Electrical Transient Analyzer Program

Load Flow Analysis

Loading Category (1): Design

Generation Category (1): Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	1	1	7	9

	XFMR2	XFMR3	Reactor	Line/Cable/ Busway	Impedance	Tie PD	Total
Number of Branches:	3	0	0	6	0	0	9

Method of Solution:	Adaptive Newton-Raphson Method
Maximum No. of Iteration:	99
Precision of Solution:	0.0001000
System Frequency:	60.00 Hz
Unit System:	English
Project Filename:	grid4
Output Filename:	C:\Users\owner's\Desktop\PSA PBL\grid4\grid4\Untitled.lfr

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable / Busway Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable / Busway Resistance:	Yes	Individual	

Bus Input Data

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
Bus_1	11.000	1	100.0	0.0								
Bus_2	11.000	1	100.0	0.0								
Bus_3	211.000	1	100.0	0.0								
Bus_4	211.000	1	100.0	0.0	26.907	29.598	5.661	6.227				
Bus_5	211.000	1	100.0	0.0	17.000	10.536	3.577	2.217				
Bus_6	211.000	1	100.0	0.0	14.400	19.200	3.030	4.040				
Bus_7	211.000	1	100.0	0.0	20.400	12.643	4.292	2.660				
Bus_8	211.000	1	100.0	0.0								
Bus_9	9.500	1	100.0	0.0	13.600	8.429	3.400	2.107				
Total Number of Buses: 9					92.307	80.405	19.960	17.251	0.000	0.000	0.000	0.000

Generation Bus				Voltage		Generation			Mvar Limits	
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Min
Bus_1	11.000	Swing	1	100.0	0.0					
Bus_2	11.000	Voltage Control	1	100.0	0.0	40.000			84.678	0.000
Bus_9	9.500	Mvar/PF Control	1	100.0	0.0	85.000	-52.678	-85.0		
						125.000	-52.678			

Line/Cable/Busway Input Data

Line/Cable/Busway			ohms or siemens/1000 ft per Conductor (Cable) or per Phase (Line/Busway)						
			Length						
ID	Library	Size	Adj. (ft)	% Tol.	#/Phase	T (°C)	R	X	Y
Line1		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010
Line3		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010
Line5		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010
Line7		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010
Line9		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010
Line10		477	5280.0	0.0	1	100	0.048250	0.157749	0.0000010

Line / Cable / Busway resistances are listed at the specified temperatures.

2-Winding Transformer Input Data

Transformer		Rating					Z Variation			% Tap Setting		Adjusted	Phase Shift	
ID	Phase	MVA	Prim. kV	Sec. kV	% Z1	X1/R1	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
T1	3-Phase	157.000	11.000	230.000	10.00	34.10	0	0	0	0	0	10.0000	YNd	0.000
T3	3-Phase	100.000	11.000	230.000	10.00	34.10	0	0	0	0	0	10.0000	YNd	0.000
T4	3-Phase	100.300	230.000	11.000	10.00	34.10	0	0	0	0	0	10.0000	Dyn	0.000

Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
T1	2W XFMR	Bus_1	Bus_3	0.19	6.37	6.37	
T3	2W XFMR	Bus_2	Bus_3	0.29	10.00	10.00	
T4	2W XFMR	Bus_8	Bus_9	0.29	9.97	9.97	
Line1	Line	Bus_3	Bus_4	0.05	0.16	0.16	0.2719868
Line3	Line	Bus_4	Bus_5	0.05	0.16	0.16	0.2719868
Line5	Line	Bus_6	Bus_3	0.05	0.16	0.16	0.2719868
Line7	Line	Bus_7	Bus_5	0.05	0.16	0.16	0.2719868
Line9	Line	Bus_8	Bus_6	0.05	0.16	0.16	0.2719868
Line10	Line	Bus_8	Bus_7	0.05	0.16	0.16	0.2719868

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
* Bus_1	11.000	100.000	0.0	-11.468	107.376	0.000	0.000	Bus_3	-11.468	107.376	5667.8	-10.6	
* Bus_2	11.000	100.000	2.9	40.000	67.734	0.000	0.000	Bus_3	40.000	67.734	4128.7	50.8	
Bus_3	211.000	101.581	0.6	0.000	0.000	0.000	0.000	Bus_4	33.892	74.581	220.7	41.4	
								Bus_6	-5.759	86.919	234.6	-6.6	
								Bus_1	11.686	-99.952	271.1	-11.6	
								Bus_2	-39.819	-61.549	197.5	54.3	
Bus_4	211.000	101.425	0.6	0.000	0.000	32.731	36.004	Bus_3	-33.854	-74.695	221.2	41.3	
								Bus_5	1.124	38.691	104.4	2.9	
Bus_5	211.000	101.352	0.6	0.000	0.000	20.674	12.813	Bus_4	-1.115	-38.899	105.1	2.9	
								Bus_7	-19.559	26.086	88.0	-60.0	
Bus_6	211.000	101.424	0.6	0.000	0.000	17.517	23.356	Bus_3	5.801	-87.017	235.3	-6.7	
								Bus_8	-23.318	63.662	182.9	-34.4	
Bus_7	211.000	101.315	0.6	0.000	0.000	24.806	15.373	Bus_5	19.565	-26.302	88.5	-59.7	
								Bus_8	-44.371	10.929	123.4	-97.1	
Bus_8	211.000	101.320	0.7	0.000	0.000	0.000	0.000	Bus_6	23.344	-63.813	183.5	-34.4	
								Bus_7	44.382	-11.126	123.6	-97.0	
								Bus_9	-67.726	74.939	272.8	-67.1	
Bus_9	9.500	98.951	5.7	85.000	-52.678	16.929	10.492	Bus_8	68.071	-63.170	5703.6	-73.3	

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

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

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Bus_1	11.000										107.987	10.6	5667.8	
Bus_2	11.000										78.663	50.8	4128.7	
Bus_3	211.000										167.809	27.2	452.0	
Bus_4	211.000		26.907	29.598	5.824	6.406					82.009	41.3	221.2	
Bus_5	211.000		17.000	10.536	3.674	2.277					44.052	46.9	118.9	
Bus_6	211.000		14.400	19.200	3.117	4.156					90.087	25.9	243.0	
Bus_7	211.000		20.400	12.643	4.406	2.730					51.581	86.0	139.3	
Bus_8	211.000										101.008	67.1	272.8	
Bus_9	9.500		13.600	8.429	3.329	2.063					105.903	80.3	6504.4	

* 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				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
T1	Transformer				157.000	107.987	68.8	100.633	64.1
T3	Transformer				100.000	78.663	78.7	73.306	73.3
T4	Transformer				100.300	101.008	100.7	92.866	92.6

* 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
Line1	33.892	74.581	-33.854	-74.695	37.3	-113.8	101.6	101.4	0.16
Line10	-44.371	10.929	44.382	-11.126	11.7	-196.9	101.3	101.3	0.00
Line3	1.124	38.691	-1.115	-38.899	8.4	-207.9	101.4	101.4	0.07
Line5	-5.759	86.919	5.801	-87.017	42.2	-97.9	101.6	101.4	0.16
Line7	-19.559	26.086	19.565	-26.302	6.0	-215.6	101.4	101.3	0.04
Line9	-23.318	63.662	23.344	-63.813	25.7	-151.4	101.4	101.3	0.10
T1	-11.468	107.376	11.686	-99.952	217.7	7424.3	100.0	101.6	6.81
T3	40.000	67.734	-39.819	-61.549	181.4	6185.2	100.0	101.6	6.81
T4	-67.726	74.939	68.071	-63.170	345.1	11768.6	101.3	99.0	8.17
					875.4	24394.6			

* This Transmission Line includes Series Capacitor.

Alert Summary Report

	% Alert Settings	
	Critical	Marginal
Loading		
Bus	100.0	95.0
Cable / Busway	100.0	95.0
Reactor	100.0	95.0
Line	100.0	95.0
Transformer	100.0	95.0
Panel	100.0	95.0
Protective Device	100.0	95.0
Generator	100.0	95.0
Inverter/Charger	100.0	95.0
Bus Voltage		
OverVoltage	105.0	102.0
UnderVoltage	95.0	98.0
Generator Excitation		
OverExcited (Q Max.)	100.0	95.0
UnderExcited (Q Min.)	100.0	

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Gen1	Generator	Over Excited	69.871	Mvar	107.376	153.7	3-Phase
Gen1	Generator	Under Power	0.000	MW	-11.468	0.0	3-Phase
Wind Farm	Wind Turbine Generator	Overload	85.000	MW	85.000	100.0	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	-11.468	107.376	107.987	10.62 Leading
Source (Non-Swing Buses):	125.000	15.056	125.903	99.28 Lagging
Total Demand:	113.532	122.432	166.970	68.00 Lagging
Total Motor Load:	92.307	80.405	122.415	75.40 Lagging
Total Static Load:	20.350	17.632	26.926	75.58 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.875	24.395		
System Mismatch:	0.000	0.000		

Number of Iterations: 4

Electrical Transient Analyzer Program

Short-Circuit Analysis

ANSI Standard

3-Phase, LG, LL, & LLG Fault Currents

1/2 Cycle Network

	Swing	V-Control	Load	Total
Number of Buses:	1	1	7	9

	XFMR2	XFMR3	Reactor	Line/Cable/ Busway	Impedance	Tie PD	Total
Number of Branches:	3	0	0	6	0	0	9

	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total
Number of Machines:	2	0	0	0	5	7

System Frequency:	60.00
Unit System:	English
Project Filename:	grid4
Output Filename:	C:\Users\owner's\Desktop\PSA PBL\grid4\grid4\Untitled.SQ1S

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable / Busway Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable / Busway Resistance:	Yes	Individual	

Bus Input Data

Bus					Initial Voltage	
ID	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang.
Bus_1	SWNG	11.000	11.000	1	100.00	0.00
Bus_2	Gen.	11.000	11.000	1	100.00	0.00
Bus_3	Load	211.000	230.000	1	100.00	30.00
Bus_4	Load	211.000	230.000	1	100.00	30.00
Bus_5	Load	211.000	230.000	1	100.00	30.00
Bus_6	Load	211.000	230.000	1	100.00	30.00
Bus_7	Load	211.000	230.000	1	100.00	30.00
Bus_8	Load	211.000	230.000	1	100.00	30.00
Bus_9	Load	9.500	11.000	1	100.00	0.00

9 Buses Total

All voltages reported by ETAP are in % of bus Nominal kV.
Base kV values of buses are calculated and used internally by ETAP.

Line/Cable/Busway Input Data

ohms or siemens per 1000 ft per Conductor (Cable) or per Phase (Line/Busway)

Line/Cable/Busway			Length									
ID	Library	Size	Adj. (ft)	% Tol.	#/Phase	T (°C)	R1	X1	Y1	R0	X0	Y0
Line1		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005
Line3		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005
Line5		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005
Line7		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005
Line9		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005
Line10		477	5280.0	0.0	1	-30	0.029292	0.1577493	0.000001	0.0803398	0.4853866	0.0000005

Line / Cable / Busway resistances are listed at the specified temperatures.

2-Winding Transformer Input Data

Transformer	Rating					Z Variation			% Tap Setting		Adjusted	Phase Shift	
ID	MVA	Prim. kV	Sec. kV	% Z	X/R	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
T1	157.000	11.000	230.000	10.00	34.10	0	0	0	0	0	10.00	YNd	30.00
T3	100.000	11.000	230.000	10.00	34.10	0	0	0	0	0	10.00	YNd	30.00
T4	100.300	230.000	11.000	10.00	34.10	0	0	0	0	0	10.00	Dyn	30.00

2-Winding Transformer Grounding Input Data

Transformer	Rating			Grounding								
				Conn.	Primary				Secondary			
ID	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	ohm	Type	kV	Amp	ohm
T1	157.000	11.000	230.000	D/Y					Solid			
T3	100.000	11.000	230.000	D/Y					Solid			
T4	100.300	230.000	11.000	D/Y					Solid			

Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVAb			
ID	Type	From Bus	To Bus	R	X	Z	Y
T1	2W XFMR	Bus_1	Bus_3	0.19	6.37	6.37	
T3	2W XFMR	Bus_2	Bus_3	0.29	10.00	10.00	
T4	2W XFMR	Bus_8	Bus_9	0.29	9.97	9.97	
Line1	Line	Bus_3	Bus_4	0.03	0.16	0.16	0.2719868
Line3	Line	Bus_4	Bus_5	0.03	0.16	0.16	0.2719868
Line5	Line	Bus_6	Bus_3	0.03	0.16	0.16	0.2719868
Line7	Line	Bus_7	Bus_5	0.03	0.16	0.16	0.2719868
Line9	Line	Bus_8	Bus_6	0.03	0.16	0.16	0.2719868
Line10	Line	Bus_8	Bus_7	0.03	0.16	0.16	0.2719868

Synchronous Generator Input Data

Synchronous Generator		Rating			Positive Seq. Impedance					Grounding			Zero Seq. Impedance		
							% Xd"								
ID	Type	MVA	kV	RPM	X"/R	% R	Adj.	Tol.	% Xd'	Conn.	Type	Amp	X/R	% R0	% X0
Gen1	Steam Turbo	100.000	11.000	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		7.00	1.000	7.00
Gen3	Steam Turbo	111.765	11.000	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		7.00	1.000	7.00

Total Connected Synchronous Generators (= 2): 211.765 MVA

Lumped Load Input Data

Lumped Load	Lumped Load				Motor Loads									
	Rating		% Load		Loading		X/R Ratio		Impedance (Machine Base)			Grounding		
ID	kVA	kV	MTR	STAT	kW	kvar	X"/R	X'/R	% R	% X"	% X'	Conn.	Type	Amp.
Data Center	25000.0	230.000	80	20	17000.0	10535.7	10.00	10.00	1.538	15.38	23.08	Delta		
Manufacturing Plant	50000.0	230.000	80	20	26906.9	29597.6	10.00	10.00	1.538	15.38	23.08	Delta		
Resident_Commercial_zone	20000.0	9.500	80	20	13600.0	8428.5	10.00	10.00	1.538	15.38	23.08	Delta		
Shopping Mall	30000.0	230.000	80	20	20400.0	12642.8	10.00	10.00	1.538	15.38	23.08	Delta		
University	30000.0	230.000	80	20	14400.0	19200.0	10.00	10.00	1.538	15.38	23.08	Delta		

Total Connected Lumped Loads (= 5): 155000.0 kVA

SHORT- CIRCUIT REPORT

Fault at bus: **Bus_4**

Prefault voltage = 211.000 kV = 100.00 % of nominal bus kV (211.000 kV)
= 91.74 % of base kV (230.000 kV)

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
Bus_4	Total	0.00	4.315	0.00	97.49	95.36	4.638	4.638	3.48E-001	5.33E+000	1.81E-001	4.29E+000
Bus_3	Bus_4	1.63	2.338	3.92	96.72	94.23	2.970	3.865	5.41E-001	9.83E+000	2.17E-001	5.15E+000
Bus_5	Bus_4	0.96	1.382	1.24	97.41	95.26	1.244	0.773	1.13E+000	1.66E+001	1.09E+000	2.58E+001
Manufacturing Plant	Bus_4	91.74	0.596	91.74	91.74	91.74	0.424	0.000	3.85E+000	3.85E+001		
Bus_6	Bus_3	2.05	0.608	3.67	96.95	94.60	0.171	0.773	2.76E+000	3.72E+001	6.84E-001	2.33E+001
Bus_1	Bus_3	24.12	0.892	58.46	60.23	91.10	1.591	2.833 *	1.19E+000	2.54E+001	1.87E-001	6.37E+000
Bus_2	Bus_3	34.88	0.838	62.92	64.76	91.08	1.208	1.805 *	1.19E+000	2.70E+001	2.93E-001	1.00E+001
Bus_7	Bus_5	1.72	1.087	2.33	97.30	95.12	1.035	0.773	1.21E+000	2.10E+001	1.01E+000	2.53E+001
Data Center	Bus_5	91.74	0.295	91.74	91.74	91.74	0.210	0.000	7.69E+000	7.69E+001		
Bus_8	Bus_6	2.23	0.258	3.24	97.16	94.93	0.078	0.773	3.33E+000	8.74E+001	7.65E-001	2.38E+001
University	Bus_6	91.74	0.350	91.74	91.74	91.74	0.249	0.000	6.41E+000	6.41E+001		
Gen1	Bus_1	91.74	18.655	91.74	91.74	91.74	11.620	0.000	1.00E+000	1.90E+001	1.00E+000	7.00E+000
Gen3	Bus_2	91.74	17.532	91.74	91.74	91.74	10.912	0.000	8.95E-001	1.70E+001	8.95E-001	6.26E+000
Bus_8	Bus_7	2.23	0.736	3.24	97.16	94.93	0.785	0.773	1.11E+000	3.07E+001	9.25E-001	2.48E+001
Shopping Mall	Bus_7	91.74	0.351	91.74	91.74	91.74	0.250	0.000	6.41E+000	6.41E+001		

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

Short-Circuit Summary Report

1/2 Cycle - 3-Phase, LG, LL, & LLG Fault Currents

Prefault Voltage = 100 % of the Bus Nominal Voltage

Bus		3-Phase Fault			Line-to-Ground Fault			Line-to-Line Fault			*Line-to-Line-to-Ground		
ID	kV	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.	Real	Imag.	Mag.
Bus_4	211.000	0.281	-4.306	4.315	0.297	-4.629	4.638	3.753	0.274	3.763	3.630	2.730	4.542

All fault currents are symmetrical (1/2 Cycle network) values in rms kA.
* LLG fault current is the larger of the two faulted line currents.

Sequence Impedance Summary Report

Bus		Positive Seq. Imp. (ohm)			Negative Seq. Imp. (ohm)			Zero Seq. Imp. (ohm)			Fault Zf (ohm)		
ID	kV	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance
Bus_4	211.000	1.83912	28.16960	28.22957	2.24758	27.75169	27.84255	0.95686	22.71052	22.73066	0.00000	0.00000	0.00000

Sequence-of-Operation Event Summary Report

Symmetrical 3-Phase Fault at Bus_4.

Time (ms)	ID	If (kA)	T1 (ms)	T2 (ms)	Condition
99.4	Relay1	1.382	99.4		Phase - OC1 - 51
105	Relay2	0.994	105		Phase - OC1 - 51
133	CB_7		33.3		Tripped by Relay1 Phase - OC1 - 51
133	CB_8		33.3		Tripped by Relay1 Phase - OC1 - 51
139	CB_17		33.3		Tripped by Relay2 Phase - OC1 - 51
139	CB_18		33.3		Tripped by Relay2 Phase - OC1 - 51