3	9.1	
3-4611-A	Diesel Starting Air Compressor 3A	38-2	5	HP	460	85	80	6.9	625	58	19.9	27.9	
3-5758A	Main Steam Isolation Valve Unit Cooler A	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
3-5758B	Main Steam Isolation Valve Unit Cooler B	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
3-5758C	Main Steam Isolation Valve Unit Cooler C	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
3-5758D	Main Steam Isolation Valve Unit Cooler D	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
3-5758E	Main Steam Isolation Valve Unit Cooler E	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
3-5758F	Main Steam Isolation Valve Unit Cooler F	38-2	1.5	HP	460	80	75	2.3	625	75	8.7	7.7	
	250V Battery Charger #3	38-2	From ETAP								66.1	58.0	
	125Vdc Alternate Batt. Electric	38-2	5	KW	480	100	100	6.0	100	100	5.0	0.0	
	125Vdc Alternate Batt. Electric	38-2	5	KW	480	100	100	6.0	100	100	5.0	0.0	
	125Vdc Alternate Batt. Electric	38-2	5	KW	480	100	100	6.0	100	100	5.0	0.0	
	120/208V Distr Xfmr FP-3	38-3	15	KVA	480	75	100	18.0	100	75	11.3	9.9	
	Diesel Circulation Water Heater 2	38-3	15	KW	480	100	100	18.0	100	100	15.0	0.0	
3-6657	DG3 Lube Oil Circulating Pump Motor 1HP	38-3	1	HP	460	80	75	1.6	625	79	6.1	4.8	
3-6660	DG3 Lube Oil Circulating Pump Motor 3/4HP	38-3	0.75	HP	460	80	75	1.2	546	83	4.2	2.8	
2/3-3903	Diesel Cooling Water Pump 2/3	38-3	87	KW	460	83	100	131.6	400	31.5	132.1	397.9	R4
2253-85	120/208V Distr Xfmr 38-3	38-3	15	KVA	480	75	100	18.0	100	75	11.3	9.9	
3-8001-A	RX Protection Bus 2 M-G Set 3A	38-3	25	HP	460	85	85	32.4	625	43	69.4	145.7	
2/3-6600-B	Diesel Starting Air Compressor 2/3B	38-4	5	HP	460	85	80	6.9	625	58	19.9	27.9	
										TOTAL STARTING KW & KVAR	896.9	1369.4	R4

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF))

Table 4B

DG Auxiliaries and Other 480V Loads Starting 0 Seconds after UV Relay Resets

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
3-1501-13A	LPCI Pump Flow Bypass Valve 3A	38-4	0.13	HP	440	80	75	0.2	527	85	0.7	0.4
3-5746A	LPCI Core Spray Pump Area Cooling Unit 3A	38-1	5	HP	460	85	80	6.9	625	58	19.9	27.9
									TOTAL STARTING KW & KVAR		20.6	28.4

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF)) | R3

Table 4B

DG Auxiliaries and Other 480V Loads Starting 10 Seconds after UV Relay Resets

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR	
3-1402-25A	Core Spray Inboard Isolation Valve 3A	38-1	4	HP	440	85	80	5.8	830	58	21.1	29.7	
3-1401-38A	Core Spray Pump Recirculation Isolation Valve 3A	38-4	0.13	HP	440	80	75	0.2	527	85	0.7	0.4	
3-1501-22A	LPCI Inboard Isolation Valve 3A	38-7	10.5	HP	460	85	83.78	13.8	826	43	39.1	82.0	R3
3-202-5A	Recirc. Pump 3A Discharge Valve	38-7	13	HP	460	85	85	16.8	775	49	51.0	90.7	
3-1501-21B	LPCI Outboard Isolation Valve 3B	39-7	16.2	HP	460	85	90	19.8	663	49	51.3	91.3	
									TOTAL STARTING KW & KVAR		163.2	294.1	R3

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF)) R3

Table 4B

DG Auxiliaries and Other 480V Loads Starting at 10+ Minutes

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
3-1501-3A	Containment Cooling Heat Exchanger Discharge Valve 3A	38-1	0.33	HP	460	80	75	0.5	245	85	0.9	0.5
										TOTAL STARTING KW & KVAR	0.9	0.5

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF))

R3

Table 4B

DG Auxiliaries and Other 480V Loads Starting at 10++ Minutes

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
3-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 1	38-3	3	HP	460	85	80	4.1	625	68	14.0	15.1
3-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 2	38-4	3	HP	460	81.5	84	4.1	780	81.5	20.8	14.8
3-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 1	38-5	3	HP	460	85	80	4.1	625	68	14.0	15.1
3-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 2	38-6	3	HP	460	85	80	4.1	625	68	14.0	15.1
									TOTAL STARTING KW & KVAR		62.7	60.0

Full Load Current (FLC) form HP = (HP x 746) / (1.732 x kV x PF x eff.)
FLC from KW = KW / (1.732 x kV x PF x eff.)
FLC from KVA = KVA / (1.732 x kV x eff.)

Starting KW (SKW) = 1.732 x kV x LRC% x FLC x SPF
Starting KVAR (SKVAR) = 1.732 x kV x LRC% x FLC x sin(acos(SPF)) R3

DRESDEN DIESEL GEN 2/3 LOAD BUS (LOOP AND LOCA CONDITION)

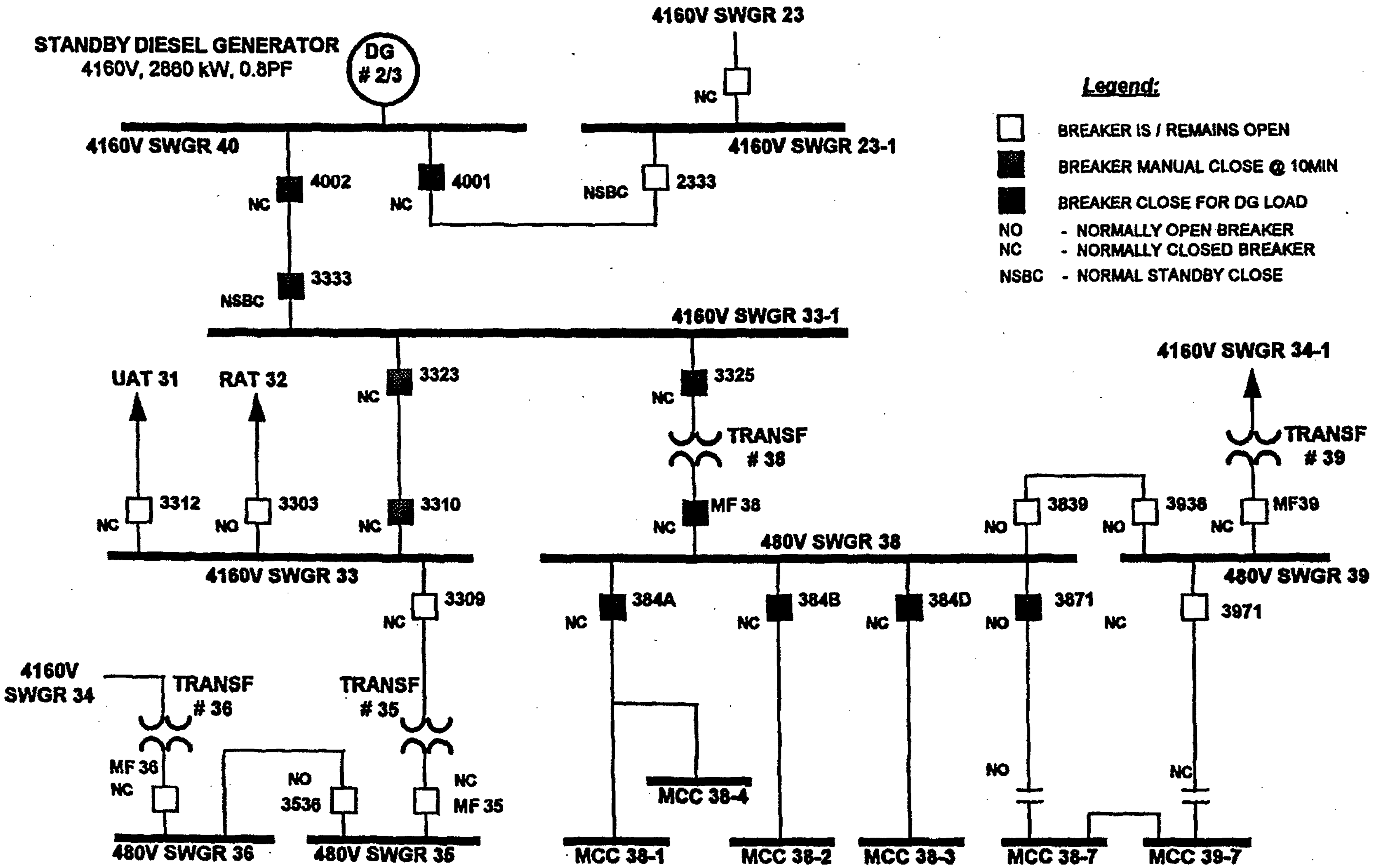

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Figure 1B

Calc. No. 9389-46-19-3, Rev. 2
Page K1/Final Proj. No. 10014-012

FIGURE 2B - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

Calc.No. 9389-46-19-3, Rev. 3 Page No. L1 , Proj.No. 10014-012

Emergency Diesel 2/3 - Powering Unit 3 Loads

Load No.	Load Description	Bus No.
3-1502-A	LPCI Pump 3A	33-1
3-1502-B	LPCI Pump 3B	33-1
3-1401-A	Core Spray Pump 3A	33-1
	Containment Cooling Service Water Pump 3A	33
	Containment Cooling Service Water Pump 3B	33
	Aux. Pt. Indicating Lights, Meter, and Relay Comb.	40
	120/208V Distr Xfmr 38-1	38-1
3-1201-7	Cleanup System Return Isolation Valve	38-1
3-1201-1	Cleanup System Inlet Isolation Valve	38-1
2/3-5203	Diesel Gen Oil Transfer Pump 2/3	38-1
2/3-5790	Diesel 2/3 Vent Fan	38-1
3-1402-25A	Core Spray Inboard Isolation Valve 3A	38-1
3-1301-4	Inbd Cond Return Vlv	38-1
3-1301-1	Steam Line Isol Vlv	38-1
3-2400-A	Post LOCA H2 & O2 Monitoring Sample Pump 3A	38-1
3-4710-A	Drywell Air Compressor	38-1
3-1103	Standby Liquid Control Tank Heater	38-1
3-5746A	LPCI Core Spray Pump Area Cooling Unit 3A	38-1
3-1501-3A	Containment Cooling Heat Exchanger Discharge Valve 3A	38-1
	120/240V Distr Xfmr 38-2	38-2
3-4321	Condensate Transfer Jockey Pump	38-2
	120/240V Distr Xfmr Inst	38-2
3-5350-MSOP	Main H2 Seal Oil Pump	38-2
3-8300-3A	125V Battery Charger 3A	38-2
3-5350-SOVP	H2 Seal Oil Vacuum Pump	38-2
3-4611A	Diesel Starting Air Compressor 3A	38-2
3-5758A	MSIV Unit Cooler A	38-2
3-5758B	MSIV Unit Cooler B	38-2
3-5758C	MSIV Unit Cooler C	38-2
3-5758D	MSIV Unit Cooler D	38-2
3-5758E	MSIV Unit Cooler E	38-2
3-5758F	MSIV Unit Cooler F	38-2
3-8350-3	250V Battery Charger #3	38-2
	125Vdc Alternate Battery Electric Heaters	38-2
	120/208V Distr Xfmr FP-3	38-3
	Diesel Circulation Water Heater 3	38-3
3-6657	Engine Lube Oil Circulating Pump Motor 1HP	38-3
3-6660	Engine Lube Oil Circulating Pump Motor 3/4HP	38-3
3-5600-TGOP	Turning Gear Oil Pump	38-3
3-5620-A	Turbine Bearing Lift Pump 3A	38-3
3-5620-B	Turbine Bearing Lift Pump 3B	38-3
3-5620-C	Turbine Bearing Lift Pump 3C	38-3
3-5620-D	Turbine Bearing Lift Pump 3D	38-3
3-5620-E	Turbine Bearing Lift Pump 3E	38-3
2/3-3903	Diesel Gen Cooling Water Pump 2/3	38-3
2253-85	120/208V Distr Xfmr 38-3	38-3

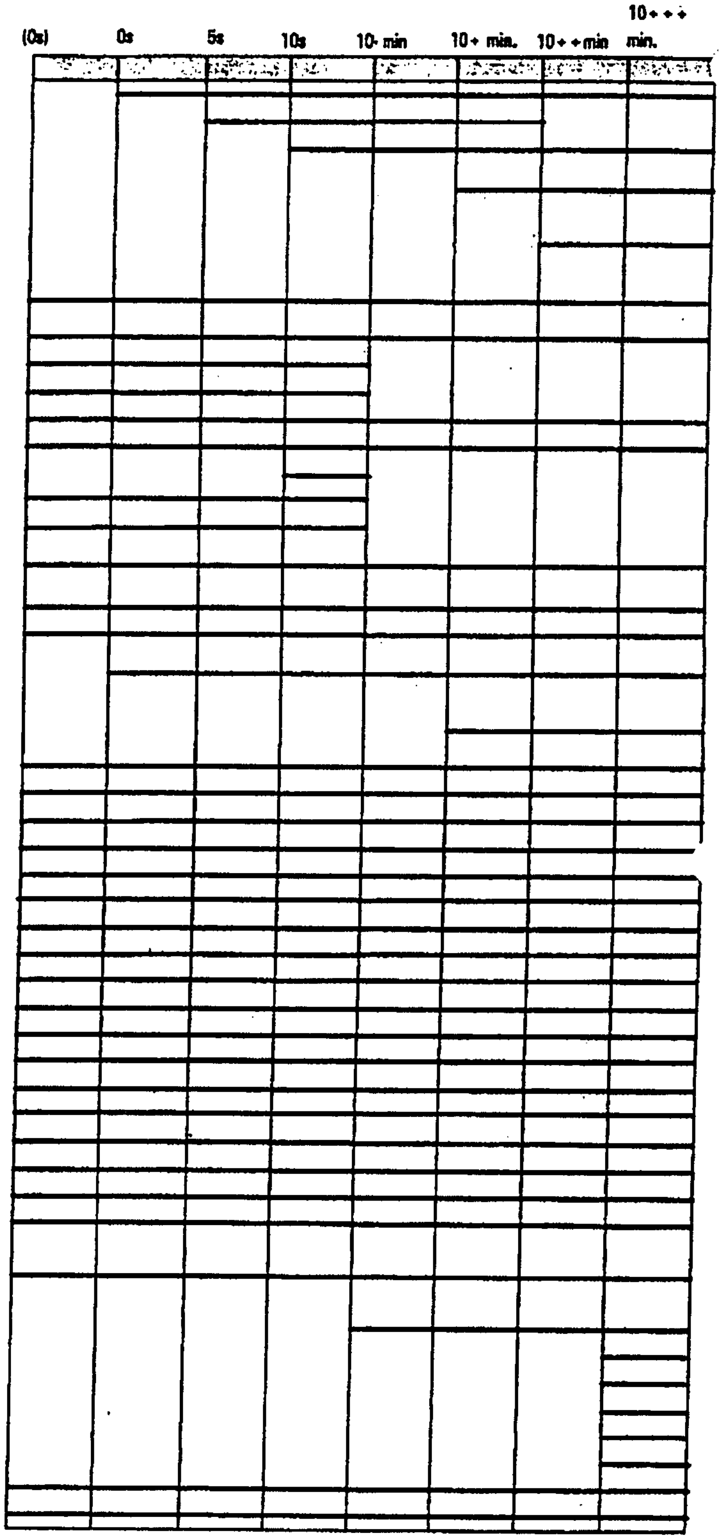
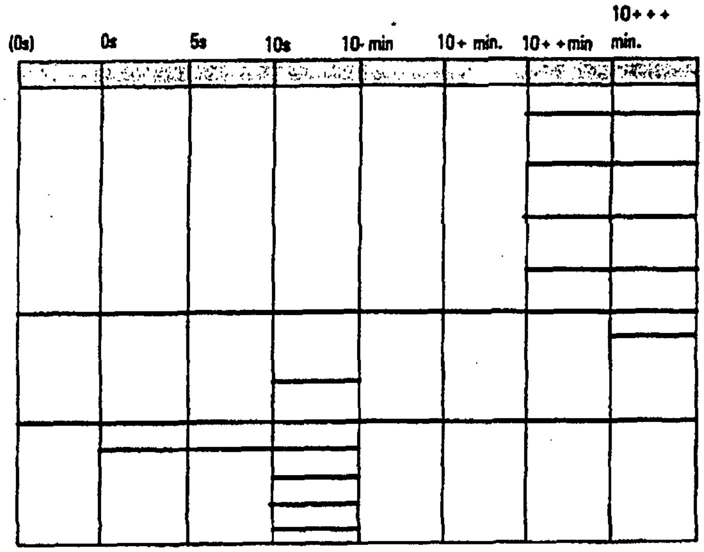


FIGURE 2B - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

Calc.No. 9389-46-19-3, Rev. 2, Page No. L2/FINAL, Proj.No. 10014-012

Emergency Diesel 2/3 - Powering Unit 3 Loads

Load No.	Load Description	Bus No.
3-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 1	38-3
3-5700-30A	Containment Cooling Service Water Pump Cooler A Fan 2	38-3
3-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 1	38-3
3-5700-30B	Containment Cooling Service Water Pump Cooler B Fan 2	38-3
3-8001-A	RX Protection System Bus 2 M-G Set 3A	38-3
3-5601-TGM	Turbine Turning Gear	38-3
3A-1402-38A	Core Spray Pump Recirculation Isolation Valve 3A	38-4
2/3-6600-B	Diesel Starting Air Compressor 2/3B	38-4
3-1501-13A	LPCI Pump Flow Bypass Valve 3A	38-4
3-1501-22A	LPCI Inboard Isolation Valve 3A	38-7
3-202-5A	Recirc. Pump 3A Discharge Valve	38-7
3-1501-21B	LPCI Outboard Isolation Valve 3B	39-7



(0s) - 0 seconds after closing of DG Breaker
0s - 0 seconds after UV reset
5s - 5 seconds after UV reset
10s - 10 seconds after UV reset

10-min - All loads that automatically stop before 10 minutes are shown off.
10+min - CCSW Pump 2A is started.
10++min - CCSW Pump 2B is started with its auxiliaries.
10+++min. - Both CCSW Pumps are running and other loads starting after 10 minutes are shown here.

Attachment M

DG Unit 3 Division I ETAP Output Reports – Nominal Voltage

Scenario	Page #'s
DG2/3_Bkr_Cl	M2-M15
DG2/3_UV_Rst	M16-M29
DG2/3_T=5sec	M30-M43
DG2/3_T=10s	M44-M57
DG2/3_T=10-m	M58-M71
DG2/3_T=10+m	M72-M85
DG2/3_T=10++m	M86-M99
DG2/3_CRHVAC	M100-M113

Only the Load Flow Report (Page 8) of these Scenarios have been included. [initials] 4/26/07

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is less than 10 minutes into the event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33-1	4.160	4.159	0.0	0	0	0	0	HIGH SIDE OF XFMR 38	0.420	0.351	76.1	76.7	
								4KV SWING BUS 40	-0.420	-0.351	76.1	76.7	
* 4KV SWING BUS 40	4.160	4.160	0.0	0.421	0.351	0	0	4KV SWGR 33-1	0.421	0.351	76.1	76.7	
38-1 ALTF 2-1301-1&4	0.480	0.474	-1.6	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.464	-1.8	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.1	
250V DC CHGR 3	0.480	0.464	-1.8	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.4	
480V MCC 38-1	0.480	0.474	-1.6	0	0	0.091	0.049	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.091	-0.049	125.6	88.2	
480V MCC 38-2	0.480	0.468	-2.0	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.7	
								125V DC CHGR 3A	0.034	0.028	55.0	77.4	
								480V SWGR 38	-0.206	-0.155	317.7	79.9	
480V MCC 38-3	0.480	0.474	-1.6	0	0	0.111	0.117	480V SWGR 38	-0.111	-0.117	196.7	69.0	
480V MCC 38-4	0.480	0.478	-1.7	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.7	85.5	
480V MCC 38-7	0.480	0.478	-1.7	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.096	0.052	132.3	88.0	
								480V MCC 38-3	0.112	0.118	196.7	69.0	
								480V MCC 38-2	0.209	0.159	317.7	79.5	
								HIGH SIDE OF XFMR 38	-0.418	-0.329	642.7	78.6	
BKR 38-4A BIFURC	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-4	0.005	0.003	6.7	85.5	
								480V SWGR 38	-0.096	-0.052	132.3	88.0	
								480V MCC 38-1	0.092	0.049	125.6	88.2	
HIGH SIDE OF XFMR 38	4.160	4.158	0.0	0	0	0	0	4KV SWGR 33-1	-0.420	-0.351	76.1	76.7	
								480V SWGR 38	0.420	0.351	76.1	76.7	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is less than 10 minutes into the event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	% Tap
4KV SWGR 33-1	4.160	4.158	0.0	0	0	0.506	0.245	HIGH SIDE OF XFMR 38	0.425	0.354	76.8	76.8	
								4KV SWING BUS 40	-0.931	-0.599	153.7	84.1	
*4KV SWING BUS 40	4.160	4.160	0.0	0.931	0.600	0	0	4KV SWGR 33-1	0.931	0.600	153.7	84.1	
38-1 ALTF 2-1301-1&4	0.480	0.474	-1.7	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.463	-1.8	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 3	0.480	0.463	-1.8	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.5	
480V MCC 38-1	0.480	0.474	-1.7	0	0	0.095	0.051	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.095	-0.051	131.8	88.0	
480V MCC 38-2	0.480	0.467	-2.1	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.7	
								125V DC CHGR 3A	0.034	0.028	55.0	77.5	
								480V SWGR 38	-0.206	-0.154	317.7	79.9	
480V MCC 38-3	0.480	0.474	-1.7	0	0	0.111	0.117	480V SWGR 38	-0.111	-0.117	196.7	69.0	
480V MCC 38-4	0.480	0.478	-1.7	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.9	85.3	
480V MCC 38-7	0.480	0.478	-1.7	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.101	0.055	138.7	87.9	
								480V MCC 38-3	0.112	0.118	196.7	69.0	
								480V MCC 38-2	0.209	0.159	317.7	79.5	
								HIGH SIDE OF XFMR 38	-0.422	-0.332	649.1	78.6	
BKR 38-4A BIFURC	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-4	0.005	0.003	6.9	85.3	
								480V SWGR 38	-0.101	-0.055	138.7	87.9	
								480V MCC 38-1	0.096	0.052	131.8	88.0	
HIGH SIDE OF XFMR 38	4.160	4.157	0.0	0	0	0	0	4KV SWGR 33-1	-0.425	-0.354	76.8	76.8	
								480V SWGR 38	0.425	0.354	76.8	76.8	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is less than 10 minutes into the event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33-1	4.160	4.157	0.0	0	0	1.022	0.495	HIGH SIDE OF XFMR 38	0.425	0.354	76.8	76.8	
								4KV SWING BUS 40	-1.446	-0.849	232.9	86.2	
* 4KV SWING BUS 40	4.160	4.160	0.0	1.448	0.850	0	0	4KV SWGR 33-1	1.447	0.850	232.9	86.2	
38-1 ALTF 2-1301-1&4	0.480	0.474	-1.7	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.463	-1.8	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 3	0.480	0.463	-1.8	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.5	
480V MCC 38-1	0.480	0.474	-1.7	0	0	0.095	0.051	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.095	-0.051	131.8	88.0	
480V MCC 38-2	0.480	0.467	-2.1	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.7	
								125V DC CHGR 3A	0.034	0.028	55.0	77.5	
								480V SWGR 38	-0.205	-0.154	317.6	80.0	
480V MCC 38-3	0.480	0.473	-1.7	0	0	0.111	0.117	480V SWGR 38	-0.111	-0.117	196.8	69.0	
480V MCC 38-4	0.480	0.477	-1.7	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.9	85.3	
480V MCC 38-7	0.480	0.478	-1.7	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.101	0.055	138.8	87.9	
								480V MCC 38-3	0.112	0.118	196.8	69.0	
								480V MCC 38-2	0.209	0.159	317.6	79.6	
								HIGH SIDE OF XFMR 38	-0.422	-0.332	649.1	78.6	
BKR 38-4A BIFURC	0.480	0.478	-1.7	0	0	0	0	480V MCC 38-4	0.005	0.003	6.9	85.3	
								480V SWGR 38	-0.101	-0.055	138.8	87.9	
								480V MCC 38-1	0.096	0.052	131.8	88.0	
HIGH SIDE OF XFMR 38	4.160	4.156	0.0	0	0	0	0	4KV SWGR 33-1	-0.425	-0.354	76.8	76.8	
								480V SWGR 38	0.425	0.354	76.8	76.8	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is less than 10 minutes into the event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33-1	4.160	4.155	0.0	0	0	1.741	0.795	HIGH SIDE OF XFMR 38	0.463	0.381	83.3	77.2	
								4KV SWING BUS 40	-2.204	-1.176	347.1	88.2	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.206	1.179	0	0	4KV SWGR 33-1	2.206	1.179	347.1	88.2	
38-1 ALTF 2-1301-1&4	0.480	0.472	-1.9	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.462	-2.0	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.4	
250V DC CHGR 3	0.480	0.462	-2.0	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.3	77.7	
480V MCC 38-1	0.480	0.472	-1.9	0	0	0.099	0.054	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.099	-0.054	137.3	87.9	
480V MCC 38-2	0.480	0.466	-2.3	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.3	77.9	
								125V DC CHGR 3A	0.034	0.028	55.0	77.7	
								480V SWGR 38	-0.205	-0.154	317.5	80.0	
480V MCC 38-3	0.480	0.472	-1.8	0	0	0.111	0.117	480V SWGR 38	-0.111	-0.117	197.1	69.0	
480V MCC 38-4	0.480	0.476	-1.9	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	7.1	85.2	
480V MCC 38-7	0.480	0.474	-1.8	0	0	0.021	0.013	480V SWGR 38	-0.035	-0.021	49.4	85.3	
								480V MCC 39-7	0.013	0.008	19.3	85.1	
480V MCC 39-7	0.480	0.474	-1.8	0	0	0.013	0.008	480V MCC 38-7	-0.013	-0.008	19.3	85.1	
480V SWGR 38	0.480	0.476	-1.9	0	0	0	0	480V MCC 38-7	0.035	0.021	49.4	85.3	
								BKR 38-4A BIFURC	0.105	0.057	144.5	87.8	
								480V MCC 38-3	0.112	0.118	197.1	69.0	
								480V MCC 38-2	0.209	0.158	317.5	79.6	
								HIGH SIDE OF XFMR 38	-0.460	-0.355	704.1	79.2	
BKR 38-4A BIFURC	0.480	0.476	-1.9	0	0	0	0	480V MCC 38-4	0.005	0.003	7.1	85.2	
								480V SWGR 38	-0.105	-0.057	144.5	87.8	
								480V MCC 38-1	0.100	0.054	137.3	87.9	
HIGH SIDE OF XFMR 38	4.160	4.154	0.0	0	0	0	0	4KV SWGR 33-1	-0.463	-0.381	83.3	77.2	
								480V SWGR 38	0.463	0.381	83.3	77.2	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

ject:	Dresden Unit3	ETAP		Page:	8
Location:	OTI	5.5.0N		Date:	03-21-2007
Contract:	123			SN:	WASHTNGRPN
Engineer:	OTI			Revision:	Base
Filename:	DRE_Unit3_0005	Study Case:	DG_0_CCSW	Config.:	DG2/3_T=10-m

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is less than 10 minutes into the event.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33-1	4.160	4.155	0.0	0	0	1.741	0.795	HIGH SIDE OF XFMR 38	0.438	0.356	78.4	77.6	
								4KV SWING BUS 40	-2.179	-1.151	342.4	88.4	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.181	1.153	0	0	4KV SWGR 33-1	2.181	1.153	342.4	88.4	
38-1 ALTF 2-1301-1&4	0.480	0.475	-1.8	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.463	-1.9	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 3	0.480	0.463	-1.9	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.5	
480V MCC 38-1	0.480	0.475	-1.8	0	0	0.071	0.029	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.071	-0.029	93.7	92.7	
480V MCC 38-2	0.480	0.467	-2.2	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.8	
								125V DC CHGR 3A	0.034	0.028	55.0	77.5	
								480V SWGR 38	-0.205	-0.154	317.6	80.0	
480V MCC 38-3	0.480	0.472	-1.8	0	0	0.148	0.140	480V SWGR 38	-0.148	-0.140	249.4	72.8	
480V MCC 38-4	0.480	0.477	-1.8	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.7	85.5	
480V MCC 38-7	0.480	0.477	-1.8	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.077	0.032	100.4	92.3	
								480V MCC 38-3	0.150	0.141	249.4	72.8	
								480V MCC 38-2	0.209	0.159	317.6	79.6	
								HIGH SIDE OF XFMR 38	-0.436	-0.332	662.7	79.5	
BKR 38-4A BIFURC	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-4	0.005	0.003	6.7	85.5	
								480V SWGR 38	-0.077	-0.032	100.4	92.3	
								480V MCC 38-1	0.072	0.029	93.7	92.7	
HIGH SIDE OF XFMR 38	4.160	4.155	0.0	0	0	0	0	4KV SWGR 33-1	-0.438	-0.356	78.4	77.6	
								480V SWGR 38	0.438	0.356	78.4	77.6	-2.500

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is 10 min or greater into the event, 1 CCSW pump.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	% Tap
4KV SWGR 33	4.160	4.152	-0.1	0	0	0.477	0.212	4KV SWGR 33-1	-0.477	-0.212	72.6	91.4	
4KV SWGR 33-1	4.160	4.154	-0.1	0	0	1.720	0.788	HIGH SIDE OF XFMR 38	0.438	0.356	78.5	77.6	
								4KV SWING BUS 40	-2.636	-1.356	412.0	88.9	
								4KV SWGR 33	0.477	0.213	72.6	91.3	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.638	1.361	0	0	4KV SWGR 33-1	2.638	1.361	412.0	88.9	
38-1 ALTF 2-1301-1&4	0.480	0.475	-1.8	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.463	-1.9	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 3	0.480	0.463	-1.9	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.5	
480V MCC 38-1	0.480	0.475	-1.8	0	0	0.072	0.029	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.072	-0.029	94.2	92.7	
480V MCC 38-2	0.480	0.467	-2.2	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.8	
								125V DC CHGR 3A	0.034	0.028	55.0	77.6	
								480V SWGR 38	-0.205	-0.154	317.6	80.0	
480V MCC 38-3	0.480	0.472	-1.8	0	0	0.148	0.140	480V SWGR 38	-0.148	-0.140	249.4	72.8	
480V MCC 38-4	0.480	0.477	-1.8	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.7	85.5	
480V MCC 38-7	0.480	0.477	-1.8	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.077	0.032	100.8	92.2	
								480V MCC 38-3	0.150	0.141	249.4	72.8	
								480V MCC 38-2	0.209	0.159	317.6	79.6	
								HIGH SIDE OF XFMR 38	-0.436	-0.333	663.3	79.5	
BKR 38-4A BIFURC	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-4	0.005	0.003	6.7	85.5	
								480V SWGR 38	-0.077	-0.032	100.8	92.2	
								480V MCC 38-1	0.072	0.029	94.2	92.6	
HIGH SIDE OF XFMR 38	4.160	4.154	-0.1	0	0	0	0	4KV SWGR 33-1	-0.438	-0.356	78.5	77.6	
								480V SWGR 38	0.438	0.356	78.5	77.6	-2.500

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\# Indicates a bus with a load mismatch of more than 0.1 MVA

Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is 10 min or greater into the event, 2 CCSW pumps.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33	4.160	4.151	-0.1	0	0	0.771	0.395	4KV SWGR 33-1	-0.771	-0.395	120.5	89.0	
4KV SWGR 33-1	4.160	4.155	0.0	0	0	1.211	0.541	HIGH SIDE OF XFMR 38	0.450	0.364	80.4	77.7	
								4KV SWING BUS 40	-2.433	-1.301	383.4	88.2	
								4KV SWGR 33	0.772	0.396	120.5	89.0	
* 4KV SWING BUS 40	4.160	4.160	0.0	2.435	1.305	0	0	4KV SWGR 33-1	2.435	1.305	383.4	88.1	
38-1 ALTF 2-1301-1&4	0.480	0.474	-1.8	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.463	-1.9	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.3	
250V DC CHGR 3	0.480	0.463	-2.0	0	0	0.066	0.054	480V MCC 38-2	-0.066	-0.054	106.2	77.6	
480V MCC 38-1	0.480	0.474	-1.8	0	0	0.072	0.029	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.072	-0.029	94.2	92.6	
480V MCC 38-2	0.480	0.466	-2.2	0	0	0.104	0.072	250V DC CHGR 3	0.067	0.054	106.2	77.8	
								125V DC CHGR 3A	0.034	0.028	55.0	77.6	
								480V SWGR 38	-0.205	-0.154	317.6	80.0	
480V MCC 38-3	0.480	0.471	-1.8	0	0	0.160	0.147	480V SWGR 38	-0.160	-0.147	265.7	73.6	
480V MCC 38-4	0.480	0.477	-1.8	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.7	85.5	
480V MCC 38-7	0.480	0.477	-1.8	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.077	0.032	100.9	92.2	
								480V MCC 38-3	0.161	0.149	265.7	73.6	
								480V MCC 38-2	0.209	0.159	317.6	79.6	
								HIGH SIDE OF XFMR 38	-0.447	-0.340	679.7	79.6	
BKR 38-4A BIFURC	0.480	0.477	-1.8	0	0	0	0	480V MCC 38-4	0.005	0.003	6.7	85.5	
								480V SWGR 38	-0.077	-0.032	100.9	92.2	
								480V MCC 38-1	0.072	0.029	94.2	92.6	
HIGH SIDE OF XFMR 38	4.160	4.154	0.0	0	0	0	0	4KV SWGR 33-1	-0.450	-0.364	80.4	77.7	
								480V SWGR 38	0.450	0.364	80.4	77.7	-2.500

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Converted from ELMS PLUS

Diesel Generator connected using nominal voltage, Time period is 10 min or greater into the event, 2 CCSW pumps.

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
4KV SWGR 33	4.160	4.151	-0.1	0	0	0.771	0.395	4KV SWGR 33-1	-0.771	-0.395	120.5	89.0	
4KV SWGR 33-1	4.160	4.155	0.0	0	0	1.211	0.541	HIGH SIDE OF XFMR 38	0.533	0.424	94.7	78.2	
								4KV SWING BUS 40	-2.516	-1.362	397.5	87.9	
								4KV SWGR 33	0.772	0.396	120.5	89.0	
*4KV SWING BUS 40	4.160	4.160	0.0	2.518	1.365	0	0	4KV SWGR 33-1	2.518	1.365	397.5	87.9	
38-1 ALTF 2-1301-1&4	0.480	0.472	-2.2	0	0	0	0	480V MCC 38-1	0.000	0.000	0.0	0.0	
125V DC CHGR 3A	0.480	0.460	-2.3	0	0	0.034	0.028	480V MCC 38-2	-0.034	-0.028	55.0	77.7	
250V DC CHGR 3	0.480	0.460	-2.3	0	0	0.066	0.053	480V MCC 38-2	-0.066	-0.053	106.3	77.9	
480V MCC 38-1	0.480	0.472	-2.2	0	0	0.071	0.029	38-1 ALTF 2-1301-1&4	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	-0.071	-0.029	94.3	92.6	
480V MCC 38-2	0.480	0.464	-2.6	0	0	0.103	0.071	250V DC CHGR 3	0.067	0.053	106.3	78.2	
								125V DC CHGR 3A	0.034	0.028	55.0	78.0	
								480V SWGR 38	-0.205	-0.152	317.4	80.2	
480V MCC 38-3	0.480	0.466	-2.2	0	0	0.241	0.197	480V SWGR 38	-0.241	-0.197	385.1	77.4	
480V MCC 38-4	0.480	0.474	-2.2	0	0	0.005	0.003	BKR 38-4A BIFURC	-0.005	-0.003	6.8	85.5	
480V MCC 38-7	0.480	0.474	-2.2	0	0	0	0	480V SWGR 38	0.000	0.000	0.0	0.0	
								480V MCC 39-7	0.000	0.000	0.0	0.0	
480V MCC 39-7	0.480	0.474	-2.2	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
480V SWGR 38	0.480	0.474	-2.2	0	0	0	0	480V MCC 38-7	0.000	0.000	0.0	0.0	
								BKR 38-4A BIFURC	0.076	0.032	101.0	92.2	
								480V MCC 38-3	0.245	0.201	385.1	77.3	
								480V MCC 38-2	0.208	0.157	317.4	79.8	
								HIGH SIDE OF XFMR 38	-0.529	-0.390	800.1	80.5	
BKR 38-4A BIFURC	0.480	0.474	-2.2	0	0	0	0	480V MCC 38-4	0.005	0.003	6.8	85.5	
								480V SWGR 38	-0.076	-0.032	101.0	92.2	
								480V MCC 38-1	0.072	0.029	94.3	92.6	
HIGH SIDE OF XFMR 38	4.160	4.154	0.0	0	0	0	0	4KV SWGR 33-1	-0.533	-0.424	94.7	78.2	
								480V SWGR 38	0.533	0.424	94.7	78.2	-2.500

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