

3.0 PROJECT ASSUMPTIONS

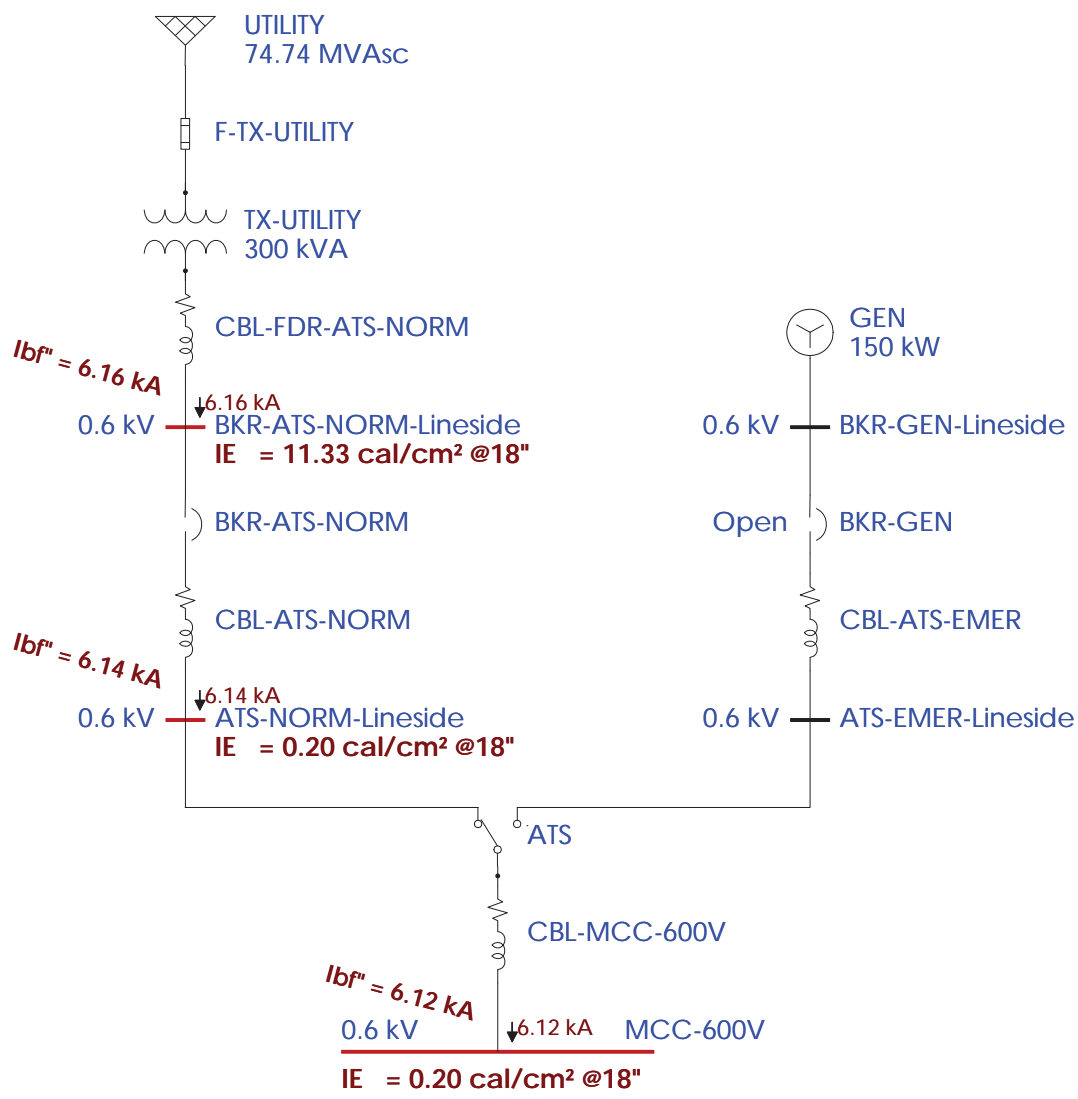
The following assumptions were made in order to complete this project:

- A cable length tolerance of 10% has been set for all cables, as cable lengths provided were estimated.

The following Utility information was provided :

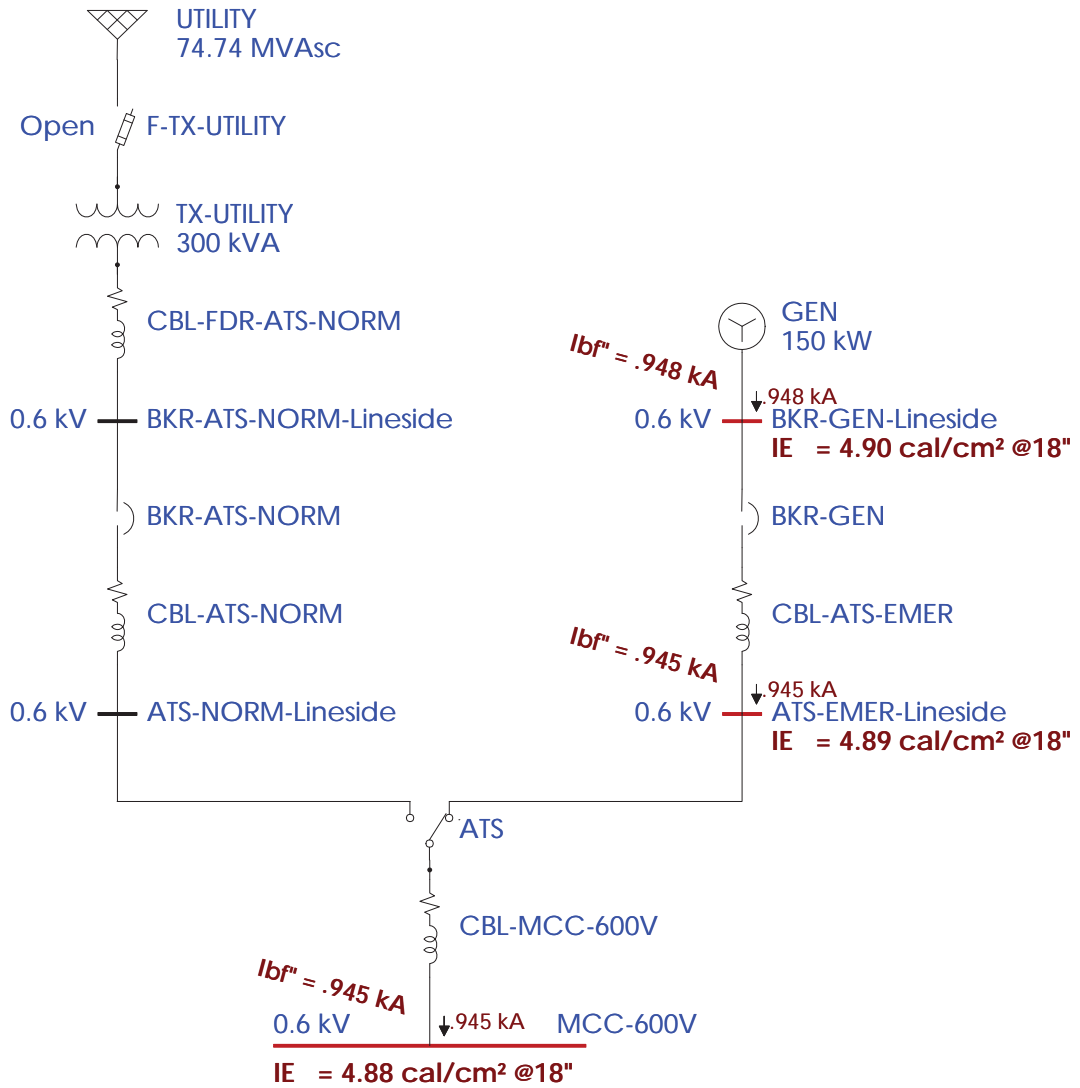
- The 13.86kV positive and zero sequence impedances (% on 100MVA base) are:
 - R1: 93.8831
 - X1: 95.3297
 - R0: 345.901
 - X0: 122.041

Single Line Diagram - Short Circuit and Arc Flash Energy Levels
Normal Operation



Single Line Diagram with Short Circuit and Arc Flash Energy Levels – Emergency Operation

Single Line Diagram - Short Circuit and Arc Flash Energy Levels
Emergency Operation



8.2 *Input and Output Data for the Short Circuit Study – Normal Operation*
Input and Output Data for the Short Circuit Study – Emergency Operation

Input and Output Data for the Short Circuit Study – Normal Operation

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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	0	5	6			
	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	1	0	0	3	0	1	5
	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total	
Number of Machines:	0	1	0	0	0	1	

System Frequency: 60.00 Hz

Unit System: English

Project Filename:

Output Filename:

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Adjustments

<u>Tolerance</u>	<u>Apply Adjustments</u>	<u>Individual /Global</u>	<u>Percent</u>
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	Yes	Global	10.0

<u>Temperature Correction</u>	<u>Apply Adjustments</u>	<u>Individual /Global</u>	<u>Degree C</u>
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

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Bus Input Data

ID	Bus				Initial Voltage	
	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang.
ATS-NORM-Lineside	Load	0.600	0.600	1	100.00	-30.00
BKR-ATS-NORM-Lineside	Load	0.600	0.600	1	100.00	-30.00
Bus1	SWNG	13.860	13.860	1	100.00	0.00
Bus2	Load	0.600	0.600	1	100.00	-30.00
Bus4	Load	0.600	0.600	1	100.00	-30.00
MCC-600V	Load	0.600	0.600	1	100.00	-30.00

6 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.

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Line/Cable Input Data

Ohms or Siemens per 1000 ft per Conductor (Cable) or per Phase (Line)

Line/Cable												
ID	Library	Size	Length		#/Phase	T (°C)	R1	X1	Y1	R0	X0	Y0
			Adj. (ft)	% Tol.								
CBL-ATS-NORM	1.0NCUS3	300	5.4	-10.0	1	75	0.0236057	0.0254813		0.0375336	0.0647212	
CBL-MCC-600V	1.0NCUS3	300	5.4	-10.0	1	75	0.0236057	0.0254813		0.0375336	0.0647212	
CBL-FDR-ATS-NORM	1.0NCUS3	300	67.5	-10.0	1	75	0.0236057	0.0254813		0.0375336	0.0647212	

Line / Cable resistances are listed at the specified temperatures.

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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
TX-UTILITY	0.300	13.860	0.600	4.10	3.09	0	0	0	0	0	4.1000	Dyn	30.000

2-Winding Transformer Grounding Input Data

Transformer	Rating			Grounding								
	ID	MVA	Prim. kV	Conn.	Primary			Secondary				
				Type	Type	kV	Amp	Ohm	Type	kV	Amp	Ohm
TX-UTILITY	0.300	13.860	0.600	D/Y						Solid		

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Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA			
ID	Type	From Bus	To Bus	R	X	Z	Y
TX-UTILITY	2W XFMR	Bus1	Bus2	420.80	1300.27	1366.67	
CBL-ATS-NORM	Cable	BKR-ATS-NORM-Lineside	ATS-NORM-Lineside	3.54	3.82	5.21	
CBL-MCC-600V	Cable	Bus4	MCC-600V	3.54	3.82	5.21	
CBL-FDR-ATS-NORM	Cable	Bus2	BKR-ATS-NORM-Lineside	44.26	47.78	65.13	
ATS	Tie Switch	Bus4	ATS-NORM-Lineside				

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Power Grid Input Data

Power Grid		Connected Bus		Rating		% Positive Seq. Impedance 100 MVA Base			Grounding	% Zero Seq. Impedance 100 MVA Base		
ID	ID	MVAsc	kV	X/R	R	X	Type	X/R	R0	X0		
UTILITY	Bus1	74.740	13.860	1.02	93.88310	95.32970	Wye - Solid	0.35	345.901000	122.04100		
Total Power Grids (= 1)		74.740 MVA										

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SHORT- CIRCUIT REPORT

Fault at bus: **ATS-NORM-Lineside**

Prefault voltage = 0.600 kV = 100.00 % of nominal bus kV (0.600 kV)
 = 100.00 % of base kV (0.600 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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
ATS-NORM-Lineside	Total	0.00	6.197	0.00	100.65	98.54	6.249	6.249	5.62E+002	1.45E+003	4.97E+002	1.43E+003
BKR-ATS-NORM-Lineside	ATS-NORM-Lineside	0.34	6.197	0.47	100.58	98.48	6.249	6.249	5.62E+002	1.45E+003	4.97E+002	1.43E+003
MCC-600V	Bus4	0.00	0.000	0.00	100.65	98.54	0.000	0.000				
Bus2	BKR-ATS-NORM-Lineside	4.53	6.197	6.29	99.74	97.67	6.249	6.249	5.59E+002	1.44E+003	4.91E+002	1.42E+003
Bus1	Bus2	92.15	6.197	97.14	100.00	95.01	6.249	6.249*	5.15E+002	1.40E+003	4.21E+002	1.30E+003
UTILITY	Bus1	100.00	0.268	100.00	100.00	100.00	0.156	0.000	9.39E+001	9.53E+001	3.46E+002	1.22E+002
ATS-NORM-Lineside	Bus4	0.00	0.000	0.00	100.65	98.54	0.000	0.000				

Indicates fault current contribution is from three-winding transformers

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

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Fault at bus: **BKR-ATS-NORM-Lineside**

Prefault voltage = 0.600 kV = 100.00 % of nominal bus kV (0.600 kV)
 = 100.00 % of base kV (0.600 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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
BKR-ATS-NORM-Lineside	Total	0.00	6.217	0.00	100.58	98.47	6.277	6.277	5.59E+002	1.44E+003	4.91E+002	1.42E+003
ATS-NORM-Lineside	BKR-ATS-NORM-Lineside	0.00	0.000	0.00	100.58	98.47	0.000	0.000				
Bus2	BKR-ATS-NORM-Lineside	4.21	6.217	5.85	99.74	97.66	6.277	6.277	5.59E+002	1.44E+003	4.91E+002	1.42E+003
MCC-600V	Bus4	0.00	0.000	0.00	100.58	98.47	0.000	0.000				
Bus1	Bus2	92.13	6.217	97.13	100.00	94.99	6.277	6.277 *	5.15E+002	1.40E+003	4.21E+002	1.30E+003
UTILITY	Bus1	100.00	0.269	100.00	100.00	100.00	0.157	0.000	9.39E+001	9.53E+001	3.46E+002	1.22E+002
Bus4	ATS-NORM-Lineside	0.00	0.000	0.00	100.58	98.47	0.000	0.000				

Indicates fault current contribution is from three-winding transformers

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

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Fault at bus: **Bus1**

Prefault voltage = 13.860 kV = 100.00 % of nominal bus kV (13.860 kV)
 = 100.00 % of base kV (13.860 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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
Bus1	Total	0.00	3.113	0.00	111.76	135.41	2.020	2.020	9.39E+001	9.53E+001	3.46E+002	1.22E+002
Bus2	Bus1	0.00	0.000	78.18	64.52	100.00	0.000	0.000				
UTILITY	Bus1	100.00	3.113	100.00	100.00	100.00	2.020	2.020	9.39E+001	9.53E+001	3.46E+002	1.22E+002
BKR-ATS-NORM-Lineside	Bus2	0.00	0.000	78.18	64.52	100.00	0.000	0.000				
ATS-NORM-Lineside	BKR-ATS-NORM-Lineside	0.00	0.000	78.18	64.52	100.00	0.000	0.000				
MCC-600V	Bus4	0.00	0.000	78.18	64.52	100.00	0.000	0.000				
Bus4	ATS-NORM-Lineside	0.00	0.000	78.18	64.52	100.00	0.000	0.000				

Indicates fault current contribution is from three-winding transformers

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

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Fault at bus: **MCC-600V**

Prefault voltage = 0.600 kV = 100.00 % of nominal bus kV (0.600 kV)
 = 100.00 % of base kV (0.600 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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
MCC-600V	Total	0.00	6.178	0.00	100.71	98.61	6.221	6.221	5.66E+002	1.45E+003	5.02E+002	1.44E+003
Bus4	MCC-600V	0.33	6.178	0.46	100.64	98.55	6.221	6.221	5.66E+002	1.45E+003	5.02E+002	1.44E+003
BKR-ATS-NORM-Lineside	ATS-NORM-Lineside	0.67	6.178	0.93	100.57	98.48	6.221	6.221	5.62E+002	1.45E+003	4.97E+002	1.43E+003
Bus2	BKR-ATS-NORM-Lineside	4.85	6.178	6.72	99.74	97.68	6.221	6.221	5.59E+002	1.44E+003	4.91E+002	1.42E+003
Bus1	Bus2	92.17	6.178	97.14	100.00	95.04	6.221	6.221 *	5.15E+002	1.40E+003	4.21E+002	1.30E+003
UTILITY	Bus1	100.00	0.267	100.00	100.00	100.00	0.155	0.000	9.39E+001	9.53E+001	3.46E+002	1.22E+002
ATS-NORM-Lineside	Bus4	0.33	6.178	0.46	100.64	98.55	6.221	6.221				

Indicates fault current contribution is from three-winding transformers

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

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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.
ATS-NORM-Lineside	0.60	2.245	-5.776	6.197	2.194	-5.851	6.249	5.003	1.944	5.367	3.933	4.907	6.289
BKR-ATS-NORM-Lineside	0.60	2.245	-5.797	6.217	2.196	-5.880	6.277	5.021	1.944	5.384	3.949	4.926	6.313
Bus1	13.86	2.185	-2.218	3.113	1.743	-1.021	2.020	1.921	1.892	2.696	-2.591	-1.602	3.047
MCC-600V	0.60	2.245	-5.756	6.178	2.191	-5.822	6.221	4.985	1.944	5.350	3.917	4.889	6.264

All fault currents are symmetrical momentary (1/2 Cycle network) values in rms kA

* LLG fault current is the larger of the two faulted line currents

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Short-Circuit Summary Report

Bus		Positive Sequence Imp. (ohm)			Negative Sequence Imp. (ohm)			Zero Sequence Imp. (ohm)		
ID	kV	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance
ATS-NORM-Lineside	0.600	0.02025	0.05210	0.05590	0.02025	0.05210	0.05590	0.01789	0.05153	0.05454
BKR-ATS-NORM-Lineside	0.600	0.02012	0.05196	0.05572	0.02012	0.05196	0.05572	0.01768	0.05118	0.05415
Bus1	13.860	1.80349	1.83128	2.57025	1.80349	1.83128	2.57025	6.64474	2.34440	7.04619
MCC-600V	0.600	0.02038	0.05224	0.05607	0.02038	0.05224	0.05607	0.01809	0.05188	0.05494

Input and Output Data for the Short Circuit Study – Emergency Operation

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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	0	3	4			
	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	0	0	0	2	0	1	3
	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total	
Number of Machines:	1	0	0	0	0	1	

System Frequency: 60.00 Hz

Unit System: English

Project Filename:

Output Filename:

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Adjustments

<u>Tolerance</u>	<u>Apply Adjustments</u>	<u>Individual /Global</u>	<u>Percent</u>
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	Yes	Global	10.0

<u>Temperature Correction</u>	<u>Apply Adjustments</u>	<u>Individual /Global</u>	<u>Degree C</u>
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

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Bus Input Data

ID	Bus			Initial Voltage		
	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang.
ATS-EMER-Lineside	Load	0.600	0.600	2	100.00	0.00
BKR-GEN-Lineside	SWNG	0.600	0.600	2	100.00	0.00
Bus4	Load	0.600	0.600	2	100.00	0.00
MCC-600V	Load	0.600	0.600	2	100.00	0.00

4 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.

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Line/Cable Input Data

Ohms or Siemens per 1000 ft per Conductor (Cable) or per Phase (Line)

Line/Cable		Length										
ID	Library	Size	Adj. (ft)	% Tol.	#/Phase	T (°C)	R1	X1	Y1	R0	X0	Y0
CBL-ATS-EMER	1.0NCUS3	300	36.0	-10.0	1	75	0.0236057	0.0254813		0.0375336	0.0647212	
CBL-MCC-600V	1.0NCUS3	300	5.4	-10.0	1	75	0.0236057	0.0254813		0.0375336	0.0647212	

Line / Cable resistances are listed at the specified temperatures.

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Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVAb			
ID	Type	From Bus	To Bus	R	X	Z	Y
CBL-ATS-EMER	Cable	BKR-GEN-Lineside	ATS-EMER-Lineside	23.61	25.48	34.74	
CBL-MCC-600V	Cable	Bus4	MCC-600V	3.54	3.82	5.21	
ATS	Tie Switch	Bus4	ATS-EMER-Lineside				

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Synchronous Generator Input Data

Synchronous Generator		Rating			Positive Seq. Impedance					Grounding			Zero Seq. Impedance		
ID	Type	MVA	kV	RPM	X"/R	% R	% Xd"		% Xd'	Conn.	Type	Amp	X/R	% R0	% X0
							Adj.	Tol.							
GEN	Diesel	0.188	0.600	1800	19.00	1.000	19.00	0.0	28.00	Wye	Solid		19.00	0.368	7.00

Total Connected Synchronous Generators (= 1): 0.188 MVA

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SHORT- CIRCUIT REPORT

Fault at bus: **ATS-EMER-Lineside**

Prefault voltage = 0.600 kV = 100.00 % of nominal bus kV (0.600 kV)
 = 100.00 % of base kV (0.600 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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
ATS-EMER-Lineside	Total	0.00	0.946	0.00	87.57	88.99	1.219	1.219	5.57E+002	1.02E+004	5.71E+002	3.80E+003
BKR-GEN-Lineside	ATS-EMER-Lineside	0.34	0.946	0.61	87.56	88.91	1.219	1.219	5.57E+002	1.02E+004	5.71E+002	3.80E+003
MCC-600V	Bus4	0.00	0.000	0.00	87.57	88.99	0.000	0.000				
GEN	BKR-GEN-Lineside	100.00	0.946	100.00	100.00	100.00	1.219	1.219	5.33E+002	1.01E+004	5.33E+002	3.73E+003
Bus4	ATS-EMER-Lineside	0.00	0.000	0.00	87.57	88.99	0.000	0.000				

Indicates fault current contribution is from three-winding transformers

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