CC-AA-309-1001 Revision 1

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

Kovach

Page 1.0-0

Design Analysi	s (Major Revis	sion)		Last Page No.	14.0-7 and R105	
Analysis No.:	9389-46-19-	2	Revision: 003	۲۰ پیرونیستان و میشوند به میشوند به میشوند با با با میشوند این میشوند این میشوند این میشوند و با این		
Title:	Calculation F	or Diesel Generator	2 Loading Under Desig	n Bases Accident	Condition	
EC/ECR No .:	EC 364066		Revision: 000			
Station(s):		Dresden		Components(s		
Unit No.:		2	Various			
Discipline:		E			······································	
Description Co	de/Keyword:	E15				
Safety/QA Class	5:	SR				
System Code:		66				
Structure:		N/A				
		CONTROLLED D	OCUMENT REFEREN	CES		
Document No.		From/To	Document No.		From/To	
See Section XIV		From				
		·				
			1			
Is this Design A	nalysis Safeg	uards Information?	Yes 🗌	No 🖄 If yes, :	see SY-AA-101-106	
Does this Desig	n Analysis Co	ontain Unverified As	sumptions? Yes	No 🛛 If yes, J	ATI/AR#	
This Design An	alysis SUPER	SEDES: N/A	· · · ·	in its er	ntirety	
Description of F	Revision (list a	ffected pages for part	ials):			
See Page 1.0-4 f	or a description	n of this revision and a	a list of affected pages.			
	,					
Branessa Soo	tt Chanhard		dolAll		4/4/107	
Print	Name		Sidn Nama			
Method of Revie	w Detailed	Review 🕅 🛛 Alte	rnate Calculations (at	tached)	sting 1	
Reviewer Glei	nn McCarthy		I Dall		1.11.2000	
Print	Name		Sign Name	<u> </u>	Date	
Review Notes:	Independent I	Review 🛛 👘 P	eer Review			
(For External Analyses Only)	(For External Analyses Only)					
External Approv	er Richau	of H. Low	Richard	How	4-4-7007	
• •	Print Name	K MARTIN CONTRACTOR	Sign Name	, 1	Date	
Evolon Postore	TC	Kannal	AAV.	and	alloulon	
EXCION REVIEWE	Print Name	Novach	Sign Name	var	Date	
Independent 3 rd	Party Review	Required? Ye	s Not	If yes, complete A	ttachment 3	
-	1 aux 1	MALLAISION		la e ,	nalog lat	
Exelon Reviewer	Drink Marrie	WLLX VIERIA	- famile	mape)		
	rint Name		Sign Name		Date	

A	Calculation For Diesel (Generator 2 Loading Under	Calc. No. 9389-46-19-
Sargent & Lundy	Design Bases Ac	cident Condition	Rev. 1 Date 10/17/9
ORIGINAL	X Safety-Related	Non-Safety-Related	Page 1.0 - 1
Client ComEd	ور ایک بر بر این بر ایک ایک ایک ایک ور ای ایک ور ایک ور	Prepared by Tagen 2	- fan Dete Ichilig
Project Dresden Station Uni	t 2	Reviewed by	Jane V Date 10/11
Proj. No. 9389-46	Equip. No.	Approved by	Date 10/17/
NOTE: FOR THE PURPO	DSE OF MICROFILMING	B THE PROJ. NO. FOR THE E	ENTIRE CALC. IS <u>"9389-4</u>
I. <u>REVISION SUN</u>	IMARY AND REVIEW	METHOD	
A. <u>Revision 0</u>			
Revision 0,	Initial issue, all pages.		
This calcula Basis Accid between Ca	tion supersedes the Cal ent Condition, Calculati Iculation 7317-33-19-2 a	culation for Diesel-Generator on Number 7317-33-19-2. Th and this calculation are as follo	Loading Under Design ne major differences ws:
1) Dres that break revis close close with	den Diesel Generator (Diesel Generator (Diesel Generator (Diese first LPCI pump star ker. This is due to the union shows that the 480 so to the bus and the first re of the DG output bre Loss Of Coolant Accide	DG) surveillance test strip char ts about 4 seconds after the c nder voltage (UV) relay disk re / auxiliaries start as soon as th st LPCI pump starts approxima aker during Loss Of Offsite Po nt (LOCA).	ts (Reference 23) show losure of the DG output esetting time. This ne DG output breaker ately 4 seconds after the ower (LOOP) concurrent
2) Crea ELM throu PLUS the ru	ted new ELMS-AC PLU S modified file D2A4.M2 gh 14 of Calculation 73 ⁴ S program in this calcula unning KVA for each st	S files for the DG for Unit 2 ba 4, including all modifications in 17-43-19-1 for Unit 2. Utilization ation is to maintain the loading ep.	ased on the latest base included in Revisions 0 on of the ELMS-AC data base and totaling
3) Addit revise Batte horse horse exists	ional loading changes w ed lighting loads, and Df ry Chargers. For non-o power was taken as rat power for pumps, unles	rere made due to DITs DR-EP R-EAD-0001-00, which revised perating loads in base ELMS-/ ed horsepower for valves and s specific running horsepower	ED-0861-00, which the model for UPS and AC file, running 90% of rated data for the load
4) Creat	ed Table 4 for Unit 2 for	totaling 480V loads starting K	W/KVAR for

	Cal	culation For Diesel G	Calc. No. 9389-46-19-2		
Sargent & Lundy…	Design Bases Accident Condition			Rev. Date	
	X	Safety-Related	Non-Safety-Related	Page 1.0-2	

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

I. Revision Summary and Review Method (Cont)

Revision 1

In this revision, the following pages were revised:

1.0-1, 1.0-2, 2.0-1, 2.0-2, 2.0-3, 4.0-7, 10.0-1 through 10.0-8, 11.0-1, 13.0-1, 14.0-1, 14.0-5, 14.0-7, A1 through A10, B4 through B13, C1 through C7, D2, E1, E2, Attachment F (ELMS-AC Reports), I2;

Note: all text pages are being re-issued to correct various typographical errors throughout the text. Revision bars were not used to denote changes made for typographical corrections only.

the following pages were added:

1.0-3, 2.0-4, Section 10.1 (10.1-0 through 10.1-26), Section 15.0 (15.0 through 15.34)

the following pages were deleted:

10.0-9 through 10.0-24, B14-B15.

This revision incorporates load parameter changes determined in Revision 18 of Calculation 7317-43-19-1 (Ref. 26) 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 update can be made easily and accurately with the file comparison program ELMSCOMP. In addition to the load/file changes, the calculation portion of the text 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 Reference 26.

REVISION 003

PAGE NO. 1.0-3 || R3

Revision Summary and Review Method (cont'd)

Revision 2

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 have been incorporated. The parameters for valve 2-1501-22B were also revised in the ETAP model to reflect the latest installed motor. Section 10 calculations previously performed using MathCad were replaced with MS Excel spreadsheets.

In this revision the following pages were revised:

2.0-4, A3, A8, E1, H1, H2, R16-R19, R91

In this revision the following pages were replaced:

1.0-3, 2.0-1, 2.0-2, 3.0-1, 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 – 9.0-6, 10.0-1 – 10.0-8, 10.1-0 – 10.1-26, 11.0-1, 14.0-1, 14.0-7, C1-C7 replaced by C1-C6, F1-F140 replaced by F1-F118, G0 replace by G1-G63

In this revision the following pages were added:

Design Analysis Cover Sheet (1.0-0), 2.0-5, R92-R100

In this revision the following pages were deleted:

15.0-0 - 15.0-34, Attachment I

CALC NO.	9389-46-19-2	REVISION	003	PAGE NO.	1.0-4(2)
					•

Revision Summary and Review Method (cont'd)

Revision 3

This revision incorporates various changes to the EDG loading. Major changes include CS, LPCI and CCSW BHP values. Other changes include a reduction in the ESS UPS loading, removal of the 120/208V Xfmr Mag Tape Drive, decreasing the LOCA bhp value for the RPS MG Set, incorporating replacement of the DG cooling water pump and turning off the HPCI Aux Coolant 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 65 to 70, 72, 73, 77 and 78.

R3

In this revision the following pages were revised:

A5, A7, B8, B10, E1, R100

In this revision the following pages were replaced:

1.0-0, 1.0-3, 2.0-1, 2.0-2, 2.0-5, 3.0-1, 3.0-2, 4.0-7, 5.0-1, 7.0-1, 9.0-2, 9.0-3, 9.0-5, 10.0-1, **1**0-8, 10.1-1, 10.1-3, 10.1-4, 10.1-10, 10.1-11, 10.1-17, 10.1-18, 10.1-24, 10.1-25, 11.0-1, 12.0-1, 14.0-1, 14.0-7, C1, C3, Attachments F and G

In this revision the following pages were added:

1.0-4, 4.0-8, R101-R105

CALCULATION TABLE OF CONTENTS

		SECTION	PAGE NO.:	SUB PAGE NO.:
11	TAB	LE OF CONTENTS / FILE DESCRIPTION		
	I.	COVER SHEET / REVISION SUMMARY & REVIEW METHOD	1.0-0 - 1.0-4	
	II.	TABLE OF CONTENTS / FILE DESCRIPTION	2.0-1 - 2.0-5	
	111.	PURPOSE/SCOPE	3.0-1 - 3.0-2	
	IV.	INPUT DATA	4.0-1 - 4.0-8	
	V.	ASSUMPTIONS	5.0-1	
	VI.	ENGINEERING JUDGEMENTS	6.0-1	
	VII.	ACCEPTANCE CRITERIA	7.0-1	
	VIII.	LOAD SEQUENCING OPERATION	8.0-1 - 8.0-7	
	IX.	METHODOLOGY	9.0-1 - 9.0-7	
	Х.	CALCULATIONS AND RESULTS	10.0-1 - 10.0-8 10.1-0 - 10.1-26	
	XI.	COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA	11.0-1 - 11.0-2	
	XII.	CONCLUSIONS	12.0-1	
	XIII.	RECOMMENDATIONS	13.0-1	
	XIV.	REFERENCES	14.0-1 - 14.0-7	
	•			

R3

CALCULATION TABLE OF CONTENTS (Continued)

CALC NO.: 9389-46-19-2 REV NO: 003 PAGE NO. 2.0-2				
	SECTION	PAGE NO.:	SUB PAGE NO.:	
Attachments	Description			
A	Table 1 – Automatically Turn ON and OFF Devices Under the Design Basis Accident Condition when DG2 is powering the Unit 2 Division II loads.	A1-A10		
В	Table 2 – The Affects of AC Voltage Dip on control circuits of Dresden Unit 2, Division II when large motor starts.	B1-B13		•
с	Table 4 – Starting KW and KVAR for all 480V Loads at each Step when DG 2 is powering Unit 2, Division II.	C1-C6		1
D	Figure 1 – Single Line Diagram when DG 2 Powers SWGR 24-1	D1-D2		H
E	Figure 2 – Time vs. Load Graph when DG 2 Powers SWGR 24-1	E1-E2		-
F	DG Unit 2 Division II ETAP Output Reports – Nominal Voltage	F1-F116		F
G	DG Unit 2 Division II ETAP Output Reports – Reduced Voltage	G1-G62		R
н	Flow Chart 1 – Method of Determining Shed and Automatically Started Loads	H1-H2		
J	Unit 2 ELMS-AC Plus Data Forms	J1-J10		
R	Reference Pages	R1-R105		R
Note: Table 3 h reserved for po	as not been created for this calculation. However, it is suble future use.			
			·	

		Calculation For Diesel Generator 2 Loading Under			Calc. No	Calc. No. 9389-46-19-2	
	Sargent & Lundy	gent S Lundy Design Bases Accident Condition		Design Bases Accident Condition			
$\left(\left(\right) \right)$		x	Safety-Related	Page 2.	0-3]]er	
1. Sec. 1.	·······						יר די

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Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

File Descriptions

Revision 0

File Name	Date	Time	File Description
D2A4DG2.G00	1/6/95	11:28:36a	General File - Original Issue
D2A4DG2R.G00	1/6/95	11:56:16a	General File - Original Issue - Reduced Voltage
D2A4DG2.100	1/6/95	10:51:24a	Initial File - Original Issue
D2A4DG2R.100	1/6/95	11:18:14a	Initial File - Original Issue - Reduced Voltage
D2TB1DG2.00	1/6/95	9:56:48a	Table 1 - Excel File
D2TB2DG2.00	1/6/95	10:31:24a	Table 2 - Excel File
D2TB4DG2.00	1/6/95	10:01:44a	Table 4 - Excel File
LDGRFDG2.00	1/6/95	10:40:12	Time vs. Load Graph
DRESDG2.00	12/19/94	6:34:02p	Flow Chart 1
DRESDG2.WP	1/6/95	7:41:08p	Calculation Text - Wordperfect



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Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

File Descriptions (cont)

Revision 1

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File Name	Date	Time	File Description
D2A4DG2.G01	9/23/96	2:04p	General File - Data upgrade, see Revision Summary for details.
D2A4DG2R.G01	9/23/96	2:10p	General File - Reduced Voltage, see Revision Summary for details.
D2A4DG2.I01	10/11/96	10:01a ,	Initial File - Data upgrade, see Revision Summary for details.
D2A4DG2R.I01	10/11/96	10:08a	Initial File - Reduced Voltage, see Revision Summary for details.
D2EXCEL.XLS	10/11/96	1:26p	Excel Workbook for Tables 1, 2, 4, and the Time vs. Load Graph. This file replaces files D2TB1DG2.00, D2TB2DG2.00, D2TB4DG2.00, and LDGRFDG2.00
DG2MCAD.MCD	10/11/96	11:29a	Mathcad file for Section 10.1
DG2SLINE.PPT	10/11/96	1:39p	Single line - Attach E (Powerpoint)
DRESDG2.00	12/19/94	6:34p	Flow Chart 1 (ABC Flowcharter)
DRESDG2.WP	10/11/96		Calculation Text - Wordperfect

CALC NO. 938

9389-46-19-2

REVISION 003

PAGE NO. 2.0-5(f...)

R3

File Descriptions (cont'd)

Revision 2

File Name	Size	Date	Time	File Description
9389-46-19-2 Rev. 2.doc	504320 bytes	8/9/06	7:52:35am	Text document
9389-46-19-2 Rev. 2 (section 10).xls	532480 bytes	[·] 7/31/06	2:13:14pm	Section 10.1
9389-46-19-2 Rev. 2 (table 4).xis	53248 bytes	4/21/06	9:05:56am	Table 4
DRE_Unit2_0003.mdb	1,7977,344 bytes	8/01/06	1:22:49pm	ETAP database
DRE_Unit2_0003.macros.xml	10595 bytes	8/01/06	10:17:20am	ETAP macros
DRE_Unit2_0003.scenarios.xml	11572 bytes	7/31/06	10:20:30am	ETAP Scenarios
DRE_Unit2_0003.oti	9728 bytes	8/01/06	1:22:48pm	ETAP "OTI" file

Revision 3

File Name	Size	Date	Time	File Description
9389-46-19-2 Rev. 3.doc	SII 48+ byTes	3/22/47	11: 59:0700	Text document
9389-46-19-2 Rev. 3 (section 10).xls	522752 bytes	3/2/07	7:25:52am	Section 10.1
9389-46-19-2 Rev. 3 (table 4) xls	55248 bytes	3/9/07	7:48:15am	Table 4
DRE_Unit2_0004.mdb	18,911,232 bytes	3/20/07	11:34:56pm	ETAP database
DRE_Unit2_0004.macros.xml	11206 bytes	3/20/07	9:46:37pm	ETAP macros
DRE_Unit2_0004.scenarios.xml	12862 bytes	2/12/07	3:49:12pm	ETAP Scenarios
DRE_Unit2_0004.oti	15206 bytes	3/21/07	9:37:49pm	ETAP "OTI" file

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CALC NO.		9389-	46-19-2	. <u></u>	PAGE NO.	3.0-1		
	PUR	POSE/SC	COPE					
	A.	Purp	lose			•		
		The p capa Calcu	purpose of this calculatio city to support the require ulation Results section.	n is to ensur ed loading du	e that the Dreso uring the maxim	den Diesel Gen num loading pro	erator has sufficient file as determined in	the
		The p	purpose of this calculatio	n includes th	e following:			
		1)	Determine automatica electrical load when th	lly actuated o e DG is powe	levices and the ering the safety	ir starting KVA related buses.	at each step for the a	с
		2)	Develop a Time versus related buses.	Load profile	e for the DG wh	en the DG is po	owering the safety	
		3)	Compare the maximur the DG at each step.	n loading in I	ETAP for the D	G load profile a	gainst the capacity of	
		4)	Determine the starting for initial loading and e	voltage dip a ach 4000V n	and one second notor starting st	l recovery volta ep.	ge at the DG terminal	s
:		5)	Evaluate the control ci	cuits during	the starting trar	nsient voltage d	ip.	
		6)	Evaluate the protective dropout during the star	device resp ting transient	onses to ensur t voltage dip.	e they do not in	advertently actuate or	
		7)	Evaluate the travel time starting transient voltage	e of MOVs to je dips:	ensure they ar	e not unaccept	ably lengthened by the	Ð
		8)	Determine the starting	duration of th	ne automaticall	/ starting 4kV p	ump motors.	
		9)	Ensure the loading on the machine increase to its	he EDG is w maximum a	ithin the 2000h Ilowable value.	r rating should t	the frequency on the	83
		10)	Determine the minimur	n power facto	or for the long t	erm loading on	the EDG.	
	В.	Scope	e					
		The se seque degrae minim DG de succes	cope of this calculation is ential load (with or withou ding the safe operating li oum voltage recovery after ead load pickup character ssfully start the motors a	i limited to de t the presence mits of the D or 1 second for ristics and co nd continue of	etermining the operation of all operation of all operation of all operation of all	apability of the us running load ed equipment & equential start v minimum recov services.	DG to start the as applicable), withou services. The will be taken from the ery required to	Jt
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CALC NO. 9389-46-19-2

REVISION 003

PAGE NO. 3.0-2(f...)

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 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 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.

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.

CALCULATION PAGE								
CALC NO.		9389-46-19-2	REVISION	002	PAGE NO. 4.0-1			
IV	INPL	JT DATA						
	The	input data extracte	ed from the references is summarized below	v:				
	А.	Abbreviation	S					
		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					
		Emerg	Emergency		1			

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		Calculation	For Diesel G	Calc. No. 9389-46-19-2			
Æ	Sargent & Lundy"	Desi	gn Bases Acc	id	ent Condition	Rev. /	Date
		X Safety	-Related		Non-Safety-Related	Page 4	0-2
	Client ComEd				Prepared by		Date
	Project Dresden Station Uni	t 2			Reviewed by		Date
	Proj. No. 9389-46	Equip. No.			Approved by		Date
	input Data (cor	nt'd):					
	ECCS	-	Emerge	en	cy Core Cooling System		
	FSAR		Final S	af	ety Analysis System		
	gpm	-	Gallons	F	Per Minute		
	GE	-	Genera	I E	Electric		
	Gen	-	Genera	to	r .		
	Hndlg	-	Handlin	g			
	HPCI	-	High Pr	es	sure Coolant Injection		
	HVAC	•	Heating	i V	entilation & Air Conditioning		
	Inbd		Inboard				
ļ	Inst	•	Instrum	en	t		
	Isoln	-	Isolation	ſ			
	LOCA	-	Loss Of	f C	colant Accident		
	LOOP	-	Loss Of	Ċ	offsite Power		
	LPCI		Low Pre	.	sure Coolant Injection		
	LRC	-	Locked	Ro	otor Current		
	Mon	-	Monitori	ng) · · ·		
	MCC	-	Motor C	on	trol Center		
	M-G	•	Motor G	en	erator		
	MOV	-	Motor O	pe	rated Valve		

	Calculation For Diesel Generator 2 Loading Under				Calc. No. 9389-46-19-2		
Sargent & Lundy			Design Bases Ac		Rev.	Date	
		х	Safety-Related	Non-Safety-Related		Page 4	1.0-3

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

	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
	ТВ		Turbine Building
	Turb	•	Turbine
·	UPS	-	Uninterruptible Power Supply
	Viv	-	Valve
	Wtr	-	Water
	Xfmr		Transformer

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	Calculation For Diesel Generator 2 Loading Under					Calc. No. 9389-46-19-2		
	Sargent & Lundy	Design Bases Accident Condition					Rev. 1	Date
(\mathbb{C})		x	Safety-Related		Non-Safety-Related]	Page (4.0-4

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

Input Data (cont'd):

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

Manufacturer	Electro - Motive Division (GM)
Model	A - 20 -C1
Serial No.	67 - K1 - 1008
Volts	2400 / 4160 v
Currents	782 / 452 Amps
Phase	3
Power Factor	0.8
RPM	900
Frequency	60
KVA	3125
Temperature Rise	85⁰C Stator - Therm 60ºC Rotor - Res
KVA Peak Rating	3575 KVA For 2000 HR / YR
Temperature Rise	105ºC Stator - Therm 70ºC 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.	1157

Á		Calculation For Diesel Generator 2 Loading Under				Calc. No. 9389-46-19-2		
Sargent & Lundy"	Design Bases Accident Condition				Rev. I	Date		
See Marine and	х	Safety-Related	Non-Safety-Related		Page 4	.0-5		

Client ComEd			Prepared by	Date
Project Dresden Station	Unit 2		Reviewed by	Date
Proj. No. 9389-46	Equip. No.]	Approved by	Date

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 1: Automatically ON and OFF devices during LOOP Concurrent with LOCA when the DG 2 is powering the Unit 2 Division II loads (Attachment A)
- H. Table 2: Affects of Voltage Dip on the Control Circuits during the Start of Each Large Motor when DG 2 is powering Unit 2, Division II loads (Attachment B).
- I. Table 4: KW/KVAR/ KVA loading tables for total and individual starting load at each step when DG 2 is powering Unit 2, Division II loads (Attachment C).
- J. Dresden DG 2 Calculation 7317-33-19-2, Revision 18 (superseded by this calculation).
- K. Quad Cities DG 1 Calculation 7318-33-19-1, Revision 0.
- L. Dresden Units 2 & 3, Equipment Manual from GE, Number GEK-786.
- M. Dresden Re-baselined Upated FSAR, Revision 0.

		CALCULATION PAG	E	
CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 4.0-6
Input D	<u>ata</u> (cont'd)			
N.	Guidelines for Estimating Data Byron & Braidwood), which is u	(Used by Electrical Analytical ised for determining %PF and	Division in Va I efficiency (At	arious Projects like Clinton, ttached).
Ο.	ANSI / IEEE C37.010-1979 for Motor	Determining X/R Range for P	ower Transfor	rmers, and 3-phase Induction
Ρ.	Dresden Re-baselined Updated offsite ac power (Reference 31	f FSAR Figure 8.3-4 DG loadi)	ng under acci	dent and during loss of
Q.	Dresden Appendix R Table 3.1	-1, DG loading for safe shutdo	wn (Referenc	:e 32)
R.	Flow Chart No. 1, showing the powering the safety buses during the safety buse	source of data and establishin ng LOOP concurrent with LOC	g which load i CA (Attachmer	is ON when the DG is nt H)
S.	ETAP Loadflow summary for co step to DG capacity for Unit 2 (omparing loading and calculat Attachments F & G).	ed KVA input	of running loads at each
Т.	S&L Standard ESA-102, Revisit Electrical Cables (Reference 11	on 04-14-93 - Electrical and P	hysical Chara	cteristics of Class B
U.	S&L Standard ESC-165, Revision 41)	on 11-03-92 - Power Plant Au	xiliary Power	System Design (Reference
V.	S&L Standard ESI-167, Revisio	n 4-16-84, Instruction for Con	nputer Program	ms (Reference 1)
W .	S&L Standard ESC-193, Revisio (Reference 39)	on 9-2-86, Page 5 for Determi	ning Motor St	arting Power Factor
X . •	S&L Standard ESA-104a, Revis 10)	ion 1-5-87, Current carrying C	apabilities of	copper Cables (Reference
Υ.	S&L Standard ESC-307, Revisio 21)	on 1-2-64, for checking voltage	e drop in starti	ing AC motors (Reference
Ζ.	S&L Standard ESI-253, Revision approval of electrical design cale	n 12-6-91 Electrical Departme culation (Reference 20)	nt instruction 1	for preparation, review, and
				·

CA	LC NO.	9389-46-19-2	REVISION	003	PAGE NO. 4.0-7	
	Input Da	<u>ata</u> (cont'd)				
	AA.	Unit 2 ETAP file from Calculation I for latest ETAP file.	DRE05-0038, Rev. 000 an	d 000A (Re	eference 60). See Section 2.0	
	AB.	125Vdc and 250Vdc Battery Charc ETAP (Reference 54)	ger, and 250Vdc UPS Mod	leis from C	alculation 9189-18-19-2 used in	
	AC.	Single Line diagram showing the b during LOOP concurrent with LOC	reaker position when the I A (Attachment D)	DG output	breaker closes to 4-kV Bus 24-1	
	AD.	Walkdown data for CCSW Pumps	(Ref 35) (Attachment R)			
	AE.	GE Drawing 992C510AB, Dresden	Core Spray Pump Motor	(Attached)		
	AF.	GE Drawing 992C510, Dresden LF	PCI Pump Motor (Attached	I)		
	AG.	IEEE Standard 399-1980, Chapter some running load is already prese	8, for determining motor s ent	starting voll	age drop at the source when	
ć	AH.	Western Engine letter dated 1/19/9 Dresden and Quad Cities (Attached	97 to Mr. Wayne Hoan ider d)	ntifying the	voltage dip curve applicable to	
	AI.	Strip Chart (1) for Diesel Generator	r Surveillance Test: Dated	April 19, 1	983	
	AJ.	DIT DR-EPED-0861-00 (Attached)				
	AK.	CIS-2: Tabulation for cable lengths				
	AL.	Letter dated November 14, 1994 re Dresden and Quad Cities" written b	garding NTS 925-201-94- by E. P. Ricohermoso	PIF-01102	"CREFS Heating Coil -	
	AM.	DOP 0202-01, Revision 13; Unit 2 I	Reactor Recirculation Syst	tem Startup	o	
	AN.	Calculation for Evaluation of 3HP, 4 Calculation Number 9215-99-19-1,	160V CCSW Motor Minimu Revision 1	um Voltage	Starting Requirements;	
	AO.	Hand calculation to determine LRC	for CCSW Pumps 2A, 2B	, 2C and 2	D	
	AP.	Calculation for Single Line Impedan	ice Diagrams for ELMS-A	C; Calculat	ion 7317-38-19-1, Revision 1	
	AQ.	The maximum allowable time to sta 61)	rt each LPCI Pump and C	ore Spray i	Pump is 5 Seconds (Reference	
		· · ·				

CALC NO.	9389-46-19-2	REVISION	003	PAGE NO.	4.0-8(f.~1)
AR.	The BHP values for the provided below (Ref. 65	CS, LPCI and CCSW pumps after , 66, 67).	er 10 minute	s into a LOCA ever	nt are
	Core Spray Pump 2B	883.2 hp (879.6 hp after 2 hrs)			
	LPCI Pump 2C	639.7 hp (637.2 hp after 2 hrs)			
	LPCI Pump 2D	619.1 hp (616.6 hp after 2 hrs)	•		
	CCSW Pump 2C	575.0 hp with 1 pump running,	465 hp with	both pumps runnir	ng
	CCSW Pump 2D	575.0 hp with 1 pump running,	465 hp with	n both pumps runnir	ng
AS.	The 2 EDG Cooling Wa efficiency, LRC and star	ter Pump has a BHP of 66.28kW ting power factor are 100%, 400%	with a powe 6 and 31.5%	er factor of 83.0. The factor of 83.0.	ne 68 & 69)
AT.	The RPS MG Sets have based on a 5% toleranc	a BHP of 3.9kW when unloaded e in the data acquisition equipmen	with a powe nt (Ref. 70)	er factor of 12.2%.	This is
AU.	The HPCI Aux Coolant I	Pump is manually controlled and r	not operated	during a LOCA (R	ef. 71)
AV.	Dresden Technical Spece EDG frequency (Ref. 74	cification Section 3.8.1.16 allows a)	a +2% tolera	ance on the nomina	1 60HZ
AW.	The continuous rating of	the EDG is 2600kW at a 0.8 pf (I	Ref. 75)		
AX.	For centrifugal pumps, the	ne break horsepower varies as the	e cube of th	e speed (Ref. 76)	
AY.	The UPS load is 37.5kW	at the 480V input (Ref. 77)			
AZ.	The Turbine & Radwaste	Bldg Emergency Lighting Load i	s 27kW (Re	ıf. 78)	
					~

<u>ASSL</u> 1) 2) 3)	JMPTIONS MCC control transformers (app of their rating as actual load an The Diesel Fuel Oil Transfer Pu available on the MCC bus, but which is normally full prior to Do Individual load on buses downs	proximately 150VA – 200V d can be neglected. ump is shown in this calcu this is not the actual case G starting. This is conserv	A each) general lation as operati as the pump res	ly have only a small p ng as soon as voltag	portion
1) 2) 3)	MCC control transformers (app of their rating as actual load an The Diesel Fuel Oil Transfer Pu available on the MCC bus, but which is normally full prior to Do	proximately 150VA – 200V d can be neglected. ump is shown in this calcu this is not the actual case G starting. This is conserv	A each) general lation as operati as the pump res	ly have only a small p ng as soon as voltag	portion
2) 3)	The Diesel Fuel Oil Transfer Po available on the MCC bus, but which is normally full prior to Do Individual load on buses downs	ump is shown in this calcu this is not the actual case G starting. This is conserv	lation as operati as the pump res	ng as soon as voltag	e is
3)	Individual load on buses downs		vative and comp	ponds to low day tan ensates for Assumpt	k level ion 1.
	determine transformer loading. the distribution transformer or a which is conservative.	stream of 480/120V transfo This transformer load on an equivalent three-phase	ormer have not t the 480V bus is loading for singl	been discretely analyze assumed to be the r e phase transformers	zed to ating of 3,
4)	When Locked Rotor Currents a is from S&L Standard ESC-165	are not available, it is consi i and is reasonable and co	dered 6.25 time nservative.	s the full load current	. This
5)	For large motors (>250HP), the large HP motors and does not r	e starting power factor is co require verification.	onsidered to be	20%. This is typical f	or
6)	The line break is in Loop "A" an	nd Loop "B" is selected for	injection.		
7)	The load on the diesel generator is 2% above its nominal value. horsepower of these pumps var corresponds to a 6% increase in different point on the performan Therefore, this assumption is co	or is assumed to increase I A majority of the load con- ries as the cube of the spe n load (1.02 ³) (Ref. 76). N nce curve and the BHP ma ponservative.	by 6% when the sists of large ce ed. Thus, a 2% lote that these p y actually increa	frequency of the man ntrifugal pumps. The increase in speed umps will operate on use less than 6%.	break a
8)	For determining starting time for throughout the evaluation. Althous as is expected, using a constan would be somewhat less if the s motor starting current is consen	r the large motors, the star ough the speed-torque cur it current will simplify the si speed-current characteristi vative and requires no furt	rting current is a ve shows a dec tarting time eval cs were include her verification.	ssumed to be consta rease in current with uation. Motor starting d. This assumption c	nt speed g time of
The at	bove assumptions 1, 2, 3, 4, 5, 6,	7 & 8 do not require verific	ation.		
	4) 5) 6) 7) 3)	 4) When Locked Rotor Currents a is from S&L Standard ESC-165 5) For large motors (>250HP), the large HP motors and does not in large HP motors and does not in 16) The line break is in Loop "A" and the large HP motors and does not in 17) The load on the diesel generate is 2% above its nominal value. Horsepower of these pumps val corresponds to a 6% increase in different point on the performant Therefore, this assumption is called throughout the evaluation. Althe as is expected, using a constant would be somewhat less if the simotor starting current is conservation. The above assumptions 1, 2, 3, 4, 5, 6, 	 4) When Locked Rotor Currents are not available, it is consilis from S&L Standard ESC-165 and is reasonable and consistence of the second se	 When Locked Rotor Currents are not available, it is considered 6.25 time is from S&L Standard ESC-165 and is reasonable and conservative. For large motors (>250HP), the starting power factor is considered to be a large HP motors and does not require verification. The line break is in Loop "A" and Loop "B" is selected for injection. The load on the diesel generator is assumed to increase by 6% when the is 2% above its nominal value. A majority of the load consists of large cert horsepower of these pumps varies as the cube of the speed. Thus, a 2% corresponds to a 6% increase in load (1.02³) (Ref. 76). Note that these p different point on the performance curve and the BHP may actually increas Therefore, this assumption is conservative. For determining starting time for the large motors, the starting current is a throughout the evaluation. Although the speed-torque curve shows a deca as is expected, using a constant current will simplify the starting time eval would be somewhat less if the speed-current characteristics were includer motor starting current is conservative and requires no further verification. 	 When I is conservative. When Locked Rotor Currents are not available, it is considered 6.25 times the full load current is from S&L Standard ESC-165 and is reasonable and conservative. For large motors (>250HP), the starting power factor is considered to be 20%. This is typical f large HP motors and does not require verification. The line break is in Loop "A" and Loop "B" is selected for injection. The load on the diesel generator is assumed to increase by 6% when the frequency of the mat is 2% above its nominal value. A majority of the load consists of large centrifugal pumps. The horsepower of these pumps varies as the cube of the speed. Thus, a 2% increase in speed corresponds to a 6% increase in load (1.02³) (Ref. 76). Note that these pumps will operate on different point on the performance curve and the BHP may actually increase less than 6%. Therefore, this assumption is conservative. For determining starting time for the large motors, the starting current is assumed to be constat throughout the evaluation. Although the speed-torque curve shows a decrease in current with as is expected, using a constant current will simplify the starting time evaluation. Motor starting would be somewhat less if the speed-current characteristics were included. This assumption c motor starting current is conservative and requires no further verification.

<u>í</u>	Cal	culation For Diesel (Generator 2 Loading Under	Calc. No. 9389-46-19	1-2
Sargent & Lundy''		Design Bases Ac	cident Condition	Rev. / Date	
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

VI. ENGINEERING JUDGEMENT

- 1.) Based on engineering judgement an efficiency of 90% is to be used to convert the cumulative 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 2-4kV motors. Also, this result is only to be used for a comparison.
- 2.) 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 first minutes of the event. In small and intermediate line break scenarios, there will be more time between the LOCA event initiation and the low pressure (i.e. AC) ECCS system initiation.
- 3.) It is acknowledged that system parameters (i.e. low level, high pressure, etc.) for different ECCS and PCIS functions have distinctly different setpoints. For the purposes of this calculation, it will be assumed that these setpoints will have been reached prior to the EDG output breaker closure except as otherwise noted. This is conservative as it will result in the greatest amount of coincidental loading at time t=0-and time t=0+.
- 4.) Based on the fact that large motors will cause larger voltage dips when started on the diesel generator, the manually initiated loads starting at t=10+ and after will be assumed to be started in the following order:
 - a) CCSW Pump 2D
 - b) CCSW Pump 2C
 - c) Train B Control Room HVAC

CALCULATION PAGE CALC NO. 9389-46-19-2 REVISION 003 VII ACCEPTANCE CRITERIA The following are used for the acceptance criteria: Continuous loading of the Diesel Generator. 1) 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 003 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 R3 tolerance. If the EDG is at 102% of its nominal frequency, the EDG load is expected to be 1.02³ or 1.06 times larger since a centrifugal pump input BHP varies as the cube of the speed (Ref. 76). EDG Power Factor during Time Sequence Steps DG2 T=10+m, DG2 T=10++m, and DG2 T=CRHVAC must be ≥88% (Ref. 79 and 80) 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.AQ): Service Allowable-Starting Time (sec.) LPCI Pump 2C 5 LPCI Pump 2D 5 5 Core Spray Pump 2B

		Cale	culation For Diesel (Gene	rator 2 Loading Under	Calc. No	. 9389-46-19-2
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

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 2 Containment Cooling Service Water Pumps and associated auxiliaries.

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 24-1, or
- Breaker from Bus 24 to Bus 24-1 opens, or
- Backup undervoltage on Bus 24-1 with a 7 second time delay under LOCA, or
- Backup undervoltage on Bus 24-1 with a 5 minutes time delay without 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) Automatic Load Sequence Operation for LOOP with LOCA When the DG automatically starts and its output breaker closes to Switchgear 24.1, the diesel auxiliaries and certain MOVs start operating, and the UV relay (IAV 69B) starts its reset recovery timing. As soon as UV relay (IAV 69B) completes its reset, the first LPCI pump starts. At the same time, associated valves and equipment with the LPCI pump starts. At the same time, associated valves and equipment with the LPCI pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. 10 seconds after the UV relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. (1) 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 58 and 64): Appropriate loads on Bus 24 will be shed and locked out. 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 Discharger Valve 28 (27:1501-38). Turn off one of the LPCI pumps After the first CCSW Pump is tarted and one of the LPCI pumps is shut off, the operator of Room Standby HVAC. 	.C NO.	9389-46-19-2		REVISION	002	PAGE NO.	8.0-2
 Automatic Load Sequence Operation for LOOP with LOCA When the DG automatically starts and its output breaker closes to Switchgear 24-1, the diesel auxiliaries and certain MOVs start operating, and the UV relay (IAV 69B) starts its reset recovery timing. As soon as UV relay (IAV 69B) completes its reset, the first LPCI pump starts. 5 seconds after UV relay (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 relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. 10 seconds after the UV relay (IAV 69B) reset, the Core Spray pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 28 (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 	LOAD	SEQUENCING O	PERATION (cont'd)				
 When the DG automatically starts and its output breaker closes to Switchgear 24-1, the diesel auxiliaries and certain MOVs start operating, and the UV relay (IAV 69B) starts its reset recovery timing. As soon as UV relay (IAV 69B) completes its reset, the first LPCI pump starts. 5 seconds after UV relay (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 relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 28 (2-1501-38). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		2) Automa	tic Load Sequence O	peration for LOOP w	ith LOCA		
 As soon as UV relay (IAV 69B) completes its reset, the first LPCI pump starts. 5 seconds after UV relay (IAV 69B) reset, the second LPCI pump start operating. 10 seconds after the UV relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the LPCI pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 28 (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• W thusta	hen the DG automati e diesel auxiliaries ar arts its reset recovery	ically starts and its ound certain MOVs start of certain MOVs start of timing.	utput breaker cl t operating, and	oses to Switchgear 24 I the UV relay (IAV 69	4-1. IB)
 5 seconds after UV relay (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 relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 28 (2-1501-38). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• As	s soon as UV relay (I/	AV 69B) completes it	s reset, the first	LPCI pump starts.	
 10 seconds after the UV relay (IAV 69B) reset, the Core Spray pump starts. At the same time, associated valves and equipment with the Core Spray pump start operating. Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 28 (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• 5 : tin	seconds after UV related valves	ay (IAV 69B) reset, th and equipment with	e second LPCI the LPCI pump	pump starts. At the solution start operating.	same
 Automatically activated loads on the DG during LOOP concurrent with LOCA are identified in Table 1. 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 2B (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• 10 sa op	eseconds after the U me time, associated erating.	V relay (IAV 69B) res valves and equipmer	et, the Core Sp nt with the Core	ray pump starts. At t Spray pump start	he
 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 2B (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		Automatically ad Table 1.	ctivated loads on the	DG during LOOP cor	ncurrent with L(DCA are identified in	
 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 64): Appropriate loads on Bus 24 will be shed and locked out. 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 2B (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		3) Manual a	actuation required for	long term cooling			
 Appropriate loads on Bus 24 will be shed and locked out. 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 2B (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		After 10 minutes operator has to	s of continued autom do the following actio	atic operation of the L ns to initiate long terr	PCI Pumps an cooling (see	d Core Spray system References 56 and 64	, the 4):
 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 2B (2-1501-3B). Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• Ap	propriate loads on Bu	us 24 will be shed and	d locked out.		
 Turn off one of the LPCI pumps After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 		• At sta Se	this point the operato irt one of the CC Sen rvice Water Discharg	r can manually close vice Water pumps, ar le Valve 2B (2-1501-3	the breaker to nd also opens t 3B).	the switchgear bus a he CC Heat Exchang	nd er
 After the first CCSW Pump is started and one of the LPCI pumps is shut off, the operator will start the second CCSW Pump. After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC. 	•	• Tu	rn off one of the LPC	l pumps			
After both CCSW Pumps have been started, the operator will proceed to start the Control Room Standby HVAC.	•	• Aft ope	er the first CCSW Pu erator will start the se	mp is started and on cond CCSW Pump.	e of the LPCI p	umps is shut off, the	
		• Aft Co	er both CCSW Pump ntrol Room Standby	os have been started HVAC.	, the operator	will proceed to start th	ne
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		Cal	culation For Diesel G	enerator 2 Loading Under	Calc. No. S	9389-46-19-2
·	Sargen r 6 , Lundy'''		Design Bases Acc	Rev. [Date	
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

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

1) LPCI/CC - LPCI Mode

LPCI/CC

To prevent a failure of fuel cladding as a result of various postulated LOCAs for line 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). For the purposes of this calculation, it is assumed that LPCI loop selection and the <350psig interlocks have occurred prior to DG output breaker closure.

- CC Service Water pumps are tripped and interlocked off.
- The Heat Exchanger Bypass Valve 1501-11B receives an open signal and is interlocked open for 30 seconds and then remains open. Note: these valves will be required to close to obtain flow through LPCI Heat Exchanger; See Section VIII.B.3.iii.
- LPCI pump suction valves (1501-5C and 5D) To prevent main system pump damage caused by overheating with no flow, these valves are normally open and remain open upon system initiation.
- Containment Cooling valves 1501-18B, 19B, 20B, 27B, 28B, and 38B are interlocked closed.
- With time delay, the Low Level/High Drywell Pressure signal closes the Recirculation Pump Discharge Valve 202-5A and 1501-22B, opens 1501-21A.
- LPCI Pump 2C will start immediately after UV relay resets.
- LPCI Pump 2D will start 5 seconds after UV relay resets.
- LPCI pumps minimum bypass valve (1501-13B) To prevent the LPCI pumps from overheating at low flow rates, a minimum flow bypass line, which routes

CALCULATION PAGE CALC NO. REVISION 002 PAGE NO. 8.0-4 9389-46-19-2 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. R2 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 1402-38B - 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 1402-24B - This valve is normally open and interlocks open automatically when reactor pressure is less than 350 psig. Inboard Injection Valve 1402-25B - This valve is normally closed, but will open automatically when reactor pressure is less than 350 psig. Test Bypass Valve 1402-4B - This is a normally closed valve and interlocks closed with Core Spray initiation.

CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 8.0-5
	Core Spray Pump interlocks open with	Suction Valve 1402-3B - h the initiation of Core Sp	This is a norm ray.	ally open valve and
	3) CC Service Water (CCS)	V) Pump		
	The CC Service Water pr water pressure for remov pump is sized to assure s exchanger for LPCI opera exchanger. The pump flo 3500gpm, so at this rate, Station was licensed on th	umps provide river water ing the heat from the LPC sufficient cooling in the se ation, even though there a by required is 3500 gpm. one pump is enough for the basis both CC Service	at a pressure CI heat exchar condary coolin are two CC Se Each CCSW adequate cool Water pumps	of 20 psig over the LPCI nger. One CC Service Water ng loop of the CC heat rvice Water pumps per heat pump has the flow rate of ing. However, the Dresden s would be operating.
	 i) The CCSW pump trips 24 and will not auto start 	when it senses UV, over when the proper voltage i	current, or a Li s back on Bus	PCI initiation signal on Bus
	ii) According to Dresden F required during LOOP con and the Core Spray pump for DG loading capacity to before the second CCSW ESAR section 5.2.3.3 and	FSAR Section 8, Table 8. neurrent with LOCA. After the operator manually to turn off one of the LPCI pump is turned on (see low lyzed the recovery portion	2.3:1 two CC 3 or 10 minutes of urns on the CC pumps [e.g. p References 56 of LOCA for	Service Water pumps are of running both LPCI pumps CSW pumps, but is required R2 ump 2D for this calculation] and 64). Dresden Updated R2 the equipment availability
	and concluded that one L recovery beyond 10 minut	PCI, one Core Spray, and es after LOCA.	i two CCSW p	ump is adequate for
	iii) After the CC Service W Exchanger Service Water the CC heat exchanger. Heat Exchanger Bypass V As this is a manual initiation this calculation.	/ater Pump is turned on, Discharge Control Valve The operator at some time /alve 1501-11B to establish on of an intermittent load,	the operator h 1501-3B to pi e during the ev sh LPCI flow the this valve operation of the theory of theory of the theory of the theory of theory of the theo	as to open the CC Heat rovide CCSW flow through vent will close the CC 3B hrough the heat exchanger. eration is not considered in
	4) Standby Gas Treatment (S	SBGT)		
	The purpose of the SBGT building to prevent ground affluent from the reactor b chimney in order to minim	system is to maintain a s level release of airborne uilding and discharges th ize the release of radioac	mall negative radioactivity. e treated afflu tive material to	pressure in the reactor The system also treats the ent through a 310 foot o the environment.
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	Calc	ulation For Diesel G	enerator 2 Loading Under	Calc. No	. 9389-46-19-2
Sargenz & Lundy''	Design Bases Accident Condition			Rev.	Date
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

The SBGT system will auto initiate on the following conditions:

- 1.) A Train in primary, B Train in standby
 - a. High radiation in Reactor Building Vent System (4mr/hr)
 - b. High radiation on refuel floor (100mr/hr)
 - c. High drywell pressure (+2 psig)
 - d. Low Reactor water level (+8 inches)
 - e. High radiation inside the drywell $(10^2 \times R/hr)$
- 2.) A Train in standby, B Train in primary

If the A train of SBGT system is in standby, a timer is enabled which will initiate the A train of SBGT if a low flow is present on B train SBGT for longer than the allowed time. Per DIS7500-01, this time is set to operate within 18 to 22 seconds

Since the Case 2 scenario is after the Core Spray Pump start and before t=10minutes, B train SBGT will be shown to operate as described in Case 1 above.

Upon initiation, the SBGT system trips the Normal Reactor Building Vent Supply and Exhaust Fans, and closes A0 valves. It also trips the drywell and torus purge fans. Inlet Butterfly Valve 7503 (N.O.) remains open. The electric heater raises the air temperature sufficiently to lower the relative humidity. Motor Operated Butterfly Valve 7504A is normally open and interlocked closed on SBGT system initiation. Motor operated Butterfly Valve 7505A is normally closed and interlocked open upon SBGT system initiation. Motor Operated Butterfly Valve 7507A is normally closed and interlocked open on SBGT initiation. SBGT Fan 2/3-7506A will drive the filtered air out through the ventilating chimney.

5) Control Room Standby Air Conditioning and Emergency Filtration System

The Dresden Control Room should be provided with long term cooling and filtration for the operators to mitigate an accident situation and to maintain long-term operability of the control room equipment. The feed for this standby equipment is fed from MCC 29-8, which is tripped on LOOP to prevent initially overloading the DG, and remains open until is manually closed at the appropriate time. The Control Room Emergency Air Filtration Unit (AFU) in this system is required to operate starting 40 minutes after a postulated accident.

	Calculation For Diesel Generator 2 Loading Under				Calc. No. 9389-46-19-2	
Sargent & Lundy"	Design Bases Accident Condition				1	Date
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

The procedure for securing Control Room HVAC according to DGA-12, Revision 16 is as follows:

- 1.) Reset UV relays on Bus 29.
- 2.) Close Bus 29 to MCC 29-8 at MCC 29-8.
- 3.) At Panel 923-5, start Air Filtration Unit by placing AIR FLTR UNIT BOOSTER FAN A/B control switch in either FAN A <u>or</u> FAN B position.
- 4.) At Panel 923-5, isolate Control Room by placing CONTROL ROOM ISOLATION switch in ISOLATE position.
- 5.) <u>If</u> Instrument Air is lost to Booster fan outlet dampers, <u>then</u> manually throttle flow to 2000 cubic feet per minute.

6.) Start Control Room Standby Air Handler Unit and Air Conditioner.

For conservatism, this calculation shows all of the associated CR HVAC to start simultaneously at 10+++ minutes.

CALC	NO.	9389-46-19-2 REVISION 002 PAGE NO. 9.0				
IX	MET	HODOLOGY				
	A.	Loading Scenarios:				
		There are three different abnor operating:	mal conditions on which the Eme	rgency Diesel Generator can be		
		1) Loss of AC Offsi	te Power (LOOP)			
		2) Safe Shutdown I	Due to Fire			
	·	3) LOOP concurrer	nt with LOCA			
		The above scenarios will be c worst case scenario and why	ompared for total loading and he the scenario was chosen.	aviest sequential loading to determine		
	В.	Continuous Loading Evalua	tion			
		The following Attachments are	used to determine and develop the	ne continuous loading of the DG:		
		Table 1				
: .4		ETAP for the load and manually star	I summary of the loading of the D rted loads (Attachments F & G).	G at selected steps of automatically R2		
		The loading based on the maxi the loading, will be tracked in the loading will be greater than that previous loads until installed an modified loading and operate w loading.	mum loading scenario, including the ETAP data file. In all of the case of the existing loading, since all r d changed to existing. Thus the within the safe operating limit of the	cumulative proposed modifications to ses that will be analyzed, the proposed R2 nodified load reductions will remain at capability of the DG to pickup the e DG will envelope the existing		
		For all of the various steps in th steady state load of all running	e DG load profile, the ETAP total and starting services for the starti	load will be the summation of the R2 ng step being analyzed.		
		The ETAP model was revised prior to Revision 002. Scenario DG load profile as loads are er	to mimic the ELMS-AC data files os were created in ETAP to mod hergized and de-energized.	that were part of the calculation el the various loading steps in the		
	·	The scenarios used to model the scenarios use loading category loading category "Condition 3". 3" as zero and the load is energy 100% in the "DG Loading" cated different than that in load condit AC data files for this calculation of the DG load profile. No spect switches. The breakers were of duplicate the loading on the DG	he DG loading in ETAP are listed "DG Loading". This loading cat In cases where a load was iden gized during the diesel loading so gory. If the bhp for a given load tion 3, it was revised to match th . Breakers were added for vario cific breaker data was entered as pened and closed as required or a for each load step previously ca	I in the table that follows. All egory was created by duplicating itified in loading category "Condition cenario, the loads were modeled as in the previous DG data files was e bhp value in the previous ELMS- ous loads that change state as part these breakers are only used as reating configurations which aptured in the ELMS-AC program.		

The scenarios used to model the DG loading in ETAP are listed in the table that follows. The scenarios use one of three loading categories were created by duplicating loading category? "Odl do 1 CCSW" and "DG Ld 2 CCSW". These loading categories were created by duplicating loading category? In the set was identified in loading category? Condition 3. The cases where a bad for a given load in the previous DG data files was different than that in load condition 3. It was revised to match the bhy 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 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 LPC 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? Freesents the first three study cases use the corresponding similarly named loading category and the DC_Vreduced case uses the DG _0 _CCSW, DG _1 _CCSW, 200 _ 1000 & and 00% for the "Nominal" and "Gen Min" for the first three study cases are DG _0 _CCSW upcases to be the study cases, the Newton Raphson method of load flow was selected with the maximum number of iterations ead at regure was ext to 1000 & and 60% for the "Nominal" and "Gen Min" for the first three sitely cases are dored DG learned of the secution categories respectively. R0% was chosen as it envelopes the lowest expected DC and moltage. This value is supported by the calculations performed in Section 10. In each of thee 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 0.00001. Only the initial bus voltages in th	CALC NO.	9389-46-19-2	REVISION	003	PAGE NO. 9.0	-2
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 category 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 Unit 2 diesel voltage was set to 100% and 60% for the "Nominal" and "Gen Min" generation categories respectively. 60% 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 0.00001. 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. 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 editors prior to each load flow run. The precision for each study case is not accurate enough to guarantee a unique solution. The scenario used to calculate the loading on the DG during each time step are listed below along with the relevant ETAP settings, configurations, etc.		The scenarios used to mode scenarios use one of three k Ld 2 CCSW". These loading In cases where a load was ic energized during the diesel k categories. If the bhp for a g condition 3, it was revised to calculation. Breakers were a No specific breaker data was were opened and closed as a for each load step previously identical except the BHP value Ld 0 CCSW" represents the "DG Ld 1 CCSW" reflects red loading value for a single CC CCSW" except CCSW bhp v	the DG loading in ETAP are bading categories named "Do categories were created by lentified in loading category" bading scenario, the loads w jiven load in the previous DG match the bhp value in the p added for various loads that of s entered as these breakers required creating configuration captured in the ELMS-AC p ues associated with the CS, I first 10 minutes of the accide duced CS and LPCI loading SW pump in operation. "DG ralues are reduced to reflect	e listed in the G Ld 0 CCSW duplicating lo 'Condition 3" a ere modeled a data files wa previous ELMS change state a are only used ons which dup rogram. The LPCI and CCS walues after 10 dues after 10 Ld 2 CCSW" operation of b	table that follows. The /", "DG Ld 1 CCSW" and "D ading category "Condition 3 as zero and the load is as 100% in these loading s different than that in load S-AC data files for this as part of the DG load profil as switches. The breakers blicate the loading on the DC three loading categories are SW pumps are varied. "DG CCSW pumps are operating 0 minutes and a 115% bhp ' is the same as "DG Ld 1 both pumps.)G R3 3" R3 e. 5 e
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.		Four study cases were create DG_2_CCSW and DG_Vred named loading category and runs correspond to less than "Nominal" and "Gen Min" for The Unit 2 diesel voltage was categories respectively. 60% This value is supported by the the Newton Raphson method at 99 and the precision set to a result of execution of the lo	ed for use with this calculation uced. The first three study of the DG_Vreduced case uses 10 minutes into the event. The the first three study cases ar a set to 100% and 60% for the owas chosen as it envelopes the calculations performed in S of load flow was selected w 0.000001. Only the initial but ad flow. No diversity factors	n: DG_0_CC ases use the s the DG_0_C he generating ad DG_Vreduc e "Nominal" a s the lowest ex Section 10. In ith the maxim us voltages we or global tole	SW, DG_1_CCSW, corresponding similarly CCSW loading category as a g category was set to ced study cases respectivel and "Gen Min" generation spected DG terminal voltage each of these study cases, um number of iterations set ere chosen to be updated a rances were used.	R3 all y. e. s
	• .	The scenario wizard in ETAP each time step in the DG load scenarios. Each scenario wa can vary depending upon the are run using the initial bus vo reached regardless of the bus for each study case is not acc calculate the loading on the D settings, configurations, etc.	was used to set up the confider of profile. The study wizard was run three times in a row as order that the study cases a pltages in the bus editor. The soltages in the bus editors curate enough to guarantee a of during each time step are	iguration, stuc as used to gro part of each re run as cert or multiple run prior to each l a unique solut listed below a	ly case, and output report fo oup and run all of the study macro. The results ain calculations within ETAI s assure a unique solution i oad flow run. The precisior ion. The scenarios used to along with the relevant ETA	or s ז P
		• • •				

CALC NO.

9389-46-19-2

003 REVISION

PAGE NO. 9.0-3

Scenario	Configuration	Study Case	DG Voltage	Output Report	Study Macro	Description
DG2_Bkr_Cl	DG2_Bkr_Cl	DG_0_CCSW	4160∨	DG2_Bkr_Close	DG2_Vnormal	Initial loading on DG due to 480V loads when DG breaker closes
DG2_UV_Reset	DG2_UV_Rst	DG_0_CCSW	4160V	DG2_UV_Reset	DG2_Vnormal	Scenario DG2_Bkr_Ci plus 1 st LPCi pump and auxiliarles
DG2_T=5sec	DG2_T=5sec	DG_0_CCSW	4160V	DG2_T=5sec	DG2_Vnormal	Scenario DG2_UV_Reset plus 2 nd LPCI pump
DG2_T=10sec	DG2_T=10sec	DG_0_CCSW	4160V	DG2_T=10sec	DG2_Vnormal	Scenario DG2_T=5sec plus Core Spray Pump and Auxiliaries
DG2_T≈10-min	DG2_T=10-m	DG_0_CCSW	4160∨	DG2_T=10-min	DG2_Vnormal	Scenario DG2_T=10sec minus MOV that have completed stroke
DG2_T=10+min	DG2_T=10+m	DG_1_CCSW	4160V	DG2_T=10+min	DG2_Vnormal	Scenarlo DG2_T=10-min plus 1 st CCSW pump and Auxiliaries
DG2_T=10++mn	DG2_T10++m	DG_2_CCSW	4160V	DG2_T≕10++min	DG2_Vnormal	Scenario DG2_T=10+min plus 2 nd CCSW pump and Auxiliaries minus 1 LPCI pump.
DG2_CR_HVAC	DG2_CR_HVAC	DG_2_CCSW	4160V	DG2_CR_HVAC	DG2_Vnormal	Scenario DG2_T=10++min plus Control Room HVAC and all other long term loads.
DG2_Bkr_Vlow	DG2_Bkr_Cl	DG_Vreduced	2496∨	DG2_Bkr_Vred	DG2_Vreduce	Scenario DG2_Bkr_Cl run at lowest expected voltage
DG2_UV_Vlow	DG2_UV_Rst	DG_Vreduced	2496V	DG2_UV_Vred	DG2_Vreduce	Scenario DG2_UV_Reset run at lowest expected voltage
DG2_T=5sVlo	DG2_T=5sec	DG_Vreduced	2496V	DG2_T=5sVred	DG2_Vreduce	Scenario DG2_T=5sec run at lowest expected voltage
DG2_T=10-mLo	DG2_T=10-m	DG_Vreduced	2496V	DG2_T=10-mred	DG2_Vreduce	Scenario DG2_T=10-min run at lowest expected voltage

CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 9.0-4
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MET	<u>'HODOLOGY</u> (cont'd)			P2
C.	Transient Loading Evaluation.			114
	The following attachments are used	to determine and dev	elop the tra	nsient loading of the DG:
	Table 1			
	Table 4			
	Flow Chart 1			
	Use of Dead Load I	Pickup Curve.		
	The following formulas will be used to motor data provided and the ETAP re	b determine the starti educed voltage scena	ng KVA on Irios.	the DG at each step from the
	Calculating starting KVA (SKVA _R) at t	the machine's rated v	oltage (V _R)	
	SKVAR = √3 V _R I _{LRC}			
	where, I _{LRC} is the machine's L	ocked Rotor Current		
· · · · ·				

C NO.	9389-46-19-2	REVISION	003	PAGE NO.	9.0-5

METHODOLOGY (cont'd)

CAL

Calculating starting KVA (SKVA) at the machine's rated voltage (V₂)

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

The starting kW/kVAR for the starting loads in each step will be calculated and tabulated separately in Table 4.

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 1st CCSW pump was modeled as starting concurrent with the auxiliary loads energized concurrently with the 2nd CCSW pump in order to create a bounding case for a CCSW pump start. 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 loads is taken from ETAP.

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

ICum@100% = Taken from ETAP output report from the study cases run at nominal voltage

R3

Icurr@reduced voltage = Taken from ETAP output report from DG_Vreduced study cases

ΔI = I_{Curr@reduced voltage} - I_{Curr@100%}

ΔKVA = ΔI x √3 x 4.16KV

Conservatively, the worst voltage drop 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 13 of Calculation 7317-33-19-2 shows that the voltage dip is 61.8% of bus rated voltage for Unit 3 when the first LPCI Pump is starting. For conservatism, 60.0% (i.e. 2496V) 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

Carlos and a second sec	CA	LCULATION PAG	E	:	. *
CALC NO.	9389-46-19-2	REVISION	002	PAGE NO.	9.0-6
	(Ref. 13) by using the total star is determined by vectorially add changed to KW/KVAR of the ru KW/KVAR of the 4000V motor to determine the voltage dip and	ting KVA value from Table ling the step starting load h nning load of the previous that is starting to determine d one second recovery at t	4. Following the W/KVAR from scenario in the scenario	ne initial start, the tot Table 4, the Δ KVA ETAP file, and the s ing KVA, which is the ls.	al KVA starting en used
	The Dead Load Pickup Curve p start based on the DG transient and the governor in order to pro utilizes the results of dynamic D curve shows voltage recovery u due to exciter and governor ope the voltage improvement past 1	rovides initial voltage dip a starting load. The curve is ovide recovery voltages. T OG characteristics reflected p to 1 second, the voltage aration. The DG Strip Char second.	and recovery af ncludes the co he voltage dip I in the manufa will continue to rt for the surve	ter 1 second followin mbined effect of the and recovery analysi cturer's curve. Thou improve after 1 sec illance test (Ref. 23)	g a exciter s gh the ond shows
	To determine motor starting terr rotor current at rated voltage. T proportional to applied voltage.	minal voltage, the cable vo his is conservative since th	Itage drop is ca he locked rotor	alculated using the lo current is directly	cked
D.	Analysis of control circuits de	uring motor starting trans	sient voltage (dip.	
	When the DG starts a large more voltage. There is a concern whe drop-out. Table 2 of this calculat operation of the mechanical equipment after UV mechanical equipment.	tor, the momentary voltage ether momentary low volta ation analyzes the effect of ipment. This table analyze reset; and 10 minutes and	e dip can be be ge could use c an AC momen es the moment d after for its ef	low 70% of generato ertain control circuits tary voltage dip on th ary voltage dip at 5 fect on the operation	r rated to ne of
E.	Protective device evaluation a voltage dip	and MOV operating time	effects during	motor starting tran	isient
	The voltage recovery after one s The duration of starting current because of better DG voltage re starting time at motor rated volta operation due to overcurrent or operating from the DG power du protection of MCC 28/29-7 has t	second will be evaluated fo is expected to be shorter the covery. Because protective age and during operation fro onger operating time is no rring LOOP concurrent with been studied in S&L Calcul	r net effect on han operation f re devices are s om offsite pow t expected to b h LOCA. The v ation 8231-05-	the protective device rom offsite power so set to allow adequate er, protective device e a concern when roltage and frequency 19-1	s. urce y
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	Ca	culation For Diesel G	Calc. No	Calc. No. 9389-46-19-2	
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Project Dresden Station Unit 2	Re	sviewed by	Date
Proj. No. 9389-46 Equip. No.	A	pproved by	Date

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 occurring 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:

 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] x 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 speedtorque curve.
- 3) The torque of the load is subtracted from the determined motor torque to obtain the net accelerating torque.
- 4) Finally the time to accelerate through an RPM increment is found using the following equation:

t = [WK²(pump + motor) x RPM increment] / (307.5 x 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 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 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 is **1541 kW**, which is adequate for Dresden Station (Note: Note 3 of Table 3.1-1 was considered when calculating this loading).

Also, the Dresden Re-baselined Updated FSAR, Rev. 0, Figure 8.3-4 shows that the maximum loading on DG 2 during LOOP concurrent with LOCA is **2247 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 1 was developed to show loads powered by the DG and the loads that will be automatically activated when the DG output breaker closes to 4-kV Bus 24-1 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 various configurations to model the loads as described in the methodology section. The CCSW Pumps are manually started and a LPCI Pump is turned off to stay within the DG capacity.

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 2 Load vs Time profile of starting loads for the DG was developed from Table 1 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 4. The following is a sample calculation for LPCI Pump 2C showing the determination of motor starting kVA and starting time. It is shown for demonstrative purposes only (based on Rev. 2). 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.

R3

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CC-AA-309-1001 Revision 1

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

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Page 1.0-0

Design Analysi	s (Major Revis	sion)		Last Page No	. 14.0-7 and R105		
Analysis No.:	9389-46-19-	2	Revision: 003				
Title:	Calculation F	or Diesel Generator	r 2 Loading Under Desig	n Bases Accident	Condition		
EC/ECR No .:	EC 364066		Revision: 000				
Station(s):		Dresden		Components(s	5)		
Unit No.:		2	Various		an		
Discipline:		E					
Description Co	de/Keyword:	E15					
Safety/QA Clas	s:	SR					
System Code:		66					
Structure:		N/A	· · ·				
		CONTROLLED	DOCUMENT REFEREN	CES			
Document No.	······································	From/To	Document No.		From/To		
See Section XIV		From					
is this Design A	nalysis Safeg	uards Information?	? Yes 🗌	No 🔯 If yes,	see SY-AA-101-106		
Does this Desig	in Analysis Co	ontain Unverified A	ssumptions? Yes 🗌	No 🛛 🛛 If yes,	ATI/AR#		
This Design An	alysis SUPER	SEDES: N/A		in its e	entirety		
Description of I	Revision (list a	ffected pages for pa	rtials):				
See Page 1.0-4	for a description	n of this revision and	a list of affected pages.				
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	Cal	Calculation For Diesel Generator 2 Loading Under					Calc. No. 9389-46-19-2		
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DIVISION: EPED FILE: 15B SYSTEM CODE: 6600

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

I. REVISION SUMMARY AND REVIEW METHOD

A. <u>Revision 0</u>

Revision 0, Initial issue, all pages.

This calculation supersedes the Calculation for Diesel-Generator Loading Under Design Basis Accident Condition, Calculation Number 7317-33-19-2. The major differences between Calculation 7317-33-19-2 and this calculation are as follows:

- Dresden Diesel Generator (DG) surveillance test strip charts (Reference 23) show that the first LPCI pump starts about 4 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 4 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 Unit 2 based on the latest base ELMS modified file D2A4.M24, including all modifications included in Revisions 0 through 14 of Calculation 7317-43-19-1 for Unit 2. 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) Additional loading changes were made due to DITs DR-EPED-0861-00, which revised lighting loads, and DR-EAD-0001-00, which revised the model for UPS and Battery Chargers. For non-operating loads in base ELMS-AC file, running horsepower was taken as rated horsepower for valves and 90% of rated horsepower for pumps, unless specific running horsepower data for the load exists.

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

	Ca	Iculation For Diesel G	Calc. No. 9389-46-19-2	
Sargent & Lundy…		Design Bases Acc	Rev. Date	
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

I. Revision Summary and Review Method (Cont)

Revision 1

In this revision, the following pages were revised:

1.0-1, 1.0-2, 2.0-1, 2.0-2, 2.0-3, 4.0-7, 10.0-1 through 10.0-8, 11.0-1, 13.0-1, 14.0-1, 14.0-5, 14.0-7, A1 through A10, B4 through B13, C1 through C7, D2, E1, E2, Attachment F (ELMS-AC Reports), 12;

Note: all text pages are being re-issued to correct various typographical errors throughout the text. Revision bars were not used to denote changes made for typographical corrections only.

the following pages were added:

1.0-3, 2.0-4, Section 10.1 (10.1-0 through 10.1-26), Section 15.0 (15.0 through 15.34)

the following pages were deleted:

10.0-9 through 10.0-24, B14-B15.

This revision incorporates load parameter changes determined in Revision 18 of Calculation 7317-43-19-1 (Ref. 26) 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 update can be made easily and accurately with the file comparison program ELMSCOMP. In addition to the load/file changes, the calculation portion of the text 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 Reference 26.

REVISION 003

PAGE NO. 1.0-3 || R3

Revision Summary and Review Method (cont'd)

Revision 2

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 have been incorporated. The parameters for valve 2-1501-22B were also revised in the ETAP model to reflect the latest installed motor. Section 10 calculations previously performed using MathCad were replaced with MS Excel spreadsheets.

In this revision the following pages were revised:

2.0-4, A3, A8, E1, H1, H2, R16-R19, R91

In this revision the following pages were replaced:

1.0-3, 2.0-1, 2.0-2, 3.0-1, 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 – 9.0-6, 10.0-1 – 10.0-8, 10.1-0 – 10.1-26, 11.0-1, 14.0-1, 14.0-7, C1-C7 replaced by C1-C6, F1-F140 replaced by F1-F118, G0 replace by G1-G63

In this revision the following pages were added:

Design Analysis Cover Sheet (1.0-0), 2.0-5, R92-R100

In this revision the following pages were deleted:

15.0-0 - 15.0-34, Attachment I

	CALC NO.	9389-46-19-2	REVISION	003	PAGE
- 1					

PAGE NO. 1.0-4(4

Revision Summary and Review Method (cont'd)

Revision 3

This revision incorporates various changes to the EDG loading. Major changes include CS, LPCI and CCSW BHP values. Other changes include a reduction in the ESS UPS loading, removal of the 120/208V Xfmr Mag Tape Drive, decreasing the LOCA bhp value for the RPS MG Set, incorporating replacement of the DG cooling water pump and turning off the HPCI Aux Coolant 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 65 to 70, 72, 73, 77 and 78.

In this revision the following pages were revised:

A5, A7, B8, B10, E1, R100

In this revision the following pages were replaced:

1.0-0, 1.0-3, 2.0-1, 2.0-2, 2.0-5, 3.0-1, 3.0-2, 4.0-7, 5.0-1, 7.0-1, 9.0-2, 9.0-3, 9.0-5, 10.0-1, 10.0-8, 10.1-1, 10.1-3, 10.1-4, 10.1-10, 10.1-11, 10.1-17, 10.1-18, 10.1-24, 10.1-25, 11.0-1, 12.0-1, 14.0-1, 14.0-7, C1, C3, Attachments F and G

In this revision the following pages were added:

1.0-4, 4.0-8, R101-R105

CALCULATION TABLE OF CONTENTS

CALC NO.: 9389-46-19-2 REV NO: 003 PAGE NO. 2.0-1					
		SECTION	PAGE NO.:	SUB PAGE NO.:	
		SLE OF CONTENTS / FILE DESCRIPTION			
	I.	COVER SHEET / REVISION SUMMARY & REVIEW METHOD	1.0-0 - 1.0-4		
	11.	TABLE OF CONTENTS / FILE DESCRIPTION	2.0-1 - 2.0-5		
	111.	PURPOSE/SCOPE	3.0-1 - 3.0-2		
	IV.	INPUT DATA	4.0-1 - 4.0-8		
	. V.	ASSUMPTIONS	5.0-1		
	VI.	ENGINEERING JUDGEMENTS	6.0-1		
	VII.	ACCEPTANCE CRITERIA	7.0-1		
	VIII.	LOAD SEQUENCING OPERATION	8.0-1 - 8.0-7		
	IX.	METHODOLOGY	9.0-1 - 9.0-7		
	Χ.	CALCULATIONS AND RESULTS	10.0-1 - 10.0-8 10.1-0 - 10.1-26		
	XI.	COMPARISON OF RESULTS WITH ACCEPTANCE CRITERIA	11.0-1 - 11.0-2	1	
1	XII.	CONCLUSIONS	12.0-1		
	XIII.	RECOMMENDATIONS	13.0-1		
	XIV.	REFERENCES	14.0-1 - 14.0-7		

R3

CALC NO.: 9389-46-19-2 REV NO: 003 PAGE NO. 2.0-2 SECTION PAGE NO.: SUB PAGE NO.: Attachments Description Table 1 - Automatically Turn ON and OFF Devices Under Α the Design Basis Accident Condition when DG2 is powering the Unit 2 Division II loads. A1-A10 Table 2 - The Affects of AC Voltage Dip on control circuits В of Dresden Unit 2, Division II when large motor starts. B1-B13 Table 4 - Starting KW and KVAR for all 480V Loads at С each Step when DG 2 is powering Unit 2, Division II. C1-C6 R3 Figure 1 - Single Line Diagram when DG 2 Powers SWGR D 24-1 D1-D2 **R**3 Figure 2 - Time vs. Load Graph when DG 2 Powers Ε SWGR 24-1 E1-E2 DG Unit 2 Division II ETAP Output Reports - Nominal F F1-F116 R3 Voltage DG Unit 2 Division II ETAP Output Reports - Reduced G R3 Voltage G1-G62 Flow Chart 1 - Method of Determining Shed and Н Automatically Started Loads H1-H2 Unit 2 ELMS-AC Plus Data Forms J J1-J10 **R**3 R **Reference Pages** R1-R105 Note: Table 3 has not been created for this calculation. However, it is reserved for possible future use.

CALCULATION TABLE OF CONTENTS (Continued)

		Са	Iculation For Diesel	Calc. N	ılc. No. 9389-46-19-2		
Sargent S. Lundy			Design Bases Accident Condition Rev.			Date	
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Proj. No. 9389-46 Equip. No.	Approved by	Date	

File Descriptions

Revision 0

File Name	Date	Time	File Description
D2A4DG2.G00	1/6/95	11:28:36a	General File - Original Issue
D2A4DG2R.G00	1/6/95	11:56:16a	General File - Original Issue - Reduced Voltage
D2A4DG2.100	1/6/95	10:51:24a	Initial File - Original Issue
D2A4DG2R.100	1/6/95	11:18:14a	Initial File - Original Issue - Reduced Voltage
D2TB1DG2.00	1/6/95	9:56:48a	Table 1 - Excel File
D2TB2DG2.00	1/6/95	10:31:24a	Table 2 - Excel File
D2TB4DG2.00	1/6/95	10:01:44a	Table 4 - Excel File
LDGRFDG2.00	1/6/95	10:40:12	Time vs. Load Graph
DRESDG2.00	12/19/94	6:34:02p	Flow Chart 1
DRESDG2.WP	1/6/95	7:41:08p	Calculation Text - Wordperfect



Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

File Descriptions (cont)

Revision 1

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File Name	Date	Time	File Description
D2A4DG2.G01	9/23/96	2:04p	General File - Data upgrade, see Revision Summary for details.
D2A4DG2R.G01	9/23/96	2:10p	General File - Reduced Voltage, see Revision Summary for details.
D2A4DG2.101	10/11/96	10:01a	Initial File - Data upgrade, see Revision Summary for details.
D2A4DG2R.101	10/11/96	10:08a	Initial File - Reduced Voltage, see Revision Summary for details.
D2EXCEL.XLS	10/11/96	1:26p	Excel Workbook for Tables 1, 2, 4, and the Time vs. Load Graph. This file replaces files D2TB1DG2.00, D2TB2DG2.00, D2TB4DG2.00, and LDGRFDG2.00
DG2MCAD.MCD	10/11/96	11:29a	Mathcad file for Section 10.1
DG2SLINE.PPT	10/11/96	1:39p	Single line - Attach E (Powerpoint)
DRESDG2.00	12/19/94	6:34p	Flow Chart 1 (ABC Flowcharter)
DRESDG2.WP	10/11/96		Calculation Text - Wordperfect

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9389-46-19-2

REVISION 003

PAGE NO. 2.0-5(f...)

R3

File Descriptions (cont'd)

Revision 2

File Name	Size	Date	Time	File Description
9389-46-19-2 Rev. 2.doc	504320 bytes	8/9/06	7:52:35am	Text document
9389-46-19-2 Rev. 2 (section 10).xls	532480 bytes	7/31/06	2:13:14pm	Section 10.1
9389-46-19-2 Rev. 2 (table 4).xls	53248 bytes	4/21/06	9:05:56am	Table 4
DRE_Unit2_0003.mdb	1,7977,344 bytes	8/01/06	1:22:49pm	ETAP database
DRE_Unit2_0003.macros.xml	10595 bytes	8/01/06	10:17:20am	ETAP macros
DRE_Unit2_0003.scenarios.xml	11572 bytes	7/31/06	10:20:30am	ETAP Scenarios
DRE_Unit2_0003.oti	9728 bytes	8/01/06	1:22:48pm	ETAP "OTI" file

Revision 3

File Name	Size	Date	Time	File Description
9389-46-19-2 Rev. 3.doc	SIL 48+ byTes	3/22/37	11: 59:0700	Text document
9389-46-19-2 Rev. 3 (section 10).xls	522752 bytes	3/2/07	7:25:52am	Section 10.1
9389-46-19-2 Rev. 3 (table 4).xls	55248 bytes	3/9/07	7:48:15am	Table 4
DRE_Unit2_0004.mdb	18,911,232 bytes	3/20/07	11:34:56pm	ETAP database
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CALC NO.		9389-	-46-19-2	REVISION	003	PAGE NO.	3.0-1		
]]]	PUR	POSE/S	COPE						
	A.	Pur	DOSE						
		The capa Calc	purpose of this calculation is to acity to support the required load culation Results section.	ensure that the Dresd ling during the maxim	len Diesel Gei um loading pr	nerator has sufficient ofile as determined in t	ne		
		The purpose of this calculation includes the following:							
		1)	Determine automatically actue electrical load when the DG i	ated devices and thei s powering the safety	r starting KVA related buses	at each step for the ac	;		
		2)	Develop a Time versus Load related buses.	profile for the DG who	en the DG is p	owering the safety			
		3)	Compare the maximum loadi the DG at each step.	ng in ETAP for the DO	G load profile a	against the capacity of			
		4)	Determine the starting voltag for initial loading and each 40	e dip and one second 00V motor starting ste	recovery volta	age at the DG terminals	;		
		5)	Evaluate the control circuits d	luring the starting tran	sient voltage	dip.			
	J	6)	Evaluate the protective device	e responses to ensure Insient voltage dip.	e they do not ir	nadvertently actuate or			
		7)	Evaluate the travel time of M0 starting transient voltage dips	OVs to ensure they are	e not unaccep	tably lengthened by the	!		
		8)	Determine the starting duration	on of the automatically	starting 4kV	pump motors.			
		9)	Ensure the loading on the ED machine increase to its maxin	G is within the 2000hr num allowable value.	rating should	the frequency on the	R3		
		10)	Determine the minimum powe	er factor for the long te	erm loading on	the EDG.			
	В.	Scop	00						
•		The s seque degra minim DG de succe	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.						

ALC NO.	9389-46-19-2		REVISION	003	PAGE NO.	3.0-2(f
PURPO	<u>SE/SCOPE</u> (cont'd)					
	The total running lo selected loading st an evaluation base functionality during	ad of the DG will al ep to confirm the lo d on review of iden the transient voltag	lso be compared a ading is within the tified drawings to d ge dips.	gainst the rating DG capacity. Ti etermine the ef	g of the DG at the he scope will also inc fects on control	lude
	The EDG has a min frequency above its increase in load du 2000 hr rating to er EDG long term load	nimum and maximu s nominal value resise to the increase in nsure the limits of the ding will be quantifie	um allowable freque ults in additional los frequency will be o ne EDG are not exc ed.	ency range. Op ading on the ED quantified and c ceeded. The m	perating the EDG at a DG. The percent compared to the EDG inimum power factor	R3 for
	The scope will also voltage dips.	include an evaluati	ion of protective de	vices which are	subject to transient	
	The scope does no of the same Divisio Operations' discreti Therefore, this ope	t include loads fed n. Although DGA-1 on and is verified to ration is not include	through the cross-t 2, Rev. 16 allows it b be within allowabi d in the scope of th	ie breakers bet s use, loading i le limits during i nis calculation.	ween Unit 2 and 3 B s performed manual manual loading.	uses ly at
	·	•				
	· · · · ·					

CALCULATION PAGE					
NO.	9389-46-19-2	REVISION 00	2 PAGE N	0. 4.0-1	
INPU	T DATA	1			
The l	nput data extracte	d from the references is summarized below:			
А.	Abbreviation	Ś			
	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	Drwell			
	EFF	Efficiency			
	EHC	Electro Hydraulic Control			
	ELMS	Electrical Load Monitoring System			
		Electrical Transient Analyzer Program		I	
	EIAF			R2	
	⊾merg	Emergency			
	NO. INPU The i A.	NO.9389-46-19-2INPUT DATAThe input data extracteAAbbreviationASAOCCCCCCSWClgClnupClnupCnmtComptDiffDiffDITDGDWEFFEHCELMSETAPEmerg	NO. 9389-46-19-2 REVISION 00 INPUI DATA INPUI DATA The input data extracted from the references is summarized below: A Abbreviation Abbreviation System Imput data extracted from the references is summarized below: A Abbreviation ADS Automatic Depressurization System Imput data extracted from the references is summarized below: AO Air Operated Compation Imput data extracted from the references is summarized below: ADS Automatic Depressurization System Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references is summarized below: Imput data extracted from the references data extracted from the reference data extractedata from the reference data extracted from the reference	CALCULATION PAGE NO. 9389-46-19-2 REVISION 002 PAGE N 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 Clig Cooling Clup Clean up Containment Comp Compressor Comp Compt Compartment Compartment Comp Differential DIT Design Information Transmittal DG Disel Generator DW Drywell EFF Efficiency EHC Electrical Load Monitoring System ETAP Electrical Transient Analyzer Program ETAP Electrical Transient Analyzer Program	

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Proj. No. 9389-46	it 2		Reviewed by		Date
	Equip. No.		Approved by		Date
input Data (co	nt'd):				
ECCS	-	Emergen	cy Core Cooling System	·	
FSAR	-	Final Saf	ety Analysis System		
gpm	-	Gallons F	Per Minute		
GE	-	General I	Electric		
Gen	-	Generato	r		
Hndig	-	Handling			
HPCI	-	High Pres	ssure Coolant Injection		
HVAC	•	Heating \	/entilation & Air Conditionir	Ig	
Inbd		Inboard			
Inst	-	Instrumen	bt .		
isoin	-	Isolation			
LOCA	-	Loss Of C	Coolant Accident		
LOOP	-	Loss Of C	Offsite Power	· ·	
LPCI	-	Low Press	sure Coolant Injection		
LRC	.	Locked Ro	otor Current		·
Mon		Monitoring			
MCC	-	Motor Con	ntroi Center		
MOV	-	Motor Ger			
	-	iviotor Ope	nated valve		

Sargent & Lundy"	Cal	culation For Diesel G	Calc. No. 9389-46-19-2			
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

	Input Dat	ta (cont'd):			
	O	utbd -		Outboard	
	Pf	= -		Power Factor	
	Pr	ress -		Pressure	
	Pr	rot -		Protection	
	Re	ecirc -		Recirculation	
	Rr	n -		Room	
(6 88	Rx	Bidg -		Reactor Building	
	SE	BGT -		Standby Gas Treatment System	
	Se	er -		Service	
	sv	VGR -		Switchgear	
	Str	m -		Steam	
	Su	ict -		Suction	
	ТВ	-		Turbine Building	
	Tu	rb -		Turbine	
	UP	rs -		Uninterruptible Power Supply	
	VIv	1	,	Valve	
	Wt	r -	,	Water	
	Xfn	nr -		Transformer	



Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

Input Data (cont'd):

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

Manufacturer	Electro - Motive Division (GM)
Model	A - 20 -C1
Serial No.	67 - K1 - 1008
Volts	2400 / 4160 v
Currents	782 / 452 Amps
Phase	3
Power Factor	0.8
RPM	900
Frequency	60
KVA	3125
Temperature Rise	85⁰C Stator - Therm 60ºC Rotor - Res
KVA Peak Rating	3575 KVA For 2000 HR / YR
Temperature Rise	105⁰C Stator - Therm 70⁰C 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.	1157

	Ca	culation For Diesel (Calc. No.	Calc. No. 9389-46-19-2	
Sargent & Lundy''		Design Bases Ac	Rev. i	Date	
	x	Safety-Related	Non-Safety-Related	Page 4	.0-5

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

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 1: Automatically ON and OFF devices during LOOP Concurrent with LOCA when the DG 2 is powering the Unit 2 Division II loads (Attachment A)
- H. Table 2: Affects of Voltage Dip on the Control Circuits during the Start of Each Large Motor when DG 2 is powering Unit 2, Division II loads (Attachment B).
- I. Table 4: KW/KVAR/ KVA loading tables for total and individual starting load at each step when DG 2 is powering Unit 2, Division II loads (Attachment C).
- J. Dresden DG 2 Calculation 7317-33-19-2, Revision 18 (superseded by this calculation).
- K. Quad Cities DG 1 Calculation 7318-33-19-1, Revision 0.
- L. Dresden Units 2 & 3, Equipment Manual from GE, Number GEK-786.
- M. Dresden Re-baselined Upated FSAR, Revision 0.

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CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 4.0-6	
input l	Data (cont'd)				
N.	Guidelines for Estimating Data Byron & Braidwood), which is u	(Used by Electrical Analytical used for determining %PF and	Division in Vario I efficiency (Attac	us Projects like Clinton, ched).	
, O.	ANSI / IEEE C37.010-1979 for Motor	Determining X/R Range for P	ower Transforme	ers, and 3-phase Induction	
P.	Dresden Re-baselined Updated offsite ac power (Reference 31	d FSAR Figure 8.3-4 DG loadi)	ing under accide	nt and during loss of	
Q.	Dresden Appendix R Table 3.1	-1, DG loading for safe shutdo	own (Reference 3	32)	
R.	Flow Chart No. 1, showing the powering the safety buses durit	source of data and establishin ng LOOP concurrent with LOC	ig which load is (CA (Attachment H	DN when the DG is +)	
S.	ETAP Loadflow summary for co step to DG capacity for Unit 2 (omparing loading and calculat Attachments F & G).	ed KVA input of	running loads at each	R2
т.	S&L Standard ESA-102, Revisi Electrical Cables (Reference 1	on 04-14-93 - Electrical and P 1)	hysical Characte	eristics of Class B	
U.	S&L Standard ESC-165, Revisi 41)	ion 11-03-92 - Power Plant Au	xiliary Power Sys	stem Design (Reference	
V.	S&L Standard ESI-167, Revisio	n 4-16-84, Instruction for Con	nputer Programs	(Reference 1)	
W.	S&L Standard ESC-193, Revision (Reference 39)	on 9-2-86, Page 5 for Determi	ining Motor Starti	ng Power Factor	
Х.	S&L Standard ESA-104a, Revis 10)	sion 1-5-87, Current carrying C	Capabilities of cop	oper Cables (Reference	
Y.	S&L Standard ESC-307, Revisio 21)	on 1-2-64, for checking voltag	e drop in starting	AC motors (Reference	
Ζ.	S&L Standard ESI-253, Revision approval of electrical design cal	n 12-6-91 Electrical Departme culation (Reference 20)	nt instruction for	preparation, review, and	
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	C NO.	9389-46-19-2	REVISION	003	PAGE NO.	4.0-7
	Input Da	ata (cont'd)				
	AA.	Unit 2 ETAP file from Calculation for latest ETAP file.	n DRE05-0038, Rev. 000 and	d 000A (R	eference 60). See S	Section 2.0
•	AB.	125Vdc and 250Vdc Battery Cha ETAP (Reference 54)	arger, and 250Vdc UPS Mod	els from C	Calculation 9189-18-	19-2 used in
	AC.	Single Line diagram showing the during LOOP concurrent with LC	e breaker position when the E DCA (Attachment D))G output	breaker closes to 4-	kV Bus 24-1
	AD.	Walkdown data for CCSW Pum	ps (Ref 35) (Attachment R)			
	AE.	GE Drawing 992C510AB, Dresd	len Core Spray Pump Motor ((Attached))	
	AF.	GE Drawing 992C510, Dresden	LPCI Pump Motor (Attached)	• •	
	AG.	IEEE Standard 399-1980, Chapt some running load is already pre	ter 8, for determining motor s esent	tarting vol	ltage drop at the sou	rce when
	AH.	Western Engine letter dated 1/19 Dresden and Quad Cities (Attack	9/97 to Mr. Wayne Hoan iden hed)	tifying the	e voltage dip curve ap	oplicable to
	AI.	Strip Chart (1) for Diesel Genera	tor Surveillance Test: Dated	April 19, 1	1983	
	AJ.	DIT DR-EPED-0861-00 (Attache	d)			
	AK.	CIS-2: Tabulation for cable lengt	hs			
	AL.	Letter dated November 14, 1994 Dresden and Quad Cities" writter	regarding NTS 925-201-94-I n by E. P. Ricohermoso	PIF-01102	2 "CREFS Heating C	oil —
	AM.	DOP 0202-01, Revision 13; Unit	2 Reactor Recirculation Syst	em Startu	p	
	AN.	Calculation for Evaluation of 3HF Calculation Number 9215-99-19-	P, 460V CCSW Motor Minimu 1, Revision 1	m Voltage	e Starting Requireme	ents;
	AO.	Hand calculation to determine LF	RC for CCSW Pumps 2A, 2B,	2C and 2	2D	
	AP.	Calculation for Single Line Imped	lance Diagrams for ELMS-AC	; Calcula	tion 7317-38-19-1, R	evision 1
	AQ.	The maximum allowable time to s	start each LPCI Pump and Co	ore Spray	Pump is 5 Seconds	(Reference

CALC NO.	9389-46-19-2	REVISION	003	PAGE NO.	4.0-8(f.~i)		
AR.	The BHP values for the CS provided below (Ref. 65, 6	6, LPCI and CCSW pumps afte 6, 67).	er 10 minute	es into a LOCA ever	nt are		
	Core Spray Pump 2B	883.2 hp (879.6 hp after 2 hrs))				
	LPCI Pump 2C	639.7 hp (637.2 hp after 2 hrs)	•				
	LPCI Pump 2D	619.1 hp (616.6 hp after 2 hrs))				
	CCSW Pump 2C	575.0 hp with 1 pump running,	465 hp with	n both pumps runnir	ng		
	CCSW Pump 2D	575.0 hp with 1 pump running,	465 hp witl	n both pumps runnir	ng 🛛		
AS.	The 2 EDG Cooling Water efficiency, LRC and starting	Pump has a BHP of 66.28kW g power factor are 100%, 400%	with a powe 6 and 31.59	er factor of 83.0. Th 6 respectively (Ref.	e 68 & 69)		
AT.	The RPS MG Sets have a based on a 5% tolerance in	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. 70)					
AU.	The HPCI Aux Coolant Pur	np is manually controlled and r	not operate	d during a LOCA (Re	ef. 71)		
AV.	Dresden Technical Specific EDG frequency (Ref. 74)	cation Section 3.8.1.16 allows a	a +2% toler	ance on the nomina	1 60HZ		
AW.	The continuous rating of th	e EDG is 2600kW at a 0.8 pf (l	Ref. 75)				
AX .	For centrifugal pumps, the	break horsepower varies as th	e cube of th	ne speed (Ref. 76)			
AY.	The UPS load is 37.5kW at	t the 480V input (Ref. 77)					
AZ.	The Turbine & Radwaste B	ldg Emergency Lighting Load i	s 27kW (Re	ef. 78)			

CALC	NO.	9389-46-19-2	REVISION	003	PAGE NO.	5.0-1(*)
· v	ASS	UMPTIONS				
	. 1)	MCC control transformers (ap of their rating as actual load ar	proximately 150VA – 200VA nd can be neglected.	(each) genera	lly have only a small p	portion
	2)	The Diesel Fuel Oil Transfer P available on the MCC bus, but which is normally full prior to D	Pump is shown in this calcula this is not the actual case a DG starting. This is conserva	ation as operat is the pump re ative and comp	ing as soon as voltag sponds to low day tan pensates for Assumpt	e is k level ion 1.
	3)	Individual load on buses down determine transformer loading the distribution transformer or which is conservative.	stream of 480/120V transfor This transformer load on t an equivalent three-phase lo	rmer have not he 480V bus is pading for sing	been discretely analyz s assumed to be the r le phase transformers	zed to ating of 5,
	4)	When Locked Rotor Currents a is from S&L Standard ESC-16	are not available, it is consic 5 and is reasonable and cor	lered 6.25 time servative.	es the full load current	. This
	5)	For large motors (>250HP), the large HP motors and does not	e starting power factor is con require verification.	nsidered to be	20%. This is typical f	or
	6)	The line break is in Loop "A" ar	nd Loop "B" is selected for in	njection.		
	7)	The load on the diesel generate is 2% above its nominal value. horsepower of these pumps va corresponds to a 6% increase different point on the performan Therefore, this assumption is c	or is assumed to increase b A majority of the load cons aries as the cube of the spee in load (1.02 ³) (Ref. 76). No nce curve and the BHP may conservative.	y 6% when the ists of large ce ed. Thus, a 2% ote that these p actually increa	e frequency of the mac entrifugal pumps. The 6 increase in speed bumps will operate on ase less than 6%.	chine break a
	8)	For determining starting time for throughout the evaluation. Alth as is expected, using a constar would be somewhat less if the motor starting current is conser	or the large motors, the start hough the speed-torque curv nt current will simplify the sta speed-current characteristic rvative and requires no furth	ing current is a re shows a dec arting time eva s were include er verification.	assumed to be consta crease in current with luation. Motor starting d. This assumption o	nt speed ; time f
	The a	bove assumptions 1, 2, 3, 4, 5, 6,	7 & 8 do not require verifica	ation.		

<u>í</u>	Cal	culation For Diesel C	Calc. No. 9389-46-19-2	
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Client ComEd			Prepared by		Date
Project Dresden Station Unit 2			Reviewed by		Date
Proj. No. 9389-46	Equip. No.		Approved by		Date

VI. ENGINEERING JUDGEMENT

- Based on engineering judgement an efficiency of 90% is to be used to convert the cumulative 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 2-4kV motors. Also, this result is only to be used for a comparison.
- 2.) 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 first minutes of the event. In small and intermediate line break scenarios, there will be more time between the LOCA event initiation and the low pressure (i.e. AC) ECCS system initiation.
- 3.) It is acknowledged that system parameters (i.e. low level, high pressure, etc.) for different ECCS and PCIS functions have distinctly different setpoints. For the purposes of this calculation, it will be assumed that these setpoints will have been reached prior to the EDG output breaker closure except as otherwise noted. This is conservative as it will result in the greatest amount of coincidental loading at time t=0-and time t=0+.
- 4.) Based on the fact that large motors will cause larger voltage dips when started on the diesel generator, the manually initiated loads starting at t=10+ and after will be assumed to be started in the following order:
 - a) CCSW Pump 2D
 - b) CCSW Pump 2C
 - c) Train B Control Room HVAC

CALCULATION PAGE CALC NO. 9389-46-19-2 REVISION 003 PAGE NO. 7.0-1(fm) VII ACCEPTANCE CRITERIA The following are used for the acceptance criteria: Continuous loading of the Diesel Generator. 1) 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 003 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 1.02³ R3 or 1.06 times larger since a centrifugal pump input BHP varies as the cube of the speed (Ref. 76). EDG Power Factor during Time Sequence Steps DG2 T=10+m, DG2 T=10++m, and DG2 T=CRHVAC must be \geq 88% (Ref. 79 and 80) 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.AQ): Service Allowable-Starting Time (sec.) LPCI Pump 2C 5 LPCI Pump 2D 5 5 Core Spray Pump 2B

Sargent & Lundy'''	Cal	culation For Diesel G		Calc. No. 9389-46-19-2		
		Design Bases Accident Condition				Date
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Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Data

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 2 Containment Cooling Service Water Pumps and associated auxiliaries.

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 24-1, or

Breaker from Bus 24 to Bus 24-1 opens, or

- Backup undervoltage on Bus 24-1 with a 7 second time delay under LOCA, or
- Backup undervoltage on Bus 24-1 with a 5 minutes time delay without 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.

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CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 8.0-2
		* 11		
LUA	D SEQUENCING OPERATION (COM	(d)		
	2) Automatic Load Sequence	Operation for LOOP wi	th LOCA	
· _	When the DG auton the diesel auxiliaries starts its reset recov	natically starts and its ou and certain MOVs start rery timing.	tput breaker clo operating, and	ses to Switchgear 24-1, the UV relay (IAV 69B)
	As soon as UV relay	(IAV 69B) completes its	s reset, the first	LPCI pump starts.
	 5 seconds after UV time, associated val 	relay (IAV 69B) reset, the ves and equipment with	e second LPCI the LPCI pump	oump starts. At the same start operating.
	 10 seconds after the same time, associat operating. 	UV relay (IAV 69B) rese ed valves and equipmen	et, the Core Spr It with the Core	ay pump starts. At the Spray pump start
	Automatically activated loads on t Table 1.	he DG during LOOP cor	ncurrent with LC	CA are identified in
**	3) Manual actuation required	for long term cooling		
	After 10 minutes of continued auto operator has to do the following a	omatic operation of the L ctions to initiate long terr	PCI Pumps and n cooling (see F	I Core Spray system, the References 56 and 64):
	Appropriate loads or	Bus 24 will be shed and	locked out.	R2
	At this point the oper start one of the CC S Service Water Disch	ator can manually close Service Water pumps, ar arge Valve 2B (2-1501-3	the breaker to t nd also opens th 3B).	he switchgear bus and e CC Heat Exchanger
	Turn off one of the L	PCI pumps		82
	After the first CCSW operator will start the	Pump is started and one second CCSW Pump.	e of the LPCI pu	mps is shut off, the
	After both CCSW Pu Control Room Stand	imps have been started by HVAC.	, the operator w	ill proceed to start the



Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

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

1) LPCI/CC - LPCI Mode

LPCI/CC

To prevent a failure of fuel cladding as a result of various postulated LOCAs for line 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). For the purposes of this calculation, it is assumed that LPCI loop selection and the <350psig interlocks have occurred prior to DG output breaker closure.

CC Service Water pumps are tripped and interlocked off.

- The Heat Exchanger Bypass Valve 1501-11B receives an open signal and is interlocked open for 30 seconds and then remains open. Note: these valves will be required to close to obtain flow through LPCI Heat Exchanger; See Section VIII.B.3.iii.
- LPCI pump suction valves (1501-5C and 5D) To prevent main system pump damage caused by overheating with no flow, these valves are normally open and remain open upon system initiation.
- Containment Cooling valves 1501-18B, 19B, 20B, 27B, 28B, and 38B are interlocked closed.
- With time delay, the Low Level/High Drywell Pressure signal closes the Recirculation Pump Discharge Valve 202-5A and 1501-22B, opens 1501-21A.
- LPCI Pump 2C will start immediately after UV relay resets.
- LPCI Pump 2D will start 5 seconds after UV relay resets.
- LPCI pumps minimum bypass valve (1501-13B) To prevent the LPCI pumps from overheating at low flow rates, a minimum flow bypass line, which routes

CALC NO.	9389-46-19	9-2	REVISION	002	PAGE NO.	8.0-4
		water from pump dis single valve for both opens automatically valve also auto-close	charge to the suppress LPCI pumps controls th upon sensing low flow i s when flow is above th	ion chamber is ne minimum flo n the discharge ne low flow sett	provided for each pu w bypass line. The v a lines from the pump ing.	mp. A alve . The
	2) Co	re Spray				
	The ma wat	e function of the Core Split intain sufficient core coord ter, enough to potentially	oray system is to provid pling on a LOCA or othe y uncover the core.	e the core with r condition, wh	cooling water spray t ich causes low reacto	o pr
	i) T	he core spray pump sta	rts automatically on any	v of the followin	g signal:	
	•	High Drywell Pressur	е (2 psig) ог,			
	•	Low -Low reactor wa	ter level (-59") and low	reactor pressur	e (<350 psig), or	
	•	Low Low reactor wate	er level (-59") for 8.5 mi	nutes.		
	ii) T	The following valves resp	oond to initiation of core	spray:		
	•	Minimum Flow Bypas open to allow enough Core Spray Pump wh flow is sensed, it will o	s Valve 1402-38B - Thi flow to be recirculated en pumping against a c close automatically	s valve is a N.C to the torus to losed discharg	D. valve, which remail prevent overheating c e valve. When suffici	ns of ent
	٠	Outboard Injection Va automatically when re	alve 1402-24B - This va actor pressure is less t	lve is normally han 350 psig.	open and interlocks o	pen
	•	Inboard Injection Valv automatically when re	e 1402-25B - This valve actor pressure is less t	e is normally clo han 350 psig.	osed, but will open	·
	•	Test Bypass Valve 14 Core Spray initiation.	02-4B - This is a norma	ally closed valve	e and interlocks close	d with
			-			

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CALC NO.	9389	-46-19-2	REVISION	002	PAGE NO. 8.0-5
		Core Spray Pump Su interlocks open with	uction Valve 1402-3B - T the initiation of Core Spr	his is a nor ay.	mally open valve and
	3)	CC Service Water (CCSW)) Pump		
· · · · · · · · · · · · · · · · · · ·		The CC Service Water pun water pressure for removin pump is sized to assure su exchanger for LPCI operati exchanger. The pump flow 3500gpm, so at this rate, of Station was licensed on the	nps provide river water a g the heat from the LPC fficient cooling in the sec on, even though there a required is 3500 gpm. I ne pump is enough for a basis both CC Service	at a pressur I heat exch condary coo re two CC 3 Each CCSV idequate co Water pum	e of 20 psig over the LPCI anger. One CC Service Water bling loop of the CC heat Service Water pumps per heat V pump has the flow rate of boling. However, the Dresden ps would be operating.
	·	i) The CCSW pump trips w 24 and will not auto start w	hen it senses UV, overcinen the proper voltage is	urrent, or a s back on B	LPCI initiation signal on Bus us 24.
		ii) According to Dresden FS required during LOOP conc and the Core Spray pump, for DG loading capacity to t before the second CCSW p FSAR section 5.2.3.3 analy and concluded that one LP0 recovery beyond 10 minutes	AR Section 8, Table 8.2 surrent with LOCA. After the operator manually tu urn off one of the LPCI p ump is turned on (see F zed the recovery portion CI, one Core Spray, and s after LOCA.	2.3:1 two CO 10 minute irns on the pumps [e.g. References of LOCA for two CCSW	C Service Water pumps are s of running both LPCI pumps CCSW pumps, but is required R2 pump 2D for this calculation] 56 and 64). Dresden Updated R2 or the equipment availability pump is adequate for
		 iii) After the CC Service Wa Exchanger Service Water D the CC heat exchanger. Th Heat Exchanger Bypass Va As this is a manual initiation this calculation. 	ter Pump is turned on, to Discharge Control Valve e operator at some time live 1501-11B to establis of an intermittent load,	he operator 1501-3B to during the h LPCI flow this valve o	has to open the CC Heat provide CCSW flow through event will close the CC 3B / through the heat exchanger. peration is not considered in
·	4)	Standby Gas Treatment (SE	IGT)		
		The purpose of the SBGT s building to prevent ground le affluent from the reactor bui chimney in order to minimize	ystem is to maintain a sr evel release of airborne i Iding and discharges the a the release of radioact	mall negativ radioactivity treated aff ive materia	re pressure in the reactor 2. The system also treats the luent through a 310 foot to the environment.

	Calculation For Diesel Generator 2 Loading Under				Calc. No. 9389-46-19-2		
Sargent & Lundy'''	Design Bases Accident Condition			Rev	.	Date	
	x	Safety-Related	Non-Safety-Related	Pag	e {	3.0-6	

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

The SBGT system will auto initiate on the following conditions:

- 1.) A Train in primary, B Train in standby
 - a. High radiation in Reactor Building Vent System (4mr/hr)
 - b. High radiation on refuel floor (100mr/hr)
 - c. High drywell pressure (+2 psig)
 - d. Low Reactor water level (+8 inches)
 - e. High radiation inside the drywell (10² x R/hr)
- 2.) A Train in standby, B Train in primary

If the A train of SBGT system is in standby, a timer is enabled which will initiate the A train of SBGT if a low flow is present on B train SBGT for longer than the allowed time. Per DIS7500-01, this time is set to operate within 18 to 22 seconds

Since the Case 2 scenario is after the Core Spray Pump start and before t=10minutes, B train SBGT will be shown to operate as described in Case 1 above.

Upon initiation, the SBGT system trips the Normal Reactor Building Vent Supply and Exhaust Fans, and closes A0 valves. It also trips the drywell and torus purge fans. Inlet Butterfly Valve 7503 (N.O.) remains open. The electric heater raises the air temperature sufficiently to lower the relative humidity. Motor Operated Butterfly Valve 7504A is normally open and interlocked closed on SBGT system initiation. Motor operated Butterfly Valve 7505A is normally closed and interlocked open upon SBGT system initiation. Motor Operated Butterfly Valve 7507A is normally closed and interlocked open on SBGT initiation. SBGT Fan 2/3-7506A will drive the filtered air out through the ventilating chimney.

5) Control Room Standby Air Conditioning and Emergency Filtration System

The Dresden Control Room should be provided with long term cooling and filtration for the operators to mitigate an accident situation and to maintain long-term operability of the control room equipment. The feed for this standby equipment is fed from MCC 29-8, which is tripped on LOOP to prevent initially overloading the DG, and remains open until is manually closed at the appropriate time. The Control Room Emergency Air Filtration Unit (AFU) in this system is required to operate starting 40 minutes after a postulated accident.



Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

The procedure for securing Control Room HVAC according to DGA-12, Revision 16 is as follows:

- 1.) Reset UV relays on Bus 29.
- 2.) Close Bus 29 to MCC 29-8 at MCC 29-8.
- 3.) At Panel 923-5, start Air Filtration Unit by placing AIR FLTR UNIT BOOSTER FAN A/B control switch in either FAN A <u>or</u> FAN B position.
- 4.) At Panel 923-5, isolate Control Room by placing CONTROL ROOM ISOLATION switch in ISOLATE position.
- 5.) <u>If</u> Instrument Air is lost to Booster fan outlet dampers, <u>then</u> manually throttle flow to 2000 cubic feet per minute.
- 6.) Start Control Room Standby Air Handler Unit and Air Conditioner.

For conservatism, this calculation shows all of the associated CR HVAC to start simultaneously at 10+++ minutes.

CALC NO.		9389-46-19-2	REVISION	002	PAGE NO. 9.0-1						
IX	MET	HODOLOGY									
	Α.	Loading Scenarios:									
		There are three different abno operating:	rmal conditions on which the	Emergency	Diesel Generator can be						
		1) Loss of AC Offs	ite Power (LOOP)								
		2) Safe Shutdown	Due to Fire								
		3) LOOP concurrent	nt with LOCA								
		The above scenarios will be o worst case scenario and why	compared for total loading an the scenario was chosen.	d heaviest s	equential loading to determine						
	В.	Continuous Loading Evalua	ition								
	r	The following Attachments are	used to determine and deve	lop the conti	nuous loading of the DG:						
		Table 1	,								
		ETAP for the load and manually state	d summary of the loading of t Irted loads (Attachments F &	he DG at sel G).	ected steps of automatically R2						
		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 R2 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 steady state load of all running	ne DG load profile, the ETAP and starting services for the s	total load wil starting step	be the summation of the R2 being analyzed.						
		The ETAP model was revised prior to Revision 002. Scenari DG load profile as loads are en	to mimic the ELMS-AC data os were created in ETAP to nergized and de-energized.	files that we model the va	ere part of the calculation arious loading steps in the						
		The scenarios used to model to scenarios use loading categor loading category "Condition 3" 3" as zero and the load is ener 100% in the "DG Loading" cate different than that in load cond AC data files for this calculation of the DG load profile. No spe switches. The breakers were of duplicate the loading on the DC	the DG loading in ETAP are I y "DG Loading". This loading In cases where a load was gized during the diesel loadin egory. If the bhp for a given I ition 3, it was revised to mato n. Breakers were added for cific breaker data was entered opened and closed as require 3 for each load step previous	listed in the f g category w identified in ng scenario, load in the p ch the bhp va various load ed as these t ed creating o sly captured	table that follows. All vas created by duplicating loading category "Condition the loads were modeled as revious DG data files was alue in the previous ELMS- s that change state as part preakers are only used as configurations which in the ELMS-AC program.						

CALC NO.	9389-46-19-2	REVISION	003	PAGE NO.	9.0-2
	The scenarios used to mode scenarios use one of three k Ld 2 CCSW". These loading In cases where a load was id energized during the diesel k categories. If the bhp for a g condition 3, it was revised to calculation. Breakers were a No specific breaker data was were opened and closed as for each load step previously identical except the BHP valit Ld 0 CCSW" represents the "DG Ld 1 CCSW" reflects re- loading value for a single CC CCSW" except CCSW bhp v	el the DG loading in ETAP are bading categories named "DG g categories were created by dentified in loading category " oading scenario, the loads we given load in the previous DG match the bhp value in the p added for various loads that of s entered as these breakers a required creating configuration captured in the ELMS-AC pro- ues associated with the CS, I first 10 minutes of the accided duced CS and LPCI loading v SW pump in operation. "DG values are reduced to reflect of	e listed in the ta 3 Ld 0 CCSW duplicating loa Condition 3" a ere modeled a data files was revious ELMS change state a are only used a ons which dupl rogram. The ta PCI and CCS ant where no C values after 10 Ld 2 CCSW" operation of bo	able that follows. The , "DG Ld 1 CCSW" and ding category "Conditions s zero and the load is s 100% in these loading different than that in lo -AC data files for this s part of the DG load pro- as switches. The break cate the loading on the pree loading categories W pumps are varied. " CSW pumps are opera- minutes and a 115% b is the same as "DG Ld oth pumps.	d "DG on 3" g yaad R3 rofile. kers b DG are b DG ating. hp 1
	Four study cases were create DG_2_CCSW and DG_Vred named loading category and runs correspond to less than "Nominal" and "Gen Min" for The Unit 2 diesel voltage was categories respectively. 60% This value is supported by th the Newton Raphson method at 99 and the precision set to a result of execution of the lo	ed for use with this calculatio uced. The first three study ca the DG_Vreduced case uses 10 minutes into the event. T the first three study cases an s set to 100% and 60% for th was chosen as it envelopes e calculations performed in S d of load flow was selected with 0.000001. Only the initial bu ad flow. No diversity factors	n: DG_0_CCS ases use the c s the DG_0_CC 'he generating d DG_Vreduc e "Nominal" ar the lowest ex Section 10. In the the maximu us voltages we or global tolera	W, DG_1_CCSW, orresponding similarly CSW loading category category was set to ed study cases respect of "Gen Min" generation bected DG terminal vol- each of these study cas m number of iterations re chosen to be update ances were used.	R3 as all ively. n tage. ses, set ed as
	The scenario wizard in ETAP each time step in the DG load scenarios. Each scenario wa can vary depending upon the are run using the initial bus vo reached regardless of the bus for each study case is not acc calculate the loading on the D settings, configurations, etc.	was used to set up the confi d profile. The study wizard w as run three times in a row as order that the study cases an oltages in the bus editor. The s voltages in the bus editors p curate enough to guarantee a OG during each time step are	guration, study as used to gro part of each s re run as certa multiple runs prior to each lo unique solution listed below al	v case, and output repo up and run all of the tudy macro. The resul- in calculations within E assure a unique solution ad flow run. The precision. The scenarios used ong with the relevant E	ort for ts TAP on is sion d to TAP
		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		

CALC NO.

9389-46-19-2

REVISION 003

PAGE NO. 9.0-3

Scenario	Configuration	Study Case	DG Voltage	Output Report	Study Macro	Description
DG2_Bkr_Cl	DG2_Bkr_Cl	DG_0_CCSW	4160∨	DG2_Bkr_Close	DG2_Vnormal	Initial loading on DG due to 480V loads when DG breaker closes
DG2_UV_Reset	DG2_UV_Rst	DG_0_CCSW	4160V	DG2_UV_Reset	DG2_Vnormal	Scenario DG2_Bkr_Cl plus 1 st LPCl pump and auxiliarles
DG2_T=5sec	DG2_T=5sec	DG_0_CCSW	4160∨	DG2_T=5sec	DG2_Vnormal	Scenario DG2_UV_Reset plus 2 nd LPCI pump
DG2_T≈10sec	DG2_T=10sec	DG_0_CCSW	4160V	DG2_T=10sec	DG2_Vnormal	Scenario DG2_T=5sec plus Core Spray Pump and Auxiliaries
DG2_T≈10-min	DG2_T=10-m	DG_0_CCSW	4160V	DG2_T=10-min	DG2_Vnormal	Scenario DG2_T=10sec minus MOV that have completed stroke
DG2_T=10+min	DG2_T=10+m	DG_1_CCSW	4160V	DG2_T=10+min	DG2_Vnormal	Scenario DG2_T=10-min plus 1 st CCSW pump and Auxiliaries
DG2_T=10++mn	DG2_T10++m	DG_2_CCSW	4160V	DG2_T=10++min	DG2_Vnormal	Scenario DG2_T=10+min plus 2 nd CCSW pump and Auxiliaries minus 1 LPCI pump.
DG2_CR_HVAC	DG2_CR_HVAC	DG_2_CCSW	4160∨	DG2_CR_HVAC	DG2_Vnormal	Scenario DG2_T=10++min plus Control Room HVAC and all other long term loads.
DG2_Bkr_Vlow	DG2_Bkr_Cl	DG_Vreduced	2496∨	DG2_Bkr_Vred	DG2_Vreduce	Scenario DG2_Bkr_Cl run at lowest expected voltage
DG2_UV_VIow	DG2_UV_Rst	DG_Vreduced	2496∨	DG2_UV_Vred	DG2_Vreduce	Scenario DG2_UV_Reset run at lowest expected voltage
DG2_T=5sVlo	DG2_T=5sec	DG_Vreduced	2496V	DG2_T≈5sVred	DG2_Vreduce	Scenario DG2_T=5sec run at lowest expected voltage
DG2_T=10-mLo	DG2_T=10-m	DG_Vreduced	2496V	DG2_T=10-mred	DG2_Vreduce	Scenario DG2_T=10-min run at lowest expected voltage

	CF	ALCOLATION PAG			
CALC NO.	9389-46-19-2	REVISION	002	PAGE NO. 9	.0-4
MET	[HODOLOGY (cont'd)				
<u>с.</u>	Transient Loading Evaluatio	n.			R2
	The following attachments are	used to determine and dev	velop the transi	ent loading of the DG:	
	Table 1				
	• Table 4				
	Flow Chart 1				
•	Use of Dead	Load Pickup Curve.		· · · ·	
	The following formulas will be motor data provided and the E	used to determine the start TAP reduced voltage scena	ing KVA on the arios.	DG at each step from the	10 R2
	Calculating starting KVA (SKV)	A_R) at the machine's rated r	voltage (V _R)		
	SKVAR = √3 V _R I _{LRC}				
•••	where, I _{LRC} is the mach	ine's Locked Rotor Current	•		
				1	
CALCULATION PAGE

CALC NO.	9389-46-19-2	REVISION	003	PAGE NO. 9.0-5
MET	HODOLOGY (cont'd)			
	Calculating starting KVA (SKVA)	at the machine's rated v	oltage (V ₂)	· · · · · · · · · · · · · · · · · · ·
	SKVA @ $V_2 = (V_2)^2 / (V_R)^2$	^t x SKVA _R		
	The starting kW/kVAR for the sta in Table 4.	rting loads in each step	will be calcul	ated and tabulated separately
	The reduced voltage ETAP files a start with the exception of the las The 1 st CCSW pump was modele concurrently with the 2 nd CCSW p The reduced DG terminal voltage starting step. The reduced termin current caused by the running loa	are run for each timefran t CCSW pump which is t ed as starting concurrent pump in order to create a s is equal to or lower than hal voltage will be used to do operating at lower that	ne immediate bounded by a with the aux bounding ca bounding ca bou	ely preceeding a large motor a start of the 1 st CCSW pump. illiary loads energized ase for a CCSW pump start. dip during the most severe an incremental increase in age.
	The difference in current will be refactor of the running loads) and a the net starting KVA.	eflected as the equivalend ded to the total starting	t kw/kvar at kw/kvar of ti	full voltage (at the power he starting loads to determine
:	The power factor of the running lo	oads is taken from ETAP	•	
1	Calculating the incremental KVA	for previously running loa	ads is done a	s follows:
	I _{Cum@100%} = Taken from ET	AP output report from th	e study case	es run at nominal voltage
	Icurr@reduced voltage = Taken fr	om ETAP output report	rom DG_Vre	educed study cases
	$\Delta I = I_{Curr@reduced voltage - I_{Curr@re$	100%		
	ΔKVA = ΔI x √3 x 4.16KV			
	Conservatively, the worst voltage large motor starting cases. The pr occurs when the Core Spray Pum voltage dip is 61.8% of bus rated conservatism, 60.0% (i.e. 2496V)	drop case due to the pre evious calculation revision p starts. Revision 13 of (voltage for Unit 3 when the of bus rated voltage will	sence of run ons show tha Calculation 7 ne first LPCI be used for a	ning load will be applied to all at the largest voltage dip 317-33-19-2 shows that the Pump is starting. For all running load conditions.
. 、	The voltage dip and one second re determined from the EMD's Dead	ecovery at the DG for the Load Pickup Curve #SS	e initial start a C-5056	at breaker closing is
· · ·			•	

CALCULATION PAGE

	CALCULATION PAGE										
CALC NO.	9389-46-19-2	REVISION	002	PAGE NO.	9.0-6						
	(Ref. 13) by using the total sta is determined by vectorially a changed to KW/KVAR of the KW/KVAR of the 4000V moto to determine the voltage dip a	arting KVA value from Table dding the step starting load l running load of the previous or that is starting to determin and one second recovery at	4. Following KW/KVAR from scenario in the e the total stat the DG termin	the initial start, the tot m Table 4, the ΔKVA le ETAP file, and the s rting KVA, which is the als.	al KVA starting f en used						
	The Dead Load Pickup Curve start based on the DG transie and the governor in order to p utilizes the results of dynamic curve shows voltage recovery due to exciter and governor o the voltage improvement past	e provides initial voltage dip a ent starting load. The curve is provide recovery voltages. T DG characteristics reflected y up to 1 second, the voltage peration. The DG Strip Cha t 1 second.	and recovery a includes the c he voltage dip d in the manuf will continue and for the surve	after 1 second followin ombined effect of the o and recovery analysi acturer's curve. Thou to improve after 1 sec eillance test (Ref. 23)	g a exciter s gh the ond shows						
	To determine motor starting to rotor current at rated voltage. proportional to applied voltage	erminal voltage, the cable vo This is conservative since t e.	bitage drop is o he locked roto	calculated using the lo or current is directly	cked						
D.	 NO. 9389-46-19-2 (Ref. 13) by using the total is determined by vectoriall changed to KW/KVAR of the 4000V m to determine the voltage d The Dead Load Pickup CL start based on the DG trar and the governor in order utilizes the results of dynal curve shows voltage recover due to exciter and governot the voltage improvement p. To determine motor starting rotor current at rated voltage proportional to applied volt D. Analysis of control circut When the DG starts a larg voltage. There is a concert drop-out. Table 2 of this coperation of the mechanical seconds & 10 seconds after mechanical equipment. E. Protective device evaluation voltage recovery after The duration of starting curve shows protection of MCC 28/29-7 No. 9389-46-19-2 No. 9389-46-19-2 (Ref. 13) by using the total is determined by vectorial is a concert operation of MCC 28/29-7 No. 9389-46-19-2 No. 93899-46-19-2 No. 93899-46-19-2 No. 93899-19-2 No.	during motor starting tran	sient 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 use 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 voltage dip	n and MOV operating time	effects durin	g motor starting tran	isient						
	The voltage recovery after one The duration of starting curren because of better DG voltage starting time at motor rated vo operation due to overcurrent of operating from the DG power protection of MCC 28/29-7 has	e second will be evaluated for the sexpected to be shorter the recovery. Because protective ltage and during operation fro or longer operating time is no during LOOP concurrent with s been studied in S&L Calcu	or net effect or han operation /e devices are rom offsite por of expected to h LOCA. The lation 8231-05	the protective device from offsite power sou set to allow adequate wer, protective device be a concern when voltage and frequency -19-1	s. urce /						
				•							
		· · · · ·									

R2

	Cal	culation For Diesel G	Calc. N	Calc. No. 9389-46-19-2			
Sarger# & Lundy***	_	Design Bases Acc	Rev.	Date			
	х	Safety-Related	Non-Safety-Related	Page	9.0-7/F.Nac		

Client ComEd	Prepared by	Date	
Project Dresden Station Unit 2	Reviewed by	Date	
Proj. No. 9389-46 Equip. No.	Approved by	Date	

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 occurring 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:

 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] x 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 speedtorque curve.
- 3) The torque of the load is subtracted from the determined motor torque to obtain the net accelerating torque.
- 4) Finally the time to accelerate through an RPM increment is found using the following equation:

t = [WK²(pump + motor) x RPM increment] / (307.5 x Net Accelerating Torque)

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

CALCULATION PAGE

CALC NO. 9389-46-19-2 REVISION 003 PAGE NO. 10.0-1

X CALCULATIONS AND RESULTS

The following set of Calculations and Results are for the condition when DG 2 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 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 is **1541 kW**, which is adequate for Dresden Station (Note: Note 3 of Table 3.1-1 was considered when calculating this loading).

Also, the Dresden Re-baselined Updated FSAR, Rev. 0, Figure 8.3-4 shows that the maximum loading on DG 2 during LOOP concurrent with LOCA is **2247 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 1 was developed to show loads powered by the DG and the loads that will be automatically activated when the DG output breaker closes to 4-kV Bus 24-1 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 various configurations to model the loads as described in the methodology section. The CCSW Pumps are manually started and a LPCI Pump is turned off to stay within the DG capacity.

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 2 Load vs Time profile of starting loads for the DG was developed from Table 1 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 4. The following is a sample calculation for LPCI Pump 2C showing the determination of motor starting kVA and starting time. It is shown for demonstrative purposes only (based on Rev. 2). 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.

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1 Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
Cub. No.							
24-1 1	Reactor Bldg. Cooling Water Pump 2/3 (2/3-3701)	Yes	Trip due to bus undervoltage and does not auto start.		12E-2397	н	M20
24-1 6	LP Coolant Injection Pump 2C (2-1502-C)	No	Trip due to bus undervoltage and auto starts 0 seconds after UV relay reset.		12E-2436 Sh. 2	W	M29 Sh. 1
24-1 8	LP Coolant Injection Pump 2D (2-1502-D)	No	Trip due to bus undervoltage and auto starts 5 seconds after UV relay reset.		12E-2436 Sh.2	W	M29 Sh.1
24 -1 9	Reactor Shutdown Cooling Pump 2B (2-1002-B)	Yes	Trip due to bus undervoltage and will not auto start.		12E-2516	G	M32
24-1 10	Core Spray Pump 2B (2-1401-B)	No	Trip due to bus undervoltage and auto starts 10 seconds after UV relay reset.		12E-2429 Sh.2	X	M27
24-1 12	Reactor Clean-Up Recirculation Pump 2B (2-1205-B)	Yes	Trip due to bus undervoltage and will not auto start.	·	12E-2520	P	M30
24-1 13	Bus Tie 24-1/34-1 ACB 152-2432 (3-6734-21)	No	N.O. breaker and does not auto close.		12E-2328	L	
24-1 14	Reactor Bldg. Cooling Water Pump 2B (2-3701-B)	Yes	Trip due to LPCI Initiation and no auto mode for starting.		12E-2397	Н	M20
29 293A	Fuel Pool Cooling Water Pump 2B (2-1902-B)	Yes	Trip due to bus undervoltage, and no auto mode for starting.		12E-2548	R	M31
29 293C	2-902-63 ESS UPS Panel (Normal feed)	No	Starts as soon as voltage is restored to Switchgear 29 (0 seconds).		12E-2811E	E	
29 294A	Recirculation MG Sets Vent Fan 2B (2B-5701)	Yes	Trips due to UV relay and does not restart.		12E-24200	K	
29 294B	480V MCC 29-3 (Main feed)	Yes	Trip due to UV and will not auto close.		12E-2374	S	

Calc. No. 9389-46-19-2 Rev. 1 Page A1 Proj. No. 9389-46

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Ti 1 Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
Cub.							
No.				·			
29	480V MCC 29-8 Main Feed	Yes	Trip due to UV and will be		12E-6811C		
294D	(2/3-7829-81A)		manually closed by the operator		•		
	·		at 10 min.		105 02970	G	M270
29	S.Turb Room Vent Fan	Yes	Trip due to bus undervoltage,		12E-230/D	G	14121.0
295A	(2B-5702)		and will not auto start.		12E-2399A	K	M269
29	Reactor Building Vent Fan 28	res	inplace to bus undervoltage,		12L-2000/1	``	
2930	Reactor Ride Exhaust Ean 2R	Ves	Trip due to bus undervoltage		12E-2399A	ĸ	M269
295C	(2B-5704)	103	and will not auto start.				
29	Reactor Bldg, Exhaust Fan 2C	Yes	Trip due to bus undervoltage,		12E-2399A	K	M269
295D	(2C-5704)	[and will not auto start.			1	
29	Drywell Cooler Blower 2C	Yes	Trip due to core spray initiation	· · · · ·	12E-2393	N	M273
296A	(2C-5734)		and will not auto start.		105 0000	+	14070
29	Drywell Cooler Blower 2D	Yes	Trip due to core spray initiation	·	12E-2393	N	M213
2968	(2D-5734)	<u> </u>	and will not auto start.	·	125 2202		14272
29	Drywell Cooler Blower 2E	Yes	Trip due to core spray initiation		122-2393		WIZI J
2300		+ 700	Trip due to LN/ and will not outo		12E-2661N	1-	
2960	400V WICC 29-5 & 29-0 Main Feed	res	close			1	
	(2-7829-5A1) (2-7829-6A1)						
29-1	120/208V Distr Xfmr 29-1	No	Turn on when MCC 29-1 has full		12E-2677/	AA	=
A4			voltage starts at 0 sec.				
29-1	Drywell Air Compressor	No	Will operate at 0 seconds.		12E-2514	С	
B1	(2-4710-A/B)						
						<u> </u>	
29-1	Standby Liquid Control Tank	No	It will turn on according to a tank	Considering worst case, this	12E-2460	ין י	'
BZ	Heater		thermistor and off by a tank low	equipment will start at 0 seconds	5n. 1		
	(2-1103)		level cut off switch.		1		

Calc. No. 9389-46-19-2 Rev. 1 Page A2 Proj. No. 9389-46

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Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
Cub. No.							
29-1 B3	Standby Liquid Control Pump 2B (2-1102-B)	Yes	Normal position of control sw. is "off" and is not expected to operate.		12E-2460 Sh.1	W	M33
29-1 C1	HPCI Floor Drain Sump Pump (2-2301-250)	No	Turn on and off by the level switch.	Water level in the sump pump is not expected to go up, pump will not run.	12E-2533	T	
29-1 C3	Drywell and Torus Purge Exhaust Fan 2B (2-5708B)	Yes	Load trips due to LPCI initiation and fan will not be started.		12E-2383	N	M269
29-1 C4	AGAD Air Compressor (2-2501)	No	Normally isolated and de- energized (see UFBAR).	Considering worst case, this equipment will be used for long term stabilization.	12E-8556	E	
29-1 D1	HPCI Turb. Inlet Isolation Valve (2-2301-4)	No	N.O. valve and interlocked closed with isolation signal at 0 seconds.		12E-2529 Sh.2	AF	M51
29-1 D2	Car Puller	No	Does not operate in auto mode.	This equipment is not expected to be used during accident conditions.	12E-26778	W	
29-1 D3	Shutdown Heat Exch, Close Cooling Water Isolation Valve (2-3704)	Yes	N.O. and is manually operated only.	It is not expected to operate.	12E-2677E	W	M20
29-1 D4	LPCI Drywell Spray Valve 2C (2-1501-27B)	Yes	N.C. & interlocked closed by LPCI initiation.		12E-2440	S	M29 Sh.1
29-1 E1	Core Spray Outboard Isolation Valve 2B (2-1402-24B)	Yes	N.O. and interlocked open with low Rx. pressure (325 psig).		12E-2431 Sh.2	×	M27
29-1 E2	Core Spray Inboard Isolation Valve 2B (2-1402-25B)	No	N.C. and interlocked open with core spray initiation at 10 seconds.		12E-2431 Sh.2		M27

Calc. No. 9389-46-19-2 Rev. DOQ Page A3 Proj. No. 9389-46

DG2EXCEL.XLS

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T: 1 Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./ Cub. No	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-1 E3	West LPCI/Core Spray Room Sump Pump 2A (2-2001-511A)	Yes	Pump operates on a level switch.	Water level in Core Spray area is not expected to go up.	12E-2677C	V	
29-1 E4	120/208V Rail Cask Xfmr (Receptacle)	No	During DBA condition, this receptacle is not used.		12E-2677C	V	
29-1 E5	East LPCI/Core Spray Room Area Sump Pump (2001-510B)	No	Pump operates on a level switch.	Water level in core spray area is not expected to go up.	12E-2677C	V	
29-1 E6	Post LOCA H2 And O2 Monitoring Sample Pump 2B (2-2400-2B)	No	Load will operate at 0 seconds.		12E-6555A	E	
29-1 F1	LPCI Pump Drywell Spray Discharge Valve 2D (2-1501-28B)	Yes	N.C. and interlocked closed by LPCI initiaton.		12E-2441 Sh.3	W	M29, A-4 Sh.1
29-1 F3	Closed Cooling Water Drywell Return Valve 2A (2-3703A)	No	N.O. and remains open.		12E-2398	D	M20
29-1 F4	Drywell / Torus Air Comp. 2B (2-8549-B)	Yes	Will not operate, switch is in off position.	Assume in off position.	12E-2372B	м	
29-2 A1	125 V Battery Charger 2 (2-8300-2)	No	Start at 0 seconds.		12E-2389D	C	
29-2 A2	Diesel Cooling Water Sump Pump 2 (2-3903)	No	Turns on by the the diesel engine shutdown relay at 0 seconds.		12E-2350B Sh.1	U	M22
29-2 A3	Diesel Starting Air Compressor 2B (2-4611-B)	No	Turns on and off by the pressure switches starts at 0 seconds.		12E-2350B Sh.1	U	M173
29-2 A4	Condensate Transfer Pump 2B (2B-4301)	Yes	Trip by power loss and will not auto start.	· · ·	12E-2370	R	

Calc. No. 9389-46-19-2 Rev. 1 Page A4 Proj. No. 9389-46

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Je 1 Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./ Cub.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-2 B1	120/208V Xinir Mag Tape Drive	No	Start at 0 seconds.		125 26768	3	
29-2 82	Diesel Oil Transfer Pump 2 (2-5203)	No		Even though day tank has enough fuel for first few hours, for conservatism,this pump is considered to start at time 0 seconds.	12E-2350B Sh.1	U	M41 Sh.2
29-2 B5	Turbine Deck Vertical Milling Machine	No	Power available when MCC 29-2 is re-energized.	Not expected to used during a DBA Condition.	12E-2678B	X	
29-2 B6	250 V Battery Charger 2 / 3 (2/3-8350-2/3)	No	Start at 0 seconds.		12E-2678B	X	
29-2 87	Turbine and Radwaste Building Emergency Lighting (2-7902)	No	Auto starts after 1 minute.	Considering the load to operate at 10 seconds after UV relay reset.	12E-2678B	S	
29-2 C2	RX. Protection System M - G Set 2B (2-8001-B)	No	Stops due to power loss and will auto start at 0 seconds.		12E-2592	J	
29-2 C4	480V MCC 115 Reserve Feed (Temporary)	No	Reserve Feed is normally de-energized.	Assume Reserve Feed is not operating.	12E-2678E	X	
29-2 D1	Containment Cooling Service Water Pump Cubicle Cooler C Fan 1 (2-5700-30C)	No	Turns on by operating the CCSWP 2C (starts at 10++ minutes).		12E-26780	E	M274
29-2 D2	Containment Cooling Service Water Pump Cubicle Cooler C Fan 2 (2-5700-30C)	No	Turns on by operating the CCSWP 2C (starts at 10++ minutes).		12E-26780	E	M274
29-2 D3	Containment Cooling Service Water Pump Cubicle Cooler D Fan 1 (2-5700-30D)	No	Turns on by operating the CCSWP 2C (starts at 10++ minutes).		12E-26780	E	M274

Calc. No. 9389-46-19-2 Rev. ©©3 Page A5 Proj. No. 9389-46

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Table 1Automatically Turn On and Off Devices Under the
Design Basis Accident Condition
Dresden Station - Unit 2

Bus No./ Cub.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-2 D4	Containment Cooling Service Water Pump Cubicle Cooler D Fan 2 (2-5700-30D)	No	Turns on by operating the CCSWP 2C (starts at 10++ minutes).	· , , , , , , , , , , , , , , , , , , ,	12E-2678C	E	M274
29-2 D5	Diesel Ventilating Fan 2 (2-5790)	No	Turns on when engine speed is 800 rpm. or greater, start at 0 sec.		12E-2350B Sh.1	U	M1297
29-4 A1	Core Spray Pump Suction Valve 2B (2-1402-3B)	Yes	N.O. & interlocked open by core spray initiation.		12E-2432	W	M27
29-4 A2	Core Spray Test Bypass Valve 2B (2-1402-4B)	Yes	N.C & interlocked closed by Core Spray initiation.		12E-2433	M	M27
29-4 A3	LPCI Pump 2C Suction Valve (2-1501-5C)	Yes	N.O. interlocked open by LPCI initiation.		12E-2440	S	M29 Sh. 1
29-4 A4	LPCI Pump 2D Suction Valve (2-1501-5D)	Yes	N.O. interlocked open by LPCI initiation.		12E-2440	S	M29 Sh.1
29-4 B1	LPCI Torus Spray Valve 2C (2-1501-38B)	Yes	N.C. & interlocked closed by LPCI initiation.		12E-2441 Sh.1	W	M29 Sh.1
29-4 B2	LPCI Torus Spray Valve 2D (2-1501-20B)	Yes	N.C. & interlocked closed by LPCI initiation.		12E-2441 Sh.2	W	M29 Sh. 1
29-4 B3	LPCI Torus Ring Spray Valve 20 (2-1501-18B)	Yes	N.C. & interlocked closed by LPCI initiation.		12E-2441 Sh.1	W	M29 Sh.1
29-4 B4	LPCI Torus Ring Spray Valve 2D (2-1501-19B)	Yes	N.C. & interlocked closed by LPCI initiation.		12E-2441 Sh.2	W	M29 Sh.1
29-4 C1	Refueling Floor JIB Cranes (2-899)	No		It is expected that the refueling JIB cranes will not be used during DBA.	12E-2680E	3 N	

Calc. No. 9389-46-19-2 Rev. 1 Page A6 Proj. No. 9389-46

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Automatically Turn On ano Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

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No./ Cub.	- dothien Descriptoinno.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
No. 29-4	Containment Cooling Heat	No	NO padiate de la dela				
C2	Exchanger Discharge Valve 2B (2-1501-3B)		N.O. and indocked closed when service water pump is not running, operator has to open valve before starting CCSWP at 10 min.		12E-2440	S	M29 Sh.1
29-4 C3	LPCI Header Cross-Tie Isolation Valve 2B (2-1501-32B)	Yes	N.O. and inflocked open.		12E-2440	S	M29 Sh.1
29-4 C4	LPCI Pump Flow Bypass Valve 2B (2-1501-13B)	No	N.O. and remains open until flow is above set point and then it will close.	Consider the valve to start operating concurrent with LPCI Pump 2C (0 seconds after UV reset)	12E-2440	S	M29 Sh.1
29-4 D2	HPCI Auxiliary Coolant Pump (2-2301-57)	No	Manually Openated .	Not operated during a LOCA	12E-2531	AB	M51 R-P フ L
29-4 D3	HPCI Pump 2 Area Cooling Unit (2-5747)	No	Start at 0 seconds.		12E-2393	N	
29-4 D4	LPCI / Core Spray Pump Area Cooling Unit 2B (2-5746B)	No	Start at 0 seconds after UV relay reset.	· · · · · · · · · · · · · · · · · · ·	12E-2393	N	
29-4 E2	Diesel Circulating Water Heater 2/3	No	Will operate at 0 seconds.		12E-2351B Sh. 2	AL	
29-4 E2	Engine Lube Oil Circulating Pump Motor (1HP) (2/3-6699-111/113)	No	Lube oil pump starts at 0 sec.		12E-2351B Sh. 2	AL.	
29-4 E2	Engine Lube Oil Circulating Pump Motor (3/4HP) (2/3-6699-111/113)	No	Lube oil pump starts at 0 sec.		12E-2351B Sh. 2	AL	

Calc. No. 9389-46-19-2 Rev. 003 Page A7 Proj. No. 9389-46

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DG2EXCEL.XLS

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Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

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Bus No./ Cub. No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-4 E3	Core Spray Pump Recirc. Isolation Valve 2B (2B-1402- 38B)	No	N.O. and if selected by the loop selection logic for injection, closes when Core Spray injection is sensed.	Considering worst condition, valve will close concurrent with Core Spray Pump start (10 seconds).	12E-2433	M	M27
29-4 E4	LPCI Heat Exch.By pass Valve 2B (2-1501-11B)	No	N.O. and remains open.		12E-2440	N	M29 Sh.1
29-4 E5	HPCI Turbine Oil Tank Heater.	No	Turn on or off by the thermostat setting. Consider worst case starting at 0 seconds.		12E-2532	V	
29-7 A3	LPCI Outboard Isolation Valve 2B (2-1501-21B)	No	N.O., and remains open.	Remains open because break is assumed in Loop "A" and Loop "B" is selected to operate.	12E-2441A	W	M29 Sh.1
29-7 B1	Recirc. Pump 2B Discharge Bypass Valve (2-202-7B)	Yes	N.C. and interlocked closed by RX, pressure below set point.		12E-24208	M	M26 Sh.2
29-7 82	Recirc. Pump 2B Discharge Valve (2-202-5B)	No	N.O. & interlocked closed by LPCI initiation if selected by the loop selection logic.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-24208	BN	M26 Sh.2
29-7 83	Recirc.Loop Equalizing Valve 2 (2-202-6B)	B Yes	N.C. and interlocked closed by RX. low water level and drywell high pressure	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2420	BN	M26 Sh.2
29-7 B4	Recirc, Equalizing Bypass Valve 2B (2-202-9B)	No	N.O. and interlocked closed by RX. low water taysl and drywst high pressure.	This is assumed to be the N.O. bypass valve.	12E-2420		M M26 Sh.2
29-7 C2	Recirc. Pump 2B Suction Valv (2-202-4B)	e No	N.O. and remains open.		12E-2420	BI	M M26 Sh.1

Calc. No. 9389-46-19-2 Rev. 002 Page A8 Proj. No. 9389-46

DG2EXCEL.XLS

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ible 1 Automatically Turn Un and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./ Cub. No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-7 C3	LPCI Inboard Isolation Valve 2B (2-1501-22B)	No	N.C. and interlocked open by LPCI initiation when selected by the loop selection logic circuit.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2441A	W	M29 Sh.1
28-7 B3	LPCI Inboard Isolation Valve 2A (2-1501-22A)	No	N.C. and interlocked closed with LPCI initiation, when it is not selected by LOOP logic ckt.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2441 Sh.4	W	M29 Sh.1
28-7 B4	Recirc. Loop Bypass Valve 2A (2-202-9A)	Yes	N.C. and interlocked closed at LPCI initiation.	This is assumed to be the N.C. bypass valve.	12E-2420A	Ρ	M26 Sh.2
28-7 C1	Recirc. Pump 2A Suction Valve (2-202-4A)	No	N.O. and interlocked open (no auto mode).		12E-2420A	Ρ	M26 Sh.2
28-7 C2	Recirc. Pump 2A Discharge Valve (2-202-5A)	No	N.O. and interlocked open with LPCI initiation if not selected by the loop selection logic.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2420A	P	M26 Sh.2
28-7 C3	Recirc. Pump 2A Discharge Bypass Valve (2-202-7A)	Yes	N.C. and interlocked closed by LPCI initiation.		12E-2420A	P	M26 Sh.2
28-7 C4	Recirc. Loop Equalizing Valve 2A (2-202-6A)	Yes	N.C. and interlocked closed if selected by the loop selection logic.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2420A	P	M26 Sh.2
28-7 D2	LPCI Outboard Isolation Valve 2A (2-1501-21A)	No	N.O. and interlocked closed by LPCI initiation when selected by the loop selection logic.	It was assumed that the break occurred at Loop "A" and the loop selection logic selected Loop "B" to operate.	12E-2441 Sh.3	W	M29 Sh.1

Calc. No. 9389-46-19-2 Rev. 1 Page A9 Proj. No. 9389-46

DG2EXCEL.XLS

T 1 Automatically Turn On and Off Devices Under the Design Basis Accident Condition Dresden Station - Unit 2

Bus No./ Cub. No.	Equipment Description/No.	Load Shed	Known Fact	Assumption / Eng. Judgement	Dwg. Ref.	Rev	Other Ref. (P & ID)
29-9 B4	Standby Gas Treatment Inlet Damper 2/3A (2/3-7505A)	No	N.C. and opens upon SBGT initiation. Starts operating at 0 seconds.		12E-2400D Sh. 1	A	
29-9 B5	Standby Gas Treatment Outside Air Supply Damper 2/3A (2/3-7504A)	No	N.O. and closes upon SBGT initiation. Starts operating at 0 seconds.		12E-2400D Sh. 1	A	
29-9 C4	Standby Gas Treatment Air Heater 2/3A (2/3-A-7503)	No	Starts operation upon iniation of SBGT (0 seconds).		12E-2400D Sh. 2	A	
29-9 D2	Standby Gas Treatment Fan Discharge Damper 2/3A (2/3-7507A)	No	N.C. and opens upon SBGT initiation. Starts operating at 0 seconds.		12E-2400D Sh. 1	A	
29-9 D3	Standby Gas Treatment Fan 2/3A (2/3-A-7506)	No	Starts operation upon iniation of SBGT (0 seconds).		12E-2400D Sh. 2	A	

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) are considered NOT load shed.

Calc. No. 9389-46-19-2 Rev. 1 Page A10 / FINAL Proj. No. 9389-46

Page 10 of 10





TABLE 2

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

Equipment Description/No.

Load Shed

Will the voltage dip at 5 seconds, 10 seconds, and 10 minutes affect the equipments' operation

(Question 1)

Explanation of What is Shown in the Column

This column lists all of the loads connected to the DG buses. It is the same list as shown in Table 1.

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.

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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AFFECTS OF A VOLTAGE DIP

Table 2 Column Description

Will the equipment restart after the voltage recovery

(Question 2)

Will the equipment operate in an adverse mode due to a voltage dip

(Question 3)

Will the time delay in operation cause any adverse affect

(Question 4)

Explanation of What is Shown in the Column

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.

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.

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 the 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. Reference 53 provides a comparaison between allowable and measured and/or calculated valve stroke times for the valves in question. This shows that the addition of 2 seconds to the stroke time of any valve will not result in the total stroke time exceeding the maximum allowable stroke time.
- b. Based on Engineering Judgement, 2 second time delays in room coolers. pumps, etc. would not cause rooms, equipment, etc. to overheat, etc.

Caic. No.93	89-46-19-2
Rev. 🔿	Date
Page BZ	
Proj. No.93	89-46

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TABLE 2

AFFECTS OF A VOLTAGE DIP

Table 2 Column Description

Drawing Reference

Revision

Other Reference

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.

This drawing shows the main schematic or wiring diagram for the control circuit reviewed.

This is the revision number of the drawing referenced above.

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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Calc. No. 389-46-19-2 Rev. O Date Page B3 Proj. No. 9389-4/0

TA 2 AFFECTS OF JLTAGE DIP

Dresden Station - Unit 2

Bus	Equipment Description/No.	Load	Will the voltage dips @	Will the equipment	Will the	Will the time delay in	Dwg, Ref.	Rev	Other
INO.		Sned	55, 105, & 10min.	start after voltage	equipt	operation cause any			rter.
		ł	anect the equipments	recovery ?	operate in	auverse aneor i			
		[operation r		mode due to				
					the voltage				1
					dips ?				
24-1	Reactor Bldg. Cooling Water	Yes	No	N/A	N/A	. N/A	12E-2397	н	M 20
1	Pump 2/3 (2/3-3701)]				
24-1	LP Coolant Injection Pump 2C	No	Yes. The pump might	Yes. Interlock relay	No	No	12E-2436	W	M 29
6	(2-1502-C)		slow down momentarily	controlled by 125V Dc			Sh.2		Sh. 1
24-1	LP Coolant Injection Pump 2D	No	Yes. The pump might	Yes. Interlock relay	No	No	12E-2436	W	M 29
8	(2-1502-D)		slow down momentarily	controlled by 125V Dc			Sh. 2		Sh. 1
24-1 9	Reactor Shutdown Cooling Pump 2B (2-1002-B)	Yes	No	N/A	N/A	N/A	12E-2516	G	M 32
24-1	Core Spray Pump 2B	No	Yes. The pump might	Yes. Interlock relay	No	No	12E-2429	X	M 27
10	(2-1401-B)		slow down	controlled by 125V			Sh.2		
		<u> </u>	momentarily.	DC.				<u> </u>	
12	Reactor Clean-Up Recirculation Pump 2B (2-1205-B)	Yes	No .	N/A	N/A	N/A	12E-2520		M 30
24-1	Bus Tie 24-1/34-1	No	No	N/A	N/A	N/A	12E-2346	AC	
13	ACB 152-2432 (3-6734-21)						Sh.1		
24-1	Reactor Bldg. Cooling Water	Yes	No	N/A	N/A	N/A	12E-2397	H	M 20
14	Pump 2B (2-3701-B)								
29 293A	Fuel Pool Cooling Water Pump 2B (2-1902-B)	Yes	No	N/A	N/A	N/A	12E-2548	R	M 31
29	2-902-63 ESS UPS Panel	No	No The back-up	Yes	No	No	12F-	$+_{F}$	+
2930	(Normal feed)		power supply is from 250Vdc Battery			110	2811B		
29 294A	Recirculation MG Sets Vent Fan 2B (2B-5701)	Yes	No	N/A	N/A	N/A	12E- 2420C	к	

Calc. No. 9389-46-19-2 Revision 1 Page No. B4 Proj. No. 9389-46

T/ _____2 AFFECTS OF JLTAGE DIP

Dresden Station - Unit 2

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 295A	S. Turb Room Vent Fan (2B-5702)	Yes	No	N/A	N/A	N/A	12E- 2387B	G	M 27U
29 295B	Reactor Building Vent Fan 2B (2B-5703)	Yes	No ·	N/A	N/A	N/A	12E- 2399A	к	M 269
29 295C	Reactor Buildg Exhaust Fan 2B (2B-5704)	Yes	No	N/A	N/A	N/A	12E- 2399A	к	M 269
29 295D	Reactor Bldg. Exhaust Fan 2C (2C-5704)	Yes	No	N/A	N/A	N/A	12E- 2399A	к	M 269
29 296A	Drywell Cooler Blower 2C (2C-5734)	Yes	N/A	N/A	N/A	N/A	12E-2393	N	M 273
29 296B	Drywell Cooler Blower 2D (2D-5734)	Yes	N/A	N/A	N/A	N/A	12E-2393	N	M 273
29 296C	Drywell Cooler Blower 2E (2E-5734)	Yes	N/A	N/A	N/A ·	N/A	12E-2393	N	M 273
29-1 A4	120/208V Distr Xfmr 29-1	No	Yes. Transformer might be momentarily interrupted.	Yes. No auxiliary relay interlock.	No	No	12E- 2677A	AF	
29-1 B1	Drywell Air Compressor (2-4710-A/B)	No	Yes. Compressor might slow down momentarily.	Yes. Interlocked with vacuum switch.	No	No	12E-2514	C	
29-1 B2	Standby Liquid Control Heater (2-1103)	No	Yes. Heater output might decrease momentarily.	Yes. Interlocked with tank thermistor.	No	No	12E-2460 Sh.1	W	
29-1 B3	Standby Liquid Control Pump 2B (2-1102-B)	Yes	N/A	N/A	N/A	N/A	12E-2460 SH. 1	W	M 33

Calc. No. 9389-46-19-2 Revision 1 Page No. B5 Proj. No. 9389-46

AFFECTS OF JLTAGE DIP

Dresden Station - Unit 2

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.
29-1 C1	HPCI Floor Drain Sump Pump (2-2301-250)	No	No. Pump is not operating. Float switch on low level.	N/A	N/A	N/A	12E-2533	T	
29-1 C3	Drywell and Torus Purge Exhaust Fan 2B (2-5708B)	Yes	N/A	N/A	N/A	N/A	12E-2393	N	M 269
29-1 C4	ACAD Air Compressor (2-2501)	No	No. Compressor is shown to start after 10 minutes.	Yes.	No	N/A	12E-6556	E	
29-1 D1	HPCI Turb. Inlet Isolation Valve (2-2301-4)	No	Yes. Valve might stop momentarily.	Yes. Interlock relay is powered by 125Vdc. Interlock relay will energize with low RX pressure, steam line break ETC.	No	No. Increased operating time is within acceptable limit.	12E-2529 Sh.2	AF	M 51
29-1 D2	Car Puller	No	No. Not required,	N/A	N/A	N/A	12E- 2677B	W	
29-1 D3	Shutdown Heat Exch. Closed Cooling Water Isolation Valve (2-3704)	Yes	N/A	N/A	N/A .	N/A	12E- 2677B	W	M 20
29-1 D4	LPCI Drywell Spray Valve 2C (2-1501-27B)	Yes	N/A	N/A	N/A	N/A	12E-2440	S	M 29 Sh.1
29-1 E1	Core Spray Outboard Isolation Valve 2B	Yes	N/A	N/A	N/A	N/A	12E-2431 Sh.2	X	M 27
29-1 E2	Core Spray Inboard Isolation Valve 2B (2-1402-25B)	No	Yes. Valve might stop operating momentarily	Yes. Interlock relay controlled by 125V DC.	No	No. The increased operating time is within the acceptable limit.	12E-2431 Sh.2	×	M 27

Calc. No. 9389-46-19-2 Revision 1 Page No. 86 Proj. No. 9389-46

<u>T</u><u>2</u> AFFECTS OF JLTAGE DIP Dresden Station - Unit 2

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.
29-1 E3	West LPCI/Core Spray Room Sump Pump 2A (2-2001-511A)	Yes	N/A	N/A	N/A	N/A	12E- 2677C	V	
29-1 E4	120/208V Rail Cask Xfmr (Receptacle)	No	No. Receptacle is not used during plant DBA condition.	N/A	N/A	N/A	12E- 2677C	V	
29-1 E5	Last LPCI/Core Spray Room Area Sump Pump (2001-510B)	No	No. Pump is not operating, Level switch at low level.	No. Not required.	N/A	N/A	12E- 2677C	V	
29-1 E6	Post LOCA H2 & O2 Monitoring Sample Pump 2B (2-2400-2B)	No	No. Pump may slow down momentarily.	Yes	No	N/A	12E- 6555A	E	
29-1 F1	LPCI Pump Drywell Spray Discharge Valve 2D (2-1501-28B)	Yes	N/A	N/A	N/A	N/A	12E-2441 Sh.3	W	
29-1 F3	Closed Cooling Water Drywell Return Valve 2A (2-3703)	No	No.	N/A	N/A	N/A	12E-2398	D	M 20
29-1 F4	Drywell / Torus Air Comp. 2B (2-8549-B)	Yes	N/A	N/A	N/A	N/A	12E- 2372B	M	
29-2 A1	125 V Battery Charger 2 (2-8300-2)	No	Yes. Charger output might decrease momentarily.	Yes. No auxiliary relay interlock.	No	No	12E- 2389D	С	
29-2 A2	Diesel Cooling Water Sump Pump 2 (2-3903)	No	Yes. Pump might stop momentarily.	Yes. Interlock relay controlled by 125 Vdc.	No	· No	12E- 2350B Sh.1	U	M 22

Calc. No. 9389-46-19-2 Revision 1 Page No. B7 Proj. No. 9389-46

AFFECTS OF L TAGE DIP

Dresden Station - Unit 2

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.	
29-2 A3	Diesel Starting Air Compressor 2B (2-4611-B)	No	Yes. Compressor might stop momentarily.	Yes. Interlocked with pressure switch only.	No	No	12E- 2350B Sh.1	υ	M 173	
29-2 A4	Condensate Transfer Pump 2B (2B-3319)	Yes	No	N/A	N/A	N/A	12E-2370	R		
29-2 B1	120/208V XIM Mag Tape Drive	No	Yes. Transformer might be momentarily interrupted.	Yes. No auxiliary relay interlock	No	No	12E- 2678B	S		R003
29-2 B2	Diesel Oil Transfer Pump 2 (2-5203)	No	No. This pump will not operate for the first 2 hours. See Assumption 2 in text.	Interlocked with level switch only.	N/A	N/A	12-2350B Sh. 1	U	M 41 Sh.2	4
29-2 B5	Turbine Deck Vertical Milling Machine	No	No	No. Not expected to be used during DBA Condition.	N/A	N/A	12E- 2678B	×		
29-2 B6	250 V Battery Charger 2/3 (2/3-8350-2/3)	No	Yes. Charger output might drop momentarily.	Yes. No auxiliary relay interlock.	No	No	12E- 2678B	X		
29-2 87	Turbine and Radwaste Building Emergency Lighting (2-7902)	No	Yes. Lighting might dim momentarily.	Yes. Interlock relay will energize when voltage is back.	No	No	12E- 2678B	S		
29-2 C2	RX. Protection System M-G Set 2B (2-8001-B)	No	Yes. Motor might slow down momentarily.	Yes.	No.	N/A	12E-2592	J		
29-2 C4	480V MCC 115 Reserve Feed (Temporary)	No	No.	No. Normal Feed is assumed to feed this MCC.	N/A	N/A	12E- 2678B	×	+	

Calc. No. 9389-46-19-2 Revision & 9 3 Page No. 88 Proj. No. 9389-46

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Dresden	Station	- Unit 2
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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.
D1	Water Pump Cubicle Cooler C Fan 1 (2-5700-30C)	NO	No. Fan will operate after the second CCSWP is operating at 10++ minutes.	N/A	N/A	N/A	12E- 2678C	E	M 274
29-2 D2	Containment Cooling Service Water Pump Cubicle Cooler C Fan 2 (2-5700-30C)	No	No. Fan will operate after the second CCSWP is operating at 10++ minutes.	N/A	N/A	N/A	12E- 2678C	E	M 274
29-2 D3	Containment Cooling Service Water Pump Cubicle Cooler D Fan 1 (2-5700-30D)	No	No. Fan will operate after the second CCSWP is operating at 10++ minutes.	N/A	N/A	N/A	12E- 2678C	E	M 274
29-2 D4	Containment Cooling Service Water Pump Cubicle Cooler D Fan 2 (2-5700-30D)	No	No. Fan will operate after the second CCSWP is operating at 10++ minutes.	N/A	N/A	N/A	12E- 2678C	E	M 274
29-2 D5	Diesel Ventilating Fan 2 (2-5790)	No	Yes. Fan might stop momentarily.	Yes. Interlock relay energizes when voltage is back.	No	No	12E- 2350B Sh.1	U	
29-4 A1	Core Spray Pump Suction Valve 2B (2-1402-3B)	Yes	N/A	N/A	N/A	N/A	12-2432	W	M 27
29-4 A2	Core Spray Test Bypass Valve 2B (2-1402-4B)	Yes	N/A	N/A	N/A	N/A	12E-2433	M	M 27
29-4 A3	LPCI Pump 2C Suction Valve (2-1501-5C)	Yes	N/A	N/A	N/A	N/A	12E-2440	S	M 29 Sh.1
29-4 A4	LPCI Pump 2D Suction Valve (2-1501-5D)	Yes	N/A	N/A	N/A	N/A	12E-2440	S	M 29 Sh.1

Calc. No. 9389-46-19-2 Revision 1 Page No. 89 Proj. No. 9389-46



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 Ret.
81	LPCI Torus Spray Valve 2C (2-1501-38B)	Yes	N/A	N/A	N/A	N/A	12E-2441 Sh. 1	W	M 29 Sh.1
29-4 B2	LPCI Torus Spray Valve 2D (2-1501-20B)	Yes	N/A ·	N/A	N/A	N/A	12E-2441 Sh.2	W	M 29 Sh.1
29-4 B3	LPCI Torus Ring Spray Valve 2C (2-1501-18B)	Yes	N/A	N/A	N/A	Ņ/A	12E-2441 Sh. 1	W	M 29 Sh.1
29-4 84	LPCI Torus Ring Spray Valve 2D (2-1501-19B)	Yes	N/A	N/A	N/A	N/A	12E-2441 Sh.2	W	M 29 Sh.1
29-4 C1	Refueling Floor JIB Cranes (2-899)	No	No. Equipment is not operating.	N/A	N/A	N/A	12E- 2680B	N	
29-4 C2	Containment Cooling Heat Exchanger Discharge Valve 2B (2-1501-3B)	No	Yes. Valve might stop momentarily.	Yes. Interlock relay controlled by 125 Vdc.	No	No	12E-2440	S	M 29 Sh.1
29-4 C3	LPCI Header Cross-Tie Isolation Valve 2B (2-1501-32B)	Yes	NVA	N/A	N/A	N/A	12E-2440	S	M 29 Sh.1
29-4 C4	LPCI Pump Flow Bypass Valve 2B (2-1501-13B)	No	No. N.O. & remains open. Valve is not operating.	Yes. Interlock relay controlled by 125Vdc.	No	No	12E-2440	S	M 29 Sh.1
D2	(2-2301-57)	No	No. Equipment is not. Openating	N/A	No	No	12E-2531	AB	M 51
D3	HPCI Pump 2 Area Cooling Unit (2-5747)	No	Yes. Pump might stop momentarily.	Yes. Interlocked only with a temperature	No	No	12E-2393	N	
D4	Area Cooling Unit 28 (2-5746B)	No	Yes. Pump might stop momentarily.	Yes. interlocked only with a temperature switch.	No	No	12E-2393	N	

Calc. No. 9389-46-19-2 Revision & %3 Page No. B10 Proj. No. 9389-46

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AFFECTS OF JLTAGE DIP

Dresden Station - Unit 2

Bus	Equipment Description/No.	Load	Will the voltage dips @	Will the equipment	Will the	Will the time delay in	Dwg, Ref.	Rev	Other Ref.	ſ
No.		Shed	55, 105, & 10min.	start alter voltage	operate in	adverse affect ?				
			affect the equipment's	recovery r	adverse					
{ {	1		operation ?		mode due to					
					the voltage					
					dips ?					
				Maa	No	N/A	12E-	AL		-
29-4	Diesel Circulating Water Heater	No	Yes. Heaters output	Yes	UNI	i wa	2351B			
E2	2/3		might decrease				Sh. 2		[
			momentarily.			Nia	12F-	AI	t	-
29-4	Engine Lube Oil Circulating	No	Yes. Pump might stop	Yes. Pumps restant	INO	INU	2351B	1	l	
E2	Pump Motor (1HP)		momentarily.	when voltage is	Į		Sh 2		Į	
	(2/3-6699-111/113)			available.					_	4
29-4	Engine Lube Oil Circulating	No	Yes. Pump might stop	Yes. Pumps restart	No	No	12E-	AL		
E2	Pump Motor (3/4HP)		momentarily.	when voltage is			2351B	Į		
	(2/3-6699-111/113)			available.	1		Sh. 2			
			Ver Metre minte atom	Van Interlook rolou	No	No The increased	12E-2433	M	Ma	27
29-4	Core Spray Pump Recirc.	NO	res. valve might stop	res. Interiock relay		operating time is within		1		
ES			momentanty.	Controlled by 125 vdc.	· •	the acceptable limit.			1	1
100 4			hla	No	No	N/A	12E-2440	i s	M	29
29-4	(2 4501 449)		INO.	1 1 1 0.				1	Sh	1.1
E4	(2-1501-11B)	<u> </u>				Alo	125-2532			
29-4	HPCI Turbine Oil Tank Heater	No	Yes. Heater's output	Yes. Interlocked with	NO	NO	120-2002	•		
E5			might decrease	a temperature switch.	·		Į			
			momentarily.				105	+ 101	-	20
29-7	LPCI Outboard Isolation Valve 2E	No No	Yes. Valve might stop	Yes. Interiock relay	No	No. The increased	125-		IN Ch	23
A3	(2-1501-21B)		operating momentarily	controlled by 125 Vdc	2 J	operating time is within	2441A		101	1. 1
						the acceptable limit.	405	+	+	20
29-7	Recirc. Pump 2B Discharge	Yes	N/A	N/A	N/A	N/A	12E-	M	M	20
B1	Bypass Valve				l		24208		15	n.2
	(2-202-7B)									
29-7	Recirc Pump 28 Discharge Valv	a No	Yes Valve might stor	Yes Interlock relay	No	No. The increased	12E-	N	I M	26
B2	(2-202-58)		operating momentarily	controlled by 125 Vd	e.	operating time is within	n 2420B		s	h.2
1			-poracing momonicanity			the acceptable limit.		~		
29	Recirc Loop Equalizing Valve 2	Ye	s N/A	N/A	N/A	N/A	12E-	N	1 M	26
B3	(2-202-6B)						2420B		s	h.2
1	(1	1	1	1	1				

Calo. No. 9389-46-19-2 Revision 1 Page No. B11 Proj. No. 9389-46

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AFFECTS OF	JLTAGE DIP

Dresden Station - Unit 2

Bus	Equipment Description/No.	Load	Will the voltage dips @	Will the equipment	Will the	Will the time delay in	Dwg. Ref.	Rev	Other
No.		Shed	5s, 10s, & 10min.	start after voltage	equipt	operation cause any	}		Ref.
[[affect the equipment's	recovery ?	operate in	adverse affect ?]		
			operation ?		adverse				
			•		mode due to				
					the voltage				
					dips?				
29.7	Recirc Equalizing Bypass Valve	No	Ves Valve might ston	Yes Interlock relay	No	No. The increased	12E-	Μ	M 26
B4	2B		operating momentarily	controlled by 125 Vdc		operating time is within	2420B		Sh.2
} {	(2-202-98)		operating memoritarity.			the acceptable limit.			
20.7	Pecirc Dump 28 Suction Value	No	No. NO. 8 interlocked	No. Not required	No	No	12E-	M	M 26
C2	(2 202 AR)	NU	open Valve is not	no, nor required.		,,,,,	2420B		Sh.2
	(2-202-40)		operating				-		
29.7	LPCI Inhoard Isolation Value 2P	Nio	Voo Volvo might stop	Veg interlock relay	No	No. The increased	12E-	W	M 29
03		NO	res. valve inight stop	controlled by 125 Vdc		operation time is within	2441A		Sh 1
	(2-1302-22B)	1	operating momentarity.	controlled by 120 vuc.		the accentable limit			
287	I PCI Inhand Insisting Value OA	-	b1/A	NI/A	NI/A	N/A	12E-2441	W	M 29
20-1	LFCI indoard isolation valve 2A	res	IN/A	N/A	I IVA		Sh 4		Sh 1
63	(2-1501-22A)						00.4	1	011.1
28-7	Recirc. Loop Bypass Valve 2A	Yes	N/A	N/A	N/A	N/A	12E-	P	M 26
B4	(2-202-9A)	· ·					2420A		Sh.2
28-7	Recirc. Pump 2A Suction Valve	Yes	N/A	N/A	N/A	N/A	12E-	P	M 26
C1	(2-202-4A)						2420A		Sh.2
28-7	Pacing Pump 24 Disphares Value	- Vac	NI/A	NI/A	<u>Ν/Α</u>	NI/A	12E.	P	M 26
C2	(2 202 5A)	Tes	IN/A	. IVA		11/1	24204	1.	Sh 2
	(2-202-5A)	<u> </u>					LALON		011.2
28-7	Recirc. Pump 2A Discharge	Yes	N/A	N/A	N/A	N/A	12E-	P	M 26
C3	Bypass Valve						2420A		Sh.2
	(2-202-7A)								
28-7	Recirc. Loop Equalizing	Yes	N/A	N/A	N/A	N/A	12E-	P	M 26
C4	Valve 2A (2-202-6A)						2420A	1	Sh.2
28.7	I PCI Outboard Indiation	+	Van Value minht dan			the The increased	405 0444	1.00	1120
20-1	Value 24 (2.4504.244)	NO	res. valve might stop	Yes. Interlock relay	. NO	No. I ne increased	12E-2441		MZS
	Valve 2A (2-1501-21A)		operating momentarily	Controlled by 125 Vac		operating time is within	1 511. 5		Sn. I
20.0	Chardha Cara Tarak	<u> </u>		<u> </u>		ine acceptable limit.		+	
23-9	Standby Gas Treatment Inlet	NO	Yes. Valve might stop	Yes	No	No. The increased	12E-	A	1
04	Damper 2/3A		operating momentarily	· •		operating time is within	1 2400D		ł
	(2/3-/DUDA)					the acceptable limit.	5n. 1		1

Calc. No. 9389-46-19-2 Revision 1 Page No. B12 Proj. No. 9389-46



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.
29-9 85	Standby Gas Treatment Outside Air Supply Damper 2/3A (2/3-7504A)	No	Yes. Valve might stop operating momentarily.	No.	No	No. The increased operating time is within the acceptable limit.	12E- 2400D Sh. 1	A	
29-9 C4	Standby Gas Treatment Air Heater 2/3A (2/3-A-7503)	No	Yes. Heater output might decrease momentarily.	Yes	No	N/A	12E- 2400D Sh. 2	A	
29-9 D2	Standby Gas Treatment Fan Discharge Damper 2/3A (2/3-7507A)	No	Yes. Valve might stop operating momentarily.	Yes	No	No. The increased operating time is within the acceptable limit.	12E- 2400D Sh. 1	A	
29-9 D3	Standby Gas Treatment Fan 2/3A (2/3-A-7506)	No	Yes. Motor might slow down momentarily.	Yes	No	N/A	12E- 2400D Sh. 2	A	

Calc. No. 9389-46-19-2 Revision 1 Page No. B13 / FINAL Proj. No. 9389-46

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	1
2-902-63	2-902-63 ESS UPS Panel	29			1 11-1-1	From	ETAP				37.9	27.9	ROOS
	120/208V Distr Xfmr 29-1	29-1	9	KVA	480	75	100	10.8	100	75	6.8	6.0	1
2-1103	Stand-by Liquid Control Heater	29-1	25	KW	440	100	100	32.8	100	100	25.0	0.0	1
2-2301-4	HPCI Turbine Inlet Isolation Valve	29-1	7.8	HP	460	85	80	10.7	827	54	38.2	59.6	1
2-2400-2B	Post LOCA H2 & O2 Monitoring Sample Pump 28	29-1	1	HP	460	80	75	1.6	625	79	6.1	4.8	1
2-8300-2	125V Battery Charger 2	29-2	1			From	ETAP		4		34.1	30.6	1
2-3903	Diesel Cooling Water Pump 2	29-2	87	KW	460	83	100	131.6	400	31.5	132 1	397.9	I ROOT
2-4611-B	Diesel Starting Air Compressor 2B	29-2	5	HP	460	85	80	6.9	625	58	19.9	27.9	1
2-5203	Diesel Oil Transfer Pump 2	29-2	1.5	HP	460	80	75	23	625	75	87	77	R00
2/3-8350-2/3	250Vdc Battery Charger 2/3	29-2		1	1	From	FTAP				66.1	58.0	1
2-5790	Diesel Ventilating Fan 2	29-2	30	HP	440	85	85	40.6	625	42	813	175.7	1
2-8001-B	RX Protection System M-G Set 2B	29-2	25	HP	440	85	85	220	625	42	60.0	145.7	1
2-5747	HPCI Pump 2 Area Cooling Unit	29-4	3		460	85	80	A 1	625	68	14.0	15.1	R00
	Diesel Circulating Water Heater 2/3	29-4	15	- KW	480	100	100	18.0	100	100	16.0	1 00	1
2/3-6699-111/113	Engine Lube Oil Circulation Pump Motor (1HP)	29-4	1	HP	460	80	75	16	625	70	6.1	4.8	{
2/3-6699-111/113	Engine Lube Oil Circulation Pump Motor (3/4HP)	29-4	0.75	НР	460	80	75	1 1 1	646	02	4.2	1 20	-
	HPCI Turbine Oil Tank Heater	29.4		KW	400	100	100	100	100	100	4.2	2.0	{
2-202-5B	Recir. Pump 2B Discharge Valve	29.7	13		460	05	05	10.0	707	40	52.4	1 0.0	ł
2-1501-22B	LPCI Inboard Isolation Valve 2B	29.7	10.5		400	00	02 70	10.0	191	49	32.4	93.3	4
2-1501-21A	LPCI Outboard Isolation Valve 2A	28.7	16.0		400	00	03.70	13,8	820	43	39.1	82.0	4
2/3-7504A	Stand-by Gas Treatment Outside Air Supply Damper 2/34	20-7	0.61		400	00	00	21.0	123	44	53.2	108.6	4
2/3-7505A	Stand-by Gas Treatment Inlet Damper	29-9	1 4		440	00	1-12-	1.0	025	85	4.0	2.5	4
2/3-A-7503	Stand-by Gas Treatment Air Heater 2/3A	20.0	30		440	00	100	2.3	625	/5	8.2	1.2	4
2/3-7507A	Stand-by Gas Treatment Fan Discharge Damoer 2/24	29-9	1 42		440	100	100	39.4	100	100	30.0	0.0	1
2/3-A-7506	Stand-by Gas Treatment Fan 2/3A	29-9	4.4		460	65	1 80	5.8	625	58	16.7	23.5	1
		1 53-2	<u> </u>	_ нр	460	85	85	25.9	625	44	56.8	115.9	

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))

> Calculation No. 9389-46-19-2 Rev. 3 Attachment C Page C1 of C6

> > ,

TOTAL STARTING KW & KVAR 834.3 1397 3 R003

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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
2-1501-138	LPCI Pump Flow Bypass Valve 2B	29-4	0.13	HP	440	80	75	0.2	527	85	0.7	0.4
2-5746B	LPCI/Core Spray Pump Area Cooling Unit 2B	29-4	5	HP	460	85	80	6.9	625	58	19.9	27.9
Full Load Current FLC from KW = K FLC from KVA = I	(FLC) form HP ≈ (HP x 746) / (1.732 x kV x PF x eff.) W / (1.732 x kV x PF x eff.) KVA / (1.732 x kV x eff.)							TOTAL S	TARTING K	W & KVAR[20.6	28.4
Starting KW (SKV Starting KVAR (S	V) = 1.732 x kV x LRC% x FLC x SPF KVAR) ≖ 1.732 x kV x LRC% x FLC x sin(acos(SPF))											R007

Calculation No. 9389-46-19-2 Rev. 2 Attachment C Page C2 of C6

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	1
2-1401-25B	Core Spray Inboard Isolation Valve 2B	29-1	4	HP	440	85	80	5.8	829.6	58	21.1	29.7	1
2-7902	Turbine & Radwaste Building Emergency Lighting	29-2	33.78	KW	480	90	100	36 1 🖌	100	90	27.0	13.1	1 R003
2-1402-38B	Core Spray Pump Redirc Isolation Valve 28	29-4	0.13	HP	440	80	75	0.2	527	85	0.7	0.4	1
Full and Current							.	TOTAL ST	ARTING K	W&KVAR	48.9	43.2	R003

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))

* From ETAP

Calculation No. 9389-46-19-2 Rev. 3 Attachment C Page C3 of C6

R003

DG Auxiliaries and Other 480V Loads Starting at 10+ Minutes (First CCSW Pump)

Construction of the local division of the lo												
Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
2-1501-3B	Containment Cooling Heat Exchanger Discharge Valve 28	29-4	0.33	HP	460	80	75	0.5	273	85	1.0	0.6
Full Load Current FLC from KW = K FLC from KVA = 1	(FLC) form HP ≖ (HP x 746) / (1.732 x kV x PF x eff.) W / (1.732 x kV x PF x eff.) (VA / (1.732 x kV x eff.)	-						TOTAL S	TARTING K	W & KVAR	1.0	0.6

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))

R002

Calculation No. 9389-46-19-2 Rev. 2 Attachment C Page C4 of C6

DG Auxiliaries and Other 480V Loads Starting at 10++ Minutes (Second CCSW Pump)

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR
2-5700-30C1	Containment Cooling Service Water Pump Cooler C Fan 1	29-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30C2	Containment Cooling Service Water Pump Cooler C Fan 2	29-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30D1	Containment Cooling Service Water Pump Cooler D Fan 1	29-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
2-5700-30D2	Containment Cooling Service Water Pump Cooler D Fan 2	29-2	3	HP	460	85	80	4.1	625	68	14.0	15.1
5 4 4 5					•		<u> </u>	TOTAL S	TARTING K	W & 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))

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Calculation No. 9389-46-19-2 Rev. 2 Attachment C Page C5 of C6

R002

DG Auxiliaries and Other 480V Loads Starting after 10 Minutes

Load No.	Load Description	Bus No.	Rating	Unit	Vrated	PF%	Eff. %	FLC	LRC%	SPF%	SKW	SKVAR	1
	120/208V Distr Xfmr 29-8	29-8	15.00	KVA	480	75	100	18.0	100	75	11.3	9.9	R002
2/3-9400-102	Control Room Standby AC	29-8	150.00	HP	460	89.5	93	168.7	578	32.2	250.2	735.7	1
2/3-9400-104A	Control Room AFU Booster Fan A	29-8	7.50	HP	480	85	80	9.9	625	56	28.8	42.6	1
2/3-9400-100	Control Room Standby AHU	29-8	50.00	HP	480	85	90	58.6	625	38	115.8	281.9	1
2/3-9400-101	Control Room AFU Heater	29-8	12.00	KW	480	100	100	14.4	100	100	12.0	0.0	1
		· · · · · · · · · · · · · · · · · · ·						TOTAL	TIGTING	11/ 0 1/1/4 001	440.4	10304	1 0000

TOTAL STARTING KW & KVAR 418.1 1070.1 R002

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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))

> Calculation No. 9389-46-19-2 Rev. 2 Attachment C Page C6 of C6

R002

	Cal	culation For Diesel G		Calc. No	. 9389-46-19-2	
Sargent & Lundy"		Design Bases Acc		Rev.)	Date	
	x	Safety-Related	Non-Safety-Related]	Page D	١
·····						

Client ComEd	Prepared by	Date
Project Dresden Station Unit 2	Reviewed by	Date
Proj. No. 9389-46 Equip. No.	Approved by	Date

Attachment D



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FIGURE 2 - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

			(Os)	C	X	56	108	10+ min	10++ min	10+++ min	
Load No.	Load Description	Bus No.		- 5,6	A. 4. 4. 4.		1000	199-14	Star 20	AL.	3
12-1502-C	LPCI Pump 2C	24-1		┢			+				7
1502-D	LPCI Pump 2D	24-1]				+	+	}		
-1401-B	Core Spray Pump 2B	24-1]					+	<u> </u>		4
1	Containment Cooling Service Water	24]
Ļ	Pump 2C		4 1								7
[Containment Cooling Service Water	24							Ļ	[
0.000.00	Pump 20						1				
2-902-63	2-902-63 ESS UPS Panel	29				1	1	1	†		1.
0.1740.470	120/2089 Distr Amr 29-1	29-1					1	1			110
2 4/10/08	Chard by Liovid Control Hostor	23-1					T				1
2-1103	Stand-by Liquid Control rieates	23-1									1
2-2201 4	HOCI Turbine inlet inclution Value	28-1									1
2-1402-250	Core Saray (shoard (solation Valve 28)	28-1						T			
2-1402-230	Core Spray inboard isolation valve 25	20-1						1			
2-2400-28	Post I OCA Ha & On Monitoring Sample	29.1									
	Pump 28						<u> </u>	1			
2-8300-2	125V Battery Charger 2	29-2					ļ				1
2-3903	Diesel Cooling Water Pump 2	29-2					1				4
2-4811-8	Diesei Starting Air Compressor 28	29-2					ļ				4
	120/208V Ximr Mag Tape Drive	29-2									- 18
2-5203	Diesel Oil Transfer Pump 2	29-2					·				4
2/3-8350-2/3	250Vdc Battery Charger 2/3	29-2						 			1.
2-5790	Diesel Ventilating Fan 2	29-2									4
2-7902	Turbine & Radwaste Building Emergency	29-2									4
	Lighting				[[[
2-5700-30C1	Containment Cooling Service Water Pump Cooler C Fan 1	29-2									
700-30C2	Containment Cooling Service Water Pump Cooler C Fan 2	29-2									
2-5700-30D1	Containment Cooling Service Water Pump Cooler D Fan 1	29-2						·			
2-5700-30D2	Containment Cooling Service Water Pump Cooler D Fan 2	29-2	1					ŀ	· · · ·		
2-8001-B	RX Protection M-G Set 2B	29-2									
2-1501-13B	LPCI Pump Flow Bypass Valve 2B	29-4						1	1		
2-2301-57	HPCI Auditary Coolent Pump	29-4	1			[1	[⁶ 3
2-5747	HPCI Pump 2 Area Cooling Unit	29-4									
2-57468	LPCI/Core Spray Pump Area Cooling Unit 28	29-4		-							
	Diesel Circulating Water Heater 2/3	29-4		-+-		{·					
2/3-6699-	Engine Lube Oil Circulating Pump	29-4									
11/113	Motor (1HP)					1					
2/3-6699-	Engine Lube Oil Circulating Pump	29-4	ļ	4	<u>}_</u>						
11/113	Motor (3/4HP)		1				1				
-1402-368	Valve 2B	29-4	1	1		·					
	HPCI Turbine Oil Tank Heater	29-4	 	+							
-1501-38	Containment Cooling Heat Exchanger	29-4	1	1	1		F				
202 59	Discharge Valve 25		L	1				1	1	1	
-202-38	Recirc, Pump 28 Uischarge Valve	29-1		T							
1501 220	PCI ishoard isolation Value 20	23-7]	
- 100 1-22D	PCI Outboard Isolation Valve 25	23-1							1	[
-214	LFUI UUDOard Isolation Valve ZA	20-1	L					. 1	1	1	

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Calculation:		9389-46-19-2		
Attachment:		E		
Revision:		003	-	-
Daga		<u>n</u> f	F2	
FIGURE 2 - DG AUXILIARIES AND OTHER 4kV AND 480V LOADS

ad No.	Load Description	Bus No
·	120/208V Distr Xfmr 29-8	29-8
2/3-9400-102	Control Room Standby AC	29-8
2/3-9400-104	Control Room AFU Booster Fan A	29-8
2/3-9400-100	Control Room Standby AHU	29-8
2/3-9400-101	Control Room AFU Heater	29-8
2/3-7505A	Stand-by Gas Treatment Inlet Damper 2/3A	29-9
2/3-7504A	Stand-by Gas Treatment Outside Air Supply Damper 2/3A	29-9
2/3-A-7503	Stand-by Gas Treatment Air Heater 2/3A	29-9
2/3-7507A	Stand-by Gas Treatment Fan Discharge Damper 2/3A	29-9
2/3-4-7506	Stand-by Gas Treatment Fan 2/3A	29-9

(0s)	0 s	5s	10 s	10+ min	10++ min	10+++ min
		•				
	1					
	<u> </u>					

(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 and first CCSW Pump is started with its Auxiliaries. 10++min - The second CCSW Pump is started.

10+++min - Both CCSW Pumps are running and Control Room HVAC is started.

Attachment F

DG Unit 2 Division II ETAP Output Reports - Nominal Voltage

<u>Scenario</u>	Page #'s
DG2_Bkr_Cl	F2-F15
DG2_UV_Rst	F16-F29
DG2_T=5sec	F30-F44
DG2_T=10sec	F45-F59
DG2_T=10-min	F60-F73
DG2_T=10+min	F74-F87
DG2_T=10++m	F88-F101
DG2_CR_HVAC	F102-F116
	Only the Load Flow Only the el new Report Scenarios MA these mela sed 4/2007 been

Calcula	ation:	9389	46-19-2	
Attach	ment:	F	:	
Revisio	on:	003.		
Page	F1	of	F116	

Project:	Dresden Unit2 OTI	ETAP 5.5.0N	Page: Date:	8 03-01-2007
Contract:			SN:	WASHTNGRPN
Engineer:	OTI	Study Case: DG 0 CCSW	Revision:	Base
Filename:	DRE_Unit2_0004		Config.:	DG2_Bkr_Cl

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	k۷	kV	Ang.	мw	Mvar	MW	Mvar	ſD	MW	Mvar	Атр	% PF	% Tap
2-902-63 ESS UPS PNL	0,480	0.481	-1.6	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80,5	
4KV SWGR 24-1	4.160	4.158	0.0	0	0	0	0	HIGH SIDE OF XFMR 29	0.414	0.284	69.7	82.4	
								DG 2 TERMINAL	-0.414	-0.284	69.7	82.4	
125V DC CHGR 2	0.480	0.463	-0.8	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.2	
250V DC CHGR 2/3	0,480	0.467	-1.3	0	0	0.066	0.055	480V MCC 29-2	-0.066	-0.055	106.1	76,9	
480V MCC 28-7	0,480	0.479	-1.5	0	0	0.014	0.009	480V MCC 29-7	-0.014	-0.009	20.2	85.1	
480V MCC 29-1	0.480	0.479	-1.6	0	0	0.044	0.011	8KR 29-4C BIFURC	-0.044	-0.011	54.2	96.9	
480V MCC 29-2	0.480	0.472	-1.6	0	0	0.105	0.103	BKR 29-3D BIFURC	-0.207	-0.187	340.9	74.3	
								250V DC CHGR 2/3	0.067	0.055	106.1	77.2	
								125V DC CHGR 2	0.035	0.028	55.0	78.1	
180V MCC 29-4	0. 480	0.480	-1.6	0	0	0.027	0.002	BKR 29-3D BIFURC	-0.027	-0.002	32.7	99.7	
480V MCC 29-7	0.480	0.479	-1.6	0	0	0.021	0.013	480V MCC 28-7	0.014	0.009	20.2	85.1	
								480V SWGR 29	-0.036	-0.022	50.3	85.4	
480V MCC 29-8	0.480	0.481	-1.6	0	0	0	0	480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-9	0.480	0.479	-1.7	0	0	0.056	0.013	BKR 29-4C BIFURC	-0.056	-0.013	69.4	97.3	
480V SWGR 29	0.480	0.481	•1.6	0	0	0	0	BKR 29-3D BIFURC	0.238	0.192	367.4	77.8	
								480V MCC 29-7	0.036	0.022	50.3	85.4	
								480V MCC 29-8	0.000	0,000	0.0	0.0	
					`			BKR 29-4C BIFURC	0,100	0.025	123.6	9 7.1	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.5	
								HIGH SIDE OF XFMR 29	-0.411	-0.267	589.0	83.9	
BKR 29-3D BIFURC	0.480	0.481	-1.6	0	0	0	0	480V MCC 29-2	0.211	0.190	340.9	74.3	
								480V MCC 29-4	0.027	0.002	32.7	99.7	
								480V SWGR 29	-0,238	-0.192	367.4	77.8	
BKR 29-4C BIFURC	0,480	0.481	-1.6	0	0	0	0	480V MCC 29-1	0.044	0.011	54.2	96. 8	
								480V MCC 29-9	0.056	0.014	69.4	97.2	
								480V SWGR 29	-0.100	-0.025	123.6	97.1	
DG 2 TERMINAL	4.160	4.160	0.0	0.414	0.285	0	0	4KV SWGR 24-1	0.414	0.285	69.7	82.4	
HIGH SIDE OF XFMR 29	4.160	4.157	0.0	0	0	0	0	4KV SWGR 24-1	-0.414	-0.284	69.7	82.4	
								IROV SWICE DO	A 414	0.164	40 7	07 /	3 500

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

Indicates a bus with a load mismatch of more than0.1 MVA

 Calculation:
 9389-46-19-2

 Attachment:
 F

 Revision:
 003

 Page
 F9
 of
 F116

roject:	Dresden Unit2 OTI	ETAP F 5.5.0N E	Page: Date:	8 03-01-2007
Contract		, S	SN:	WASHTNGRPN
Engineer	OTI	Study Case: DG 0 CCSW	Revision:	Base
Filename	: DRE_Unit2_0004		Config.:	DG2_UV_Rst

Diesel Generator connected using nominal voltage,2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Volt	age	Gene	ration	Lo	ad		Load Flo	W			XFMR
ID	kV	k٧	Ang.	MW	Mvar	MW	Mvar	υD	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0,480	0,480	-1.6	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80.5	
4KV SWGR 24-1	4,160	4,155	0.0	0	0	0.520	0.252	HIGH SIDE OF XFMR 29	0.418	0.287	70,5	82.4	
								DG 2 TERMINAL	-0.938	-0.539	150.3	86.7	
125V DC CHGR 2	0.480	0.463	-0.8	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.3	
250V DC CHGR 2/3	0.480	0.467	-1.4	0	0	0.066	0.055	480V MCC 29-2	-0.066	-0.055	106.1	77.0	
480V MCC 28-7	0,480	0.478	-1.6	0	0	0.014	0.009	480V MCC 29-7	-0.014	-0.009	20.2	85.1	
480V MCC 29-1	0.480	0.479	-1.6	0	0	0.044	0.011	BKR 29-4C BIFURC	-0.044	-0.011	54.2	96.9	
480V MCC 29-2	0.480	0.472	-1.6	0	0	0.105	0.103	BKR 29-3D BIFURC	-0.207	-0.186	341.0	74.3	
								250V DC CHGR 2/3	0.067	0.055	106.1	77.3	· .
								125V DC CHGR 2	0.035	0.028	55.0	78.1	
180V MCC 29-4	0.480	0.479	-1.6	0	0	0.031	0.005	BKR 29-3D BIFURC	-0.031	-0.005	38.4	98.8	
480V MCC 29-7	0.480	0.478	-1.6	0	0	0.021	0.013	480V MCC 28-7	0.014	0.009	20.2	85.I	
								480V SWGR 29	-0.036	-0.022	50.3	85.4	
480V MCC 29-8	0.480	0.480	-1.6	0	0	0	0	480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-9	0.480	0.478	-1.7	0	0 -	0.056	0.013	BKR 29-4C BIFURC	-0.056	-0.013	69.4	97.3	
480V SWGR 29	0.480	0.480	-1.6	0	0	0	0	BKR 29-3D BIFURC	0.242	0.195	373.8	77.9	
								480V MCC 29-7	0.036	0.022	50.3	85.4	
								480V MCC 29-8	0.000	0.000	0.0	0.0	
								BKR 29-4C BIFURC	0.100	0.025	123.6	97.1	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.5	
								HIGH SIDE OF XFMR 29	-0.416	-0.269	595.5	83.9	
BKR 29-3D BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-2	0.211	0.190	341.0	74.3	
								480V MCC 29-4	0.032	0.005	38.4	98.8	
								480 V SWGR 29	-0.242	-0.195	373.8	77.9	
BKR 29-4C BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-1	0.044	0.011	54.2	96.8	
								480V MCC 29-9	0.056	0.014	69.4	97.2	•
								480V SWGR 29	-0.100	-0.025	123.6	97.1	
DG 2 TERMINAL	4 160	4,160	0.0	0,939	0.540	0	0	4KV SWGR 24-1	0.939	0.540	150.3	86.7	
HIGH SIDE OF XFMR 29	4.160	4.155	0.0	0	0	0	0	4KV SWGR 24-1	-0.418	-0.287	70.5	82.4	
								180V SWGR 29	0.418	0.287	70.5	82.4	-2.500

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

Indicates a bus with a load mismatch of more than 0.1 MVA

Calculatio	หา: <u>_</u>	389-	46-19-2	_
Attachme	nt:	F		
Revision:		003		
Page	F23	of	F116	

ject	Dresden Unit2	ETAP	Page:	8
Location:	ΟΤΙ	5.5.0N	Date:	03-01-2007
Contract:			SN:	WASHTNGRPN
Engineer	OTI	Study Case: DG 0 CCSW	Revision:	Base
Filename:	DRE_Unit2_0004		Config.:	DG2_T=5sec

Diesel Generator connected using nominal voltage,2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Volt	age	Gene	ration	Lo	ad		Load Flo	w			XFMR
ID	k٧	k٧	Ang.	мW	Mvar	MW	Mvar	١D	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0,480	0.480	-1.6	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80.6	
4KV SWGR 24-1	4,160	4,153	-0.1	0	0	1.025	0.496	HIGH SIDE OF XFMR 29	0.418	0.287	70.5	82.4	
								DG 2 TERMINAL	-1.443	-0.783	228.2	87.9	
125V DC CHGR 2	0.480	0.462	-0.9	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	\$5.0	77.3	
250V DC CHGR 2/3	0.480	0.467	-1.4	0	0	0.0 66	0.055	480V MCC 29-2	-0.066	-0.055	10 6 .1	77.0	
480V MCC 28-7	0.480	0.478	-1.6	0	0	0.014	0.009	480V MCC 29-7	-0.014	-0.009	20.3	85.1	
480V MCC 29-1	0.480	0.479	-1.7	0	0	0.044	0.011	BKR 29-4C BIFURC	-0.044	-0.011	54.2	96.9	
480V MCC 29-2	0.480	0.471	-1.7	0	0	0.105	0,103	BKR 29-3D BIFURC	-0.207	-0,186	341.1	74.4	
								250V DC CHGR 2/3	0.067	0.055	106.1	77.3	
								125V DC CHGR 2	0.035	0.028	55.0	78.2	
30V MCC 29-4	0,480	0.479	-1.7	0	0	0.031	0.005	BKR 29-3D BIFURC	-0.031	-0.005	38.4	98.8	
480V MCC 29-7	0,480	0.478	-1.6	0	0	0.021	0.013	480V MCC 28-7	0.014	0.009	20.3	85.1	
								480V SWGR 29	-0.036	-0.022	50.4	85.4	
480V MCC 29-8	0.480	0.480	-1.6	0	0	0	0	480V SWGR 29	0,000	0,000	0.0	0.0	
480V MCC 29-9	0.480	0.478	-1.8	0	0	0.056	0.013	BKR 29-4C BIFURC	-0.056	-0.013	69.4	97.3	
480V SWGR 29	0.480	0.480	-1.6	0	0	O	0	BKR 29-3D BIFURC	0.242	0.195	373.9	77.9	
								480 V MCC 29-7	0.036	0.022	50.4	85.4	
								480V MCC 29-8	0.000	0.000	0,0	0.0	
								BKR 29-4C BIFURC	0.100	0.025	123.6	97.1	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.6	
								HIGH SIDE OF XFMR 29	-0.416	-0.269	595.6	83.9	
BKR 29-3D BIFURC	0,480	0.480	-1.6	0	0	0	0	480 V MCC 29-2	0.211	0.190	341.1	74.3	
								480V MCC 29-4	0.032	0.005	38.4	98.7	
								480V SWGR 29	-0.242	-0.195	373.9	77.9	
BKR 29-4C BIFURC	0.480	0.480	-1.6	0	Û	0	0	480V MCC 29-1	0.044	0.011	54.2	96.8	
								480V MCC 29-9	0.056	0.014	69.4	97.2	
								480V SWGR 29	-0.100	-0.025	123.6	97.1	
DG 2 TERMINAL	4.160	4.160	0.0	[.444	0.786	0	0 -	4KV SWGR 24-1	1.444	0.786	228.2	87.8	
HIGH SIDE OF XFMR 29	4.160	4.152	-0.1	0	0	0	0 4	KV SWGR 24-1	-0.418	-0.287	70.5	82.4	
							4	180V SWGR 29	0.418	0.287	70.5	F CS	-2 500

• Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

Indicates a bus with a load mismatch of more than0.1 MVA

Calculat	tion:	9389-4	46-19-2
Attachm	nent:	F	
Revision	n:	003	
Page _	F37	_ of _	F116

		···		
^p roject:	Dresden Unit2	ETAP	Page:	8
Location:	OTI	5.5.0N	Date:	03-01-2007
Contract:	· · · · ·		SN:	WASHTNGRPN
Engineer.	πο	Study Case: DG 0 CCSW	Revision:	Base
Filename:	DRE_Unit2_0004		Config.:	DG2_T=10sec

Diesel Generator connected using nominal voltage,2 LPCI, This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Vol	tage	Gene	ration	Lo	oad Load Flow				XFMR		
ID	k۷	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0.480	0.479	-1.8	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80.7	
4KV SWGR 24-1	4.160	4.150	-0.1	0	0	1.738	0.7 96	HIGH SIDE OF XFMR 29	0.448	0.304	75,4	82.7	
			,					DG 2 TERMINAL	-2.186	-1.101	340.6	89.3	
125V DC CHGR 2	0.480	0.460	-1.1	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.6	
250V DC CHGR 2/3	0.480	0.465	-1.6	0	0	0.066	0.054	480V MCC 29-2	-0.066	-0.054	106.2	77.3	
480V MCC 28-7	0.480	0.477	-1.8	0	0	0.014	0.009	480V MCC 29-7	-0.014	-0.009	20.3	85,1	
480V MCC 29-1	0,480	0.477	-1.8	· 0	0	0.047	0.013	BKR 29-4C BIFURC	-0.047	-0.013	59.2	96.1	
480V MCC 29-2	0,480	0.469	-1.9	0	0	0.131	0.116	BKR 29-3D BIFURC	-0.233	-0.198	376.0	76,2	
								250V DC CHGR 2/3	0.067	0.054	106.2	77.6	
								125V DC CHGR 2	0.035	0.028	55.0	78,5	
180V MCC 29-4	0.480	0.478	-1.8	0	0	0.031	0.005	BKR 29-3D BIFURC	-0.031	-0.005	38.5	98 .7	
480V MCC 29-7	0.480	0.477	1,8	0	Q	0.021	0.013	480V MCC 28-7	0.014	0.009	20.3	85.1	
								480V SWGR 29	-0.036	-0.022	50.5	85.4	
480V MCC 29-8	0.480	0.479	-1.8	0	0	0	. 0	480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-9	0.480	0.477	-1.9	0	0	0.056	0.013	BKR 29-4C BIFURC	-0.056	-0.013	69.4	97.3	
480V SWGR 29	0.480	0.479	-1.8	0	0	0	0	BKR 29-3D BIFURC	0.269	0.207	409.4	79.2	
								480V MCC 29-7	0.036	0.022	50,5	85.4	
								480V MCC 29-8	0.000	0.000	0.0	0.0	
								BKR 29-4C BIFURC	0.103	0.027	128.5	96.7	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.7	
								HIGH SIDE OF XFMR 29	-0.446	-0.284	637.1	84.3	
BKR 29-3D BIFURC	0.480	0.479	-1.8	0	0	0	0	480V MCC 29-2	0.237	0.202	376.0	76,1	
								480V MCC 29-4	0.032	0.005	38.5	9 8 .7	
								480V SWGR 29	-0.269	-0.207	409.4	79.2	
BKR 29-4C BIFURC	0.480	0.479	-1.8	0	0	0	0	480V MCC 29-1	0.047	0.014	59.2	96.1	
							· .	180V MCC 29-9	0.056	0.014	69.4	97.2	
								180V SWGR 29	-0.103	-0.027	128.5	96.7	
DG 2 TERMINAL	4.160	4,160	0.0	2.190	1.107	0	0	IKV SWGR 24-1	2.190	1.107	340.6	89.2	
HIGH SIDE OF XFMR 29	4.160	4.149	-0.1	0	0	0	0	IKV SWGR 24-1	-0,448	-0.304	75.4	82.7	
							4	80V SWGR 29	0.448	0.304	75.4	82.7	-2.500

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

-Indicates a bus with a load mismatch of more than 0.1 MVA

/ ·	ာject: Location:	Dresden Unit2 OTI	ETAP 5.5.0N	Page: Date:	8 03-01-2007
(Contract:		·	SN:	WASHTNGRPN
ł	Engineer:	ОТІ	Study Case: DG 0 CCSW	Revision:	Base
ł	Filename:	DRE_Unit2_0004		Config.:	DG2_T=10-m

Diesel Generator connected using nominal voltage,2 LPCl. This time period is less than 10 min into event.

LOAD FLOW REPORT

Bus		Vol	tage	Gene	ration	Lo	ad	Load Flow			XFMR		
D	kV	kV	Ang.	MW	Mvar	MW	Mvar	١D	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0.480	0.480	-1.6	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80.5	
4K.V SWGR 24-1	4.160	4.150	-0.1	0	0	1.738	0.796	HIGH SIDE OF XFMR 29	0.396	0.268	66.5	82.8	
								DG 2 TERMINAL	-2.134	-1.065	331.7	89.5	
125V DC CHGR 2	0.480	0.462	-0.9	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.4	
250V DC CHGR 2/3	0.480	0,466	-1.4	0	0	0,066	0.055	480V MCC 29-2	-0.066	-0.055	106.1	77.1	
480V MCC 28-7	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-1	0.480	0.479	-1.6	0	0	0.036	0.007	BKR 29-4C BIFURC	-0.036	-0.007	44.3	98.3	
480V MCC 29-2	0.480	0.471	-1.6	0	0	0.131	0.116	BKR 29-3D BIFURC	-0.233	-0.199	375.5	76.1	
								250V DC CHGR 2/3	0.067	0.055	106.1	77.4	
								125V DC CHGR 2	0.035	0.028	55.0	78,3	
180V MCC 29-4	0.480	0.480	-1.6	0	0	0.032	0.005	BKR 29-3D BIFURC	-0.032	-0.005	38.7	98.7	
480V MCC 29-7	0.480	0.480	-1.6	. 0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
								480V SWGR 29	0.000	0.000	0,0	0.0	
480V MCC 29-8	0,480	0.480	-1.6	0	0	0	0	480V SWGR 29	0.000	0.000	0,0	0.0	
480V MCC 29-9	0.480	0.479	-1.7	0	0	0.050	0.009	BKR 29-4C BIFURC	-0.050	-0.009	61.4	98.3	
480V SWGR 29	0.480	0.480	-1.6	0	0	0	0	BKR 29-3D BIFURC	0.269	0.208	409.1	79.1	
								480V MCC 29-7	0.000	0.000	0.0	0,0	
								480V MCC 29-8	0.000	0.000	0.0	0,0	
								BKR 29-4C BIFURC	0.086	0.016	105.7	98.3	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.5	
								HIGH SIDE OF XFMR 29	-0.394	-0.252	561.9	84.2	
BKR 29-3D BIFURC	0.480	0.480	-1.6	. 0	0	0	0	480V MCC 29-2	0.238	0.203	375.5	76.1	
								480V MCC 29-4	0.032	0.005	38.7	98.7	
						•		480V SWGR 29	-0.269	-0.208	409.1	79.1	
BKR 29-4C BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-1	0.036	0.007	44.3	98.3	
								480V MCC 29-9	0.050	0.010	61.4	98.2	
								480V SWGR 29	-0.086	-0.016	105.7	98.3	
DG 2 TERMINAL	4,160	4,160	0.0	2.137	1,071	.0	0	4KV SWGR 24-1	2.137	1.071	331.7	89.4	
HIGH SIDE OF XFMR 29	4,160	4.150	-0.1	0	0	0	0.	IKV SWGR 24-1	-0.396	-0.268	66,5	82.8	
								180V SWGR 29	0.396	0.268	66.5	82,8	-2.500

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

. Indicates a bus with a load mismatch of more than 0.1 MVA

Calculati	on: _	9389-4	46-19-2
Attachme	ent:	٦	
Revision		003	
Page _	F67	of	F116

Toject:	Dresden Unit2 OTI	ET 5.5	AP .on	Page: Date:	8 03-01-2007
Contract:				SN:	WASHTNGRPN
Engineer:	στι	Study Case	DGLCCSW	Revision:	Base
Filename:	DRE_Unit2_0004	orday case.	00	Config.:	DG2_T=10+m

Diesel Generator connected using nominal voltage,2 LPC1 Pump, 1 CCSW, This time period is 10+ min into event.

LOAD FLOW REPORT

Bus		Vol	tage	Gene	ration	Lo	ad	•	Load Flo	W			XFMR
ID	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Атр	% PF	% Tap
2-902-63 ESS UPS PNL	0.480	0.480	-1.6	0	0	0.038	0.028	480V SWGR 29	-0.038	-0.028	\$6.5	\$0.6	
4KV SWGR 24	4.160	4.146	-0.1	Ō	0	0.477	0.212	4KV SWGR 24-1	-0.477	-0.212	72.7	91.4	
4KV SWGR 24-1	4.160	4.148	-0,1	0	´ 0	1.716	0.790	4KV SWGR 24	0.477	0.213	72.7	91.3	
								HIGH SIDE OF XFMR 29	0.396	0.268	66.5	82.8	
								DG 2 TERMINAL	-2.589	-1.270	401.4	89.8	
125V DC CHGR 2	0.480	0.461	-0.9	0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.4	
250V DC CHGR 2/3	0.480	0.466	-1.4	· 0	. 0	0.066	0.055	480V MCC 29-2	-0.066	-0.055	106.1	77.1	
480V MCC 28-7	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-1	0,480	0.479	-1.6	0	0	0.036	0.007	BKR 29-4C BIFURC	-0.036	-0.007	44.3	98.3	
480V MCC 29-2	.0.480	0.471	-1.7	0	0	0.131	0.116	BKR 29-3D BIFURC	-0.233	-0.199	375.6	76.1	
								250V DC CHGR 2/3	0.067	0.055	106.1	77.4	
								125V DC CHGR 2	0.035	0.028	55.0	78.3	
480V MCC 29-4	0,480	0.479	-1.6	0	0	0.032	0.005	BKR 29-3D BIFURC	-0.032	-0.005	38.6	98.7	
480V MCC 29-7	0.480	0.480	-1.6	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
								480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-8	0.480	0.480	-1.6	0	0	0	0	480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-9	0. 480	0.479	-1.7	0	0	0.050	0.009	BKR 29-4C BIFURC	-0.050	-0.009	61.4	98.3	
480V SWGR 29	0.480	0.480	-1.6	0	0	0	0	BKR 29-JD BIFURC	0.269.	0.208	409.1	79.1	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
								480V MCC 29-8	0.000	0.000	0.0	0.0	
								BKR 29-4C BIFURC	0.086	0.016	105.7	98.3	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.6	
					ŕ			HIGH SIDE OF XFMR 29	-0.394	-0.252	562.0	84.2	
BKR 29-3D BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-2	0.238	0.203	375.6	76.1	
								480V MCC 29-4	0.032	0.005	38.6	98.7	
								180V SWGR 29	-0.269	-0.208	469.1	79.2	
BKR 29-4C BIFURC	0.480	0.480	-1.6	0	0	0	Û-	180V MCC 29-1	0.036	0.007	44.3	98.3	
							4	180V MCC 29-9	0.050	0.010	61.4	98.2	
					÷		4	80V SWGR 29	-0.086	-0.016	105.7	98.3	
DG 2 TERMINAL	4.160	4.160	0.0	2,594	1.279	0	0 4	KV SWGR 24-1	2.594	1.279	401.4	89.7	
HIGH SIDE OF XFMR 29	4.160	4.147	-0.1	0	0	ο.	04	KV SWGR 24-1	-0.395	-0.268	66.5	82.8	

480V SWGR 29

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

· Indicates a bus with a load mismatch of more than0.1 MVA

Calculation:	9389-46-19-2	
Attachment:	F	
Revision:	003	
Page F8	11 of F116	

66.5 82.8

-2.500

0.395

0.268

oject: Location: Contract:	Dresden Unit2 OTI	ETAP 5.5.0N	Page: Date: SN:	8 03-01-2007 WASHTNGRPN
Engineer:	OTI	Study Case: DG_2_CCSW	Revision:	Base
Filename:	DRE_Unit2_0004		Config.:	DG2_T=10++m

Diesel Generator connected using nominal voltage,1 LPCI Pump, 2 CCSW, This time period is 10+ min into event.

LOAD FLOW REPORT

Bus	_	Vol	tage	Gene	ration	Lo	ad		Load Flo	w			XFMR
۱D	kV	kV	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0.480	0.480	-1.6	0	.0	0.038	0.028	480V SWGR 29	-0.038	-0.028	56.5	80.6	
4KV SWGR 24	4.160	4.145	-0.1	0	0	0.772	0.395	4KV SWGR 24-1	-0.772	-0.395	120.8	89.0	
4KV SWGR 24-1	4.160	4.149	-0.1	0	0	1.218	0.549	4KV SWGR 24	0.772	0,396	120.8	89.0	
								HIGH SIDE OF XFMR 29	0.407	0.276	68.5	82.8	
								DG 2 TERMINAL	-2.398	-1.221	374.5	89.1	
125V DC CHGR 2	0.480	0.461	-0.9	. 0	0	0.034	0.028	480V MCC 29-2	-0.034	-0.028	55.0	77.5	
250V DC CHGR 2/3	0.480	0.465	-1.4	0	0	0.066	0.054	480V MCC 29-2	-0.066	-0.054	106.2	77.2	
480V MCC 28-7	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-1	0.480	0.479	-1.7	0	0	0.036	0.007	BKR 29-4C BIFURC	-0.036	-0.007	44.3	98.3	
480V MCC 29-2	0.480	0.470	-1.7	0	0	0,142	0.123	BKR 29-3D BIFURC	-0.244	-0.205	392.0	76.6	
					÷			250V DC CHGR 2/3	0.067	0.055	106.2	77.5	
·								125V DC CHGR 2	0.035	0.028	55.0	78.4	
480V MCC 29-4	0,480	0.479	-1.7	0	0	0.032	0.005	BKR 29-3D BIFURC	-0.032	-0.005	38.6	98.7	
480V MCC 29-7	0.480	0.480	-1.6	0	0	σ	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
								480V SWGR-29	0.000	0.000	0.0	0.0	
480V MCC 29-8	0.480	0.480	-1.6	0	0	0	0	480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-9	0.480	0.478	-1.8	0	0	0.050	0.009	BKR 29-4C BIFURC	-0.050	-0.009	61.4	98.3	
480V SWGR 29	0.480	0.480	-1.6	0	0	0	0	BKR 29-3D BIFURC	0.281	0.215	425.6	79.4	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
								480V MCC 29-8	0.000	0.000	0.0	0.0	
								BKR 29-4C BIFURC	0.086	0.016	105.7	98.3	
								2-902-63 ESS UPS PNL	0.038	0.028	56.5	80.6	
								HIGH SIDE OF XFMR 29	-0,405	-0.259	578.6	84.3	
BKR 29-3D BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-2	0.249	0.210	392.0	76.5	
								480V MCC 29-4	0.032	0.005	38.6	98.7	
								480V SWGR 29	-0.281	-0.215	425.6	79.4	
BKR 29-4C BIFURC	0.480	0.480	-1.6	0	0	0	0	480V MCC 29-1	0.036	0.007	44.3	98.3	
								480V MCC 29-9	0.050	0.010	61.4	98.2	
							-	180V SWGR 29	-0.086	-0.016	105.7	98.3	
DG 2 TERMINAL	4.160	4.160	0.0	2.402	1.229	0	0 4	KV SWGR 24-1	2.402	1.229	374.5	89.0	
HIGH SIDE OF XFMR 29	4.160	4.148	-0.1	o	0	o	0 4	IKV SWGR 24-1	-0.407	-0.276	68.5	82.8	
·						_	و	RAV SWGR 79	0 107	0.226	68 5	87.8	2 500

* Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

Indicates a bus with a load mismatch of more than 0.1 \dot{MVA}

Calculatio	n:	<u>9389-4</u>	<u>6-19-2</u>	
Attachme	nt:	F		
Revision:		003		
Page	F95	of	F116	

(ojecti	Dresden Unit2	ETAP	Page:	8
C	ocation:	оп	5.5.0N	Date:	03-01-2007
Cc	ontract:			SN:	WASHTNGRPN
En	igineer:	то	Study Case: DG 2 CCSW	Revision:	Base
Fil	lename:	DRE_Unit2_0004		Config.:	DG2_CR_HVAC

Diesel Generator connected using nominal voltage, 1 LPCI Pump, 2 CCSW, This time period is 10+ min into event

LOAD FLOW REPORT

Bus		Vol	tage	Gene	ration	Lo	ad		Load Flo	W			XFMR
۱D	kŸ	k٧	Ang,	MW	Mvar	MW	Mvar	۱D	MW	Mvar	Amp	% PF	% Tap
2-902-63 ESS UPS PNL	0.480	0.475	-2.4	0	0	0.038	0.027	480V SWGR 29	-0.038	-0.027	56.6	81.3	
4KV SWGR 24	4.160	4.144	-0.2	0	0	0.772	0.395	4KV SWGR 24-1	-0.772	-0.395	120.8	89.0	
4KV SWGR 24-1	4.160	4.148	-0.1	0	0	1.218	0.549	4KV SWGR 24	0.772	0.396	120.8	89.0	
								HIGH SIDE OF XFMR 29	0.597	0.392	99.4	83.6	
								DG 2 TERMINAL	-2.587	-1.337	405.4	88.8	
125V DC CHGR 2	0.480	0.456	-1.7	0	0	0.034	0.027	480V MCC 29-2	-0.034	-0.027	55.0	78.3	
250V DC CHGR 2/3	0.480	0.461	-2.2	0	0	0.066	0.053	480V MCC 29-2	-0.066	-0.053	106.3	77.9	
480V MCC 28-7	0.480	0.475	-2.4	0	0	0	0	480V MCC 29-7	0.000	0.000	0.0	0.0	
480V MCC 29-1	0.480	0.474	-2.4	0	0	0.035	0.007	BKR 29-4C BIFURC	-0.035	-0.007	43.9	98.3	
480V MCC 29-2	0.480	0.465	-2.5	0	0	0.142	0.123	BKR 29-3D BIFURC	-0.244	-0.203	393.8	76.9	
								250V DC CHGR 2/3	0.067	0.053	106.3	78.2	
								125V DC CHGR 2	0.035	0.027	55.0	79.2	
480V MCC 29-4	0.480	0.474	-2.4	٥	0	0.031	0.005	BKR 29-3D BIFURC	-0.031	-0.005	38.5	98.7	
480V MCC 29-7	0.480	0.475	-2.4	0	0	0	0	480V MCC 28-7	0.000	0.000	0.0	0.0	
								480V SWGR 29	0.000	0.000	0.0	0.0	
480V MCC 29-8	0.480	0.467	-2.7	0	0	0.187	0.097	480V SWGR 29	-0.187	-0.097	260.1	88.7	
480V MCC 29-9	0.480	0.474	-2.5	٥	0	0.049	0.009	BKR 29-4C BIFURC	-0.049	-0.009	61.2	98.2	
480V SWGR 29	0.480	0.475	-2.4	0	0	0	0.	BKR 29-3D BIFURC	0.280	0.213	427.5	79.6	
								480V MCC 29-7	0.000	0.000	0.0	0.0	
								480V MCC 29-8	0.189	0.100	260.1	88.5	
	•							BKR 29-4C BIFURC	0.085	0.016	105.1	98.2	
								2-902-63 ESS UPS PNL	0.038	0.027	56.6	81.3	
								HIGH SIDE OF XFMR 29	-0.592	-0.356	839.6	85.7	
BKR 29-3D BIFURC	0.480	0.475	-2.4	0	0	0	0	480V MCC 29-2	0.249	0.208	393.8	76.8	
								480V MCC 29-4	0.031	0.005	38.5	98.7	
								480V SWGR 29	-0.280	-0.213	427.5	79.6	
BKR 29-4C BIFURC	0.480	0.475	-2.4	0	0	0	0	480V MCC 29-1	0.036	0.007	43.9	98.3	•
								480V MCC 29-9	0.049	0.010	61.2	98.Z	
								480V SWGR 29	-0,085	-0.016	105.1	98.2	
DG 2 TERMINAL	4.160	4.160	0.0	2.592	1.346	0	0 -	4KV SWGR 24-1	2.592	1.346	405.4	88.8	
HIGH SIDE OF XFMR 29	4,160	4.147	-0.1	0	0	0	0 4	KV SWGR 24-1	-0,597	-0,392	99.4	83.6	
					•		4	80V SWGR 29	0 597	0 397	499.4	83.6	.7 500

Indicates a voltage regulated bus(voltage controlled or swing type machine connected to i)

 π -indicates a bus with a load mismatch of more than 0.1 MVA

Calculatio	n: <u>938</u>	9-46-19-2
Attachme	nt:	F
Revision:	00	3
Page	F109 of	F116