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	2	6	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:	grid3
Output Filename:	C:\Users\owner's\Desktop\PSA PBL\grid3\grid3\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
Bus1	6.600	1	100.0	0.0								
Bus2	20.000	1	100.0	0.0								
Bus3	20.000	1	100.0	0.0	2.040	1.264	0.510	0.316				
Bus4	20.000	1	100.0	0.0	2.720	1.686	0.680	0.421				
Bus_5	6.600	1	100.0	0.0								
Bus_6	20.000	1	100.0	0.0	2.448	1.517	3.812	2.779				
Bus_7	20.000	1	100.0	0.0	1.700	1.054	2.356	2.815				
Bus_8	20.000	1	100.0	0.0								
Bus_9	6.600	1	100.0	0.0								
Total Number of Buses: 9					8.908	5.521	7.358	6.332	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
Bus1	6.600	Swing	1	100.0	0.0					
Bus_5	6.600	Voltage Control	1	100.0	0.0	10.000			10.000	-10.000
Bus_6	20.000	Mvar/PF Control	1	100.0	0.0	30.000	-22.500	-80.0		
Bus_9	6.600	Voltage Control	1	100.0	0.0	10.000			30.000	-30.000
						50.000	-22.500			

Line/Cable/Busway Input Data

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

Line/Cable/Busway ID	Library	Size	Length Adj. (ft)	% Tol.	#/Phase	T (°C)	R	X	Y
Cable1	25MCUS1	750	3000.0	0.0	12	75	0.024798	0.093000	
Cable3	25MCUS1	750	3000.0	0.0	12	75	0.024798	0.093000	
Line1		477	5280.0	0.0	1	75	0.044604	0.157749	0.0000010
Line3		477	5280.0	0.0	1	75	0.044604	0.157749	0.0000010
Line7		477	5280.0	0.0	1	75	0.044604	0.157749	0.0000010
Line8		477	5280.0	0.0	1	75	0.044604	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
T3	3-Phase	100.000	6.600	20.000	6.50	34.10	0	0	0	0	0	6.5000	YNd	0.000
T6	3-Phase	100.000	20.000	6.600	6.50	34.10	0	0	0	0	0	6.5000	Dyn	0.000
T7	3-Phase	100.000	20.000	6.600	6.50	34.10	0	0	0	0	0	6.5000	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
T3	2W XFMR	Bus1	Bus2	0.19	6.50	6.50	
T6	2W XFMR	Bus4	Bus_5	0.19	6.50	6.50	
T7	2W XFMR	Bus_8	Bus_9	0.19	6.50	6.50	
Cable1	Cable	Bus_7	Bus_8	0.15	0.58	0.60	
Cable3	Cable	Bus_6	Bus_8	0.15	0.58	0.60	
Line1	Line	Bus2	Bus3	5.89	20.82	21.64	0.0020566
Line3	Line	Bus3	Bus4	5.89	20.82	21.64	0.0020566
Line7	Line	Bus2	Bus_6	5.89	20.82	21.64	0.0020566
Line8	Line	Bus4	Bus_7	5.89	20.82	21.64	0.0020566

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
* Bus1	6.600	100.000	0.0	-33.280	13.710	0.000	0.000	Bus2	-33.280	13.710	3148.6	-92.5	
Bus2	20.000	99.197	1.3	0.000	0.000	0.000	0.000	Bus3	-8.684	2.908	266.5	-94.8	
								Bus_6	-24.621	9.961	772.9	-92.7	
								Bus1	33.305	-12.868	1039.0	-93.3	
Bus3	20.000	99.122	2.4	0.000	0.000	2.541	1.575	Bus2	8.734	-2.732	266.5	-95.4	
								Bus4	-11.275	1.157	330.1	-99.5	
Bus4	20.000	99.578	3.8	0.000	0.000	3.394	2.104	Bus3	11.352	-0.887	330.1	-99.7	
								Bus_7	-4.749	4.926	198.4	-69.4	
								Bus_5	-9.997	-6.143	340.2	85.2	
* Bus_5	6.600	100.000	4.2	10.000	6.233	0.000	0.000	Bus4	10.000	6.233	1030.8	84.9	
Bus_6	20.000	98.735	4.6	30.000	-22.500	6.164	4.227	Bus_8	-1.207	-18.257	534.9	6.6	
								Bus2	25.043	-8.470	772.9	-94.7	
Bus_7	20.000	98.837	4.6	0.000	0.000	4.001	3.804	Bus_8	-8.778	1.026	258.1	-99.3	
								Bus4	4.777	-4.830	198.4	-70.3	
Bus_8	20.000	98.845	4.6	0.000	0.000	0.000	0.000	Bus_7	8.780	-1.022	258.1	-99.3	
								Bus_6	1.213	18.277	534.9	6.6	
								Bus_9	-9.992	-17.255	582.3	50.1	
* Bus_9	6.600	100.000	5.0	10.000	17.520	0.000	0.000	Bus_8	10.000	17.520	1764.6	49.6	

* 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
Bus1	6.600										35.994	92.5	3148.6	
Bus2	20.000										35.705	93.3	1039.0	
Bus3	20.000		2.040	1.264	0.501	0.311					11.602	97.2	337.9	
Bus4	20.000		2.720	1.686	0.674	0.418					16.336	90.3	473.6	
Bus_5	6.600										11.783	84.9	1030.8	
Bus_6	20.000		2.448	1.517	3.716	2.709					41.088	76.0	1201.3	
Bus_7	20.000		1.700	1.054	2.301	2.750					10.019	87.6	292.6	
Bus_8	20.000										20.830	48.0	608.3	
Bus_9	6.600										20.173	49.6	1764.6	

* 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	%
Cable1	Cable	7697.38	258.14	3.35					
Cable3	Cable	7697.38	534.94	6.95					
T3	Transformer				100.000	35.994	36.0	35.705	35.7
T6	Transformer				100.000	11.783	11.8	11.734	11.7
T7	Transformer				100.000	20.173	20.2	19.940	19.9

* 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
Cable1	-8.778	1.026	8.780	-1.022	1.2	4.6	98.8	98.8	0.01
Cable3	-1.207	-18.257	1.213	18.277	5.3	20.0	98.7	98.8	0.11
Line1	-8.684	2.908	8.734	-2.732	50.2	175.5	99.2	99.1	0.08
Line3	-11.275	1.157	11.352	-0.887	77.0	270.3	99.1	99.6	0.46
Line7	-24.621	9.961	25.043	-8.470	422.1	1490.8	99.2	98.7	0.46
Line8	-4.749	4.926	4.777	-4.830	27.8	96.3	99.6	98.8	0.74
T3	-33.280	13.710	33.305	-12.868	24.7	841.7	100.0	99.2	0.80
T6	-9.997	-6.143	10.000	6.233	2.6	90.2	99.6	100.0	0.42
T7	-9.992	-17.255	10.000	17.520	7.8	264.4	98.8	100.0	1.16
					618.7	3253.8			

* 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	-9.677	Mvar	13.710	0.0	3-Phase
Gen1	Generator	Under Power	0.000	MW	-33.280	0.0	3-Phase
Wind Farm	Wind Turbine Generator	Overload	30.000	MW	30.000	100.0	3-Phase
Wind Farm	Wind Turbine Generator	Under Excited	-10.000	Mvar	-22.500	0.0	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	-33.280	13.710	35.994	92.46 Leading
Source (Non-Swing Buses):	50.000	1.253	50.016	99.97 Lagging
Total Demand:	16.720	14.962	22.437	74.52 Lagging
Total Motor Load:	8.908	5.521	10.480	85.00 Lagging
Total Static Load:	7.193	6.188	9.488	75.81 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.619	3.254		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

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	2	6	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:	3	0	0	0	4	7

System Frequency:	60.00
Unit System:	English
Project Filename:	grid3
Output Filename:	C:\Users\owner's\Desktop\PSA PBL\grid3\grid3\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.
Bus1	SWNG	6.600	6.600	1	100.00	0.00
Bus2	Load	20.000	20.000	1	100.00	30.00
Bus3	Load	20.000	20.000	1	100.00	30.00
Bus4	Load	20.000	20.000	1	100.00	30.00
Bus_5	Gen.	6.600	6.600	1	100.00	0.00
Bus_6	Load	20.000	20.000	1	100.00	30.00
Bus_7	Load	20.000	20.000	1	100.00	30.00
Bus_8	Load	20.000	20.000	1	100.00	30.00
Bus_9	Gen.	6.600	6.600	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
Cable1	25MCUS1	750	3000.0	0.0	12	75	0.0247982	0.093		0.2861325	0.248	
Cable3	25MCUS1	750	3000.0	0.0	12	75	0.0247982	0.093		0.2861325	0.248	
Line1		477	5280.0	0.0	1	75	0.0446045	0.1577493	0.000001	0.0956523	0.4853866	0.0000005
Line3		477	5280.0	0.0	1	75	0.0446045	0.1577493	0.000001	0.0956523	0.4853866	0.0000005
Line7		477	5280.0	0.0	1	75	0.0446045	0.1577493	0.000001	0.0956523	0.4853866	0.0000005
Line8		477	5280.0	0.0	1	75	0.0446045	0.1577493	0.000001	0.0956523	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
T3	100.000	6.600	20.000	6.50	34.10	0	0	0	0	0	6.50	YNd	30.00
T6	100.000	20.000	6.600	6.50	34.10	0	0	0	0	0	6.50	Dyn	30.00
T7	100.000	20.000	6.600	6.50	34.10	0	0	0	0	0	6.50	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
T3	100.000	6.600	20.000	D/Y					Solid			
T6	100.000	20.000	6.600	D/Y					Solid			
T7	100.000	20.000	6.600	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
T3	2W XFMR	Bus1	Bus2	0.19	6.50	6.50	
T6	2W XFMR	Bus4	Bus_5	0.19	6.50	6.50	
T7	2W XFMR	Bus_8	Bus_9	0.19	6.50	6.50	
Cable1	Cable	Bus_7	Bus_8	0.15	0.58	0.60	
Cable3	Cable	Bus_6	Bus_8	0.15	0.58	0.60	
Line1	Line	Bus2	Bus3	5.89	20.82	21.64	0.0020566
Line3	Line	Bus3	Bus4	5.89	20.82	21.64	0.0020566
Line7	Line	Bus2	Bus_6	5.89	20.82	21.64	0.0020566
Line8	Line	Bus4	Bus_7	5.89	20.82	21.64	0.0020566

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	15.000	6.600	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		7.00	1.000	7.00
Gen3	Steam Turbo	25.000	6.600	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		7.00	1.000	7.00
Gen5	Steam Turbo	30.000	6.600	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		7.00	1.000	7.00

Total Connected Synchronous Generators (= 3): 70.000 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.
GOVT. University	3600.0	20.000	80	20	2448.0	1517.1	10.00	10.00	1.538	15.38	23.08	Delta		
HOSPITAL	3000.0	20.000	80	20	2040.0	1264.3	10.00	10.00	1.538	15.38	23.08	Delta		
OLD_AGE_HOME	2500.0	20.000	80	20	1700.0	1053.6	10.00	10.00	1.538	15.38	23.08	Delta		
TECH_PARK	4000.0	20.000	80	20	2720.0	1685.7	10.00	10.00	1.538	15.38	23.08	Delta		

Total Connected Lumped Loads (= 4): 13100.0 kVA

SHORT- CIRCUIT REPORT

Fault at bus: **Bus_6**

Prefault voltage = 20.000 kV = 100.00 % of nominal bus kV (20.000 kV)
= 100.00 % of base kV (20.000 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_6	Total	0.00	17.404	0.00	125.72	130.11	9.799	9.799	1.02E+000	1.66E+001	9.88E+000	5.47E+001
Bus_8	Bus_6	1.53	7.326	1.18	125.83	129.67	3.578	2.415	3.06E+000	3.93E+001	4.25E+001	2.22E+002
Bus2	Bus_6	17.78	2.372	62.40	95.56	96.46	3.357	7.384	1.22E+001	1.21E+002	1.28E+001	7.27E+001
Wind Farm	Bus_6	101.01	7.176	101.01	101.01	101.01	2.669	0.000	1.15E+000	4.02E+001		
GOVT. University	Bus_6	100.00	0.538	100.00	100.00	100.00	0.200	0.000	5.34E+001	5.34E+002		
Bus_7	Bus_8	2.21	3.262	2.06	125.82	129.11	2.032	2.415	9.19E+000	8.67E+001	4.07E+001	2.20E+002
Bus_9	Bus_8	10.66	4.067	77.44	75.45	99.64	1.546	0.000	3.52E+000	6.98E+001		
Bus3	Bus2	22.16	0.585	45.83	104.72	106.78	0.587	2.415	4.01E+001	4.05E+002	1.06E+000	2.64E+001
Bus1	Bus2	21.71	1.787	80.56	77.89	99.62	3.944	9.799 *	6.86E+000	1.33E+002	1.91E-001	6.50E+000
Bus4	Bus_7	23.92	2.896	28.29	115.98	118.90	1.897	2.415	1.02E+001	9.70E+001	3.89E+001	2.19E+002
OLD_AGE_HOME	Bus_7	100.00	0.365	100.00	100.00	100.00	0.136	0.000	7.69E+001	7.69E+002		
Gen5	Bus_9	100.00	12.323	100.00	100.00	100.00	4.025	0.000	3.33E+000	6.33E+001	3.33E+000	2.33E+001
Bus4	Bus3	23.92	0.234	28.29	115.98	118.90	0.716	2.415	6.96E+001	9.61E+002	1.37E+001	9.04E+001
HOSPITAL	Bus3	100.00	0.351	100.00	100.00	100.00	0.130	0.000	6.41E+001	6.41E+002		
Gen1	Bus1	100.00	5.416	100.00	100.00	100.00	1.766	0.000	6.67E+000	1.27E+002	6.67E+000	4.67E+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_6	20.000	1.066	-17.372	17.404	1.362	-9.704	9.799	15.174	1.113	15.215	-15.672	2.236	15.830

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_6	20.000	0.04064	0.66221	0.66345	0.05549	0.64877	0.65114	0.39514	2.18976	2.22512	0.00000	0.00000	0.00000

Sequence-of-Operation Event Summary Report

Symmetrical 3-Phase Fault at Bus_6.

Time (ms)	ID	If (kA)	T1 (ms)	T2 (ms)	Condition
99.4	Relay3	2.372	99.4		Phase - OC1 - 51
183	CB1		83.3		Tripped by Relay3 Phase - OC1 - 51
183	CB2		83.3		Tripped by Relay3 Phase - OC1 - 51