A project report on

STUDY ON POWER SYSTEM PROTECTION AT JSL MRSS (JAJPUR).

Submitted in fulfillment of internship process at

Jindal Stainless Limited Jajpur

Submitted by

MANAV S ZAVERI

KUMAR SURYAMAULI SHAH

B.Tech Electrical Engineering

IIEST Shibpur

JINDAL STAINLESS LIMITED

Kalinga Nagar Industrial Complex

Dist: Jajpur

Odisha – 755026, India

Phone +916726 268449 / 315

Fax +916726 266006

www.jindalstainless.com

CERTIFICATE

JINDAL STAINLESS LIMITED

This is to certify that **Mr. Manav S Zaveri** and **Mr. Kumar Suryamauli Shah**, intern 2021, have successfully completed their project on **"STUDY ON POWER SYSTEM PROTECTION AND VARIOUS EQUIPMENTS USED AT JSL MRSS (JAJPUR)."** , at **MRSS** and their work is observed to be satisfactory.

Project Guide	Project Mentor
Mr. Purnendu Pradhan	**Mr.Purnendu Pradhan**
(DGM) MRSS	(DGM) MRSS

ACKNOWLEDGEMENT

We are very thankful to Jindal Stainless Limited Jajpur, for facilitating us with such an opportunity. Every person has shown us the right direction with their helping hand and constant support for this project.

First and foremost, We would like to express my sincere gratitude to our college IIEST Shibpur ***,*** *for providing us with this opportunity to work as an intern at a prestigious company like Jindal Stainless.*

We would like to express our sincere gratitude to our mentor ***Mr. Purnendu Pradhan (DGM) MRSS*** *and* ***Mr. Prabhat Kumar Sahoo*** *for their continuous support and motivation to do the project. Without Their guidance this project would not have been possible.*

My sincere thanks to my colleagues who were always there to assist me with the different aspects of the project. They have really provided me with the moral support.

MANAV S ZAVERI
KUMAR SURYAMAULI SHAH
B.Tech Electrical Engineering
IIEST Shibpur

JINDAL STAINLESS LIMITED

KNIC, Jajpur, Odisha-755026

DECLARATION

We hereby declare that the project entitled **STUDY ON POWER SYSTEM PROTECTION AND VARIOUS EQUIPMENTS USED AT JSL MRSS (JAJPUR)** is original and has not been submitted for any other presentation. It is further to state that this project, its findings and its inferences is now an intellectual property of the Company and may be used by the Company for its developmental purposes.

MANAV S ZAVERI

KUMAR SURYAMAULI SHAH

B.Tech Electrical Engineering

IIEST Shibpur

JINDAL STAINLESS LIMITED

Founded by Shri O.P Jindal in 1970, Jindal Stainless is one of the largest stainless steel conglomerates in India and ranks amongst the top 10 stainless steel conglomerates in the world. Jindal Stainless Group has an annual crude steel capacity of 1.8 MTPA and the group has an annual turnover of US $ 3.1 billion. The Jajpur plant in Odisha of Jindal Stainless has the production capacity of 0.8 MTPA. Its main products are coils and plates and the various finishes offered are N1, 2E, 2D and 2B. The Jajpur plant presently produces 200,300 and 400 series products for applications in different sectors.

VISION

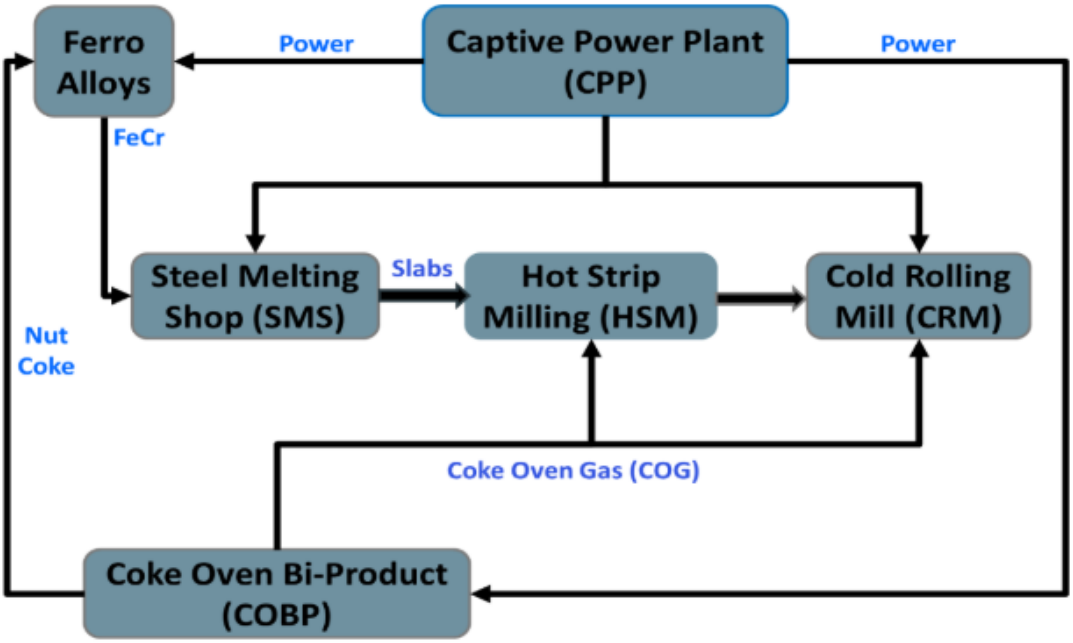
- *Improving lives through trustworthy and innovative stainless solutions*

MISSION

- *To be a leading stainless steel company in the world*
- *Forging reliable relationship with customers, suppliers, employees and all other stakeholders*
- *Building strong capabilities, driving innovative practices, high quality and competitive solutions.*

INTRODUCTION

Plant Overview



Production units

The plant comprises of 250,000 tons per annum of ferro alloys facilities with world class technology sourced from , SMS siemag and Andritz sundwig.Stainless steel plant with a melting capacity of 1.1 MTPA.Coke oven production upto 430,000TPA.Hot rolling capacity up to 1.6 MTPA.Cold rolling capacity up to 0.95 MTPA.

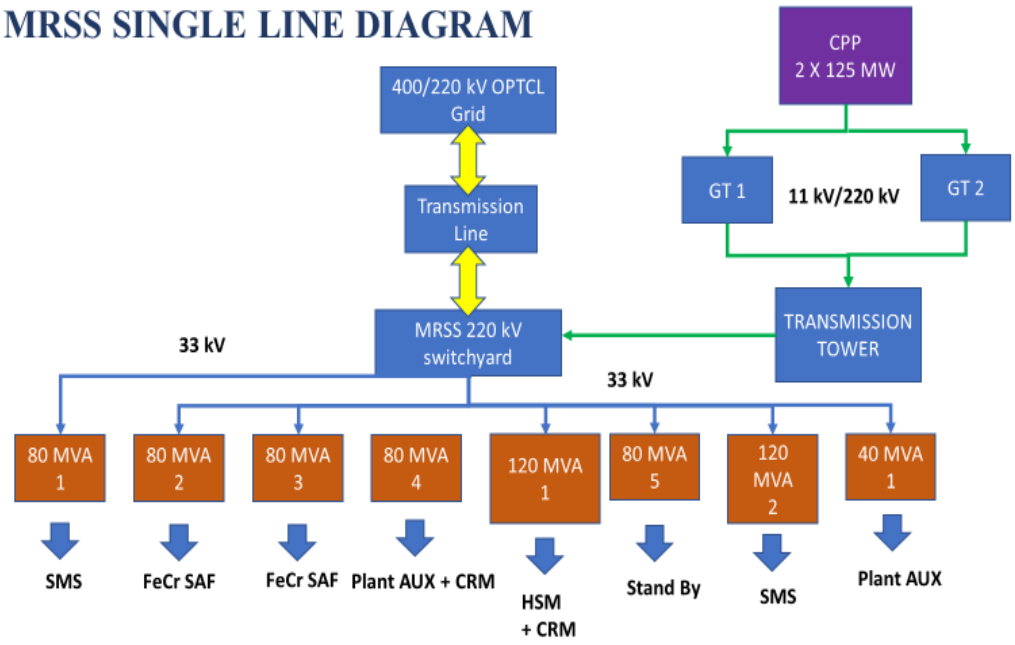
Phase-i

- ✓ Coke Oven and By-products(COBP)
- ✓ Captive Power Plant (CPP)
- ✓ Ferro Alloys

Phase-ii

- ✓ Steel Melting Shop (SMS)
- ✓ Hot Strip Mill (HSM)
- ✓ Cold Rolling Mill (CRM)

Department Overview



Functions:

- ✓ To manage power allocation to various loads.
- ✓ To deal with import of power when there is power shortage
- ✓ To deal with purchase of power from IEX and open access
- ✓ To deal with export of power in case of excess power is generated.
- ✓ To continuously communicate with all loads to know their demand and to keep inadvertent power minimum

Features:

- ✓ 220 kV Double bus with Transfer bus scheme
- ✓ 16 bay switch yard
- ✓ 8 Power Transformers to stepdown from 220 kV to 33kV
- ✓ Connected to OPTCL by 5 km double circuit line.

POWER purchased through:

- ✓ Indian Energy Exchange
- ✓ Open Access
- ✓ PXIL(power exchange india limited)

Objectives of Power System Protection

It takes a lot of effort and money to design a power system. Of course, every investor wants to get a maximum return on investment. But what if some equipment fails?

The whole system may confront the risk of severe damage and deterioration, consequently leading to putting life, property and other equipment in danger. To minimize the probability of damage caused by failure, protection devices come in.

Protection devices reduce the chances of discontinuity of electricity and restrict failure to the failed equipment or area. This way, the system owners keep their customers satisfied with continuous service and the whole system keeps operating without major breakdowns and power outages.

To continuously monitor the system and keep it secure by detaching only the components that are under fault and to retain as much of the grid as possible still in operation, different protection schemes were developed.

CONSTITUENTS

- Current & Voltage Transformers are used for both the metering & protection at substations. The purpose of these transformers is to limit the voltage & current so that it could be used by relays for operation.
- Relays are intelligent devices that initiate a trip sequence when any specific parameter goes beyond normal range.
- Circuit Breakers operate on the trip sequence initiated by the relays in order to open the circuit.
- Batteries are used as back up power supply in the event of mains supply failure.

LOAD FLOW STUDY

A load flow study is the analysis of an electrical network carried out by an electrical engineer. The purpose is to understand how power flows around the electrical network. Carrying out a load flow study assists the engineer in designing electrical systems which work correctly, have sufficient power supplied by the power grid, where equipment is correctly sized, reactive power compensation is correctly placed and transformer taps are optimised.

A load flow study is the analysis of an electrical network carried out by an electrical engineer. The purpose is to understand how power flows around the electrical network. Carrying out a load flow study assists the engineer in designing electrical systems which work correctly, have sufficient power supplied by the power grid, where equipment is correctly sized, reactive power compensation is correctly placed and transformer taps are optimised.

Understanding how power flows is crucial to the design of any system. For simple radial systems, often no formal 'load flow study' is carried out, but invariably it is part of any analysis carried out during the design of the system. For larger power distribution systems, a formal 'load flow study' is carried out; typically using software, with the results presented in a report.

Primarily the load flow study investigates power flow (both real and reactive). . In addition to power flow, a load flow study is often used to investigate other parameters such as current flow, system power factors, losses, and equipment loading.

In carrying out a load flow study, it is necessary to mathematically describe the electrical network and carry out calculations to obtain the desired results. Most real life studies are solved using software, so we will only briefly touch on the mathematics (numerous text books deal with load flow if the reader is interested in more depth).

The basic representation of an electrical network is given by:

$[Y][V]=[I]$

The admittance matrix ($Y_{11} \ldots Y_{nn}$) represents the admittance of between each network node (typically each busbar) of the electrical system. At each node, the voltages ($V_1 \ldots V_n$) and currents ($I_1 \ldots I_n$) are represented by it's appropriate matrix It should be noted that the admittances, voltages and current are complex.

and at each node, the complex power S = (P+jQ) is given by:

$S=VI^*$

At the start of the load flow study, many of the voltages and currents are unknown. An iterative approach is required to find the value of these voltages and currents. Several methods exist (Gauss-Seidel, Newton-Raphson, and others). It is the iterative nature of solving the equations that make hand calculation difficult except for all but the smallest systems.

SHORT CIRCUIT STUDY

A Short circuit analysis is used to determine the magnitude of short circuit current, the system is capable of producing, and compares that magnitude with the interrupting rating of the overcurrent protective devices (OCPD). Since the interrupting ratings are based by the standards, the methods used in conducting a short circuit analysis must conform to the procedures which the standard making organizations specify for this purpose. The American National Standards Institute (ANSI) publishes both the standards for equipment and the application guides, which describes the calculation methods.

Short-Circuit Currents are currents that introduce large amounts of destructive energy in the forms of heat and magnetic force into a power system. A short circuit is sometimes called a fault. It is a specific kind of current that introduces a large amount of energy into a power system. It can be in the form of heat or in the form of magnetic force. Basically, it is a low-resistance path of energy that skips part of a circuit and causes the bypassed part of the circuit to stop working. The reliability and safety of electric power distribution systems depend on accurate and thorough knowledge of short-circuit fault currents that can be present, and on the ability of protective devices to satisfactorily interrupt these currents. Knowledge of the computational methods of power system analysis is essential to engineers responsible for planning, design, operation, and troubleshooting of distribution systems.

Short circuit currents impose the most serious general hazard to power distribution system components and are the prime concerns in developing and applying protection systems. Fortunately, short circuit currents are relatively easy to calculate. The application of three or four fundamental concepts of circuit analysis will derive the basic nature of short circuit currents. These concepts will be stated and utilized in a step-by step development.

The three phase bolted short circuit currents are the basic reference quantities in a system study. In all cases, knowledge of the three phase bolted fault value is wanted and needs to be singled out for independent treatment. This will set the pattern to be used in other cases.

A device that interrupts short circuit current, is a device connected into an electric circuit to provide protection against excessive damage when a short circuit occurs. It provides this protection by automatically interrupting the large value of current flow, so the device should be rated to interrupt and stop the flow of fault current without damage to the overcurrent protection device. The OCPD will also provide automatic interruption of overload currents.

Short-circuit calculations are required for the application and coordination of protective relays and the rating of equipment. All fault types can be simulated. Short circuit analysis essentially consists of determining the steady state solution of a linear network with balanced three phase excitation. Such an analysis provides currents and voltages in a power system during the faulted condition. This information is needed to determine the required interrupting capacity of the circuit breakers and to design proper relaying system. To get enough information, different types of faults are simulated at different locations and the study is repeated. Normally in the short circuit analysis, all the shunt parameters like loads, lime charging admittances are neglected* Then the linear network that has to be solved comprises of

- Transmission network
- Generator system and
- Fault. By properly combining the representations of these components we can solve the short circuit problem

The first short-circuit analysis should be performed when a power system is originally designed, though this should not be the only time. These studies need to occur with any facility expansion or with the addition of any new electrical equipment such as circuit breakers or new transformers and cables. Without any new additions or changes, short circuit studies still need to occur on a regular basis of at least every 5-6 years.

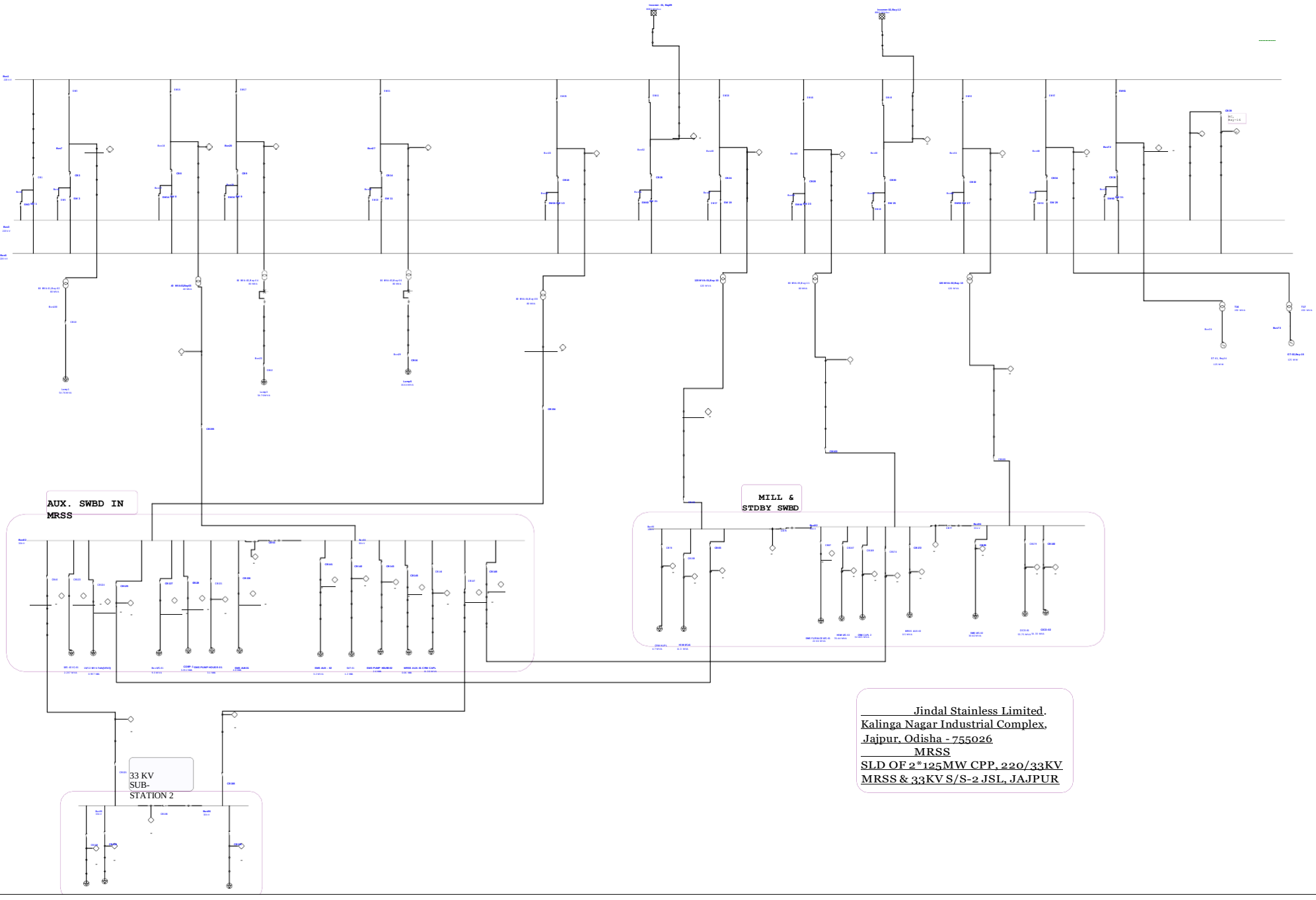
Conducting a short circuit analysis has the following benefits:

- Helps avoid unplanned outages and downtime
- Is critical for avoiding interruptions of essential services
- Reduces the risk of equipment damage and fires
- Increases safety and protects people from injuries
- Determines the level and type of protective devices that are needed
- Provides the information needed for NEC and NFPA required labels
- Keeps you in compliance with NEC requirements
- Reduces the risk a facility could face and help avoid catastrophic losses
- Increases the safety and reliability of the power system and related equipment

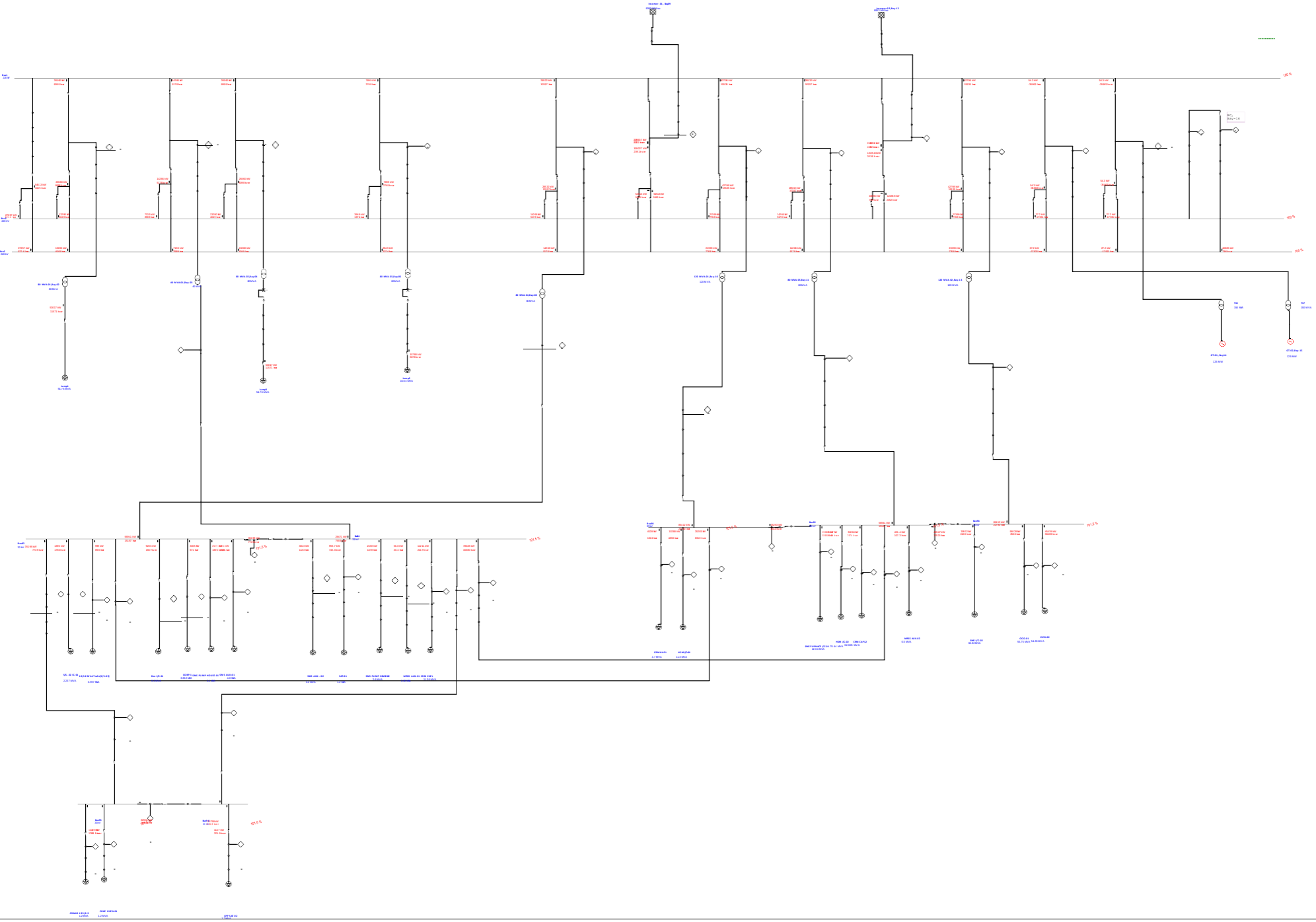
ASSUMPTIONS

The software used for load flow and short circuit analysis is ETAP. A few assumptions were made while making the load flow analysis and short circuit analysis which were mainly due to lack of data. The assumptions taken for various parameters were reasonable according to the standard data available for the power system in the ETAP software. The 220 Kv bus was taken as the slack bus. A few parameters such as X/R ratio of the incoming grid, Short circuit capacity of grid and X/R ratio of various transformers were taken from various reliable online sources. Due to lack of data for a few loads, the power factor for some of them was taken as 0.8 which is close to real life data. All other data was readily made available from the actual substation and the calculations obtained from the software are fairly accurate and reliable. Thus the study has been performed with accurate real life data and minimal assumptions.

One-Line Diagram - OLV1 (Edit Mode)



One-Line Diagram - OLV1 (Load Flow Analysis)



Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Bus1	220.000										230.888	94.4	605.9	
Bus3	220.000										141.611	96.2	371.6	
Bus5	220.000										181.467	97.6	476.2	
Bus6	220.000										54.524	100.0	143.1	
Bus7	220.000										55.534	95.7	145.7	
Bus8	220.000										27.767	95.7	72.9	
Bus17	220.000										15.177	94.0	39.8	
Bus18	220.000										30.354	94.0	79.7	
Bus19	220.000										27.767	95.7	72.9	
Bus20	220.000										55.534	95.7	145.7	
Bus23	34.500		42.800	9.342	10.217	2.230					54.265	97.7	929.4	
Bus26	220.000										8.363	94.4	21.9	
Bus27	220.000										16.726	94.4	43.9	
Bus29	34.500		12.673	4.075	3.115	1.001					16.584	95.2	279.9	
Bus32	220.000										30.354	94.0	79.7	
Bus33	220.000										60.707	94.0	159.3	
Bus47	220.000										45.531	94.0	119.5	
Bus48	220.000										91.061	94.0	239.0	
Bus51	220.000										109.047	100.0	286.2	
Bus52	220.000										218.094	100.0	572.3	
Bus55	220.000										30.354	94.0	79.7	
Bus56	220.000										60.707	94.0	159.3	
Bus59	220.000										163.571	100.0	429.3	
Bus60	220.000										218.094	100.0	572.3	
Bus63	220.000										45.531	94.0	119.5	
Bus64	220.000										91.061	94.0	239.0	
Bus67	220.000										35.863	0.2	94.1	
Bus68	220.000										71.726	0.2	188.2	
Bus71	220.000										35.863	0.2	94.1	
Bus72	220.000										71.726	0.2	188.2	
Bus73	11.000										76.616	-	4021.3	
Bus74	11.000										76.616	-	4021.3	
Bus82	33.000		17.366	6.361	4.472	1.638					95.180	96.9	1640.8	
Bus84	33.000		13.836	4.438	3.563	1.143					97.921	97.5	1688.1	
Bus90	33.000		11.791	4.899	3.036	1.261					88.398	96.6	1523.9	
Bus92	33.000		98.064	21.747	25.251	5.600					174.870	97.4	3014.6	
Bus94	33.000		105.256	28.080	27.103	7.231					136.988	96.6	2361.5	
Bus95	33.000		1.824	0.600	0.470	0.154					36.041	97.7	621.3	
Bus96	33.000		0.912	0.300	0.235	0.077					33.640	97.8	579.9	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Bus100	33.000		42.800	9.342	10.217	2.230					54.265	97.7	929.4	

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).
# Indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Busway / Cable & Reactor			Transformer				
		Ampacity	Loading		Capability	Loading (input)		Loading (output)	
ID	Type	(Amp)	Amp	%	(MVA)	MVA	%	MVA	%
40 MVA-01,Bay-03	Transformer				40.000	30.354	75.9	29.466	73.7
80 MVA-01,Bay-02	Transformer				80.000	55.534	69.4	54.265	67.8
80 MVA-02,Bay-04	Transformer				80.000	55.534	69.4	54.265	67.8
80 MVA-03,Bay-06	Transformer				80.000	16.726	20.9	16.584	20.7
80 MVA-04,Bay-08	Transformer				80.000	60.707	75.9	58.932	73.7
80 MVA-05,Bay-11	Transformer				80.000	60.707	75.9	58.932	73.7
120 MVA-01,Bay-10	Transformer				120.000	91.061	75.9	88.398	73.7
120 MVA-02,Bay-13	Transformer				120.000	91.061	75.9	88.398	73.7
T16	Transformer				150.000	76.616	51.1	71.726	47.8
T17	Transformer				150.000	76.616	51.1	71.726	47.8

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
120 MVA-01,Bay-10	85.596	31.070	-85.412	-22.780	184.2	8290.1	100.0	101.5	2.92
120 MVA-02,Bay-13	85.596	31.070	-85.412	-22.780	184.2	8290.1	100.0	101.5	2.92
40 MVA-01,Bay-03	28.532	10.357	-28.471	-7.593	61.4	2763.4	100.0	101.5	2.92
80 MVA-01,Bay-02	53.120	16.196	-53.017	-11.571	102.8	4624.9	100.0	102.2	2.29
80 MVA-02,Bay-04	53.120	16.196	-53.017	-11.571	102.8	4624.9	100.0	97.7	2.29
80 MVA-03,Bay-06	15.797	5.496	-15.788	-5.076	9.3	419.5	100.0	99.2	0.85
80 MVA-04,Bay-08	57.064	20.714	-56.941	-15.187	122.8	5526.7	100.0	101.5	2.92
80 MVA-05,Bay-11	57.064	20.714	-56.941	-15.187	122.8	5526.7	100.0	101.5	2.92
T16	0.109	-71.725	0.000	76.616	108.7	4890.5	100.0	100.0	6.82
T17	0.109	-71.725	0.000	76.616	108.7	4890.5	100.0	100.0	6.82
					1107.7	49847.2			

* This Transmission Line includes Series Capacito

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus1**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus1	Total	0.00	6.489	-49.886	7.7	50.307
Bus74	Bus72	48.51	0.056	-1.470	26.1	1.471
Bus73	Bus68	48.51	0.056	-1.470	26.1	1.471
Bus94	Bus64	37.90	0.073	-0.973	13.3	0.976
Incomer-02,Bay-12	Bus60	110.00	3.000	-20.999	7.0	21.212
Bus92	Bus56	37.90	0.049	-0.649	13.3	0.651
Incomer -01, Bay-09	Bus52	110.00	3.000	-20.999	7.0	21.212
Bus90	Bus48	37.90	0.073	-0.973	13.3	0.976
Bus82	Bus33	37.90	0.049	-0.649	13.3	0.651
Bus29	Bus27	12.36	0.020	-0.221	11.0	0.222
Bus23	Bus20	32.36	0.045	-0.579	13.0	0.581
Bus84	Bus18	37.90	0.024	-0.324	13.3	0.325
Bus100	Bus7	33.83	0.045	-0.579	13.0	0.581
GT-01, Bay14	Bus74	102.98	1.203	-31.408	26.1	31.431
GT-02,Bay-15	Bus73	102.98	1.203	-31.408	26.1	31.431
CICO-01	Bus94	115.00	0.289	-3.904	13.5	3.914
CICO-02	Bus94	115.00	0.281	-3.804	13.5	3.815
SMS I/C-02	Bus94	115.00	0.160	-2.158	13.5	2.164
CRM CAPL 2	Bus92	115.00	0.169	-2.283	13.5	2.289
HSM I/C-02	Bus92	115.00	0.365	-4.932	13.5	4.946
MRSS AUX-02	Bus92	115.00	0.004	-0.035	8.1	0.035
SMS FURNACE I/C-01	Bus92	115.00	0.114	-1.543	13.5	1.547
CRM HAPL	Bus90	115.00	0.024	-0.329	13.5	0.330
HSM I/C=01	Bus90	115.00	0.059	-0.791	13.5	0.793
10/12 MVA Trafo(S/S-03)	Bus82	115.00	0.008	-0.064	8.1	0.065
Boc I/C-01	Bus82	115.00	0.044	-0.601	13.5	0.603
COBP-1	Bus82	115.00	0.016	-0.217	13.5	0.217

(Cont.)

3-Phase fault at bus: **Bus1**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
S/S -02 IC-01	Bus82	115.00	0.011	-0.145	13.5	0.145
SMS AUX-01	Bus82	115.00	0.023	-0.310	13.5	0.311
SMS PUMP HOUSE-01	Bus82	115.00	0.015	-0.200	13.5	0.201
COKE OVEN 01	Bus95	115.00	0.010	-0.084	8.1	0.084
CRMHS 1 33/6.9	Bus95	115.00	0.010	-0.084	8.1	0.084
CPP SAT 02	Bus96	115.00	0.010	-0.084	8.1	0.084
Lump5	Bus29	110.00	0.128	-1.409	11.0	1.414
Lump3	Bus23	110.00	0.285	-3.692	13.0	3.703
CRM CAPL	Bus84	115.00	0.054	-0.734	13.5	0.736
MRSS AUX-01	Bus84	115.00	0.000	-0.004	8.1	0.004
SAT-01	Bus84	115.00	0.010	-0.077	8.1	0.078
SMS AUX - 02	Bus84	115.00	0.015	-0.207	13.5	0.207
SMS PUMP HOUSE-02	Bus84	115.00	0.012	-0.168	13.5	0.169
Lump1	Bus100	110.00	0.285	-3.692	13.0	3.703
Bus6	Bus1	0.00	2.372	-17.721	7.5	17.879
Bus7	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus1	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus1	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus52	Bus1	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus60	Bus1	0.00	2.372	-17.721	7.5	17.879
Bus64	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus5	Bus3	0.00	0.157	-0.819	5.2	0.834
Bus3	Bus6	0.00	1.186	-8.861	7.5	8.940
Bus8	Bus3	0.00	0.011	-0.145	13.0	0.145

(Cont.)

3-Phase fault at bus: **Bus1**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus17	Bus3	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus3	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus3	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus3	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus59	Bus3	0.00	0.157	-0.819	5.2	0.834
Bus63	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus5	Bus6	0.00	1.186	-8.861	7.5	8.940
Bus8	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus17	Bus5	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus5	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus5	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus59	Bus5	0.00	0.471	-2.458	5.2	2.503
Bus63	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus7	Bus8	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus17	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus19	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus26	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus32	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus47	0.00	0.036	-0.487	13.3	0.488

(Cont.)

3-Phase fault at bus: **Bus1**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus52	Bus51	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus55	0.00	0.024	-0.324	13.3	0.325
Bus60	Bus59	0.00	0.628	-3.278	5.2	3.337
Bus64	Bus63	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus67	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus71	0.00	0.028	-0.735	26.1	0.736
Bus95	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus84	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus82	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus84	Bus96	37.90	0.161	-2.321	14.4	2.327
Bus92	Bus84	37.90	0.416	-5.772	13.9	5.787
Bus92	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus94	Bus92	37.90	0.265	-3.659	13.8	3.669
Bus96	Bus95	37.90	0.171	-2.405	14.0	2.411

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	50.003	69.029	47.589
0.02	49.894	59.634	32.662
0.03	49.767	54.466	22.131
0.04	49.625	51.842	14.996
0.05	49.466	50.733	11.267
0.06	49.408	50.018	7.793
0.07	49.341	49.635	5.391
0.08	49.267	49.408	3.729
0.09	49.185	49.253	2.579
0.10	49.088	49.147	2.396
0.15	48.720	48.722	0.440
0.20	48.321	48.321	0.081
0.25	47.938	47.938	0.015

(Cont.)

3-Phase fault at bus: **Bus1**

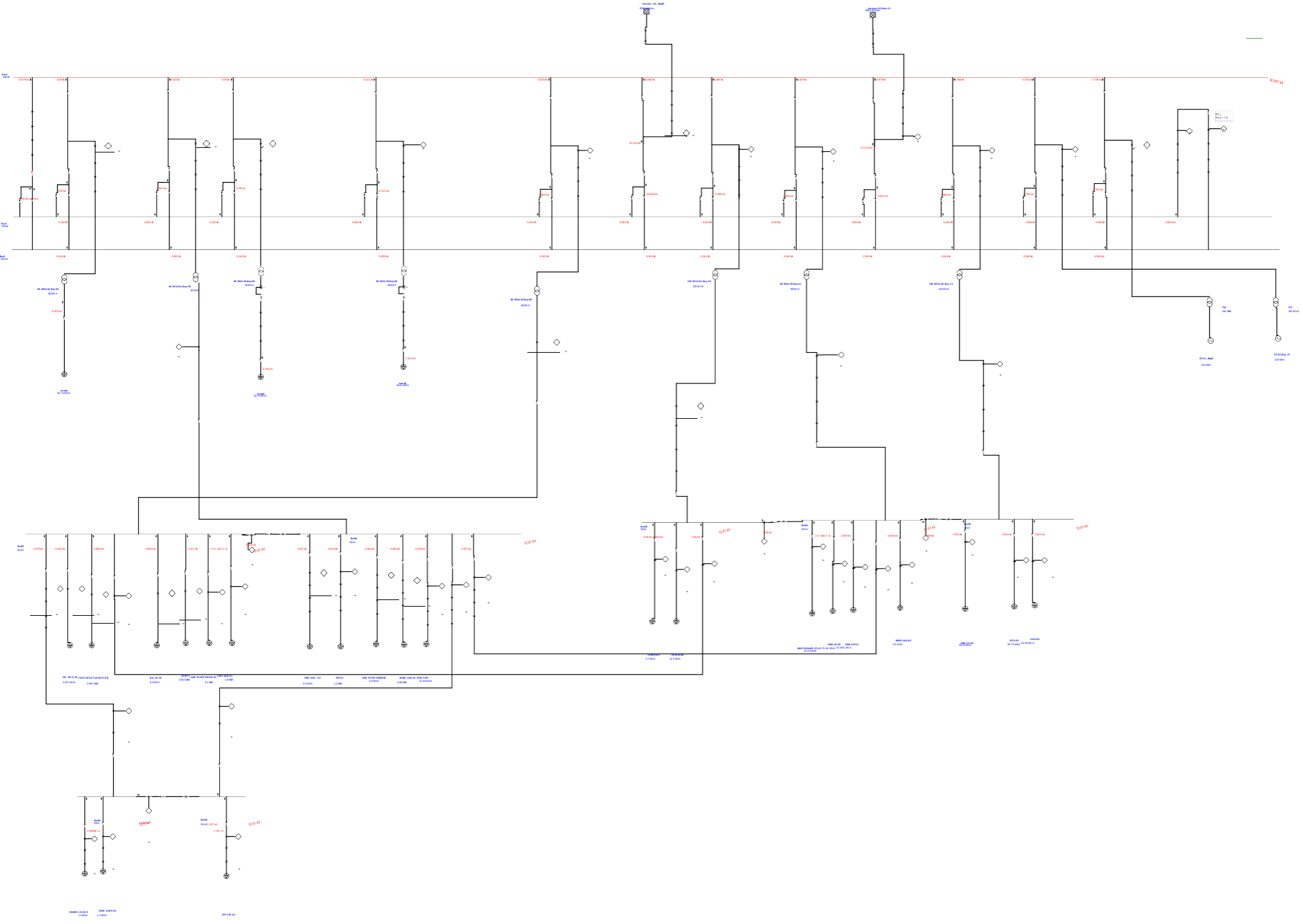
Nominal kV	= 220.000	
Voltage c Factor	= 1.10	(User-Defined)
Peak Value	= 119.889	kA Method C
Steady State	= 43.704	kA rms

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.30	47.938	47.938	0.003

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus1**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus1	Total	0.00	50.307	0.00	105.39	105.34	54.904	54.904	7.40E-002	5.69E-001	5.57E-002	4.23E-001
Bus74	Bus72	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus94	Bus64	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Incomer-02,Bay-12	Bus60	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus92	Bus56	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Incomer -01, Bay-09	Bus52	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus90	Bus48	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Bus82	Bus33	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Bus29	Bus27	12.36	0.222	9.02	107.63	107.03	0.162	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	32.36	0.581	23.61	111.40	110.25	0.424	0.000	3.82E+000	4.96E+001		
Bus84	Bus18	37.90	0.325	27.65	117.26	115.97	0.237	0.000	6.63E+000	8.85E+001		
Bus100	Bus7	33.83	0.581	24.68	116.46	115.26	0.424	0.000	3.82E+000	4.96E+001		
GT-01, Bay14	Bus74	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
GT-02,Bay-15	Bus73	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
CICO-01	Bus94	115.00	3.914	115.00	115.00	115.00	2.856	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	115.00	3.815	115.00	115.00	115.00	2.783	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	115.00	2.164	115.00	115.00	115.00	1.579	0.000	5.68E+000	5.68E+001		
CRM CAPL 2	Bus92	115.00	2.289	115.00	115.00	115.00	1.670	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	115.00	4.946	115.00	115.00	115.00	3.608	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	115.00	0.035	115.00	115.00	115.00	0.026	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	115.00	1.547	115.00	115.00	115.00	1.129	0.000	7.94E+000	7.94E+001		
CRM HAPL	Bus90	115.00	0.330	115.00	115.00	115.00	0.241	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	115.00	0.793	115.00	115.00	115.00	0.579	0.000	1.55E+001	1.55E+002		
10/12 MVA Trafo(S/S -03)	Bus82	115.00	0.065	115.00	115.00	115.00	0.047	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	115.00	0.603	115.00	115.00	115.00	0.440	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	115.00	0.217	115.00	115.00	115.00	0.158	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	115.00	0.145	115.00	115.00	115.00	0.106	0.000	8.48E+001	8.48E+002		

(Cont.)

Fault at bus: **Bus1**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS AUX-01	Bus82	115.00	0.311	115.00	115.00	115.00	0.227	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	115.00	0.201	115.00	115.00	115.00	0.147	0.000	6.12E+001	6.12E+002		
COKE OVEN 01	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CPP SAT 02	Bus96	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
Lump5	Bus29	110.00	1.414	110.00	110.00	110.00	1.032	0.000	1.15E+001	1.15E+002		
Lump3	Bus23	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
CRM CAPL	Bus84	115.00	0.736	115.00	115.00	115.00	0.537	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	115.00	0.004	115.00	115.00	115.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	115.00	0.078	115.00	115.00	115.00	0.057	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	115.00	0.207	115.00	115.00	115.00	0.151	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	115.00	0.169	115.00	115.00	115.00	0.123	0.000	7.29E+001	7.29E+002		
Lump1	Bus100	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
Bus6	Bus1	0.00	12.943	0.00	105.39	105.34	14.191	14.356				
Bus7	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus1	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus1	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus68	Bus1	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus72	Bus1	0.00	12.943	0.00	105.39	105.34	14.191	14.356				
Bus3	Bus5	0.00	2.870	0.00	105.39	105.34	3.083	2.960				
Bus3	Bus6	0.00	6.471	0.00	105.39	105.34	7.095	7.178				
Bus8	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus3	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				

(Cont.)

Fault at bus: **Bus1**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus26	Bus3	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus3	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus3	Bus71	0.00	2.870	0.00	105.39	105.34	3.083	2.960				
Bus5	Bus6	0.00	6.471	0.00	105.39	105.34	7.095	7.178				
Bus8	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus5	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus26	Bus5	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus5	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus5	Bus71	0.00	8.609	0.00	105.39	105.34	9.250	8.879				
Bus7	Bus8	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus17	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus19	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus26	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus32	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus47	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus51	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus55	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus59	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus63	0.00	0.488	0.00	105.39	105.34	0.356	0.000				

(Cont.)

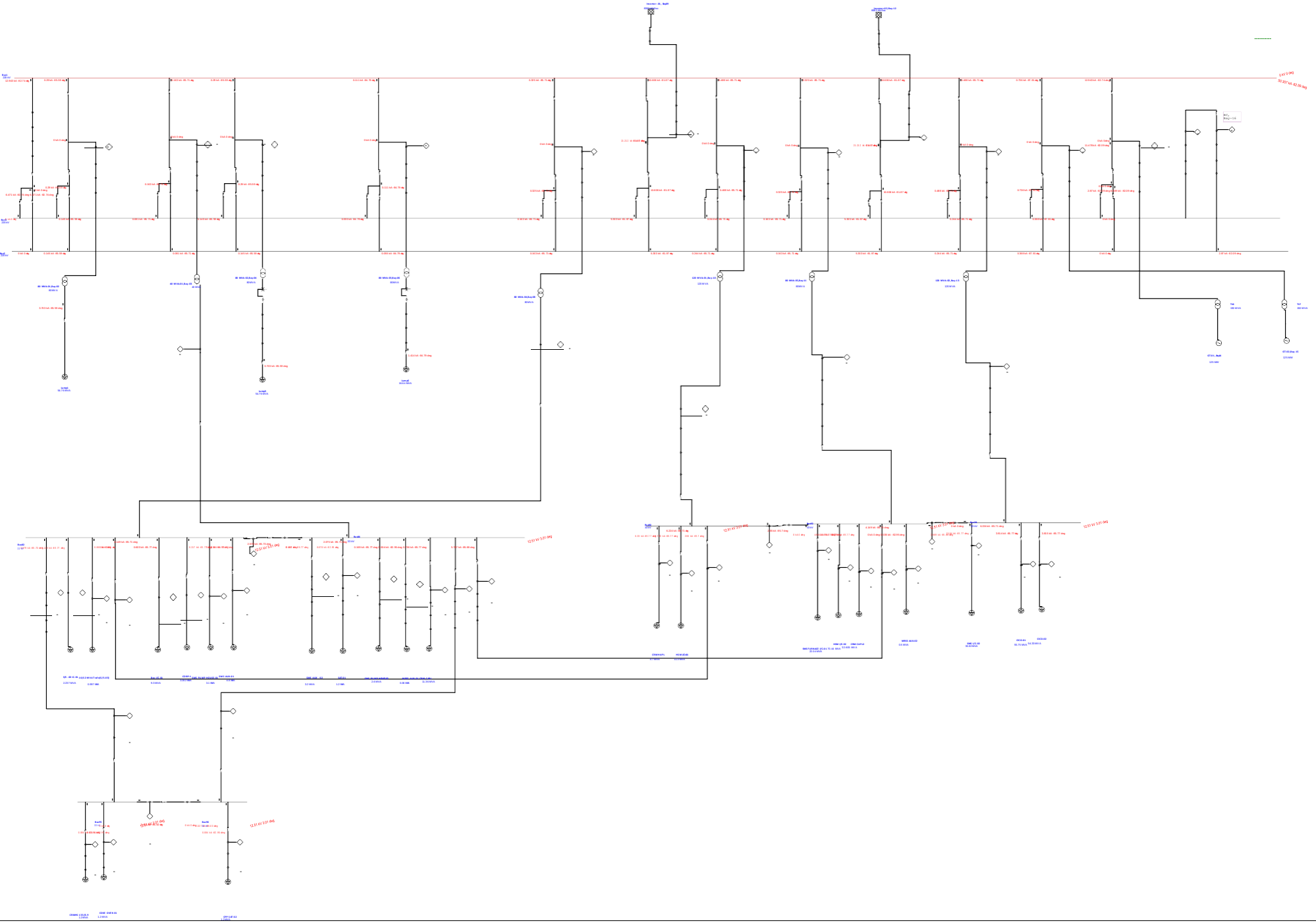
Fault at bus: **Bus1**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus68	Bus67	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus71	Bus72	0.00	11.478	0.00	105.39	105.34	12.333	11.839				
Bus95	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus84	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus82	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus84	Bus96	37.90	2.327	27.65	117.26	115.97	1.697	0.000				
Bus92	Bus84	37.90	5.787	27.65	117.26	115.97	4.222	0.000				
Bus92	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus94	Bus92	37.90	3.669	27.65	117.26	115.97	2.677	0.000				
Bus96	Bus95	37.90	2.411	27.65	117.26	115.97	1.759	0.000				

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	50.307	54.904	43.448	53.076
Peak Current (kA), Method C	:	119.889	130.846	103.545	126.490
Breaking Current (kA, rms, symm)	:		54.904	43.448	53.076
Steady State Current (kA, rms)	:	43.704	54.904	43.448	53.076

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus3**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Total	0.00	6.489	-49.886	7.7	50.307
Bus74	Bus72	48.51	0.056	-1.470	26.1	1.471
Bus73	Bus68	48.51	0.056	-1.470	26.1	1.471
Bus94	Bus64	37.90	0.073	-0.973	13.3	0.976
Incomer-02,Bay-12	Bus60	110.00	3.000	-20.999	7.0	21.212
Bus92	Bus56	37.90	0.049	-0.649	13.3	0.651
Incomer -01, Bay-09	Bus52	110.00	3.000	-20.999	7.0	21.212
Bus90	Bus48	37.90	0.073	-0.973	13.3	0.976
Bus82	Bus33	37.90	0.049	-0.649	13.3	0.651
Bus29	Bus27	12.36	0.020	-0.221	11.0	0.222
Bus23	Bus20	32.36	0.045	-0.579	13.0	0.581
Bus84	Bus18	37.90	0.024	-0.324	13.3	0.325
Bus100	Bus7	33.83	0.045	-0.579	13.0	0.581
GT-01, Bay14	Bus74	102.98	1.203	-31.408	26.1	31.431
GT-02,Bay-15	Bus73	102.98	1.203	-31.408	26.1	31.431
CICO-01	Bus94	115.00	0.289	-3.904	13.5	3.914
CICO-02	Bus94	115.00	0.281	-3.804	13.5	3.815
SMS I/C-02	Bus94	115.00	0.160	-2.158	13.5	2.164
CRM CAPL 2	Bus92	115.00	0.169	-2.283	13.5	2.289
HSM I/C-02	Bus92	115.00	0.365	-4.932	13.5	4.946
MRSS AUX-02	Bus92	115.00	0.004	-0.035	8.1	0.035
SMS FURNACE I/C-01	Bus92	115.00	0.114	-1.543	13.5	1.547
CRM HAPL	Bus90	115.00	0.024	-0.329	13.5	0.330
HSM I/C=01	Bus90	115.00	0.059	-0.791	13.5	0.793
10/12 MVA Trafo(S/S-03)	Bus82	115.00	0.008	-0.064	8.1	0.065
Boc I/C-01	Bus82	115.00	0.044	-0.601	13.5	0.603
COBP-1	Bus82	115.00	0.016	-0.217	13.5	0.217

(Cont.)

3-Phase fault at bus: **Bus3**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
S/S -02 IC-01	Bus82	115.00	0.011	-0.145	13.5	0.145
SMS AUX-01	Bus82	115.00	0.023	-0.310	13.5	0.311
SMS PUMP HOUSE-01	Bus82	115.00	0.015	-0.200	13.5	0.201
COKE OVEN 01	Bus95	115.00	0.010	-0.084	8.1	0.084
CRMHS 1 33/6.9	Bus95	115.00	0.010	-0.084	8.1	0.084
CPP SAT 02	Bus96	115.00	0.010	-0.084	8.1	0.084
Lump5	Bus29	110.00	0.128	-1.409	11.0	1.414
Lump3	Bus23	110.00	0.285	-3.692	13.0	3.703
CRM CAPL	Bus84	115.00	0.054	-0.734	13.5	0.736
MRSS AUX-01	Bus84	115.00	0.000	-0.004	8.1	0.004
SAT-01	Bus84	115.00	0.010	-0.077	8.1	0.078
SMS AUX - 02	Bus84	115.00	0.015	-0.207	13.5	0.207
SMS PUMP HOUSE-02	Bus84	115.00	0.012	-0.168	13.5	0.169
Lump1	Bus100	110.00	0.285	-3.692	13.0	3.703
Bus1	Bus6	0.00	0.872	-7.222	8.3	7.274
Bus7	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus1	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus1	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus52	Bus1	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus1	Bus60	0.00	0.872	-7.222	8.3	7.274
Bus64	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus5	Bus3	0.00	2.590	-19.527	7.5	19.698
Bus6	Bus3	0.00	0.436	-3.611	8.3	3.637
Bus8	Bus3	0.00	0.011	-0.145	13.0	0.145

(Cont.)

3-Phase fault at bus: **Bus3**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus17	Bus3	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus3	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus3	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus3	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus59	Bus3	0.00	2.590	-19.527	7.5	19.698
Bus63	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus6	Bus5	0.00	0.436	-3.611	8.3	3.637
Bus8	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus17	Bus5	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus5	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus5	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus59	Bus5	0.00	1.282	-8.694	6.8	8.788
Bus63	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus7	Bus8	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus17	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus19	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus26	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus32	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus47	0.00	0.036	-0.487	13.3	0.488

(Cont.)

3-Phase fault at bus: **Bus3**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus52	Bus51	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus55	0.00	0.024	-0.324	13.3	0.325
Bus60	Bus59	0.00	3.872	-28.221	7.3	28.485
Bus64	Bus63	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus67	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus71	0.00	0.028	-0.735	26.1	0.736
Bus95	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus84	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus82	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus84	Bus96	37.90	0.161	-2.321	14.4	2.327
Bus92	Bus84	37.90	0.416	-5.772	13.9	5.787
Bus92	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus94	Bus92	37.90	0.265	-3.659	13.8	3.669
Bus96	Bus95	37.90	0.171	-2.405	14.0	2.411

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	50.003	69.029	47.589
0.02	49.894	59.634	32.662
0.03	49.767	54.466	22.131
0.04	49.625	51.842	14.996
0.05	49.466	50.733	11.267
0.06	49.408	50.018	7.793
0.07	49.341	49.635	5.391
0.08	49.267	49.408	3.729
0.09	49.185	49.253	2.579
0.10	49.088	49.147	2.396
0.15	48.720	48.722	0.440
0.20	48.321	48.321	0.081
0.25	47.938	47.938	0.015

(Cont.)

3-Phase fault at bus: **Bus3**

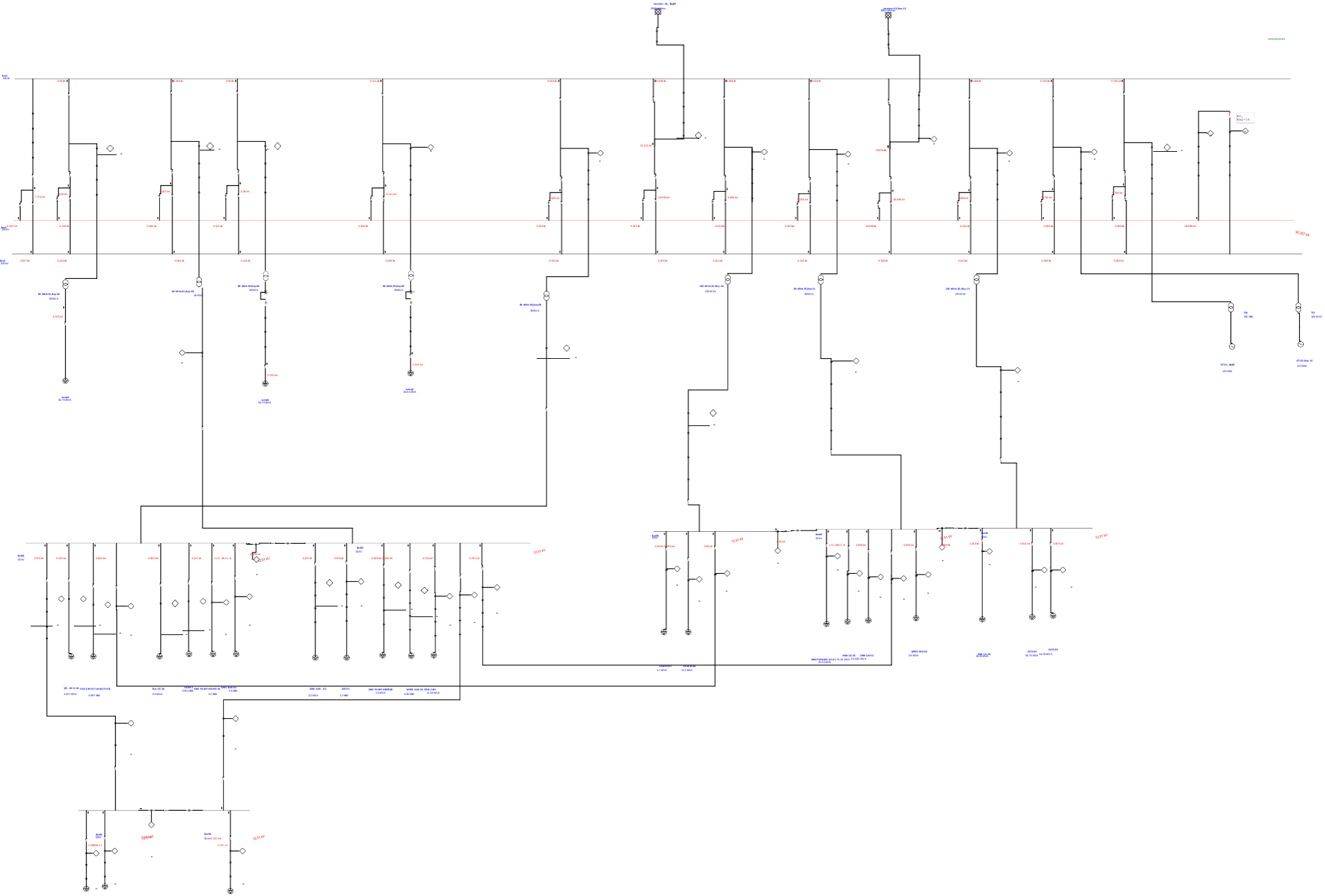
Nominal kV	= 220.000	
Voltage c Factor	= 1.10	(User-Defined)
Peak Value	= 119.889	kA Method C
Steady State	= 43.704	kA rms

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.30	47.938	47.938	0.003

One-Line Diagram - OLV1 (Short-Circuit Analysis)



Location:

19.0.1C

Date: Feb 21, 2021

Contract:

SN:

Engineer:

Revision: Base

Filename: SLD 2

Study Case: SC

Config.: Normal

SHORT- CIRCUIT REPORT

Fault at bus: **Bus3**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus ID	To Bus ID	% V From Bus	kA Symm. rms	% Voltage at From Bus Va	Vb	Vc	kA Symm. rms Ia	3I0	% Impedance on 100 MVA base R1	X1	R0	X0
Bus3	Total	0.00	50.307	0.00	105.39	105.34	54.904	54.904	7.40E-002	5.69E-001	5.57E-002	4.23E-001
Bus74	Bus72	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus94	Bus64	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Incomer-02,Bay-12	Bus60	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus92	Bus56	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Incomer -01, Bay-09	Bus52	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus90	Bus48	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Bus82	Bus33	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Bus29	Bus27	12.36	0.222	9.02	107.63	107.03	0.162	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	32.36	0.581	23.61	111.40	110.25	0.424	0.000	3.82E+000	4.96E+001		
Bus84	Bus18	37.90	0.325	27.65	117.26	115.97	0.237	0.000	6.63E+000	8.85E+001		
Bus100	Bus7	33.83	0.581	24.68	116.46	115.26	0.424	0.000	3.82E+000	4.96E+001		
GT-01, Bay14	Bus74	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
GT-02,Bay-15	Bus73	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
CICO-01	Bus94	115.00	3.914	115.00	115.00	115.00	2.856	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	115.00	3.815	115.00	115.00	115.00	2.783	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	115.00	2.164	115.00	115.00	115.00	1.579	0.000	5.68E+000	5.68E+001		
CRM CAPL 2	Bus92	115.00	2.289	115.00	115.00	115.00	1.670	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	115.00	4.946	115.00	115.00	115.00	3.608	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	115.00	0.035	115.00	115.00	115.00	0.026	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	115.00	1.547	115.00	115.00	115.00	1.129	0.000	7.94E+000	7.94E+001		
CRM HAPL	Bus90	115.00	0.330	115.00	115.00	115.00	0.241	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	115.00	0.793	115.00	115.00	115.00	0.579	0.000	1.55E+001	1.55E+002		
10/12 MVA Trafo(S/S -03)	Bus82	115.00	0.065	115.00	115.00	115.00	0.047	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	115.00	0.603	115.00	115.00	115.00	0.440	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	115.00	0.217	115.00	115.00	115.00	0.158	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	115.00	0.145	115.00	115.00	115.00	0.106	0.000	8.48E+001	8.48E+002		

(Cont.)

Fault at bus: **Bus3**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS AUX-01	Bus82	115.00	0.311	115.00	115.00	115.00	0.227	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	115.00	0.201	115.00	115.00	115.00	0.147	0.000	6.12E+001	6.12E+002		
COKE OVEN 01	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CPP SAT 02	Bus96	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
Lump5	Bus29	110.00	1.414	110.00	110.00	110.00	1.032	0.000	1.15E+001	1.15E+002		
Lump3	Bus23	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
CRM CAPL	Bus84	115.00	0.736	115.00	115.00	115.00	0.537	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	115.00	0.004	115.00	115.00	115.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	115.00	0.078	115.00	115.00	115.00	0.057	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	115.00	0.207	115.00	115.00	115.00	0.151	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	115.00	0.169	115.00	115.00	115.00	0.123	0.000	7.29E+001	7.29E+002		
Lump1	Bus100	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
Bus1	Bus6	0.00	12.210	0.00	105.39	105.34	13.262	13.097				
Bus7	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus1	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus1	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus68	Bus1	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus1	Bus72	0.00	12.210	0.00	105.39	105.34	13.262	13.097				
Bus5	Bus3	0.00	15.996	0.00	105.39	105.34	17.506	17.630				
Bus6	Bus3	0.00	6.105	0.00	105.39	105.34	6.631	6.548				
Bus8	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus3	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				

(Cont.)

Fault at bus: **Bus3**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus26	Bus3	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus3	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus71	Bus3	0.00	15.996	0.00	105.39	105.34	17.506	17.630				
Bus6	Bus5	0.00	6.105	0.00	105.39	105.34	6.631	6.548				
Bus8	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus5	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus26	Bus5	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus5	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus5	Bus71	0.00	2.321	0.00	105.39	105.34	2.388	2.021				
Bus7	Bus8	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus17	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus19	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus26	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus32	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus47	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus51	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus55	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus59	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus63	0.00	0.488	0.00	105.39	105.34	0.356	0.000				

(Cont.)

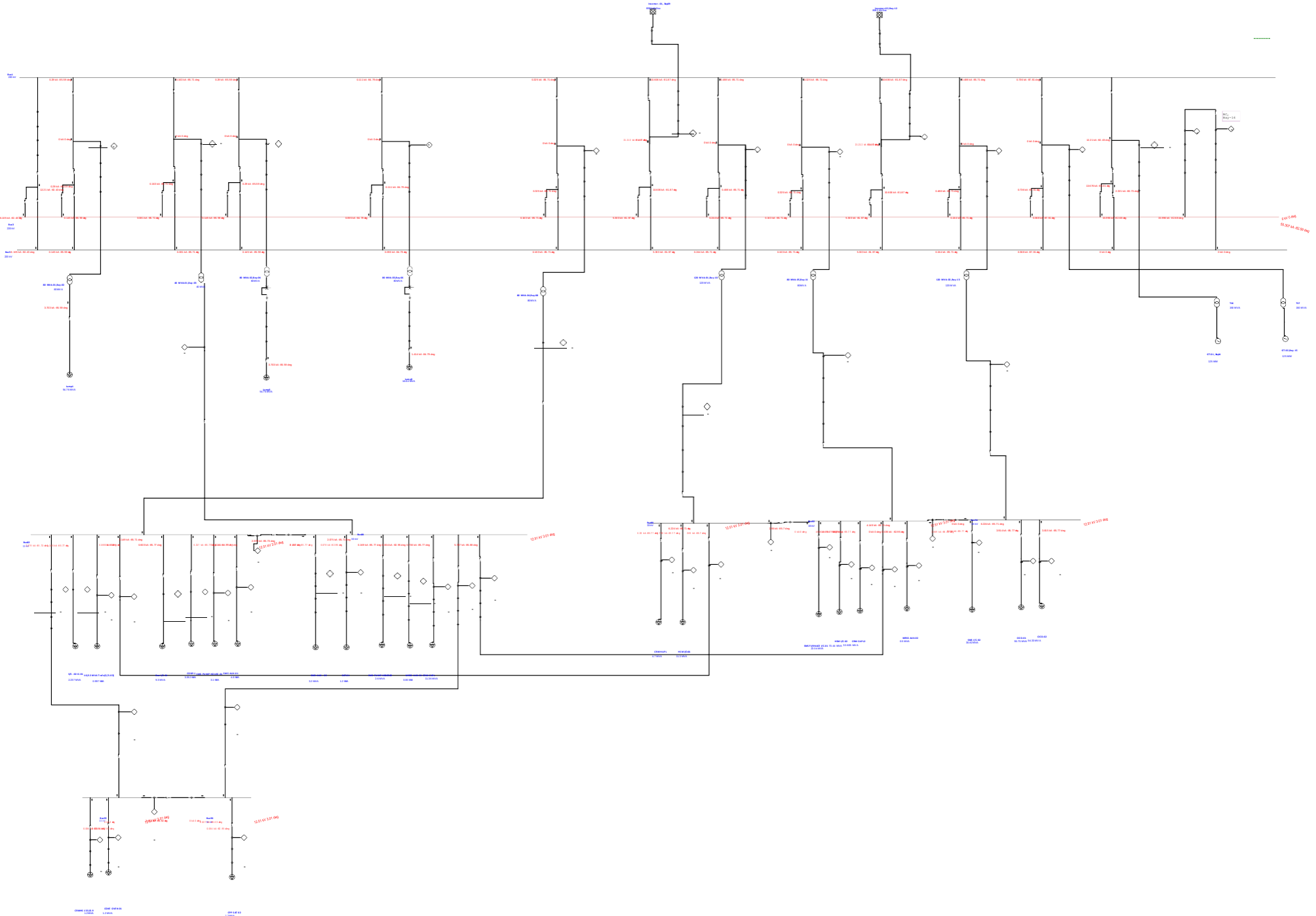
Fault at bus: **Bus3**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus68	Bus67	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus72	Bus71	0.00	13.676	0.00	105.39	105.34	15.121	15.616				
Bus95	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus84	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus82	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus84	Bus96	37.90	2.327	27.65	117.26	115.97	1.697	0.000				
Bus92	Bus84	37.90	5.787	27.65	117.26	115.97	4.222	0.000				
Bus92	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus94	Bus92	37.90	3.669	27.65	117.26	115.97	2.677	0.000				
Bus96	Bus95	37.90	2.411	27.65	117.26	115.97	1.759	0.000				

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	50.307	54.904	43.448	53.076
Peak Current (kA), Method C	:	119.889	130.846	103.545	126.490
Breaking Current (kA, rms, symm)	:		54.904	43.448	53.076
Steady State Current (kA, rms)	:	43.704	54.904	43.448	53.076

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus5**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus5	Total	0.00	6.489	-49.886	7.7	50.307
Bus74	Bus72	48.51	0.056	-1.470	26.1	1.471
Bus73	Bus68	48.51	0.056	-1.470	26.1	1.471
Bus94	Bus64	37.90	0.073	-0.973	13.3	0.976
Incomer-02,Bay-12	Bus60	110.00	3.000	-20.999	7.0	21.212
Bus92	Bus56	37.90	0.049	-0.649	13.3	0.651
Incomer -01, Bay-09	Bus52	110.00	3.000	-20.999	7.0	21.212
Bus90	Bus48	37.90	0.073	-0.973	13.3	0.976
Bus82	Bus33	37.90	0.049	-0.649	13.3	0.651
Bus29	Bus27	12.36	0.020	-0.221	11.0	0.222
Bus23	Bus20	32.36	0.045	-0.579	13.0	0.581
Bus84	Bus18	37.90	0.024	-0.324	13.3	0.325
Bus100	Bus7	33.83	0.045	-0.579	13.0	0.581
GT-01, Bay14	Bus74	102.98	1.203	-31.408	26.1	31.431
GT-02,Bay-15	Bus73	102.98	1.203	-31.408	26.1	31.431
CICO-01	Bus94	115.00	0.289	-3.904	13.5	3.914
CICO-02	Bus94	115.00	0.281	-3.804	13.5	3.815
SMS I/C-02	Bus94	115.00	0.160	-2.158	13.5	2.164
CRM CAPL 2	Bus92	115.00	0.169	-2.283	13.5	2.289
HSM I/C-02	Bus92	115.00	0.365	-4.932	13.5	4.946
MRSS AUX-02	Bus92	115.00	0.004	-0.035	8.1	0.035
SMS FURNACE I/C-01	Bus92	115.00	0.114	-1.543	13.5	1.547
CRM HAPL	Bus90	115.00	0.024	-0.329	13.5	0.330
HSM I/C=01	Bus90	115.00	0.059	-0.791	13.5	0.793
10/12 MVA Trafo(S/S-03)	Bus82	115.00	0.008	-0.064	8.1	0.065
Boc I/C-01	Bus82	115.00	0.044	-0.601	13.5	0.603
COBP-1	Bus82	115.00	0.016	-0.217	13.5	0.217

(Cont.)

3-Phase fault at bus: **Bus5**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
S/S -02 IC-01	Bus82	115.00	0.011	-0.145	13.5	0.145
SMS AUX-01	Bus82	115.00	0.023	-0.310	13.5	0.311
SMS PUMP HOUSE-01	Bus82	115.00	0.015	-0.200	13.5	0.201
COKE OVEN 01	Bus95	115.00	0.010	-0.084	8.1	0.084
CRMHS 1 33/6.9	Bus95	115.00	0.010	-0.084	8.1	0.084
CPP SAT 02	Bus96	115.00	0.010	-0.084	8.1	0.084
Lump5	Bus29	110.00	0.128	-1.409	11.0	1.414
Lump3	Bus23	110.00	0.285	-3.692	13.0	3.703
CRM CAPL	Bus84	115.00	0.054	-0.734	13.5	0.736
MRSS AUX-01	Bus84	115.00	0.000	-0.004	8.1	0.004
SAT-01	Bus84	115.00	0.010	-0.077	8.1	0.078
SMS AUX - 02	Bus84	115.00	0.015	-0.207	13.5	0.207
SMS PUMP HOUSE-02	Bus84	115.00	0.012	-0.168	13.5	0.169
Lump1	Bus100	110.00	0.285	-3.692	13.0	3.703
Bus1	Bus6	0.00	0.872	-7.222	8.3	7.274
Bus7	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus1	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus1	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus1	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus52	Bus1	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus1	0.00	0.024	-0.324	13.3	0.325
Bus1	Bus60	0.00	0.872	-7.222	8.3	7.274
Bus64	Bus1	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus1	0.00	0.028	-0.735	26.1	0.736
Bus3	Bus5	0.00	0.654	-5.416	8.3	5.456
Bus6	Bus3	0.00	0.436	-3.611	8.3	3.637
Bus8	Bus3	0.00	0.011	-0.145	13.0	0.145

(Cont.)

3-Phase fault at bus: **Bus5**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus17	Bus3	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus3	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus3	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus3	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus3	0.00	0.012	-0.162	13.3	0.163
Bus3	Bus59	0.00	0.654	-5.416	8.3	5.456
Bus63	Bus3	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus3	0.00	0.014	-0.368	26.1	0.368
Bus6	Bus5	0.00	0.436	-3.611	8.3	3.637
Bus8	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus17	Bus5	0.00	0.006	-0.081	13.3	0.081
Bus19	Bus5	0.00	0.011	-0.145	13.0	0.145
Bus26	Bus5	0.00	0.005	-0.055	11.0	0.055
Bus32	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus47	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus51	Bus5	0.00	0.750	-5.250	7.0	5.303
Bus55	Bus5	0.00	0.012	-0.162	13.3	0.163
Bus59	Bus5	0.00	4.526	-33.637	7.4	33.940
Bus63	Bus5	0.00	0.018	-0.243	13.3	0.244
Bus67	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus71	Bus5	0.00	0.014	-0.368	26.1	0.368
Bus7	Bus8	0.00	0.022	-0.290	13.0	0.290
Bus18	Bus17	0.00	0.012	-0.162	13.3	0.163
Bus20	Bus19	0.00	0.022	-0.290	13.0	0.290
Bus27	Bus26	0.00	0.010	-0.110	11.0	0.111
Bus33	Bus32	0.00	0.024	-0.324	13.3	0.325
Bus48	Bus47	0.00	0.036	-0.487	13.3	0.488

(Cont.)

3-Phase fault at bus: **Bus5**

Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 119.889 kA Method C
Steady State = 43.704 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus52	Bus51	0.00	1.500	-10.500	7.0	10.606
Bus56	Bus55	0.00	0.024	-0.324	13.3	0.325
Bus60	Bus59	0.00	3.872	-28.221	7.3	28.485
Bus64	Bus63	0.00	0.036	-0.487	13.3	0.488
Bus68	Bus67	0.00	0.028	-0.735	26.1	0.736
Bus72	Bus71	0.00	0.028	-0.735	26.1	0.736
Bus95	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus84	Bus82	37.90	0.192	-2.572	13.4	2.579
Bus82	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus84	Bus96	37.90	0.161	-2.321	14.4	2.327
Bus92	Bus84	37.90	0.416	-5.772	13.9	5.787
Bus92	Bus90	37.90	0.191	-2.543	13.3	2.550
Bus94	Bus92	37.90	0.265	-3.659	13.8	3.669
Bus96	Bus95	37.90	0.171	-2.405	14.0	2.411

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	50.003	69.029	47.589
0.02	49.894	59.634	32.662
0.03	49.767	54.466	22.131
0.04	49.625	51.842	14.996
0.05	49.466	50.733	11.267
0.06	49.408	50.018	7.793
0.07	49.341	49.635	5.391
0.08	49.267	49.408	3.729
0.09	49.185	49.253	2.579
0.10	49.088	49.147	2.396
0.15	48.720	48.722	0.440
0.20	48.321	48.321	0.081
0.25	47.938	47.938	0.015

(Cont.)

3-Phase fault at bus: **Bus5**

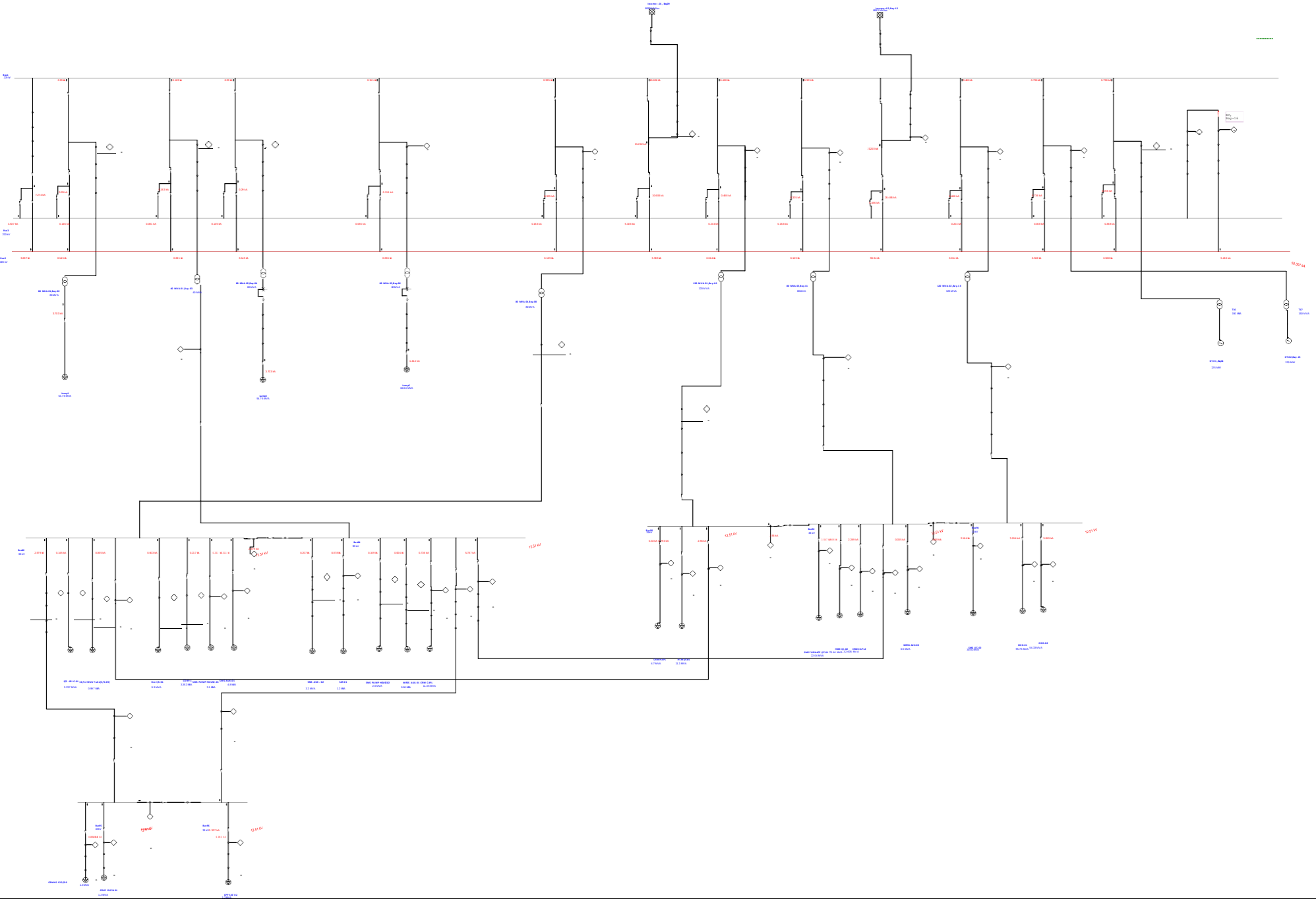
Nominal kV	= 220.000	
Voltage c Factor	= 1.10	(User-Defined)
Peak Value	= 119.889	kA Method C
Steady State	= 43.704	kA rms

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.30	47.938	47.938	0.003

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus5**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus5	Total	0.00	50.307	0.00	105.39	105.34	54.904	54.904	7.40E-002	5.69E-001	5.57E-002	4.23E-001
Bus74	Bus72	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	48.51	1.471	73.86	75.60	104.80	1.866	2.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus94	Bus64	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Incomer-02,Bay-12	Bus60	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus92	Bus56	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Incomer -01, Bay-09	Bus52	110.00	21.212	110.00	110.00	110.00	23.788	24.935	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus90	Bus48	37.90	0.976	27.65	117.26	115.97	0.712	0.000	2.21E+000	2.95E+001		
Bus82	Bus33	37.90	0.651	27.65	117.26	115.97	0.475	0.000	3.32E+000	4.42E+001		
Bus29	Bus27	12.36	0.222	9.02	107.63	107.03	0.162	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	32.36	0.581	23.61	111.40	110.25	0.424	0.000	3.82E+000	4.96E+001		
Bus84	Bus18	37.90	0.325	27.65	117.26	115.97	0.237	0.000	6.63E+000	8.85E+001		
Bus100	Bus7	33.83	0.581	24.68	116.46	115.26	0.424	0.000	3.82E+000	4.96E+001		
GT-01, Bay14	Bus74	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
GT-02,Bay-15	Bus73	102.98	31.431	102.98	102.98	102.98	18.737	0.000	5.46E-001	1.04E+001	1.16E+000	8.11E+000
CICO-01	Bus94	115.00	3.914	115.00	115.00	115.00	2.856	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	115.00	3.815	115.00	115.00	115.00	2.783	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	115.00	2.164	115.00	115.00	115.00	1.579	0.000	5.68E+000	5.68E+001		
CRM CAPL 2	Bus92	115.00	2.289	115.00	115.00	115.00	1.670	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	115.00	4.946	115.00	115.00	115.00	3.608	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	115.00	0.035	115.00	115.00	115.00	0.026	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	115.00	1.547	115.00	115.00	115.00	1.129	0.000	7.94E+000	7.94E+001		
CRM HAPL	Bus90	115.00	0.330	115.00	115.00	115.00	0.241	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	115.00	0.793	115.00	115.00	115.00	0.579	0.000	1.55E+001	1.55E+002		
10/12 MVA Trafo(S/S -03)	Bus82	115.00	0.065	115.00	115.00	115.00	0.047	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	115.00	0.603	115.00	115.00	115.00	0.440	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	115.00	0.217	115.00	115.00	115.00	0.158	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	115.00	0.145	115.00	115.00	115.00	0.106	0.000	8.48E+001	8.48E+002		

(Cont.)

Fault at bus: **Bus5**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS AUX-01	Bus82	115.00	0.311	115.00	115.00	115.00	0.227	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	115.00	0.201	115.00	115.00	115.00	0.147	0.000	6.12E+001	6.12E+002		
COKE OVEN 01	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
CPP SAT 02	Bus96	115.00	0.084	115.00	115.00	115.00	0.061	0.000	2.17E+002	1.45E+003		
Lump5	Bus29	110.00	1.414	110.00	110.00	110.00	1.032	0.000	1.15E+001	1.15E+002		
Lump3	Bus23	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
CRM CAPL	Bus84	115.00	0.736	115.00	115.00	115.00	0.537	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	115.00	0.004	115.00	115.00	115.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	115.00	0.078	115.00	115.00	115.00	0.057	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	115.00	0.207	115.00	115.00	115.00	0.151	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	115.00	0.169	115.00	115.00	115.00	0.123	0.000	7.29E+001	7.29E+002		
Lump1	Bus100	110.00	3.703	110.00	110.00	110.00	2.702	0.000	3.49E+000	3.49E+001		
Bus1	Bus6	0.00	12.210	0.00	105.39	105.34	13.262	13.097				
Bus7	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus1	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus1	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus1	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus1	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus1	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus1	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus68	Bus1	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus1	Bus72	0.00	12.210	0.00	105.39	105.34	13.262	13.097				
Bus3	Bus5	0.00	9.158	0.00	105.39	105.34	9.946	9.822				
Bus6	Bus3	0.00	6.105	0.00	105.39	105.34	6.631	6.548				
Bus8	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus3	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus3	0.00	0.145	0.00	105.39	105.34	0.106	0.000				

(Cont.)

Fault at bus: **Bus5**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus26	Bus3	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus3	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus3	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus3	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus3	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus3	Bus71	0.00	9.158	0.00	105.39	105.34	9.946	9.822				
Bus6	Bus5	0.00	6.105	0.00	105.39	105.34	6.631	6.548				
Bus8	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus17	Bus5	0.00	0.081	0.00	105.39	105.34	0.059	0.000				
Bus19	Bus5	0.00	0.145	0.00	105.39	105.34	0.106	0.000				
Bus26	Bus5	0.00	0.055	0.00	105.39	105.34	0.040	0.000				
Bus32	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus47	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus51	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus55	Bus5	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus59	Bus5	0.00	5.303	0.00	105.39	105.34	5.947	6.234				
Bus63	Bus5	0.00	0.244	0.00	105.39	105.34	0.178	0.000				
Bus67	Bus5	0.00	0.368	0.00	105.39	105.34	0.467	0.633				
Bus71	Bus5	0.00	22.833	0.00	105.39	105.34	25.066	25.438				
Bus7	Bus8	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus18	Bus17	0.00	0.163	0.00	105.39	105.34	0.119	0.000				
Bus20	Bus19	0.00	0.290	0.00	105.39	105.34	0.212	0.000				
Bus27	Bus26	0.00	0.111	0.00	105.39	105.34	0.081	0.000				
Bus33	Bus32	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus48	Bus47	0.00	0.488	0.00	105.39	105.34	0.356	0.000				
Bus52	Bus51	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus56	Bus55	0.00	0.325	0.00	105.39	105.34	0.237	0.000				
Bus60	Bus59	0.00	10.606	0.00	105.39	105.34	11.894	12.467				
Bus64	Bus63	0.00	0.488	0.00	105.39	105.34	0.356	0.000				

(Cont.)

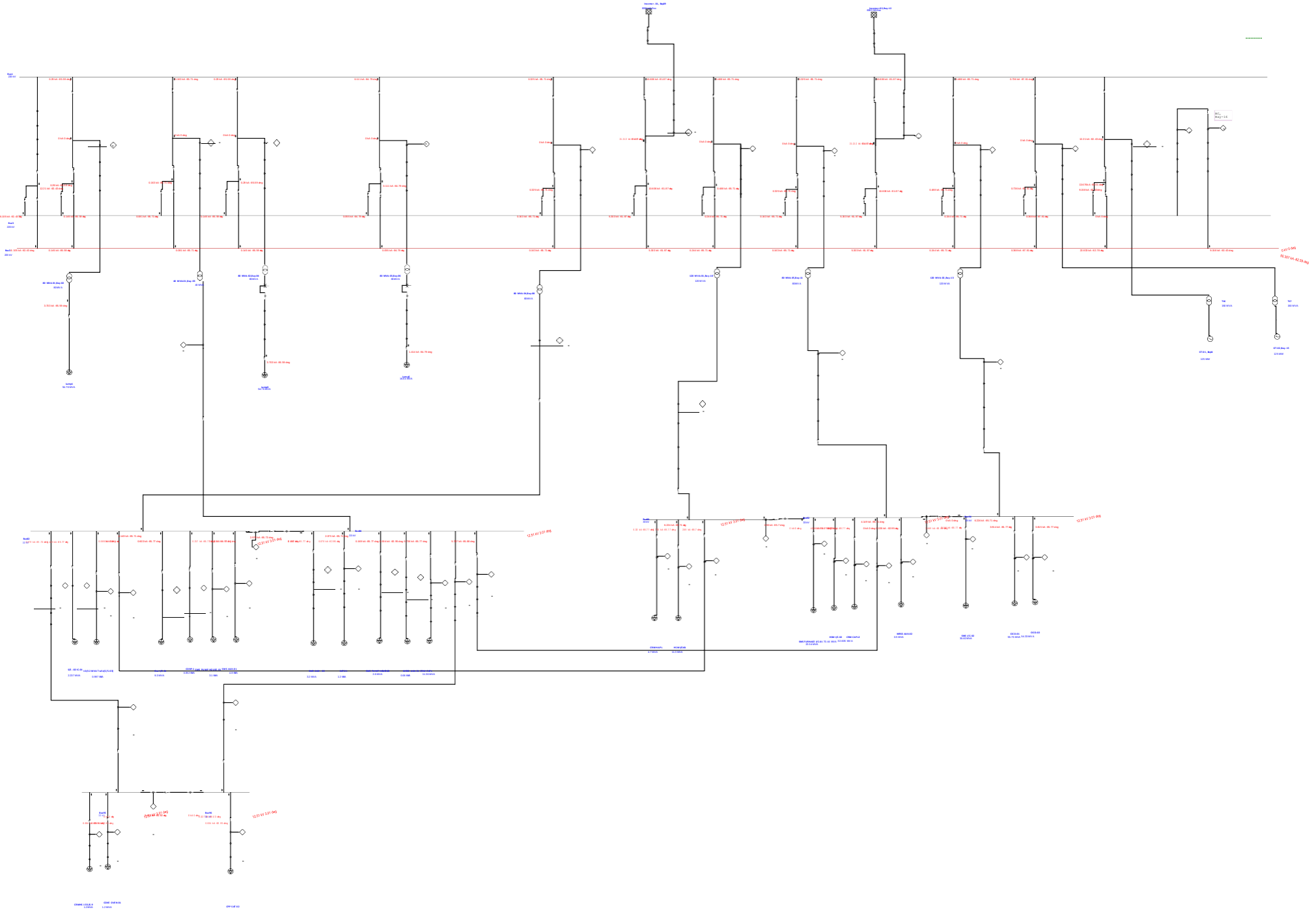
Fault at bus: **Bus5**
Nominal kV = 220.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus68	Bus67	0.00	0.736	0.00	105.39	105.34	0.933	1.267				
Bus72	Bus71	0.00	13.676	0.00	105.39	105.34	15.121	15.616				
Bus95	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus84	Bus82	37.90	2.579	27.65	117.26	115.97	1.882	0.000				
Bus82	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus84	Bus96	37.90	2.327	27.65	117.26	115.97	1.697	0.000				
Bus92	Bus84	37.90	5.787	27.65	117.26	115.97	4.222	0.000				
Bus92	Bus90	37.90	2.550	27.65	117.26	115.97	1.861	0.000				
Bus94	Bus92	37.90	3.669	27.65	117.26	115.97	2.677	0.000				
Bus96	Bus95	37.90	2.411	27.65	117.26	115.97	1.759	0.000				

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	50.307	54.904	43.448	53.076
Peak Current (kA), Method C	:	119.889	130.846	103.545	126.490
Breaking Current (kA, rms, symm)	:		54.904	43.448	53.076
Steady State Current (kA, rms)	:	43.704	54.904	43.448	53.076

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

One-Line Diagram - OLV1 (Short-Circuit Analysis)



Project: **ETAP**

Location: 19.0.1C Date: Feb 21, 2021

Contract: SN:

Engineer: Revision: Base

Filename: SLD 2 Study Case: SC Config.: Normal

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus82**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus82	Total	0.00	5.589	-86.107	15.4	86.288
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120

(Cont.)

3-Phase fault at bus: **Bus82**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus95	Bus82	0.00	2.274	-33.012	14.5	33.090
Bus84	Bus82	0.00	2.274	-33.012	14.5	33.090
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus84	Bus96	0.00	2.220	-32.656	14.7	32.731
Bus92	Bus84	0.00	4.108	-59.090	14.4	59.232
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus96	Bus95	0.00	2.238	-32.775	14.6	32.851
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus82**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus82**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

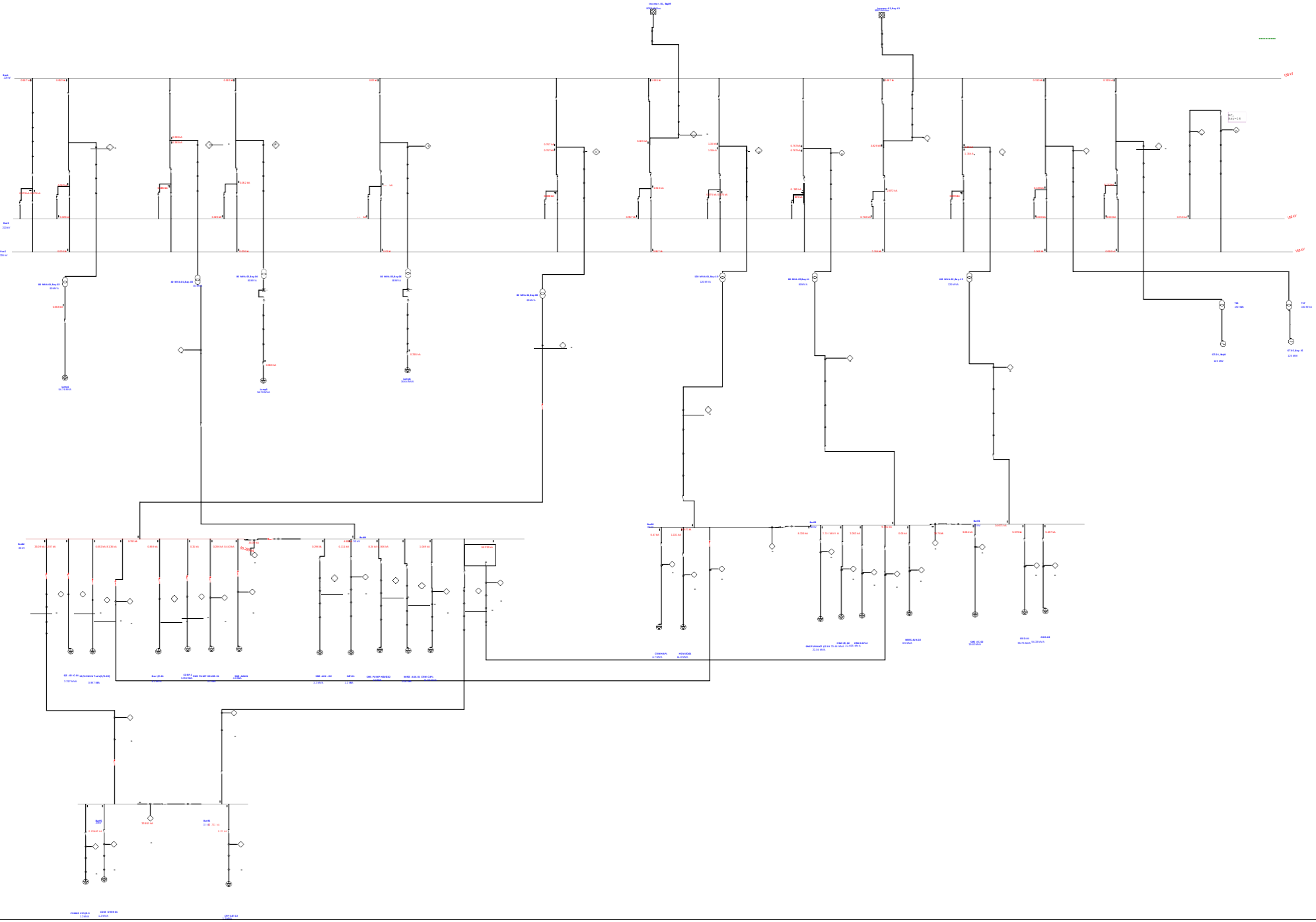
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus82**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus82	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		

(Cont.)

Fault at bus: **Bus82**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus ID	To Bus ID	% V From Bus Symm.	kA rms	% Voltage at From Bus Va	Vb	Vc	kA Symm. rms Ia	3I0	% Impedance on 100 MVA base R1	X1	R0	X0
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus84**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus84	Total	0.00	5.589	-86.107	15.4	86.288
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443

(Cont.)

3-Phase fault at bus: **Bus84**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus82	Bus95	0.00	0.521	-10.041	19.3	10.055
Bus82	Bus84	0.00	0.521	-10.041	19.3	10.055
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus96	Bus84	0.00	0.574	-10.398	18.1	10.413
Bus92	Bus84	0.00	4.108	-59.090	14.4	59.232
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus95	Bus96	0.00	0.556	-10.279	18.5	10.294
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus84**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus84**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

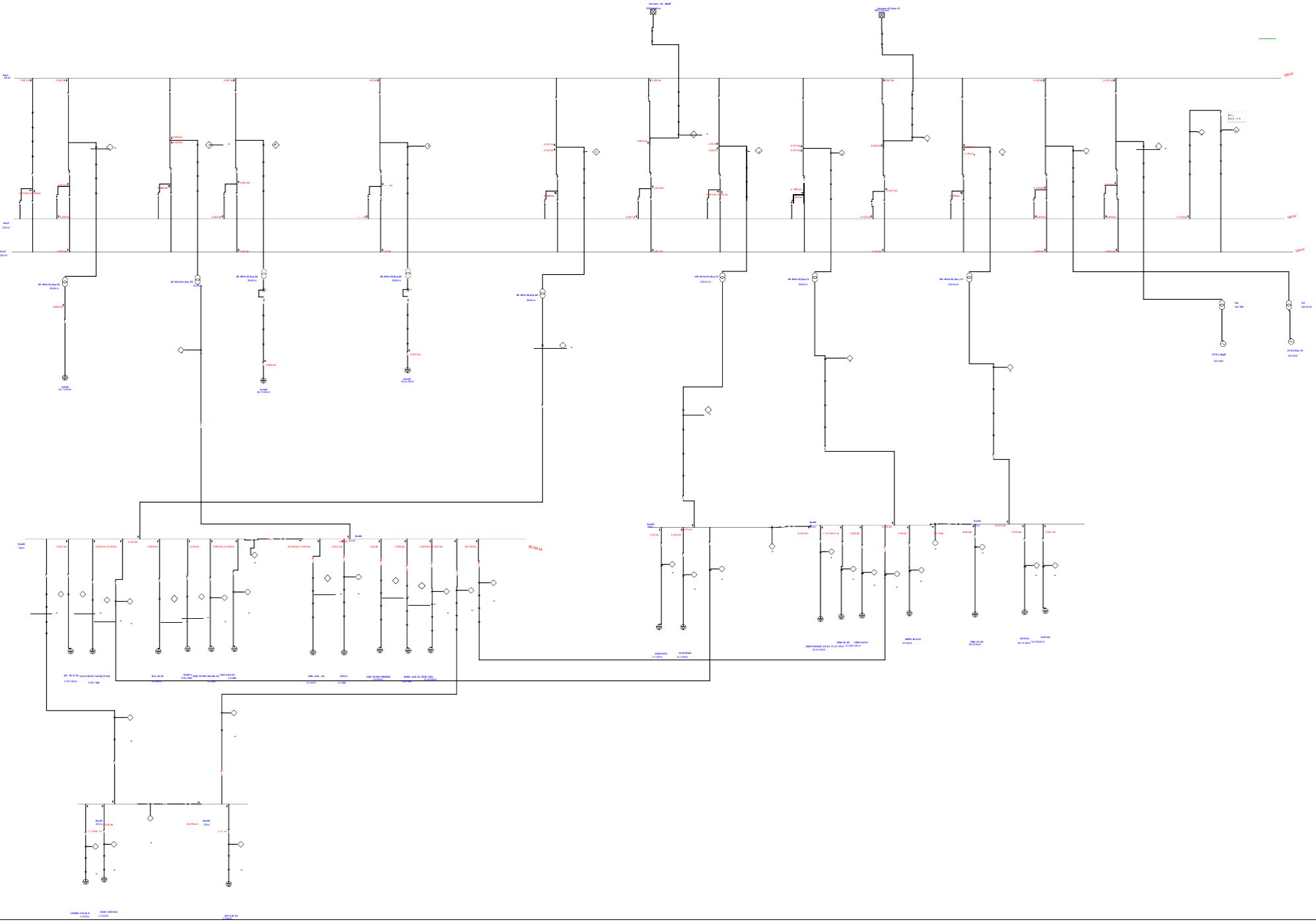
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus84**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus84	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		

(Cont.)

Fault at bus: **Bus84**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta- Y transformer.

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus90**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus90	Total	0.00	5.589	-86.107	15.4	86.288
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437

(Cont.)

3-Phase fault at bus: **Bus90**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus95	Bus82	0.00	0.876	-11.485	13.1	11.519
Bus84	Bus82	0.00	0.876	-11.485	13.1	11.519
Bus82	Bus90	0.00	2.398	-34.928	14.6	35.010
Bus84	Bus96	0.00	0.823	-11.129	13.5	11.160
Bus92	Bus84	0.00	1.313	-16.036	12.2	16.090
Bus92	Bus90	0.00	2.398	-34.928	14.6	35.010
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus96	Bus95	0.00	0.841	-11.248	13.4	11.279
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus90**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus90**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

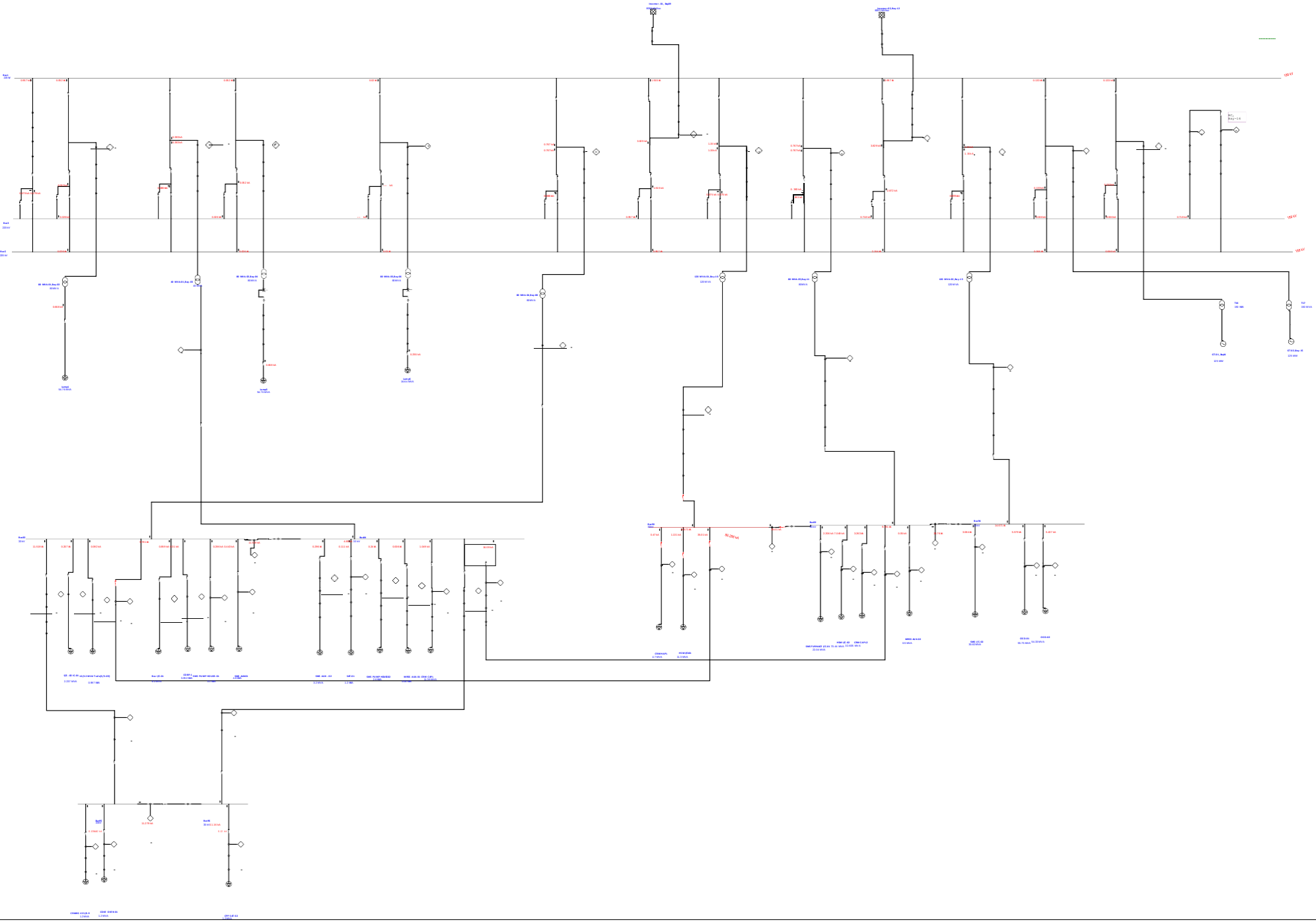
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus90**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus90	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		

(Cont.)

Fault at bus: **Bus90**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus92**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus92	Total	0.00	5.589	-86.107	15.4	86.288
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470

(Cont.)

3-Phase fault at bus: **Bus92**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus82	Bus95	0.00	0.521	-10.041	19.3	10.055
Bus82	Bus84	0.00	0.521	-10.041	19.3	10.055
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus96	Bus84	0.00	0.574	-10.398	18.1	10.413
Bus84	Bus92	0.00	1.481	-27.017	18.2	27.058
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus95	Bus96	0.00	0.556	-10.279	18.5	10.294
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus92**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus92**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

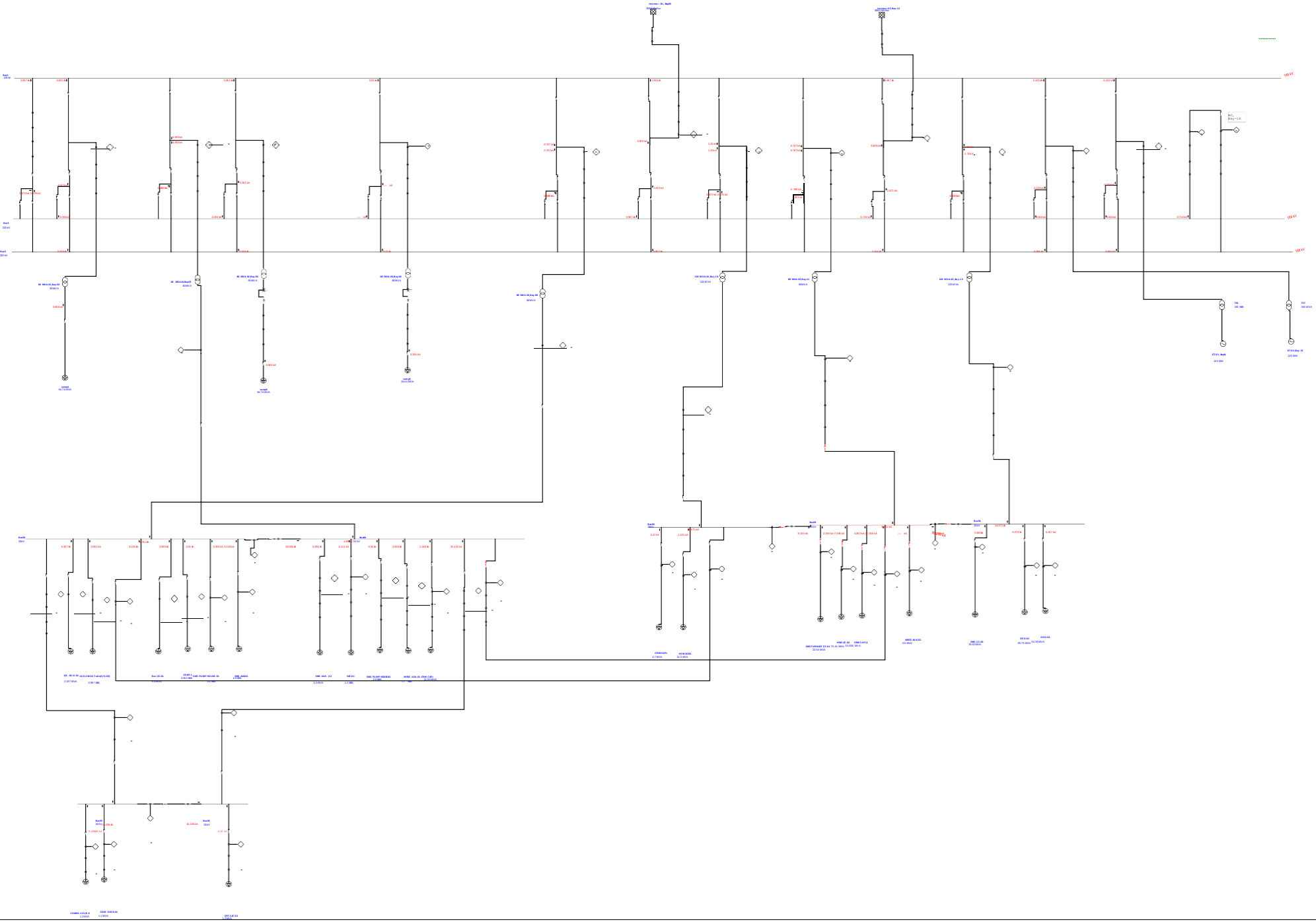
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus92**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus92	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		

(Cont.)

Fault at bus: **Bus92**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus94**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus94	Total	0.00	5.589	-86.107	15.4	86.288
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470

(Cont.)

3-Phase fault at bus: **Bus94**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus82	Bus95	0.00	0.521	-10.041	19.3	10.055
Bus82	Bus84	0.00	0.521	-10.041	19.3	10.055
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus96	Bus84	0.00	0.574	-10.398	18.1	10.413
Bus84	Bus92	0.00	1.481	-27.017	18.2	27.058
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus92	Bus94	0.00	3.553	-57.419	16.2	57.529
Bus95	Bus96	0.00	0.556	-10.279	18.5	10.294
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus94**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus94**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

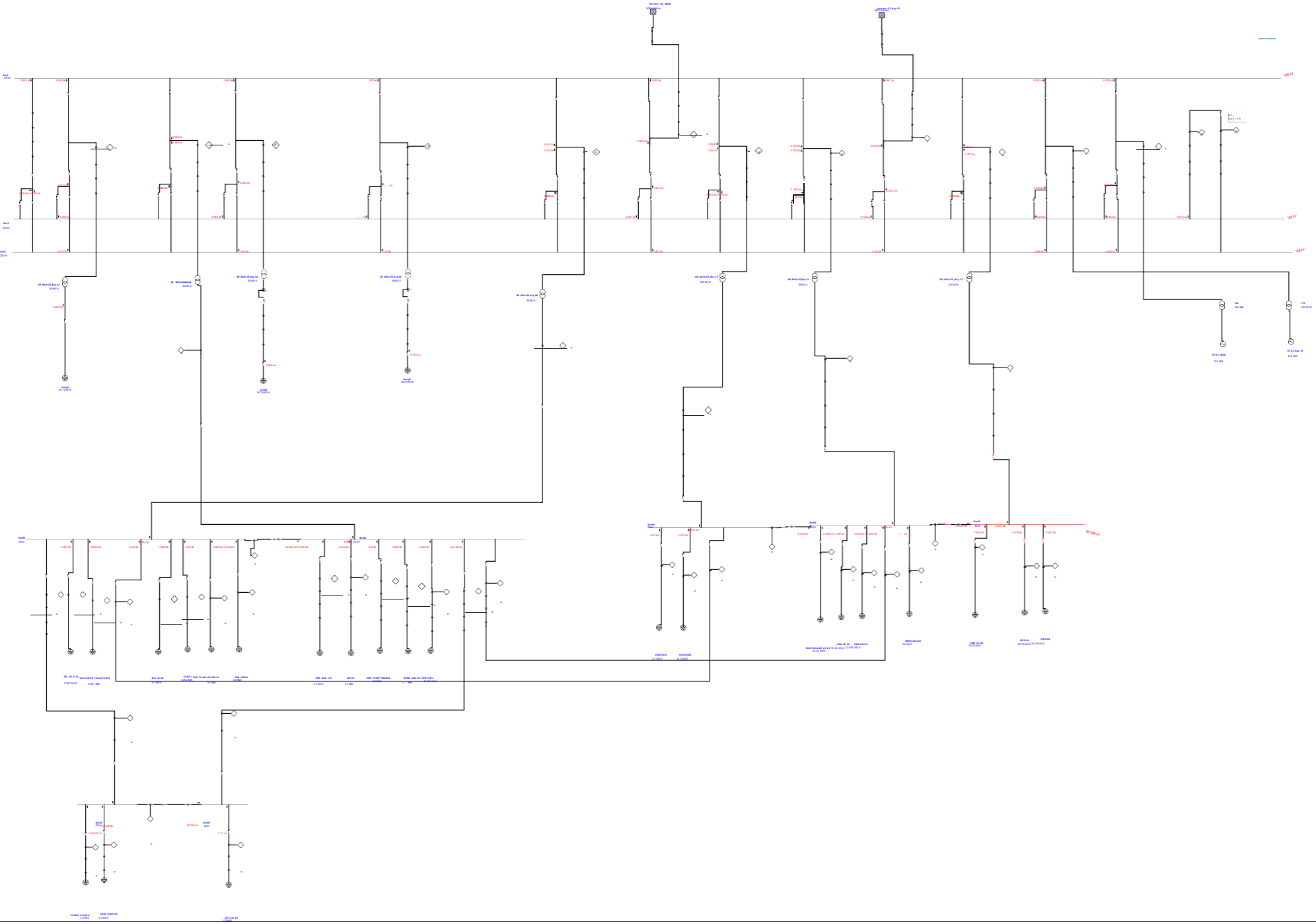
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus94**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus94	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		

(Cont.)

Fault at bus: **Bus94**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

SHORT- CIRCUIT REPORT

Fault at bus: **Bus95**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus95	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		

(Cont.)

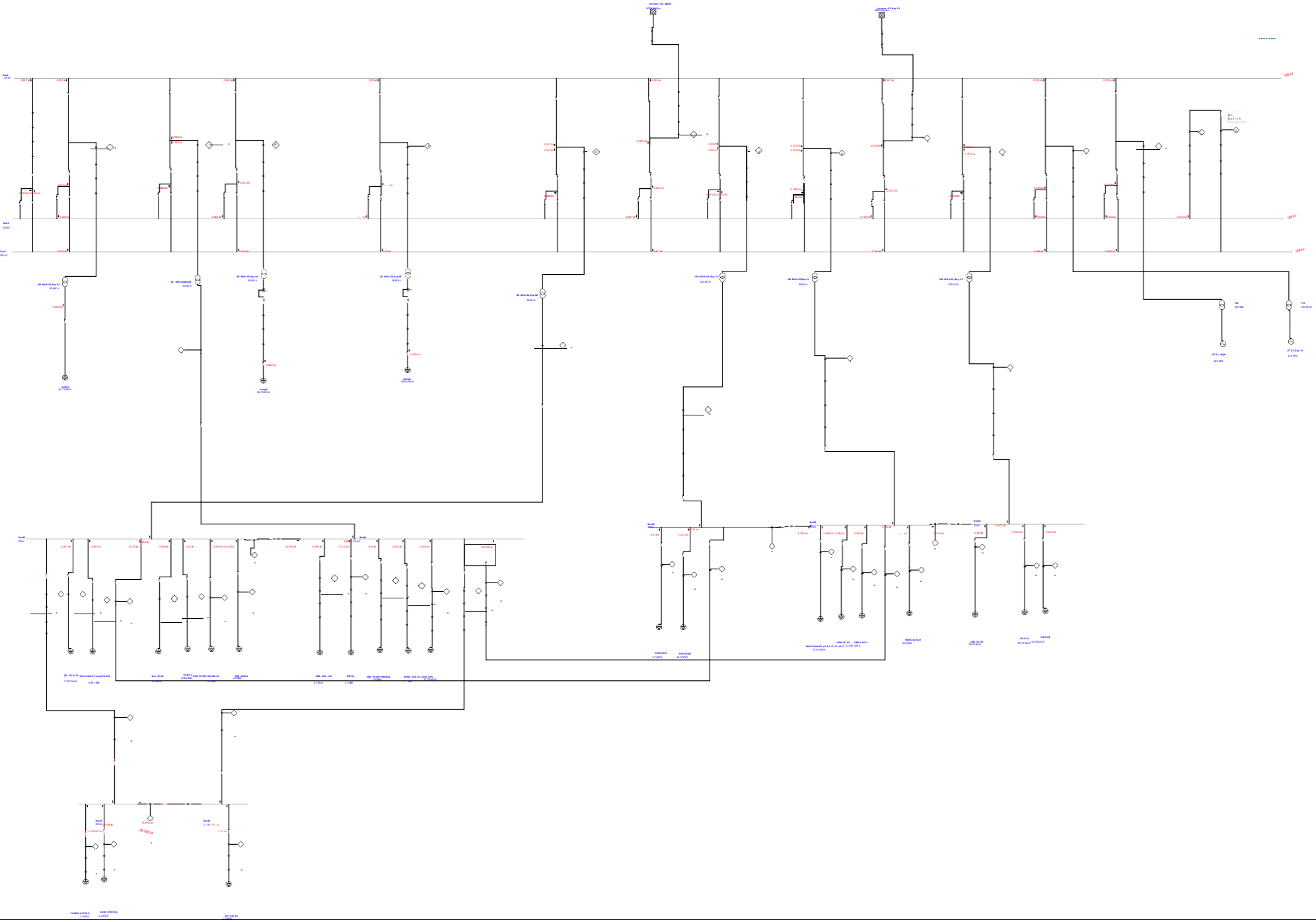
Fault at bus: **Bus95**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta- Y transformer.

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus95**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus95	Total	0.00	5.589	-86.107	15.4	86.288
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443

(Cont.)

3-Phase fault at bus: **Bus95**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus82	Bus95	0.00	0.521	-10.041	19.3	10.055
Bus82	Bus84	0.00	0.521	-10.041	19.3	10.055
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus84	Bus96	0.00	5.015	-75.709	15.1	75.875
Bus92	Bus84	0.00	4.108	-59.090	14.4	59.232
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus96	Bus95	0.00	5.033	-75.828	15.1	75.995
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus95**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus95**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

SHORT-CIRCUIT REPORT

3-Phase fault at bus: **Bus96**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus96	Total	0.00	5.589	-86.107	15.4	86.288
CPP SAT 02	Bus96	110.00	0.018	-0.119	6.7	0.120
Bus18	Bus84	85.46	0.211	-4.886	23.1	4.890
CRM CAPL	Bus84	110.00	0.104	-1.044	10.0	1.049
MRSS AUX-01	Bus84	110.00	0.001	-0.005	6.7	0.006
SAT-01	Bus84	110.00	0.016	-0.110	6.7	0.111
SMS AUX - 02	Bus84	110.00	0.029	-0.294	10.0	0.296
SMS PUMP HOUSE-02	Bus84	110.00	0.024	-0.239	10.0	0.240
Bus56	Bus92	85.46	0.422	-9.772	23.1	9.781
CRM CAPL 2	Bus92	110.00	0.325	-3.247	10.0	3.263
HSM I/C-02	Bus92	110.00	0.701	-7.014	10.0	7.049
MRSS AUX-02	Bus92	110.00	0.007	-0.049	6.7	0.050
SMS FURNACE I/C-01	Bus92	110.00	0.219	-2.195	10.0	2.206
Bus64	Bus94	85.46	0.633	-14.657	23.1	14.671
CICO-01	Bus94	110.00	0.555	-5.551	10.0	5.579
CICO-02	Bus94	110.00	0.541	-5.410	10.0	5.437
SMS I/C-02	Bus94	110.00	0.307	-3.069	10.0	3.084
Bus48	Bus90	85.46	0.633	-14.657	23.1	14.671
CRM HAPL	Bus90	110.00	0.047	-0.468	10.0	0.470
HSM I/C=01	Bus90	110.00	0.113	-1.125	10.0	1.131
Bus33	Bus82	85.46	0.422	-9.772	23.1	9.781
10/12 MVA Trafo(S/S-03)	Bus82	110.00	0.014	-0.091	6.7	0.092
Boc I/C-01	Bus82	110.00	0.085	-0.855	10.0	0.859
COBP-1	Bus82	110.00	0.031	-0.308	10.0	0.310
S/S -02 IC-01	Bus82	110.00	0.021	-0.206	10.0	0.207
SMS AUX-01	Bus82	110.00	0.044	-0.441	10.0	0.443
SMS PUMP HOUSE-01	Bus82	110.00	0.028	-0.285	10.0	0.286
COKE OVEN 01	Bus95	110.00	0.018	-0.119	6.7	0.120

(Cont.)

3-Phase fault at bus: **Bus96**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
CRMHS 1 33/6.9	Bus95	110.00	0.018	-0.119	6.7	0.120
Bus74	Bus72	88.73	-0.014	-0.265	19.2	0.266
Bus73	Bus68	88.73	-0.014	-0.265	19.2	0.266
Incomer-02,Bay-12	Bus60	105.22	0.197	-3.824	19.4	3.829
Incomer -01, Bay-09	Bus52	105.22	0.197	-3.824	19.4	3.829
Bus29	Bus27	87.69	0.000	-0.040	1588.8	0.040
Bus23	Bus20	91.29	-0.001	-0.105	74.4	0.105
Bus100	Bus7	95.44	-0.001	-0.105	74.4	0.105
Bus82	Bus95	0.00	0.521	-10.041	19.3	10.055
Bus82	Bus84	0.00	0.521	-10.041	19.3	10.055
Bus90	Bus82	0.00	0.396	-8.125	20.5	8.135
Bus84	Bus96	0.00	5.015	-75.709	15.1	75.875
Bus92	Bus84	0.00	4.108	-59.090	14.4	59.232
Bus90	Bus92	0.00	0.396	-8.125	20.5	8.135
Bus94	Bus92	0.00	2.036	-28.688	14.1	28.760
Bus95	Bus96	0.00	0.556	-10.279	18.5	10.294
Bus6	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus7	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus1	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus1	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus1	85.46	0.000	-0.020	1588.8	0.020
Bus1	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus1	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus1	85.46	0.099	-1.912	19.4	1.915
Bus1	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus1	85.46	0.049	-0.956	19.4	0.957
Bus1	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus1	85.46	-0.007	-0.133	9999.0	0.133
Bus5	Bus3	85.46	0.037	-0.717	19.4	0.718

(Cont.)

3-Phase fault at bus: **Bus96**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus3	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus3	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus3	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus3	85.46	0.000	-0.010	1588.8	0.010
Bus3	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus3	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus3	85.46	0.049	-0.956	19.4	0.957
Bus3	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus3	85.46	0.037	-0.717	19.4	0.718
Bus3	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus3	85.46	-0.003	-0.066	9999.0	0.066
Bus5	Bus6	85.46	0.025	-0.478	19.4	0.479
Bus8	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus5	Bus17	85.46	0.008	-0.192	23.1	0.192
Bus19	Bus5	85.46	0.000	-0.026	9999.0	0.026
Bus26	Bus5	85.46	0.000	-0.010	1588.8	0.010
Bus5	Bus32	85.46	0.017	-0.383	23.1	0.383
Bus5	Bus47	85.46	0.025	-0.575	23.1	0.575
Bus51	Bus5	85.46	0.049	-0.956	19.4	0.957
Bus5	Bus55	85.46	0.017	-0.383	23.1	0.383
Bus59	Bus5	85.46	0.111	-2.151	19.4	2.154
Bus5	Bus63	85.46	0.025	-0.575	23.1	0.575
Bus67	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus71	Bus5	85.46	-0.003	-0.066	9999.0	0.066
Bus7	Bus8	85.46	-0.001	-0.052	9999.0	0.052
Bus17	Bus18	85.46	0.017	-0.383	23.1	0.383
Bus20	Bus19	85.46	-0.001	-0.052	9999.0	0.052
Bus27	Bus26	85.46	0.000	-0.020	1588.8	0.020

(Cont.)

3-Phase fault at bus: **Bus96**

Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)
Peak Value = 223.082 kA Method C
Steady State = 53.489 kA rms

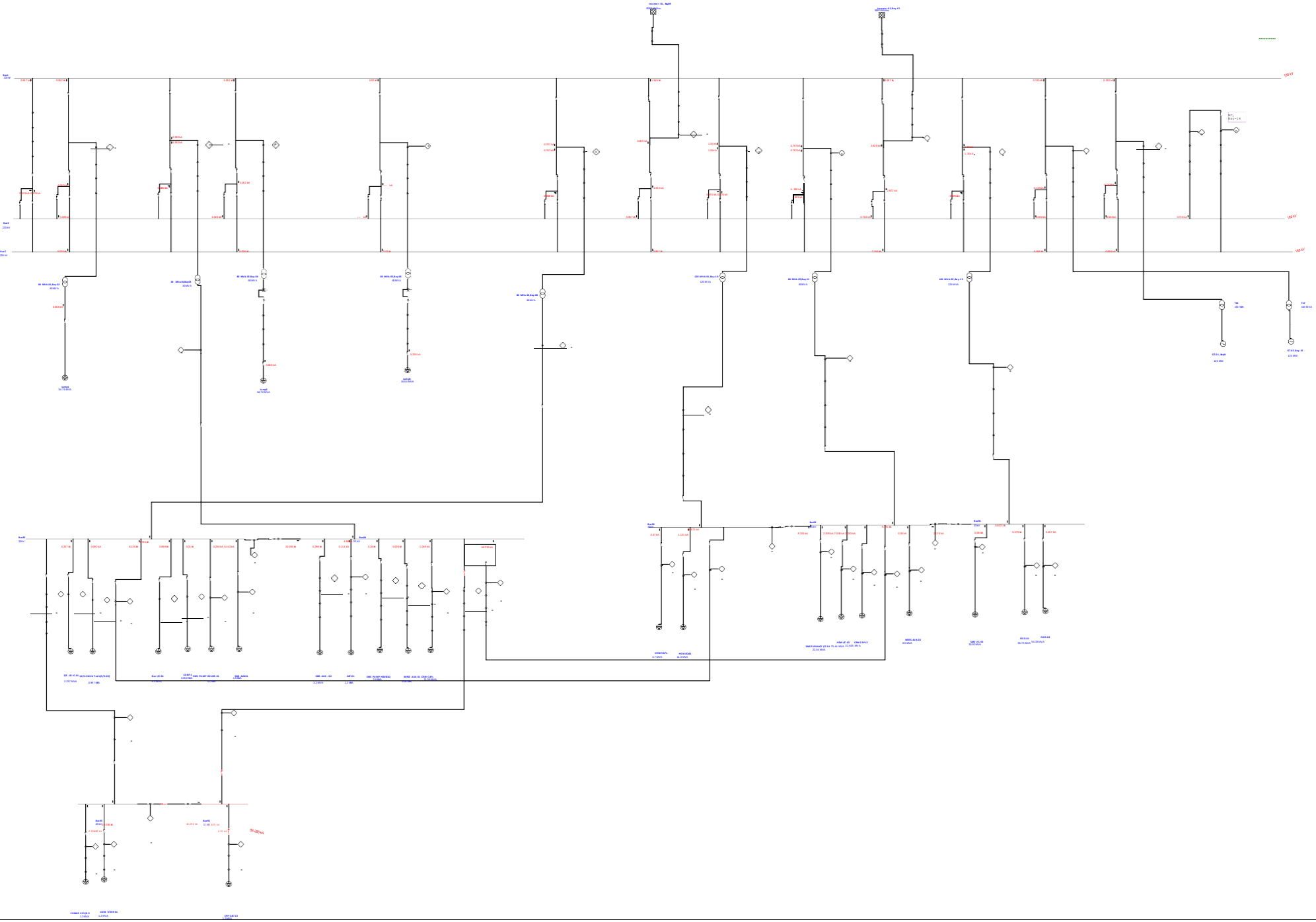
Contribution		Voltage & Initial Symmetrical Current (rms)				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magnitude
Bus32	Bus33	85.46	0.033	-0.766	23.1	0.767
Bus47	Bus48	85.46	0.050	-1.149	23.1	1.150
Bus52	Bus51	85.46	0.099	-1.912	19.4	1.915
Bus55	Bus56	85.46	0.033	-0.766	23.1	0.767
Bus60	Bus59	85.46	0.148	-2.868	19.4	2.872
Bus63	Bus64	85.46	0.050	-1.149	23.1	1.150
Bus68	Bus67	85.46	-0.007	-0.133	9999.0	0.133
Bus72	Bus71	85.46	-0.007	-0.133	9999.0	0.133

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Idc
0.01	83.617	130.324	99.962
0.02	82.591	117.279	83.265
0.03	81.462	106.615	68.781
0.04	80.235	98.315	56.816
0.05	78.891	93.374	49.948
0.06	78.333	88.777	41.776
0.07	77.693	85.189	34.941
0.08	77.046	82.402	29.225
0.09	76.332	80.150	24.444
0.10	75.446	79.152	23.937
0.15	72.491	73.262	10.602
0.20	69.372	69.530	4.696
0.25	66.431	66.464	2.080
0.30	66.431	66.437	0.921

One-Line Diagram - OLV1 (Short-Circuit Analysis)



SHORT- CIRCUIT REPORT

Fault at bus: **Bus96**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus	Symm. rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus96	Total	0.00	86.288	0.00	119.73	117.91	73.726	73.726	1.32E-001	2.04E+000	1.15E-001	3.08E+000
CPP SAT 02	Bus96	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus18	Bus84	85.46	4.890	87.71	105.63	105.45	5.019	6.702	1.55E+000	3.60E+001	1.26E+000	3.39E+001
CRM CAPL	Bus84	110.00	1.049	110.00	110.00	110.00	0.598	0.000	1.67E+001	1.67E+002		
MRSS AUX-01	Bus84	110.00	0.006	110.00	110.00	110.00	0.003	0.000	4.71E+003	3.14E+004		
SAT-01	Bus84	110.00	0.111	110.00	110.00	110.00	0.063	0.000	2.36E+002	1.57E+003		
SMS AUX - 02	Bus84	110.00	0.296	110.00	110.00	110.00	0.168	0.000	5.93E+001	5.93E+002		
SMS PUMP HOUSE-02	Bus84	110.00	0.240	110.00	110.00	110.00	0.137	0.000	7.29E+001	7.29E+002		
Bus56	Bus92	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
CRM CAPL 2	Bus92	110.00	3.263	110.00	110.00	110.00	1.859	0.000	5.37E+000	5.37E+001		
HSM I/C-02	Bus92	110.00	7.049	110.00	110.00	110.00	4.017	0.000	2.49E+000	2.49E+001		
MRSS AUX-02	Bus92	110.00	0.050	110.00	110.00	110.00	0.029	0.000	5.22E+002	3.48E+003		
SMS FURNACE I/C-01	Bus92	110.00	2.206	110.00	110.00	110.00	1.257	0.000	7.94E+000	7.94E+001		
Bus64	Bus94	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CICO-01	Bus94	110.00	5.579	110.00	110.00	110.00	3.179	0.000	3.14E+000	3.14E+001		
CICO-02	Bus94	110.00	5.437	110.00	110.00	110.00	3.098	0.000	3.22E+000	3.22E+001		
SMS I/C-02	Bus94	110.00	3.084	110.00	110.00	110.00	1.757	0.000	5.68E+000	5.68E+001		
Bus48	Bus90	85.46	14.671	87.71	105.63	105.45	15.057	20.107	5.18E-001	1.20E+001	4.21E-001	1.13E+001
CRM HAPL	Bus90	110.00	0.470	110.00	110.00	110.00	0.268	0.000	3.73E+001	3.73E+002		
HSM I/C=01	Bus90	110.00	1.131	110.00	110.00	110.00	0.644	0.000	1.55E+001	1.55E+002		
Bus33	Bus82	85.46	9.781	87.71	105.63	105.45	10.038	13.405	7.77E-001	1.80E+001	6.31E-001	1.69E+001
10/12 MVA Trafo(S/S -03)	Bus82	110.00	0.092	110.00	110.00	110.00	0.052	0.000	2.83E+002	1.89E+003		
Boc I/C-01	Bus82	110.00	0.859	110.00	110.00	110.00	0.490	0.000	2.04E+001	2.04E+002		
COBP-1	Bus82	110.00	0.310	110.00	110.00	110.00	0.176	0.000	5.66E+001	5.66E+002		
S/S -02 IC-01	Bus82	110.00	0.207	110.00	110.00	110.00	0.118	0.000	8.48E+001	8.48E+002		
SMS AUX-01	Bus82	110.00	0.443	110.00	110.00	110.00	0.253	0.000	3.95E+001	3.95E+002		
SMS PUMP HOUSE-01	Bus82	110.00	0.286	110.00	110.00	110.00	0.163	0.000	6.12E+001	6.12E+002		
COKE OVEN 01	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		

(Cont.)

Fault at bus: **Bus96**
Nominal kV = 33.000
Voltage c Factor = 1.10 (User-Defined)

Contribution		3-Phase Fault		Line-To-Ground Fault					Positive & Zero Sequence Impedances Looking into "From Bus"			
From Bus	To Bus	% V	kA	% Voltage at From Bus			kA Symm. rms		% Impedance on 100 MVA base			
ID	ID	From Bus Symm.	rms	Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
CRMHS 1 33/6.9	Bus95	110.00	0.120	110.00	110.00	110.00	0.068	0.000	2.17E+002	1.45E+003		
Bus74	Bus72	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Bus73	Bus68	88.73	0.266	93.85	94.63	98.75	0.322	0.534 *	7.51E-001	1.96E+001	2.05E-001	9.24E+000
Incomer-02,Bay-12	Bus60	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Incomer -01, Bay-09	Bus52	105.22	3.829	105.22	105.22	105.22	3.937	5.251	1.92E-001	1.35E+000	1.33E-001	9.30E-001
Bus29	Bus27	87.69	0.040	88.98	105.93	105.79	0.023	0.000	1.18E+001	1.30E+002		
Bus23	Bus20	91.29	0.105	91.04	106.41	106.37	0.060	0.000	3.82E+000	4.96E+001		
Bus100	Bus7	95.44	0.105	95.17	111.24	111.20	0.060	0.000	3.82E+000	4.96E+001		

		3-Phase	L-G	L-L	L-L-G
Initial Symmetrical Current (kA, rms)	:	86.288	73.726	74.703	81.970
Peak Current (kA), Method C	:	223.082	190.606	193.132	211.918
Breaking Current (kA, rms, symm)	:		73.726	74.703	81.970
Steady State Current (kA, rms)	:	53.489	73.726	74.703	81.970

# Indicates a fault current contribution from a three-winding transformer.
* Indicates a zero sequence fault current contribution (3I0) from a grounded Delta - Y transformer.

Recent development in power system protection and control

With the fast progress in high-speed communication network and information technology, there were significant developments in power system protection, power system control and wide area control in recent years, particularly in the wide-area and integrated protection.

Recent development

Wide area protection

In recent years, the fast development in communication technologies makes the wide-area information exchange possible. In this respect, the emergence of the wide area measurement system provides a new idea for the design of power system protection systems. The first wide-area protection principle is derived from the transient based protection in 1996 [2], in which GPS time synchronization played a major role in the design [3]. This was immediately followed by a summary paper in 1997, which systematically outlines the concept of the so-called “wide area protection” [4], focusing principally on the control aspect of the area. The wide area protection based on novel algorithms, which is derived from the measurements of multiple information points, is able to provide fast, reliable and accurate fault clearance, analyse the effects on the system stability based on the fault system analysis and take necessary control measures to perform the functions of relay protection, security, and stability control in order to prevent voltage collapse. Wide area relay protection has quickly become a hot research topic with many research results published particularly in recent years.

Integrated protection

With the development of digital technology, more and more protection functions for any given apparatus (line, transformer, generator, etc.) have been implemented within one protective device to achieve a certain degree of integration. For example, a numeric line protection relay may have distance or current differential function as the main protection, and directional and overcurrent functions as the backup protection. The recent developments in microprocessor and communication techniques provided new means to derive new protection principles and schemes based on the information obtained from multiple power plants and components, which could have significant advantages over the existing protection techniques based on the individual plant or component [5]. Unlike centralized protection (or substation area protection), the integrated protection does not simply centralize the relay hardware/software, but concentrates on the developments of new concepts and algorithms based on

multiple points of measurements; via this means it is hoped that the performance of protection can be improved significantly. There was also research in the field of integrated wide area protection [9].

Wide area control

The increased deployment of wide-area measurements will significantly enhance the power system wide-area power system operation and control. They provide voltage and current phasor information, synchronized with high precision to a common time reference provided by GPS. Therefore, a wide range of power system monitoring and control applications can be implemented in the system for improving system awareness and reliability, which includes enhanced state estimation based on mixed Remote Terminal Unit (RTU) and Phasor Measurement Unit (PMU) measurements [10], dynamic model online estimation and validation [11], real-time congestion management, real-time stability estimation [12], detection and damping of inter-area oscillations [13]. However, the most important and challengeable applications are the implementations of wide area stability real-time detection and control to prevent blackouts [14]. There was also research in the integrated protection and control [15].

New concept and development

Based on the developments mentioned above, a new concept of the integrated wide area protection and control (IWAPC) has been proposed recently. The main focus of the concept [16, 17] is the integration between the protection and control, particularly at the wide-area or regional level, aimed to provide a number of benefits to the future protection and control system, e.g., the potential to merge the three lines of defence system and on-line self-healing decision making, in order to prevent cascading tripping of large area power network. The concept of integrated wide area protection and control is introduced, in which a three-level hierarchically coordinated system, supported by the specially designed real-time synchronised wide-area communication network, provides the protection and control for wide area or regional power substations/plants and their associated power network. The key element in the system is the integrated wide area protection and control information platform, which receives real-time synchronised data from the communication network to support the integration of protection and control at the wide area/regional level.

The information platform also supports the application of a cloud computing system, which is specially designed to implement a number of secondary functions for substations and power networks. In addition to the basic functions of relay protection, the platform should have a large capacity of fault information and data storage, fast data processing functions, powerful communication

functions, and other protection, control devices and scheduling network to share the whole system data, information and network resources, and can also carry out remote monitoring with the computer monitoring system of substation communication. With the proposed platform, the architecture of future substation equipment may be reshaped to provide a flexible framework for building an interactive grid and subsequently improve the reliability and security of power grids.

Integrated wide area/regional protection and control

Architecture of integrated wide area protection and control

The proposed integrated wide area or regional protection and control system (IWAPC) is illustrated in Fig. 2. There have been fast developments in both power transmission and distribution networks, e.g., the series compensation in AC lines and high-voltage DC lines in transmission systems, distributed generation and energy storage in distribution systems, etc. These new developments result in far more complicated characteristics than that of conventional systems. Consequently, the existing protection and control system will no longer be effective to cope with the new systems, and this has led to the proposed IWAPC system. As is shown, the IWAPC system consists of different equipment at different layers: from bottom to top, there is the integrated multiple-function intelligent equipment at the local level; the substation communication network and the integrated substation protection and control at the substation level; the wide area communication network, the integrated wide area information platform and the integrated wide area (regional) protection and control at wide area level. The key parts of the system are the high-speed wide area communication network and the real-time synchronisation information platform.

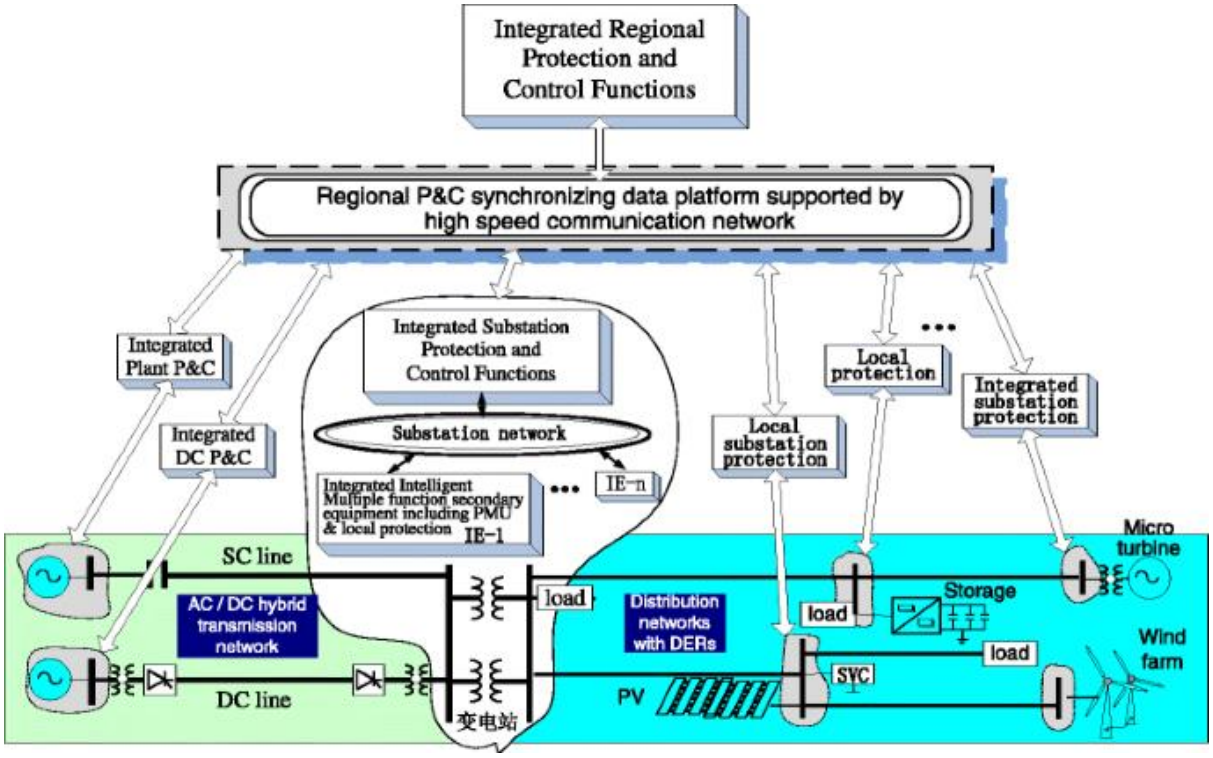


Fig. 2 Integrated wide area protection and control

The IWAPC is further extended to dispatching in order to achieve the integration of dispatching automation, protection and control of power grid, and according to the three-level dispatching (country, province, regional) architecture to implement the functions of regional protection, control and dispatching managements.

Multiple functions intelligent equipment at the local level

As shown in Fig. 2, the Intelligent equipment at local level is an integrated multiple function secondary equipment in the substation, which mainly consists of the MU, intelligent terminal, metrology measurement, PMU & local protection. The equipment is responsible for sampling all real-time data and sending information to the integrated substation P&C and wide area P&C. It also receives and carries out the control commands from the integrated substation P&C and the IWAPC. The equipment can be integrated into primary power apparatuses and achieve local protection for 90 % of its associated line sections. It has a redundant configuration to ensure reliability, together with other integrated functions such as fault recorder, data storage and network analysis, etc.

Integrated substation protection and control at the substation/plant level

The substation P&C integrates functions of line, bus, transformer protections, switch failure; autoreclosure, automatic bus transfer, UFLS, UVLS, overload inter-tripping and substation control function, etc. It utilizes information from the entire substation to achieve substation backup protection and safety automatic control, etc. The CBs are used as units to configure the adaptive backup protection, and current differential protection is used to replace the stage overcurrent protection, breaker failure protection and dead zone protection in the conventional protection system.

Integrated wide area/regional protection and control

The IWAPC specially designed for the protection and control of power network is able to offer fast protection. In addition, they both integrate functions of automatic UFLS and UVLS, voltage and frequency control, oscillation detection and out-of-step separation, etc. In addition, the IWAPC also incorporates the function of transmission cross-section safety P&C. Unlike conventional protection and control, which are separated in both design and operation, the IWAPC integrates protection and control into one optimal combined system, which effectively coordinates the wide area (regional) protection and control, in order to achieve significant improvements in the protection and control of power systems.

Synchronised high speed communication network

One of the most important elements of the IWAPC system is the fast communication network. In this respect, the latest development in communication network, the Packet Transport Network (PTN) may be a better choice to implement such a task. The present power communication network is mainly used in multi-service transport platform based on the Synchronous Digital Hierarchy (SDH). Its advantages lie in its high efficiency for carrying TDM services, low latency, high reliability, with end management capabilities. However, with the new trends in smart grid development, SDH technology gradually revealed its limitations, such as low bearing efficiency and poor flexibility for data services. In contrast, PTN can realise statistical multiplexing and efficient transfer of packet service by using packet-switched core, which can overcome the weaknesses of SDH rigid bandwidth. In addition, it can provide good quality of service, operation, administration and maintenance. Self-healing fibre optical network is employed to connect a number of substations in the region, to ensure full sharing of dynamic and transient information for all electrical measurements, breaker status and protection operations; using high reliability IEEE-1588 technology to ensure the synchronization timing of the sharing data, to prove the data for the integrated wide area protection and control.

However, SDH is still an option for the task since it has been widely applied in power network.

Synchronized information platform

Substation is installed with a wide range of electrical equipment with complex designs and is difficult to maintain. With the continuing improvement in power system automation and the intelligence level, the system network has been expanding, along with the huge amount of information in protection and control. As each piece of information is collected and stored by different devices in each separate system, the interoperability of the internal power system data between systems is poor, whereas complex communication protocols tend to create information islands. Consequently, the measurement data and protection control mechanism cannot be shared, which restricts the information integration. The protection and control of smart grid requires dealing with the new situation demands of the application, in order to improve further the information platform capabilities for the future development of key technologies, and to make the information platform system more open.

The real-time synchronized information platform accurately collects wide area information and conducts data mining to investigate the logic relation between the real-time information to increase the sensitivity, reliability and fault tolerance capability. The data received from the platform includes static, dynamic, transient measurements and states of circuit breakers, etc. Valuable information is extracted from the data and allocated to various specially-designed computation algorithms in the platform to perform advanced functions of protection and control for the power network. In the platform, sets of data need to be transferred and their transferring speed depends on the application, e.g., slow speed for contingency analysis, near real time speed for monitoring, real time speed for control, and high speed for wide area protection,; in particular, time synchronization. The information can also include other types of data, such as the oil and ambient temperature of the transformer, wind speed and direction, sun intensity, etc. On the other hand, the information is stored in a hierarchical manner instead of a centralized one, which comprises the hierarchical protection and control system. Equipped with the latest high-speed synchronised communication technology, integrated with the advanced protection techniques and the latest developments in control system, the system offers not only fast protection, but also complete control of entire power network.

The advanced computing technology is introduced to establish a synchronized information platform for wide area protection and control, to build a panoramic operation and maintenance data collection network, providing a standardized interface to the terminal device, to form a resource sharing, flexible and

interactive, open and ordered information platform. In summary, advanced computing technologies are used to build a distributed collaborative intelligent information platform, simplifying terminal data collection equipment, and breaking the barriers between protection and control systems at different substations through the specially designed synchronized information platform.

Wide area power cloud

Based on the information platform mentioned above, a distributed cloud system is designed to implement functions at substation and regional levels, such as wide area fault location, fault line selection, power quality monitoring, protection settings, etc. The extended functions also include the equipment monitoring, life cycle and operation management, as shown in Fig. 3.

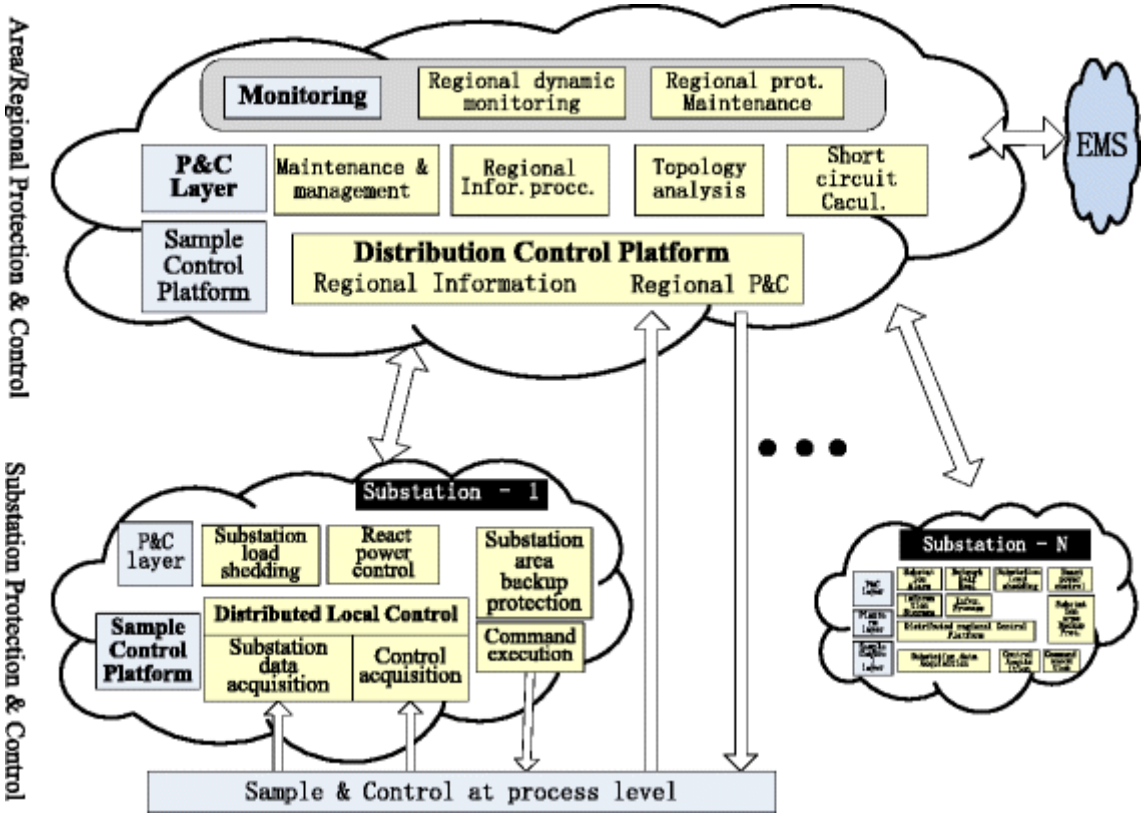


Fig. 3 Structure of distributed power cloud

Currently, many kinds of secondary equipments achieving different functions are installed in each substation, and an increasing number of distributed energy resources of small capacity added to the system greatly increase the number of equipments. To implement these equipments, complex functions in a specially developed distributed "cloud" system will greatly reduce the equipment investment. The cloud at substation level receives the data from process level, and the regional cloud receives the data from the information platform, which

includes static, dynamic, transient measurements and states of circuit breakers, extracting valuable information and allocating them to various specially-designed computation algorithms in the platform to perform advanced functions in order to identify the faulted line, the accurate fault location and the contents of harmonics, etc.

The cloud computing platform can make full use of "processing ability of cloud" to reduce the burden of terminal secondary equipment. Based on big data technique, the computing clouds enjoy strong processing power based on demand. There is no need for endless upgrades to improve the processing capacity of the equipment, and there is also no need to update the software to achieve a variety of task processing. There are many more advantages which can be derived from the cloud system, such as the wide area information sharing, standardization of software and algorithm, reduction of equipment investment, substation area occupation and work load for operation and maintenance.

CONCLUSIONS

From the various load flow and short circuit analysis for various buses we can infer the various load conditions. We can see that the voltage utilization remains at 100% and the load current in the various buses is under the limits. The load flow analysis is very important to know the ratings of various circuit breakers in the different buses. We can see that none of the circuit breakers operate in normal load conditions which means that all the ratings are sufficient.

From the short circuit analysis for various buses we get to know the operation of the circuit breakers. We see that the circuit breakers operate in the right order for different short circuits. The circuit breakers both in the upstream and downstream operate correctly and isolate the faulty bus properly. The buses are affected by the short circuit but none of them reach abnormal conditions when under fault. This shows that the circuit breakers and relays are capable of isolating the fault both single phase and three phase in nature. When there is a short circuit fault in the 220kV bus the power is fed from other bus and the load on that bus increases but never reaches abnormal value. We also see that power generated from the two generators is sometimes sufficient to supply the load and in conditions when the load demand is not high it can even deliver the power back to the grid.

Thus various short circuit and load flow analysis are very important to conduct from time to time on the power plant to know the capability of the plant and the ratings of various components of the power system. From the various data we can ascertain that there is a possibility of future expansion in the power system. We can also gather the best possible condition of operation of the power system from the results obtained. The losses in various buses as obtained for normal and short circuit conditions are necessary to know in order to minimize them using various techniques and increase the efficiency of the system. We also see that generators operate in under excited condition under normal conditions which can be improved upon.

Therefore conducting this short circuit and load flow analysis on a real power system was a very enjoyable and learning experience for us as we got to learn how the real power system operates under normal condition and how the circuit breakers operate under short circuit condition. It was truly enhancing experience to apply the concepts learned in theory subjects onto practical life and we hope to carry this experience forward in our careers and help the company in future endeavors.

Covering both transmission and distribution networks, the system is supported by the proposed high-speed synchronised communication network and the real-time protection and control information platform. The system, which integrates the advanced protection techniques and the latest developments in control system, offers not only fast protection, but also complete control of the entire power network. It offers a potential for the merger of the three lines of defence into a unified system to ensure more effectively the reliable and safe operation of power grid. Based on the system information platform, a distributed power cloud system is also designed to support many advanced applications for the integrated wide area protection and control.

With the continuous advances in measurement, communication and information technologies, the system presents a bright future for practical application. Overall improved performance of protection and control can be expected from the proposed system. However, for the system to become useful in power system application, it is equally important that its practical implementation be readily manageable, user-friendly and cost-effective.

BIBLIOGRAPHY

For the successful completion of this project, we took help from various books and websites. At first it was necessary to gather information about the power system analysis methods through various books and research papers. During the project we consulted various websites in order to collect necessary data and used them for the analysis. All in all we are very grateful for these research papers and websites without whose help we would not have been able to complete the project. The various books and research papers are:

- Power System Engineering, By Abhijit Chakrabarti
- Power System Analysis, By John J Grainger
- Load Flow analysis of Power Systems, By Asirwad Dubey

The websites from which we took help are:

- https://www.electrical4u.com/load-flow-or-power-flow-analysis/
- https://djes.info/index.php/djes/article/download/387/352
- https://youtube.com/playlist?list=PL_6_U09jayh1eKXovkHqnIK9KNAmm7thA
- https://pcmp.springeropen.com/articles