

Electrical Transient Analyzer Program

Short-Circuit Analysis

IEC 60909 Standard

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

	Swing	V-Control	Load	Total			
Number of Buses:	1	1	20	22			
	XFMR2	XFMR3	Reactor	Line/Cable/ Busway	Impedance	Tie PD	Total
Number of Branches:	3	0	0	17	0	1	21
	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Inverter	Total
Number of Machines:	1	0	0	0	1	9	11

System Frequency: 50.00

Unit System: Metric

Project Filename: Ofosu Replication

Output Filename: C:\ETAP 2401\Ofosu Replication\Protection and coordination.SQ2S

Project:

Location:

Contract:

Engineer:

Filename:

ETAP

24.0.1N

Study Case: SM

Ofosu Replication

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Date: 28-09-2026

SN: DNDLYIR

Revision: Base

Config.: ISLAND_PV_BE

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.
Bus3	Load	0.400	0.401	1	100.00	30.00
Bus4	Load	0.400	0.401	1	100.00	30.00
Bus5	Load	0.400	0.401	1	100.00	30.00
Bus7	Load	0.400	0.401	1	100.00	30.00
Bus9	Load	0.400	0.401	1	100.00	30.00
Bus11	SWNG	0.700	0.701	1	0.00	0.00
Bus12	Load	0.400	0.401	1	100.00	30.00
Bus14	Load	0.400	0.401	1	100.00	30.00
Bus15	Load	11.000	11.016	1	100.00	60.00
Bus16	Load	11.000	11.016	1	100.00	60.00
Bus18	Load	0.400	0.401	1	100.00	30.00
Bus20	Load	0.400	0.401	1	100.00	30.00
Bus21	Load	0.400	0.401	1	100.00	30.00
Bus23	Load	0.400	0.401	1	100.00	30.00
Bus24	Gen.	0.400	0.401	1	100.00	30.00
LOAD 1 - BUS	Load	0.400	0.401	1	100.00	30.00
LOAD 2 - BUS	Load	0.400	0.401	1	100.00	30.00
Main Bus	Load	0.400	0.401	1	100.00	30.00
PVDB 1	Load	0.400	0.401	1	100.00	30.00
PVDB 2	Load	0.400	0.401	1	100.00	30.00
PVDB 3	Load	0.400	0.401	1	100.00	30.00
PVDB 4	Load	0.400	0.401	1	100.00	30.00

22 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 m per Conductor (Cable) or per Phase (Line/Busway)												
Line/Cable/Busway												
ID	Library	Size	Length		#/Phase	T (°C)	R1	X1	Y1	R0	X0	Y0
			Adj. (m)	% Tol.								
Cable2	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable3	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable4	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable5	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable6	1.0NCUN4	120	30.0	0.0	1	75	0.1893115	0.0776682		0.1918382	1.43126	
Cable7	1.0NCUN4	120	30.0	0.0	1	75	0.1893115	0.0776682		0.1918382	1.43126	
Cable12	1.0NCUN4	240	30.0	0.0	3	75	0.095046	0.0776857		0.0975164	1.3658938	
Cable13	1.0NCUN4	70	30.0	0.0	1	75	0.3280143	0.079681		0.3305991	1.478074	
Cable14	1.0NCUN4	240	30.0	0.0	3	75	0.095046	0.0776857		0.0975164	1.3658938	
Cable15	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable16	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable17	1.0NCUN4	120	30.0	0.0	1	75	0.1893115	0.0776682		0.1918382	1.43126	
Cable18	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable19	1.0NCUN4	25	30.0	0.0	1	75	0.8847708	0.0839219		0.8873967	1.5668335	
Cable20	1.0NCUN4	120	30.0	0.0	1	75	0.1893115	0.0776682		0.1918382	1.43126	
Cable21	1.0NCUN4	240	30.0	0.0	3	75	0.095046	0.0776857		0.0975164	1.3658938	
Line1		100	300.0	0.0	1	75	0.3700864	0.2949753	0.000004	0.7405352	0.9726894	0.0000017

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

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
ISOLATION TX	0.500	0.700	0.400	4.00	1.50	0	0	0	0	0	4.00	Dyn	-30.00
STEP DOWN TX	0.300	11.000	0.400	4.00	1.50	0	0	0	0	0	4.00	Dyn	30.00
STEP UP TX @ GEN SITE	0.500	0.400	11.000	4.00	1.50	0	0	0	0	0	4.00	YNd	30.00

2-Winding Transformer Grounding Input Data

Grounding													
Transformer	Rating			Conn.	Primary				Secondary				
	ID	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	ohm	Type	kV	Amp	ohm
ISOLATION TX	0.500	0.700	0.400	D/Y						Solid			
STEP DOWN TX	0.300	11.000	0.400	D/Y						Solid			
STEP UP TX @ GEN SITE	0.500	0.400	11.000	D/Y						Resistor		635.1	10.00029

Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVAb			
ID	Type	From Bus	To Bus	R	X	Z	Y
ISOLATION TX	2W XFMR	Bus11	Bus12	432.75	649.12	780.15	
STEP DOWN TX	2W XFMR	Bus16	LOAD 1 - BUS	721.25	1081.87	1300.24	
STEP UP TX @ GEN SITE	2W XFMR	Bus14	Bus15	432.75	649.12	780.15	
Cable2	Cable	PVDB 1	Bus3	1654.22	156.90	1661.64	
Cable3	Cable	PVDB 1	Bus4	1654.22	156.90	1661.64	
Cable4	Cable	PVDB 2	Bus5	1654.22	156.90	1661.64	
Cable5	Cable	PVDB 2	Bus7	1654.22	156.90	1661.64	
Cable6	Cable	Main Bus	PVDB 1	353.95	145.21	382.58	
Cable7	Cable	Main Bus	PVDB 2	353.95	145.21	382.58	
Cable12	Cable	Bus12	Main Bus	59.23	48.42	76.50	
Cable13	Cable	LOAD 2 - BUS	Main Bus	613.27	148.98	631.11	
Cable14	Cable	Bus14	Main Bus	59.23	48.42	76.50	
Cable15	Cable	PVDB 3	Bus18	1654.22	156.90	1661.64	
Cable16	Cable	PVDB 3	Bus20	1654.22	156.90	1661.64	
Cable17	Cable	Main Bus	PVDB 3	353.95	145.21	382.58	
Cable18	Cable	PVDB 4	Bus21	1654.22	156.90	1661.64	
Cable19	Cable	PVDB 4	Bus23	1654.22	156.90	1661.64	
Cable20	Cable	Main Bus	PVDB 4	353.95	145.21	382.58	
Cable21	Cable	Bus9	Bus24	59.23	48.42	76.50	
Line1	Line	Bus16	Bus15	9.15	7.29	11.70	0.0001473
CB8	Tie Breakr	Main Bus	Bus9				

Synchronous Generator						% Impedance in Machine Base								Excitation	
						Rating				Xd''					
ID	Type	MVA	kV	RPM	% PF	R	Adj.	Tol.	R/X	Xd, sat	Conn.	Type	Amp	Type	
Gen1	Steam Turbo	0.556	0.400	1500	90.00	1.000	19.00	0.0	0.05	155.00	Wye	Solid	0.00	Turbine 130%	
Total Connected Synchronous Generators (= 1.00) : 0.556 MVA															

Lumped Load							Motor Loads								
							Rating		% Load		Loading		% Impedance (Machine Base)		
Lumped Load ID	kVA	kV	Amp	% PF	MTR	STAT	kW	kvar	R	X"	R/X"	Conn.	Type	Amp	MW/PP
COMMUNITY LOAD	140.0	0.400	202.07	85.00	80	20	95.20	59.00	6.46	15.37	0.42	Delta			0.10
Total Connected Lumped Loads (= 1): 140.0 kVA															

SHORT-CIRCUIT REPORT

Fault at bus: **LOAD 1 - BUS**
Nominal kV = 0.400
Voltage c Factor = 1.05 (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			kA Symm. rms		% Impedance on 100 MVA base			
				Va	Vb	Vc	Ia	3I0	R1	X1	R0	X0
LOAD 1 - BUS	Total	0.00	4.613	0.00	94.33	104.30	5.343	5.343	1.19E+003	3.75E+003	7.21E+002	1.08E+003
Bus16	LOAD 1 - BUS	32.47	3.594	60.12	112.41	71.93	4.492	5.343 *	1.65E+003	3.87E+003	7.21E+002	1.08E+003
COMMUNITY LOAD	LOAD 1 - BUS	105.00	1.018	105.00	105.00	105.00	0.863	0.000	5.75E+003	1.37E+004		
Bus15	Bus16	32.75	0.131	60.15	112.43	72.10	0.082	0.000	2.64E+003	1.44E+003		
Bus14	Bus15	52.23	0.131	55.49	96.23	107.00	0.082	0.000 *	2.63E+003	1.43E+003		
PVA1	Bus3	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA2	Bus4	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA3	Bus5	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA4	Bus7	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PCS 500KVA	Bus11	58.46	0.436	84.13	70.56	116.28	0.412	0.000				
PVA5	Bus18	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA6	Bus20	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA7	Bus21	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
PVA8	Bus23	55.13	0.077	58.08	97.20	108.79	0.073	0.000				
Initial Symmetrical Current (kA, rms)		3-Phase		L-G			L-L		L-L-G			
Peak Current (kA), Method C			4.613		5.343		3.703		5.874			
Breaking Current (kA, rms, symm)			8.413		9.743		6.753		10.713			
Steady State Current (kA, rms)					5.343		3.703		5.874			
			2.150		5.343		3.703		5.874			

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 Summary Report

3-Phase, LG, LL, LLG Fault Currents

Bus		3-Phase Fault			Line-to-Ground Fault				Line-to-Line Fault				*Line-to-Line-to-Ground			
ID	kV	I"k	ip	Ik	I"k	ip	Ib	Ik	I"k	ip	Ib	Ik	I"k	ip	Ib	Ik
LOAD 1 - BUS	0.400	4.613	8.413	2.150	5.343	9.743	5.343	5.343	3.703	6.753	3.703	3.703	5.874	10.713	5.874	5.874

All fault currents are in rms kA. Current ip is calculated using Method C.

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

Project:

Location:

Contract:

Engineer:

Filename: Ofosu Replication

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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
LOAD 1 - BUS	0.400	0.01915	0.06016	0.06314	0.02059	0.05856	0.06207	0.01157	0.01736	0.02086	0.00000	0.00000	0.00000

Sequence-of-Operation Event Summary Report

Symmetrical 3-Phase Fault at LOAD 1 - BUS.

Time (ms)	ID	If (kA)	T1 (ms)	T2 (ms)	Condition
60.0	CB12	3.594	5.0	60.0	Phase
298	Relay1	0.131	298		Phase - OC1 - 51
358	CB11		60.0		Tripped by Relay1 Phase - OC1 - 51