

Variable Renewable Energy Integration Studies

Solomon Power



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1 Project Introduction

The Solomon Islands is an island nation lies in the South Pacific Oceanic Region towards the West of Vanuatu and towards the East of Papua New Guinea. The island nation consists of 6 major islands and over 900 smaller islands with a total land area of 28,400 square kilometres. In 2020, the World Bank reported a total population of approximately 700,000 people with an annual population growth rate of 2.4%. Honiara, the capital city, recorded a total population of 90,441 in that same period.

Electrification is limited to Honiara, the capital city. This equates to a national electrification rate of 12% and an electrification rate of 64% in the capital city. In 2019, SP recorded a total of 19,000 customers within the Honiara grid. Annual generation with the current customer base was 85.115GWh with maximum demand at 16MW. Diesel generation remains the main source of generation on the island with renewable energy (RE) contributions of about 1MW from a 1MW solar PV power plant at Henderson and a 50kW PV installation at the SP head office carpark in Ranadi.

Under these circumstances, the Ministry of Mines, Energy and Rural Electrification (MMERE) and Solomon Power (SP) aims to achieve a national renewable energy ratio of 100% by 2030. Given the current power development plan (PDP) implemented by SP, 100% RE supply from a mix of Photovoltaic (PV) and Hydro sources is possible during the rainy season. Critical to this will be the integration of rightly rated Battery Energy Storage Systems (BESS) to stabilise voltage and frequency fluctuations introduced by the PV systems.

In consultation and agreement with Solomon Power (SP), this study will combine project proposals submitted to SP for grid expansion and assess system stability in response to the following changes in the current network,

1. a 2% annual growth rate applied to increases in power demand from 2021 to 2030,
2. the implementation of the SP's PDP to transition to 100% RE generation sources by 2030,
3. the integration of a 4MW/2MWh for spinning reserve and 4MW/24MWh BESS as for peak shifting to help address PV generation intermittencies,

This study will be presented in this report in the following sections:

- The Executive Summary section providing concise review of the study findings
- The Project Introduction section providing a brief overview of the report
- The Input Data provides a description of the SP electrical network along with the parameters of all components modelled in this study.
- The Methodology section provides a summary of the procedures used to conduct the steady state studies.
- The Study Results section presents and comments on the obtained study results.
- The Annex section gives detailed tabulated results and single line diagrams.

An important note: There was no grid code available at the time of study for the Kiribati electricity distribution system. Therefore, this study uses best engineering practices and the relevant Australian codes and standards for comparison and evaluation of obtained results.

2 Data for Network Analysis

2.1 Study Activities

The following activities were done as part of the network analysis:

- A review of the SP network for maximum and minimum loads in 2020, 2030, and 2040.
- Development of the base network model using all network elements provided by SP in the latest single line diagram.
- Completion of the variable renewable energy steady state studies to determine maximum allowable PV as proposed the planned developments.

2.2 Network Single Line Diagram

The DIgSILENT model currently used by SP was shared with the PPA consultant and used as a starting point for power system modelling on DIgSILENT. Given the time limitations to complete this study and slow correspondences between both parties, a complete review of the DIgSILENT model was not possible to verify data quality. As advised by SP the current model is an accurate reflection of the SP power grid to the best of their knowledge. DIgSILENT data registry records November 2021 to be the date changes were last made to the model. Hence, this study was conducted based on the assumption that the model is an accurate reflection of the SP power network up to the year 2021.

2.3 Generators

The current diesel power generation from SP is provided by eleven generators. Generators L1, L2, L3, L4, L5, L6, L7, L8, L9, and L10 operate on the 11kV voltage level and are connected directly to the 11kV grid from Lungga Power Station. These provide the generation for base load. Additionally, two other generators labelled H1 and H2 are located at Honiara Power Station and operate on the 0.415kV. These are connected to the grid via separate 11/0.415kV transformers and are treated in this study as backup generation for power or voltage support. This study has not relied on these backup generators for support during normal operation analysis.

This study assumes that the generator parameters built into the model are an accurate representation of the generators installed at Lungga and Honiara power stations. The generator models used do not have governor and excitor models installed. This is accepted as this study only considers steady-state analysis.

Any additional generator parameters included in this study were adopted from the following sources:

1. Renewable Energy Road Map in Solomon Islands (May 2021) completed by the Japan International Cooperation Agency (JICA), Tokyo Electric Power Services Co., Ltd. (TEPSCO), and Deloitte Tohmatsu Consulting LLC (DTC),
2. Correspondence with SP electrical engineers from the Planning Department,
3. and Single-line diagrams provided by SP Planning Department.

As advised by SP, these have been set to operate at a nominal power factor of 0.95. A summary of the generator nominal, maximum and minimum power is presented in Table 2.1.

Table 2.1. Operational Plans for SP Power Generators

Sites	Unit	Type	Capacity (MW)	COD / Decommission
Lungga	L1	Diesel	2.5	2016 / 2039
	L2	Diesel	2.5	2016 / 2039
	L3	Diesel	2.5	2016 / 2039
	L4	Diesel	2.5	2016 / 2039
	L6	Diesel	2.2	1998 / 2024
	L7	Diesel	3.8	2005 / 2036
	L8	Diesel	3	1993 / 2024
	L9	Diesel	3.8	1999 / 2024
	L10	Diesel	3.8	2006 / 2036
	H1	Diesel	1.5	2013 / 2038
Honiara	H2	Diesel	1.5	2013 / 2038
	Total Diesel Capacity			29.6
Henderson Fighter 1	PV1	PV	1	Installed

Henderson Fighter 1	PV2	PV	2	Proposed
Henderson Fighter 1	PV3	PV	1	Proposed
Tenaru	PV4	PV	4	Proposed
Foxwood Makira	PV5	PV	3	Proposed
Okea	PV6	PV	4	Proposed
Lungga	PV7	PV	4	Proposed
SP-Rooftop	PV8	PV	0.22	Proposed
Tasahe	PV9	PV	2	Proposed
Tanagai	PV10	PV	1	Proposed
Total PV			22.22	
White River	-	BESS	4	Proposed
Lungga BESS	-	BESS	4	Proposed
Total BESS			8	
Tina 1	1	Hydro	5	Proposed
Tina 2	2	Hydro	5	Proposed
Tina 3	3	Hydro	5	Proposed
Total Hydro			15	
Total Generation			74.82	

The bus voltage setpoint of 1.05 for Generator 2 at Lungga PS was used to keep voltage/reactive power within permissible limits. Generator 6 and 10 at Lungga PS and Generator 1 and 2 at Honiara PS were kept out of service and only brought into service to keep the voltage profile within accepted limits for the year. Generator 2 was set as the network reference generator.

2.4 Photovoltaic (PV) & BESS Systems

The PV generation was modelled using the maximum generation output to offset reliance on diesel generation. This was done on the assumption that stable operation would be maintained during an N-1 contingency event. The PV the rated capacities are as listed in the table above.

Choice of BESS connection points to the SP grid were based on proposals submitted in the JICA study proposing BESS provision for two purposes. The first would be a 4MW/2MWh rated BESS to provide short-cycle fluctuation control to stabilise small fluctuations introduced to the grid by connected PV systems. This would be connected direct to the 33kV network to form the backbone system. The second would be a 4MW/24MWh rated BESS to provide long-period fluctuation control for peak shifting purposes and would be connected to the 11kV grid in order to limit the flow of BESS charging current through the network.

The BESS was modelled as a static generator allowing for simulation of BESS power recharging (absorb power from the network) and discharging (release power to the network).

2.5 Power Cable Parameters

Power flow in the SP network is provided via 11kV and 33kV overhead cables, 33/11kV, and 11/0.415kV transformers. The ratings and parameters of all cables and transformers employed were included in the steady-state analysis as provided to the PPA consultant in the DIGSILENT model. All connections and rated capacities were accepted current and sufficient to carry out an accurate simulation of power flow throughout the SP power grid.

2.6 Load Details

Peak generation output of 16,082kW was recorded on 12 December 2021 (11:00am) while the minimum in generation was recorded on 5 June 2022 (Time – 7:00pm) at 9,037kW. These values have been adopted as maximum and minimum loads respectively in this study. The maximum load of 16,082kW was used to simulate day loads while the minimum load of 9,037kW was used to simulate night loads.

As part of load assessments, an annual growth rate of two percent was applied to every year for a period of 10 years. Based on this, the projected maximum and minimum were calculated as show in the table below. Maximum (day load) and minimum (night load) demands for each of the years used in the study were applied to each load in the SP grid using the resultant scaling factor.

Table 2.2. Projected Maximum and Minimum 24-hour Load Profiles and Scaling Factors

Maximum Load Profiles				
Year	Time (Years)	Annual Growth Rate	Max Demand	Scaling Factor
2021	0	2%	16082	0
2025	4	2%	17408	1.082
2030	9	2%	19219	1.195
Minimum Load Profiles				
Year	Time (Years)	Annual Growth Rate	Max Demand	Scaling Factor
2021	0	2%	16082	0
2025	4	2%	17408	1.082
2030	9	2%	19219	1.195

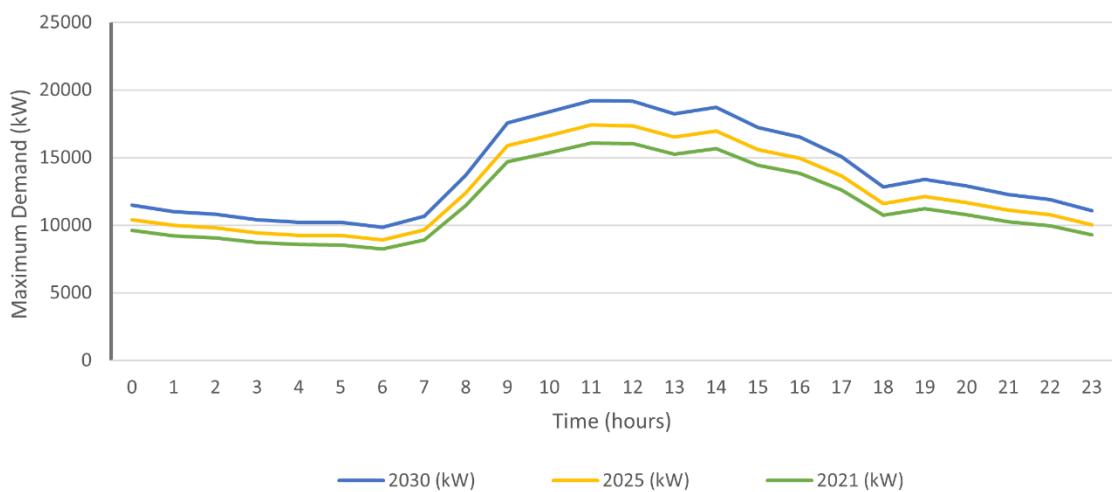


Figure 2.1. 24-hour Load Profile of the Expected Maximum Demands

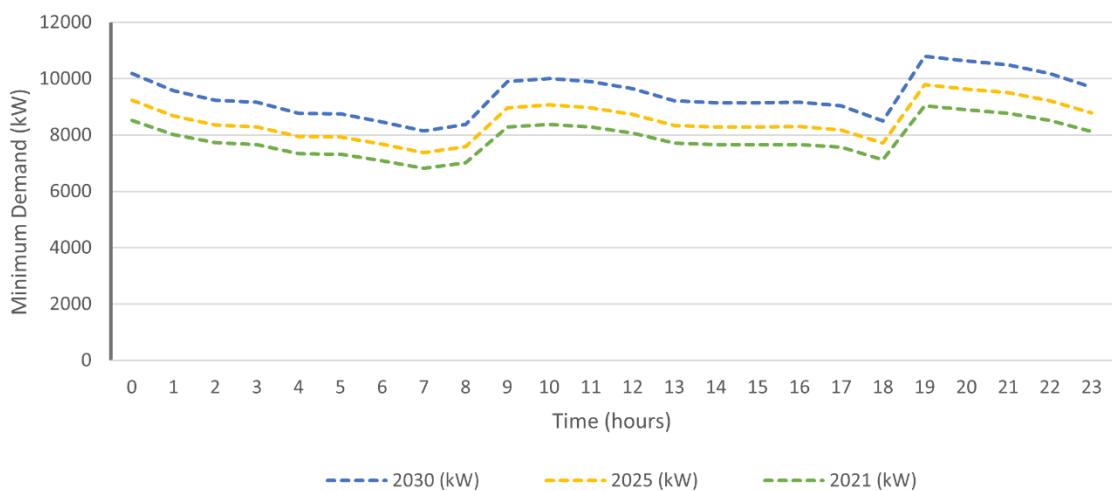


Figure 2.2. 24-hour Load Profile of the Expected Minimum Demands

The load summary at the distribution transformer level is provided in Table 2.21 for the year 2021, Table 2.22 for the year 2025, and Table 2.23 for the year 2040. Given the high loads expected over each 10-year interval, this table also shows transformer capacity upgrades required to ensure minimal overloads at the customer end.

Table 2.3. 2021 Load Details for Day & Night Operation

Location	Day 2021		Night 2021	
	MW	MVar	MW	MVar
1 Aekafo - Load	0.0690	0.0227	0.0388	0.0127
2 Barana 1 - Load	0.0655	0.0215	0.0368	0.0121
3 Bulkshop Storage - Load	0.1200	0.0394	0.0674	0.0222
4 Burns creek - Load	0.0545	0.0179	0.0306	0.0101
5 DC Park - Load	0.0200	0.0066	0.0112	0.0037
6 East Kolaa - Station Supply Load	0.1000	0.0329	0.0562	0.0185
7 General Load	0.2230	0.0733	0.1253	0.0412
8 Henderson Alligator - Load	0.0500	0.0164	0.0281	0.0092
9 Honiara - Station Supply Load	0.0300	0.0099	0.0169	0.0055
10 Kwaio Valley - Load	0.0810	0.0266	0.0455	0.0150
11 Lio Creek - Load	0.1000	0.0329	0.0562	0.0185
12 Lungga - Station Supply Load	0.0500	0.0164	0.0281	0.0092
13 Ngalimera - Load	0.0300	0.0099	0.0169	0.0055
14 PORTS - Load	0.2015	0.0662	0.1132	0.0372
15 Ranadi - Station Supply Load 1	0.1000	0.0329	0.0562	0.0185
16 Ranadi - Station Supply Load 2	0.1000	0.0329	0.0562	0.0185
17 Sopapera - Load	0.0148	0.0049	0.0083	0.0027
18 Station Supply Load 2	0.0500	0.0164	0.0281	0.0092
19 T# PG23 - Load	0.1913	0.0629	0.1075	0.0353
20 T# SINIS - Load	0.0765	0.0251	0.0430	0.0141
21 T# SP23 - Load	0.0765	0.0251	0.0430	0.0141
22 T001 Hibiscus Ave - Load	0.1278	0.0420	0.0718	0.0236
23 T002 PNG Chancerry - Load	0.1278	0.0420	0.0718	0.0236
24 T003 Lengakiki - Load	0.0737	0.0242	0.0414	0.0136
25 T004 Vavaya Ridge - Load	0.0600	0.0197	0.0337	0.0111
26 T005 Mbokonavera - Load	0.0283	0.0093	0.0159	0.0052
27 T007 Manusata - Load	0.0898	0.0295	0.0505	0.0166
28 T008 Mbuburu - Load	0.0509	0.0167	0.0286	0.0094
29 T009 Mbokon(SIWA) - Load	0.0821	0.0270	0.0461	0.0152
30 T009 Mbokon(SIWA) - Load	0.1000	0.0329	0.0562	0.0185
31 T010 Titinge Ridge - Load	0.0209	0.0069	0.0117	0.0039
32 T011 Huhuru - Load	0.1000	0.0329	0.0562	0.0185
33 T012 Ngosi - Load	0.0792	0.0260	0.0445	0.0146
34 T013 TasaheRidge - Load	0.1579	0.0519	0.0887	0.0292
35 T051 Mbokonavera Heights - Load	0.0625	0.0205	0.0351	0.0115
36 T052 Mamulele - Load	0.0540	0.0177	0.0303	0.0100
37 T052 Skyline - Load	0.0320	0.0105	0.0180	0.0059
38 T053 Tuvaruhu - Load	0.1500	0.0493	0.0843	0.0277
39 T054 Marble street - Load	0.0300	0.0099	0.0169	0.0055
40 T055 Vara Creek - Load	0.0205	0.0067	0.0115	0.0038

Location	Day 2021		Night 2021	
	MW	MVar	MW	MVar
41 T056 West Kola - Load	0.0541	0.0178	0.0304	0.0100
42 T057 FFA - Load	0.0252	0.0083	0.0142	0.0047
43 T058 Tanuli Ridge - Load	0.0772	0.0254	0.0434	0.0143
44 T059 Bahai Centre - Load	0.1411	0.0464	0.0793	0.0261
45 T060 East Kola - Load	0.0793	0.0261	0.0446	0.0147
46 T061 DCPcomp - Load	0.0353	0.0116	0.0199	0.0065
47 T062 Naha - Load	0.0875	0.0288	0.0492	0.0162
48 T063 Mambulu - Load	0.0284	0.0093	0.0160	0.0052
49 T064 Nazarine Church - Load	0.0167	0.0055	0.0094	0.0031
50 T065 Kombivatu - Load	0.0500	0.0164	0.0281	0.0092
51 T066 Green valley 1 - Load	0.0655	0.0215	0.0368	0.0121
52 T067 Green Valley 2 - Load	0.0655	0.0215	0.0368	0.0121
53 T068 Ferakusia - Load	0.0243	0.0080	0.0136	0.0045
54 T069 Africa Hill - Load	0.0150	0.0049	0.0084	0.0028
55 T071 Barana 2 - Load	0.0105	0.0035	0.0059	0.0019
56 T101 King Solomon Hotel - Load	0.1563	0.0514	0.0879	0.0289
57 T102 Telekom Exchange - Load	0.2274	0.0747	0.1278	0.0420
58 T103 Heritage - Load	0.1022	0.0336	0.0574	0.0189
59 T104 Secretariat - Load	0.1741	0.0572	0.0978	0.0321
60 T105 MOFT - Load	0.0938	0.0308	0.0527	0.0173
61 T106 SolPlaza - Load	0.0511	0.0168	0.0287	0.0094
62 T107 Coral Sea - Load	0.2500	0.0822	0.1405	0.0462
63 T108 Iron Bottom Sound - Load	0.2500	0.0822	0.1405	0.0462
64 T109 Rove - Load	0.2500	0.0822	0.1405	0.0462
65 T110 SIBC - Load	0.0750	0.0247	0.0421	0.0139
66 T151 ANZ Bank - Load	0.1252	0.0411	0.0703	0.0231
67 T152 Kua - Load	0.1549	0.0509	0.0871	0.0286
68 T153 Hyundai Mall - Load	0.1083	0.0356	0.0609	0.0200
69 T154 Central Plaza - Load	0.1542	0.0507	0.0866	0.0285
70 T155 Market - Load	0.0961	0.0316	0.0540	0.0177
71 T156 MID - Load	0.0731	0.0240	0.0411	0.0135
72 T157 Chinatown - Load	0.3007	0.0988	0.1690	0.0555
73 T158 H_Hotel - Load	0.0668	0.0220	0.0376	0.0123
74 T159 Koloale - Load	0.0731	0.0240	0.0411	0.0135
75 T160 Multipurpose Hall - Load	0.0925	0.0304	0.0520	0.0171
76 T161 MID Office - Load	0.1000	0.0329	0.0562	0.0185
77 T201 Anthony Saru - Load	0.2197	0.0722	0.1234	0.0406
78 T202 NPF Plaza - Load	0.0676	0.0222	0.0380	0.0125
79 T203 City Centre - Load	0.1194	0.0393	0.0671	0.0221
80 T204 Fox Street - Load	0.1295	0.0426	0.0728	0.0239
81 T205 Tongs Building - Load	0.1401	0.0461	0.0787	0.0259
82 T206 Tom Yu - Load	0.0855	0.0281	0.0481	0.0158
83 T207 Paliment House - Load	0.1437	0.0472	0.0807	0.0265
84 T251 CBSI - Load	0.3713	0.1220	0.2086	0.0686

Location	Day 2021		Night 2021	
	MW	MVar	MW	MVar
85 T252 Mendana Hotel - Load	0.2354	0.0774	0.1323	0.0435
86 T253 P. Boat Base - Load	0.0404	0.0133	0.0227	0.0075
87 T254 PORTS AUTH 1 - Load	0.2244	0.0738	0.1261	0.0415
88 T301 SP Staff - Load	0.0224	0.0074	0.0126	0.0041
89 T302 Dalgro - Load	0.0450	0.0148	0.0253	0.0083
90 T303 KG Farm - Load	0.0545	0.0179	0.0306	0.0101
91 T304 LKK KG - Load	0.0028	0.0009	0.0016	0.0005
92 T305 Capital Investment - Load	0.0133	0.0044	0.0075	0.0025
93 T351 Betikama - Load	0.0300	0.0099	0.0169	0.0055
94 T353 SIBC - Load	0.0225	0.0074	0.0126	0.0042
95 T354 St Josephs School - Load	0.0127	0.0042	0.0072	0.0024
96 T355 NA Centre - Load	0.0014	0.0004	0.0008	0.0003
97 T356 HNMS - Load	0.0023	0.0007	0.0013	0.0004
98 T357 Foxwood - Load	0.1000	0.0329	0.0562	0.0185
99 T359 Okea Mobile - Load	0.0011	0.0004	0.0006	0.0002
100 T360 Ngalibiu - Load	0.0148	0.0049	0.0083	0.0027
101 T361 Red Beach - Load	0.0200	0.0066	0.0112	0.0037
102 T362 Blackpost - Load	0.0500	0.0164	0.0281	0.0092
103 T401 Geokama - Load	0.0405	0.0133	0.0228	0.0075
104 T402 Panantina Campus - Load	0.0475	0.0156	0.0267	0.0088
105 T403 SIFF Office - Load	0.0318	0.0105	0.0179	0.0059
106 T404 KGVI School - Load	0.0141	0.0046	0.0079	0.0026
107 T405 Panantina Campus - Load	0.0475	0.0156	0.0267	0.0088
108 T449 Kanzai - Load	0.0373	0.0122	0.0209	0.0069
109 T451 Tongs/ANZ - Load	0.0430	0.0141	0.0242	0.0079
110 T452 S/SHEET STEEL - Load	0.0282	0.0093	0.0158	0.0052
111 T453 Panantina Zone - Load	0.0466	0.0153	0.0262	0.0086
112 T454 Tobacco - Load	0.1000	0.0329	0.0562	0.0185
113 T455 Ela Motor - Load	0.1195	0.0393	0.0671	0.0221
114 T456 Fielders - Load	0.5000	0.1643	0.2810	0.0923
115 T457 Panantina Plaza - Load	0.1876	0.0617	0.1054	0.0347
116 T458 J.Witness Panatina - Load	0.0419	0.0138	0.0235	0.0077
117 T459 Fisheries - Load	0.1169	0.0384	0.0657	0.0216
118 T460 Simitri - Load	0.0468	0.0154	0.0263	0.0086
119 T461 SINU Kukum Campus - Load	0.0111	0.0036	0.0062	0.0020
120 T462 Jackson Ridge - Load	0.0243	0.0080	0.0137	0.0045
121 T463 Kobito One - Load	0.0179	0.0059	0.0101	0.0033
122 T464 Gilbert Camp - Load	0.0690	0.0227	0.0388	0.0127
123 T465 Kwaimani Bldg - Load	0.1600	0.0526	0.0899	0.0296
124 T466 Vura 1 - Load	0.0655	0.0215	0.0368	0.0121
125 T467 Vura 2 - Load	0.0327	0.0108	0.0184	0.0060
126 T468 Bua - Load	0.0982	0.0323	0.0552	0.0181
127 T470 Central Hospital - Load	0.2236	0.0735	0.1257	0.0413
128 T471 Bred Bank - Load	0.1637	0.0538	0.0920	0.0302

Location	Day 2021		Night 2021	
	MW	MVar	MW	MVar
129 T472 Mbaranamba - Load	0.1000	0.0329	0.0562	0.0185
130 T473 SINU Res - Load	0.0111	0.0036	0.0062	0.0020
131 T475 SICHE Kukum Campus 2 - Load	0.2000	0.0657	0.1124	0.0369
132 T501 Island Enterprise - Load	0.1285	0.0422	0.0722	0.0237
133 T502 SolGreen - Load	0.0821	0.0270	0.0461	0.0152
134 T503 SolBrew - Load	0.3000	0.0986	0.1686	0.0554
135 T504 Szeba - Load	0.0667	0.0219	0.0375	0.0123
136 T505 Prime Products - Load	0.0961	0.0316	0.0540	0.0178
137 T506 Daisol - Load	0.1728	0.0568	0.0971	0.0319
138 T507 Top Timber - Load	0.0686	0.0225	0.0385	0.0127
139 T508 Fair Star - Load	0.1604	0.0527	0.0901	0.0296
140 T509 BOC Gases - Load	0.0757	0.0249	0.0425	0.0140
141 T510 Sol Rice - Load	0.1493	0.0491	0.0839	0.0276
142 T511 Soap Factory - Load	0.1139	0.0375	0.0640	0.0210
143 T513 Top Timber 2 - Load	0.0686	0.0225	0.0385	0.0127
144 T551 Swim - Load	0.0023	0.0007	0.0013	0.0004
145 T601 Kakabona - Load	0.2000	0.0657	0.1124	0.0369
146 T602 Training Yard - Load	0.0250	0.0082	0.0140	0.0046
147 T603 DonBosco - Load	0.0500	0.0164	0.0281	0.0092
148 T604 NDP - Load	0.1000	0.0329	0.0562	0.0185
149 T605 GBR - Load	0.1200	0.0394	0.0674	0.0222
150 T606 Domestic Terminal - Load	0.1500	0.0493	0.0843	0.0277
151 T607 International Terminal - Load	0.2500	0.0822	0.1405	0.0462
152 T608 SPO Henderson - Load	0.0200	0.0066	0.0112	0.0037
153 T609 Chengs - Load	0.0200	0.0066	0.0112	0.0037
154 T610 Aviation Dme Stn - Load	0.0300	0.0099	0.0169	0.0055
155 T610 Aviation Dme Stn - Load	0.0240	0.0079	0.0135	0.0044
156 T611 Cross Road - Load	0.1000	0.0329	0.0562	0.0185
157 T612 SolStar - Load	0.0500	0.0164	0.0281	0.0092
158 T613 Cema Lungga - Load	0.1000	0.0329	0.0562	0.0185
159 T614 SDA MPH - Load	0.0125	0.0041	0.0070	0.0023
160 T615 Lungga Indust. Site - Load	0.1800	0.0592	0.1011	0.0332
161 T616 Markwarth - Load	0.0500	0.0164	0.0281	0.0092
162 T617 AJ City Load	0.0783	0.0257	0.0440	0.0145
163 T617 Henderson Court Load	0.2000	0.0657	0.1124	0.0369
164 T701 01 Bus Stop - Load	0.1529	0.0503	0.0859	0.0282
165 T702 W/River Water Pump - Load	0.0000	0.0000	0.0000	0.0000
166 T703 Home Finance - Load	0.0282	0.0093	0.0158	0.0052
167 T704 Tasahe B - Load	0.0186	0.0061	0.0105	0.0034
168 T705 Taubage - Load	0.0282	0.0093	0.0158	0.0052
169 T706 Chlorine Plant - Load	0.0200	0.0066	0.0112	0.0037
170 T707 Satsol - Load	0.0108	0.0036	0.0061	0.0020
171 T708 Kongulai Water Pump - Load	0.1902	0.0625	0.1069	0.0351

Location	Day 2021		Night 2021	
	MW	MVar	MW	MVar
172 T709 Bishop Dale - Load	0.1500	0.0493	0.0843	0.0277
173 T710 Tavio Ridge - Load	0.0918	0.0302	0.0516	0.0170
174 T711 Tinge Pump - Load	0.1029	0.0338	0.0578	0.0190
175 T712 7Up - Load	0.1000	0.0329	0.0562	0.0185
176 T712 Tinge-Hatanga - Load	0.1000	0.0329	0.0562	0.0185
177 T714 Solomon Star - Load	0.0108	0.0036	0.0061	0.0020
178 T716 Kongulai - Load	0.0060	0.0020	0.0034	0.0011
179 Vutu - Load	0.0300	0.0099	0.0169	0.0055
Total Load	16.0823	5.2860	9.0372	2.9704

Table 2.4. 2025 Load Details for Day & Night Operation

Name	Day 2025		Night 2025	
	MW	MVar	MW	MVar
1 Aekafo - Load	0.0747	0.0245	0.0420	0.0138
2 Barana 1 - Load	0.0709	0.0233	0.0398	0.0131
3 Bulkshop Storage - Load	0.1298	0.0427	0.0730	0.0240
4 Burns creek - Load	0.0590	0.0194	0.0331	0.0109
5 DC Park - Load	0.0216	0.0071	0.0122	0.0040
6 East Kolaa - Station Supply Load	0.1082	0.0356	0.0608	0.0200
7 General Load	0.2413	0.0793	0.1356	0.0446
8 Henderson Alligator - Load	0.0541	0.0178	0.0304	0.0100
9 Honiara - Station Supply Load	0.0325	0.0107	0.0182	0.0060
10 Kwaio Valley - Load	0.0876	0.0288	0.0493	0.0162
11 Lio Creek - Load	0.1082	0.0356	0.0608	0.0200
12 Lungga - Station Supply Load	0.0541	0.0178	0.0304	0.0100
13 Ngalimera - Load	0.0325	0.0107	0.0182	0.0060
14 PORTS - Load	0.2180	0.0717	0.1226	0.0403
15 Ranadi - Station Supply Load 1	0.1082	0.0356	0.0608	0.0200
16 Ranadi - Station Supply Load 2	0.1082	0.0356	0.0608	0.0200
17 Sopapera - Load	0.0161	0.0053	0.0090	0.0030
18 Station Supply Load 2	0.0541	0.0178	0.0304	0.0100
19 T# PG23 - Load	0.2070	0.0680	0.1164	0.0382
20 T# SINIS - Load	0.0828	0.0272	0.0465	0.0153
21 T# SP23 - Load	0.0828	0.0272	0.0465	0.0153
22 T001 Hibiscus Ave - Load	0.1382	0.0454	0.0777	0.0255
23 T002 PNG Chancerry - Load	0.1382	0.0454	0.0777	0.0255
24 T003 Lengakiki - Load	0.0798	0.0262	0.0448	0.0147
25 T004 Vavaya Ridge - Load	0.0649	0.0213	0.0365	0.0120
26 T005 Mbokonavera - Load	0.0306	0.0101	0.0172	0.0057
27 T007 Manusata - Load	0.0972	0.0319	0.0546	0.0180
28 T008 Mbuburu - Load	0.0551	0.0181	0.0310	0.0102
29 T009 Mbokon(SIWA) - Load	0.0888	0.0292	0.0499	0.0164

	Name	Day 2025		Night 2025	
		MW	MVar	MW	MVar
30	T009 Mbokon(SIWA) - Load	0.1082	0.0356	0.0608	0.0200
31	T010 Titinge Ridge - Load	0.0226	0.0074	0.0127	0.0042
32	T011 Huhuru - Load	0.1082	0.0356	0.0608	0.0200
33	T012 Ngosi - Load	0.0856	0.0282	0.0481	0.0158
34	T013 TasaheRidge - Load	0.1708	0.0562	0.0960	0.0316
35	T051 Mbokonavera Heights - Load	0.0676	0.0222	0.0380	0.0125
36	T052 Mamulele - Load	0.0584	0.0192	0.0328	0.0108
37	T052 Skyline - Load	0.0346	0.0114	0.0195	0.0064
38	T053 Tuvaruhu - Load	0.1623	0.0533	0.0912	0.0300
39	T054 Marble street - Load	0.0325	0.0107	0.0182	0.0060
40	T055 Vara Creek - Load	0.0222	0.0073	0.0125	0.0041
41	T056 West Kola - Load	0.0585	0.0192	0.0329	0.0108
42	T057 FFA - Load	0.0273	0.0090	0.0153	0.0050
43	T058 Tanuli Ridge - Load	0.0835	0.0274	0.0469	0.0154
44	T059 Bahai Centre - Load	0.1527	0.0502	0.0858	0.0282
45	T060 East Kola - Load	0.0858	0.0282	0.0482	0.0159
46	T061 DCPcomp - Load	0.0382	0.0126	0.0215	0.0071
47	T062 Naha - Load	0.0947	0.0311	0.0532	0.0175
48	T063 Mambulu - Load	0.0307	0.0101	0.0173	0.0057
49	T064 Nazarine Church - Load	0.0181	0.0059	0.0102	0.0033
50	T065 Kombivatu - Load	0.0541	0.0178	0.0304	0.0100
51	T066 Green valley 1 - Load	0.0709	0.0233	0.0398	0.0131
52	T067 Green Valley 2 - Load	0.0709	0.0233	0.0398	0.0131
53	T068 Ferakusia - Load	0.0262	0.0086	0.0148	0.0048
54	T069 Africa Hill - Load	0.0162	0.0053	0.0091	0.0030
55	T071 Barana 2 - Load	0.0114	0.0037	0.0064	0.0021
56	T101 King Solomon Hotel - Load	0.1692	0.0556	0.0951	0.0313
57	T102 Telekom Exchange - Load	0.2460	0.0809	0.1383	0.0455
58	T103 Heritage - Load	0.1106	0.0363	0.0622	0.0204
59	T104 Secretariat - Load	0.1883	0.0619	0.1059	0.0348
60	T105 MOFT - Load	0.1015	0.0334	0.0571	0.0188
61	T106 SolPlaza - Load	0.0553	0.0182	0.0311	0.0102
62	T107 Coral Sea - Load	0.2705	0.0889	0.1521	0.0500
63	T108 Iron Bottom Sound - Load	0.2705	0.0889	0.1521	0.0500
64	T109 Rove - Load	0.2705	0.0889	0.1521	0.0500
65	T110 SIBC - Load	0.0812	0.0267	0.0456	0.0150
66	T151 ANZ Bank - Load	0.1354	0.0445	0.0761	0.0250
67	T152 Kua - Load	0.1676	0.0551	0.0942	0.0310
68	T153 Hyundai Mall - Load	0.1172	0.0385	0.0659	0.0217
69	T154 Central Plaza - Load	0.1668	0.0548	0.0938	0.0308
70	T155 Market - Load	0.1039	0.0342	0.0584	0.0192
71	T156 MID - Load	0.0791	0.0260	0.0444	0.0146
72	T157 Chinatown - Load	0.3253	0.1069	0.1829	0.0601
73	T158 H_Hotel - Load	0.0723	0.0238	0.0407	0.0134

	Name	Day 2025		Night 2025	
		MW	MVar	MW	MVar
74	T159 Koloale - Load	0.0791	0.0260	0.0444	0.0146
75	T160 Multipurpose Hall - Load	0.1001	0.0329	0.0563	0.0185
76	T161 MID Office - Load	0.1082	0.0356	0.0608	0.0200
77	T201 Anthony Saru - Load	0.2377	0.0781	0.1336	0.0439
78	T202 NPF Plaza - Load	0.0731	0.0240	0.0411	0.0135
79	T203 City Centre - Load	0.1292	0.0425	0.0727	0.0239
80	T204 Fox Street - Load	0.1401	0.0461	0.0788	0.0259
81	T205 Tongs Building - Load	0.1516	0.0498	0.0852	0.0280
82	T206 Tom Yu - Load	0.0925	0.0304	0.0520	0.0171
83	T207 Paliment House - Load	0.1554	0.0511	0.0874	0.0287
84	T251 CBSI - Load	0.4017	0.1320	0.2258	0.0742
85	T252 Mendana Hotel - Load	0.2547	0.0837	0.1432	0.0471
86	T253 P. Boat Base - Load	0.0437	0.0144	0.0246	0.0081
87	T254 PORTS AUTH 1 - Load	0.2428	0.0798	0.1365	0.0449
88	T301 SP Staff - Load	0.0242	0.0080	0.0136	0.0045
89	T302 Dalgro - Load	0.0487	0.0160	0.0274	0.0090
90	T303 KG Farm - Load	0.0590	0.0194	0.0331	0.0109
91	T304 LKK KG - Load	0.0030	0.0010	0.0017	0.0006
92	T305 Capital Investment - Load	0.0144	0.0047	0.0081	0.0027
93	T351 Betikama - Load	0.0325	0.0107	0.0182	0.0060
94	T353 SIBC - Load	0.0243	0.0080	0.0137	0.0045
95	T354 St Josephs School - Load	0.0138	0.0045	0.0077	0.0025
96	T355 NA Centre - Load	0.0015	0.0005	0.0008	0.0003
97	T356 HNMS - Load	0.0025	0.0008	0.0014	0.0005
98	T357 Foxwood - Load	0.1082	0.0356	0.0608	0.0200
99	T359 Okea Mobile - Load	0.0012	0.0004	0.0007	0.0002
100	T360 Ngilibiu - Load	0.0161	0.0053	0.0090	0.0030
101	T361 Red Beach - Load	0.0216	0.0071	0.0122	0.0040
102	T362 Blackpost - Load	0.0541	0.0178	0.0304	0.0100
103	T401 Geokama - Load	0.0439	0.0144	0.0247	0.0081
104	T402 Panantina Campus - Load	0.0514	0.0169	0.0289	0.0095
105	T403 SIFF Office - Load	0.0344	0.0113	0.0194	0.0064
106	T404 KGVI School - Load	0.0152	0.0050	0.0086	0.0028
107	T405 Panantina Campus - Load	0.0514	0.0169	0.0289	0.0095
108	T449 Kanzai - Load	0.0403	0.0133	0.0227	0.0075
109	T451 Tongs/ANZ - Load	0.0465	0.0153	0.0261	0.0086
110	T452 S/SHEET STEEL - Load	0.0305	0.0100	0.0171	0.0056
111	T453 Panantina Zone - Load	0.0504	0.0166	0.0284	0.0093
112	T454 Tobacco - Load	0.1082	0.0356	0.0608	0.0200
113	T455 Ela Motor - Load	0.1293	0.0425	0.0727	0.0239
114	T456 Fielders - Load	0.5410	0.1778	0.3041	0.1000
115	T457 Panantina Plaza - Load	0.2030	0.0667	0.1141	0.0375
116	T458 J.Witness Panatina - Load	0.0453	0.0149	0.0255	0.0084
117	T459 Fisheries - Load	0.1264	0.0416	0.0711	0.0234

	Name	Day 2025		Night 2025	
		MW	MVar	MW	MVar
118	T460 Simitri - Load	0.0507	0.0167	0.0285	0.0094
119	T461 SINU Kukum Campus - Load	0.0120	0.0039	0.0067	0.0022
120	T462 Jackson Ridge - Load	0.0263	0.0086	0.0148	0.0049
121	T463 Kobito One - Load	0.0194	0.0064	0.0109	0.0036
122	T464 Gilbert Camp - Load	0.0747	0.0245	0.0420	0.0138
123	T465 Kwaimani Bldg - Load	0.1731	0.0569	0.0973	0.0320
124	T466 Vura 1 - Load	0.0709	0.0233	0.0398	0.0131
125	T467 Vura 2 - Load	0.0354	0.0116	0.0199	0.0065
126	T468 Bua - Load	0.1063	0.0349	0.0597	0.0196
127	T470 Central Hospital - Load	0.2420	0.0795	0.1360	0.0447
128	T471 Bred Bank - Load	0.1771	0.0582	0.0996	0.0327
129	T472 Mbaranamba - Load	0.1082	0.0356	0.0608	0.0200
130	T473 SINU Res - Load	0.0120	0.0039	0.0067	0.0022
131	T475 SICHE Kukum Campus 2 - Load	0.2164	0.0711	0.1217	0.0400
132	T501 Island Enterprise - Load	0.1391	0.0457	0.0782	0.0257
133	T502 SolGreen - Load	0.0888	0.0292	0.0499	0.0164
134	T503 SolBrew - Load	0.3246	0.1067	0.1825	0.0600
135	T504 Szeba - Load	0.0722	0.0237	0.0406	0.0133
136	T505 Prime Products - Load	0.1040	0.0342	0.0585	0.0192
137	T506 Daisol - Load	0.1869	0.0614	0.1051	0.0345
138	T507 Top Timber - Load	0.0742	0.0244	0.0417	0.0137
139	T508 Fair Star - Load	0.1736	0.0570	0.0976	0.0321
140	T509 BOC Gases - Load	0.0819	0.0269	0.0460	0.0151
141	T510 Sol Rice - Load	0.1615	0.0531	0.0908	0.0298
142	T511 Soap Factory - Load	0.1233	0.0405	0.0693	0.0228
143	T513 Top Timber 2 - Load	0.0742	0.0244	0.0417	0.0137
144	T551 Swim - Load	0.0025	0.0008	0.0014	0.0005
145	T601 Kakabona - Load	0.2164	0.0711	0.1217	0.0400
146	T602 Training Yard - Load	0.0271	0.0089	0.0152	0.0050
147	T603 DonBosco - Load	0.0541	0.0178	0.0304	0.0100
148	T604 NDP - Load	0.1082	0.0356	0.0608	0.0200
149	T605 GBR - Load	0.1298	0.0427	0.0730	0.0240
150	T606 Domestic Terminal - Load	0.1623	0.0533	0.0912	0.0300
151	T607 International Terminal - Load	0.2705	0.0889	0.1521	0.0500
152	T608 SPO Henderson - Load	0.0216	0.0071	0.0122	0.0040
153	T609 Chengs - Load	0.0216	0.0071	0.0122	0.0040
154	T610 Aviation Dme Stn - Load	0.0325	0.0107	0.0182	0.0060
155	T610 Aviation Dme Stn - Load	0.0260	0.0085	0.0146	0.0048
156	T611 Cross Road - Load	0.1082	0.0356	0.0608	0.0200
157	T612 SolStar - Load	0.0541	0.0178	0.0304	0.0100
158	T613 Cema Lungga - Load	0.1082	0.0356	0.0608	0.0200
159	T614 SDA MPH - Load	0.0135	0.0044	0.0076	0.0025
160	T615 Lungga Indust. Site - Load	0.1948	0.0640	0.1095	0.0360

	Name	Day 2025		Night 2025	
		MW	MVar	MW	MVar
161	T616 Markwarth - Load	0.0541	0.0178	0.0304	0.0100
162	T617 AJ City Load	0.0847	0.0278	0.0476	0.0157
163	T617 Henderson Court Load	0.2164	0.0711	0.1217	0.0400
164	T701 01 Bus Stop - Load	0.1655	0.0544	0.0930	0.0306
165	T702 W/River Water Pump - Load	0.0000	0.0000	0.0000	0.0000
166	T703 Home Finance - Load	0.0305	0.0100	0.0171	0.0056
167	T704 Tasahe B - Load	0.0202	0.0066	0.0113	0.0037
168	T705 Taubage - Load	0.0305	0.0100	0.0171	0.0056
169	T706 Chlorine Plant - Load	0.0216	0.0071	0.0122	0.0040
170	T707 Satsol - Load	0.0117	0.0038	0.0066	0.0022
171	T708 Kongulai Water Pump - Load	0.2058	0.0676	0.1157	0.0380
172	T709 Bishop Dale - Load	0.1623	0.0533	0.0912	0.0300
173	T710 Tavio Ridge - Load	0.0993	0.0326	0.0558	0.0184
174	T711 Tinge Pump - Load	0.1113	0.0366	0.0626	0.0206
175	T712 7Up - Load	0.1082	0.0356	0.0608	0.0200
176	T712 Tinge-Hatanga - Load	0.1082	0.0356	0.0608	0.0200
177	T714 Solomon Star - Load	0.0117	0.0038	0.0066	0.0022
178	T716 Kongulai - Load	0.0065	0.0021	0.0036	0.0012
179	Vutu - Load	0.0325	0.0107	0.0182	0.0060
Total Load		17.4011	5.7195	9.7821	3.2152

Table 2.5. 2030 Load Details for Day & Night Operation

	Location	Day 2030		Night 2030	
		MW	MVar	MW	MVar
1	Aekafo - Load	0.0824	0.0271	0.0463	0.0152
2	Barana 1 - Load	0.0783	0.0257	0.0440	0.0145
3	Bulkshop Storage - Load	0.1434	0.0471	0.0806	0.0265
4	Burnscreek - Load	0.0651	0.0214	0.0366	0.0120
5	DC Park - Load	0.0239	0.0079	0.0134	0.0044
6	East Kolaa - Station Supply Load	0.1195	0.0393	0.0672	0.0221
7	General Load	0.2665	0.0876	0.1498	0.0492
8	Henderson Alligator - Load	0.0598	0.0196	0.0336	0.0110
9	Honiara - Station Supply Load	0.0359	0.0118	0.0201	0.0066
10	Kwaio Valley - Load	0.0968	0.0318	0.0544	0.0179
11	Lio Creek - Load	0.1195	0.0393	0.0672	0.0221
12	Lungga - Station Supply Load	0.0598	0.0196	0.0336	0.0110
13	Ngalimera - Load	0.0359	0.0118	0.0201	0.0066
14	PORTS - Load	0.2408	0.0791	0.1353	0.0445
15	Ranadi - Station Supply Load 1	0.1195	0.0393	0.0672	0.0221
16	Ranadi - Station Supply Load 2	0.1195	0.0393	0.0672	0.0221
17	Sopapera - Load	0.0177	0.0058	0.0100	0.0033
18	Station Supply Load 2	0.0598	0.0196	0.0336	0.0110
19	T# PG23 - Load	0.2286	0.0751	0.1285	0.0422

Location	Day 2030		Night 2030	
	MW	MVar	MW	MVar
20 T# SINIS - Load	0.0914	0.0300	0.0514	0.0169
21 T# SP23 - Load	0.0914	0.0300	0.0514	0.0169
22 T001 Hibiscus Ave - Load	0.1527	0.0502	0.0858	0.0282
23 T002 PNG Chancerry - Load	0.1527	0.0502	0.0858	0.0282
24 T003 Lengakiki - Load	0.0881	0.0290	0.0495	0.0163
25 T004 Vavaya Ridge - Load	0.0717	0.0236	0.0403	0.0132
26 T005 Mbokonavera - Load	0.0338	0.0111	0.0190	0.0062
27 T007 Manusata - Load	0.1073	0.0353	0.0603	0.0198
28 T008 Mbuburu - Load	0.0608	0.0200	0.0342	0.0112
29 T009 Mbokon(SIWA) - Load	0.0981	0.0322	0.0551	0.0181
30 T009 Mbokon(SIWA) - Load	0.1195	0.0393	0.0672	0.0221
31 T010 Titinge Ridge - Load	0.0250	0.0082	0.0140	0.0046
32 T011 Huhuru - Load	0.1195	0.0393	0.0672	0.0221
33 T012 Ngosi - Load	0.0946	0.0311	0.0532	0.0175
34 T013 TasaheRidge - Load	0.1887	0.0620	0.1060	0.0349
35 T051 Mbokonavera Heights - Load	0.0746	0.0245	0.0419	0.0138
36 T052 Mamulele - Load	0.0645	0.0212	0.0363	0.0119
37 T052 Skyline - Load	0.0383	0.0126	0.0215	0.0071
38 T053 Tuvaruhu - Load	0.1793	0.0589	0.1007	0.0331
39 T054 Marble street - Load	0.0359	0.0118	0.0201	0.0066
40 T055 Vara Creek - Load	0.0245	0.0081	0.0138	0.0045
41 T056 West Kola - Load	0.0647	0.0213	0.0363	0.0119
42 T057 FFA - Load	0.0301	0.0099	0.0169	0.0056
43 T058 Tanuli Ridge - Load	0.0922	0.0303	0.0518	0.0170
44 T059 Bahai Centre - Load	0.1686	0.0554	0.0948	0.0311
45 T060 East Kola - Load	0.0948	0.0312	0.0533	0.0175
46 T061 DCPcomp - Load	0.0422	0.0139	0.0237	0.0078
47 T062 Naha - Load	0.1046	0.0344	0.0588	0.0193
48 T063 Mambulu - Load	0.0339	0.0112	0.0191	0.0063
49 T064 Nazarine Church - Load	0.0200	0.0066	0.0112	0.0037
50 T065 Kombivatu - Load	0.0598	0.0196	0.0336	0.0110
51 T066 Green valley 1 - Load	0.0783	0.0257	0.0440	0.0145
52 T067 Green Valley 2 - Load	0.0783	0.0257	0.0440	0.0145
53 T068 Ferakusia - Load	0.0290	0.0095	0.0163	0.0054
54 T069 Africa Hill - Load	0.0179	0.0059	0.0101	0.0033
55 T071 Barana 2 - Load	0.0125	0.0041	0.0071	0.0023
56 T101 King Solomon Hotel - Load	0.1868	0.0614	0.1050	0.0345
57 T102 Telekom Exchange - Load	0.2717	0.0893	0.1527	0.0502
58 T103 Heritage - Load	0.1221	0.0401	0.0686	0.0226
59 T104 Secretariat - Load	0.2080	0.0684	0.1169	0.0384
60 T105 MOFT - Load	0.1121	0.0368	0.0630	0.0207
61 T106 SolPlaza - Load	0.0611	0.0201	0.0343	0.0113
62 T107 Coral Sea - Load	0.2988	0.0982	0.1679	0.0552

Location	Day 2030		Night 2030	
	MW	MVar	MW	MVar
63 T108 Iron Bottom Sound - Load	0.2988	0.0982	0.1679	0.0552
64 T109 Rove - Load	0.2988	0.0982	0.1679	0.0552
65 T110 SIBC - Load	0.0896	0.0295	0.0504	0.0166
66 T151 ANZ Bank - Load	0.1496	0.0492	0.0841	0.0276
67 T152 Kua - Load	0.1851	0.0608	0.1040	0.0342
68 T153 Hyundai Mall - Load	0.1295	0.0426	0.0728	0.0239
69 T154 Central Plaza - Load	0.1842	0.0606	0.1035	0.0340
70 T155 Market - Load	0.1148	0.0377	0.0645	0.0212
71 T156 MID - Load	0.0873	0.0287	0.0491	0.0161
72 T157 Chinatown - Load	0.3593	0.1181	0.2019	0.0664
73 T158 H_Hotel - Load	0.0799	0.0263	0.0449	0.0148
74 T159 Koloale - Load	0.0873	0.0287	0.0491	0.0161
75 T160 Multipurpose Hall - Load	0.1105	0.0363	0.0621	0.0204
76 T161 MID Office - Load	0.1195	0.0393	0.0672	0.0221
77 T201 Anthony Saru - Load	0.2625	0.0863	0.1475	0.0485
78 T202 NPF Plaza - Load	0.0808	0.0266	0.0454	0.0149
79 T203 City Centre - Load	0.1427	0.0469	0.0802	0.0264
80 T204 Fox Street - Load	0.1548	0.0509	0.0870	0.0286
81 T205 Tongs Building - Load	0.1675	0.0550	0.0941	0.0309
82 T206 Tom Yu - Load	0.1022	0.0336	0.0574	0.0189
83 T207 Paliment House - Load	0.1717	0.0564	0.0965	0.0317
84 T251 CBSI - Load	0.4437	0.1458	0.2493	0.0819
85 T252 Mendana Hotel - Load	0.2813	0.0924	0.1581	0.0520
86 T253 P. Boat Base - Load	0.0483	0.0159	0.0271	0.0089
87 T254 PORTS AUTH 1 - Load	0.2682	0.0882	0.1507	0.0495
88 T301 SP Staff - Load	0.0267	0.0088	0.0150	0.0049
89 T302 Dalgro - Load	0.0538	0.0177	0.0302	0.0099
90 T303 KG Farm - Load	0.0651	0.0214	0.0366	0.0120
91 T304 LKK KG - Load	0.0033	0.0011	0.0019	0.0006
92 T305 Capital Investment - Load	0.0159	0.0052	0.0090	0.0029
93 T351 Betikama - Load	0.0359	0.0118	0.0201	0.0066
94 T353 SIBC - Load	0.0269	0.0088	0.0151	0.0050
95 T354 St Josephs School - Load	0.0152	0.0050	0.0085	0.0028
96 T355 NA Centre - Load	0.0016	0.0005	0.0009	0.0003
97 T356 HNMS - Load	0.0027	0.0009	0.0015	0.0005
98 T357 Foxwood - Load	0.1195	0.0393	0.0672	0.0221
99 T359 Okea Mobile - Load	0.0013	0.0004	0.0007	0.0002
100 T360 Ngalibiu - Load	0.0177	0.0058	0.0100	0.0033
101 T361 Red Beach - Load	0.0239	0.0079	0.0134	0.0044
102 T362 Blackpost - Load	0.0598	0.0196	0.0336	0.0110
103 T401 Geokama - Load	0.0484	0.0159	0.0272	0.0089
104 T402 Panantina Campus - Load	0.0568	0.0187	0.0319	0.0105
105 T403 SIFF Office - Load	0.0380	0.0125	0.0214	0.0070
106 T404 KGVI School - Load	0.0168	0.0055	0.0094	0.0031

Location	Day 2030		Night 2030	
	MW	MVar	MW	MVar
107 T405 Panantina Campus - Load	0.0568	0.0187	0.0319	0.0105
108 T449 Kanzai - Load	0.0445	0.0146	0.0250	0.0082
109 T451 Tongs/ANZ - Load	0.0514	0.0169	0.0289	0.0095
110 T452 S/SHEET STEEL - Load	0.0337	0.0111	0.0189	0.0062
111 T453 Panantina Zone - Load	0.0557	0.0183	0.0313	0.0103
112 T454 Tobacco - Load	0.1195	0.0393	0.0672	0.0221
113 T455 Ela Motor - Load	0.1428	0.0469	0.0802	0.0264
114 T456 Fielders - Load	0.5975	0.1964	0.3358	0.1104
115 T457 Panantina Plaza - Load	0.2242	0.0737	0.1260	0.0414
116 T458 J.Witness Panatina - Load	0.0500	0.0164	0.0281	0.0092
117 T459 Fisheries - Load	0.1396	0.0459	0.0785	0.0258
118 T460 Simitri - Load	0.0560	0.0184	0.0314	0.0103
119 T461 SINU Kukum Campus - Load	0.0132	0.0043	0.0074	0.0024
120 T462 Jackson Ridge - Load	0.0290	0.0095	0.0163	0.0054
121 T463 Kobito One - Load	0.0214	0.0070	0.0120	0.0040
122 T464 Gilbert Camp - Load	0.0824	0.0271	0.0463	0.0152
123 T465 Kwaimani Bldg - Load	0.1912	0.0628	0.1074	0.0353
124 T466 Vura 1 - Load	0.0783	0.0257	0.0440	0.0145
125 T467 Vura 2 - Load	0.0391	0.0129	0.0220	0.0072
126 T468 Bua - Load	0.1174	0.0386	0.0660	0.0217
127 T470 Central Hospital - Load	0.2673	0.0878	0.1502	0.0494
128 T471 Bred Bank - Load	0.1956	0.0643	0.1099	0.0361
129 T472 Mbaranamba - Load	0.1195	0.0393	0.0672	0.0221
130 T473 SINU Res - Load	0.0132	0.0043	0.0074	0.0024
131 T475 SICHE Kukum Campus 2 - Load	0.2390	0.0786	0.1343	0.0441
132 T501 Island Enterprise - Load	0.1536	0.0505	0.0863	0.0284
133 T502 SolGreen - Load	0.0981	0.0322	0.0551	0.0181
134 T503 SolBrew - Load	0.3585	0.1178	0.2015	0.0662
135 T504 Szeba - Load	0.0797	0.0262	0.0448	0.0147
136 T505 Prime Products - Load	0.1149	0.0378	0.0646	0.0212
137 T506 Daisol - Load	0.2065	0.0679	0.1160	0.0381
138 T507 Top Timber - Load	0.0820	0.0269	0.0461	0.0151
139 T508 Fair Star - Load	0.1917	0.0630	0.1077	0.0354
140 T509 BOC Gases - Load	0.0904	0.0297	0.0508	0.0167
141 T510 Sol Rice - Load	0.1784	0.0586	0.1002	0.0330
142 T511 Soap Factory - Load	0.1362	0.0448	0.0765	0.0252
143 T513 Top Timber 2 - Load	0.0820	0.0269	0.0461	0.0151
144 T551 Swim - Load	0.0027	0.0009	0.0015	0.0005
145 T601 Kakabona - Load	0.2390	0.0786	0.1343	0.0441
146 T602 Training Yard - Load	0.0299	0.0098	0.0168	0.0055
147 T603 DonBosco - Load	0.0598	0.0196	0.0336	0.0110
148 T604 NDP - Load	0.1195	0.0393	0.0672	0.0221
149 T605 GBR - Load	0.1434	0.0471	0.0806	0.0265

Location	Day 2030		Night 2030	
	MW	MVar	MW	MVar
150 T606 Domestic Terminal - Load	0.1793	0.0589	0.1007	0.0331
151 T607 International Terminal - Load	0.2988	0.0982	0.1679	0.0552
152 T608 SPO Henderson - Load	0.0239	0.0079	0.0134	0.0044
153 T609 Chengs - Load	0.0239	0.0079	0.0134	0.0044
154 T610 Aviation Dme Stn - Load	0.0359	0.0118	0.0201	0.0066
155 T610 Aviation Dme Stn - Load	0.0287	0.0094	0.0161	0.0053
156 T611 Cross Road - Load	0.1195	0.0393	0.0672	0.0221
157 T612 SolStar - Load	0.0598	0.0196	0.0336	0.0110
158 T613 Cema Lungga - Load	0.1195	0.0393	0.0672	0.0221
159 T614 SDA MPH - Load	0.0149	0.0049	0.0084	0.0028
160 T615 Lungga Indust. Site - Load	0.2151	0.0707	0.1209	0.0397
161 T616 Markwarth - Load	0.0598	0.0196	0.0336	0.0110
162 T617 AJ City Load	0.0936	0.0308	0.0526	0.0173
163 T617 Henderson Court Load	0.2390	0.0786	0.1343	0.0441
164 T701 01 Bus Stop - Load	0.1828	0.0601	0.1027	0.0338
165 T702 W/River Water Pump - Load	0.0000	0.0000	0.0000	0.0000
166 T703 Home Finance - Load	0.0336	0.0111	0.0189	0.0062
167 T704 Tasahe B - Load	0.0223	0.0073	0.0125	0.0041
168 T705 Taubage - Load	0.0336	0.0111	0.0189	0.0062
169 T706 Chlorine Plant - Load	0.0239	0.0079	0.0134	0.0044
170 T707 Satsol - Load	0.0129	0.0042	0.0073	0.0024
171 T708 Kongulai Water Pump - Load	0.2273	0.0747	0.1277	0.0420
172 T709 Bishop Dale - Load	0.1793	0.0589	0.1007	0.0331
173 T710 Tavio Ridge - Load	0.1097	0.0361	0.0616	0.0203
174 T711 Tinge Pump - Load	0.1229	0.0404	0.0691	0.0227
175 T712 7Up - Load	0.1195	0.0393	0.0672	0.0221
176 T712 Tinge-Hatanga - Load	0.1195	0.0393	0.0672	0.0221
177 T714 Solomon Star - Load	0.0129	0.0042	0.0073	0.0024
178 T716 Kongulai - Load	0.0072	0.0024	0.0040	0.0013
179 Vutu - Load	0.0359	0.0118	0.0201	0.0066
Total Load	19.2184	6.3168	10.8003	3.5499

2.7 System Balances

The summary of generation and load balances for the completed models is presented in Table 2.24 for the year 2021, Table 2.25 for the year 2025, and Table 2.26 for the year 2030. These contain the maximum and minimum loading conditions for night and day operations. The BESS and Generator 5 cover demand while also providing reactive power and maintaining voltage profile within permissible limits.

Table 2.6. 2021 System Balance

Sites	Unit	Type	2021					
			Day			Night		
			kW	KVar	PF	kW	KVar	PF
Lungga	L1	Diesel	2213	727	0.95	2213	727.4	0.95
	L2	Diesel	1506	495	0.95	3168	-1240.2	0.92
	L3	Diesel	2213	727	0.95	-	-	-
	L4	Diesel	2213	727	0.95	-	-	-
	L5	Diesel	-	-	-	-	-	-
	L6	Diesel	-	-	-	-	-	-
	L7	Diesel	2530	832.5	0.95	-	-	-
	L8	Diesel	2600	855.5	0.95	1500.0	493.0	0.95
	L9	Diesel	2530	832.5	0.95	1500.0	493.0	0.95
	L10	Diesel	-	-	-	-	-	-
Honiora	H1	Diesel	-	-	-	-	-	-
	H2	Diesel	-	-	-	-	-	-
Total Diesel			15804.83	5197.5	0.94	8381	473.2	1.00
Fighter 1	-	PV	1000	328.7	0.95	-	-	-
Ranadi	-	PV	-	-	-	-	-	-
Henderson Extension	-	PV	-	-	-	-	-	-
Ranadi Rooftop	-	PV	-	-	-	-	-	-
Tanagai	-	PV	-	-	-	-	-	-
Foxwood	-	PV	-	-	-	-	-	-
Lungga SDA	-	PV	-	-	-	-	-	-
Tenaru	-	PV	-	-	-	-	-	-
Tasahe	-	PV	-	-	-	-	-	-
Makira	-	PV	-	-	-	-	-	-
Total PV			800	328.7	0.95	-	-	-
White River								
Lungga BESS	-	BESS	-	-	-	-	-	-
Total BESS			-	-	-	-	-	-
Tina 1	1	Hydro	-	-	-	-	-	-
Tina 2	2	Hydro	-	-	-	-	-	-
Tina 3	3	Hydro	-	-	-	-	-	-
Total Hydro			-	-	-	-	-	-
Total Generation			16604.83	5526.2	0.95	9181	987.6	1.00
Load			16082	5285.9	0.95	8996.8	2922.3	0.94
Losses			595.59	-391.8		184.0	-1934.7	

Table 2.7. 2025 System Balance

Sites	Unit	Type	Day			Night		
			kW	KVAr	PF	kW	KVAr	PF
Lungga	L1	Diesel	2213	727	0.95	2213	727	0.95
	L2	Diesel	2938	471	0.99	1180	-358	0.96
	L3	Diesel	2500	822	0.95	-	-	-
	L4	Diesel	2500	822	0.95	-	-	-
	L5	Diesel	-	-	-	-	-	-
	L6	Diesel	-	-	-	-	-	-
	L7	Diesel	2530	831.6	0.95	-	-	-
	L8	Diesel	2600	854.6	0.95	2300	756	0.95
	L9	Diesel	2530	832.5	0.95	2213	727	0.95
	L10	Diesel	2213	727.4	0.95	-	-	-
Honiara	H1	Diesel	-	-	-	-	-	-
	H2	Diesel	-	-	-	-	-	-
Total Diesel			20024.28	6087.7	0.95	7906	1853	0.97
Fighter 1	-	PV	800	262.9	0.95	-	-	-
Ranadi	-	PV	-	-	-	-	-	-
Henderson Extension	-	PV	1700	558.8	0.95	-	-	-
Ranadi Rooftop	-	PV	176	57.8	0.95	-	-	-
Tanagai	-	PV	800	262.9	0.95	-	-	-
Foxwood	-	PV	-	-	-	-	-	-
Lungga SDA	-	PV	3200	1051.8	0.95	-	-	-
Tenaru	-	PV	-	-	-	-	-	-
Tasahe	-	PV	-	-	-	-	-	-
Makira	-	PV	-	-	-	-	-	-
Total PV			6676	2194.3	0.95	-	-	-
White River	-	BESS	-4000	-1002.5	0.97	1000	-250.6	0.97
Lungga BESS	-	BESS	-4000	-1002.5	0.97	1000	-250.6	0.95
Total BESS			-8000	-1002.5	0.97	2000	-501.2	0.96
Tina 1	1	Hydro	-	-	-	-	-	-
Tina 2	2	Hydro	-	-	-	-	-	-
Tina 3	3	Hydro	-	-	-	-	-	-
Total Hydro			-	-	-	-	-	-
Total Generation			18700.28	7279.5	0.96	9906	1351.9	0.97
Load			17407.7	5272.6	0.96	9782	3215.2	0.95
Losses			1377.26	1507.9		168.31	-1887.9	

Table 2.8. 2030 System Balance

Sites	Unit	Type	Day			Night		
			kW	KVAr	PF	kW	KVAr	PF
Lungga	L1	Diesel	2150	706.7	0.95	-	-	-
	L2	Diesel	2150	-1361.4	0.84	-	-	-
	L3	Diesel	2150	706.7	0.95	-	-	-
	L4	Diesel	-	-	-	-	-	-
	L5	Diesel	-	-	-	-	-	-
	L6	Diesel	-	-	-	-	-	-
	L7	Diesel	-	-	-	-	-	-
	L8	Diesel	-	-	-	-	-	-
	L9	Diesel	-	-	-	-	-	-
	L10	Diesel	-	-	-	-	-	-
Honiara	H1	Diesel	-	-	-	-	-	-

Sites	Unit	Type	kW	Day			Night			
				H2	Diesel	kVAr	PF	kW	kVAr	PF
Total Diesel			6450	-	-	-	-	-	-	-
Henderson Fighter 1_1	-	PV	1000	328.7	0.95	-	-	-	-	-
Henderson Fighter 1_2	-	PV	1000	328.7	0.95	-	-	-	-	-
Henderson Fighter 1_3	-	PV	2000	657.4	0.95	-	-	-	-	-
Tenaru	-	PV	4000	1314.7	0.95	-	-	-	-	-
Foxwood Makira	-	PV	3000	986.1	0.95	-	-	-	-	-
Okea	-	PV	4000	1314.7	0.95	-	-	-	-	-
Lungga	-	PV	4000	1314.7	0.95	-	-	-	-	-
SP-Rooftop	-	PV	220	72.3	0.95	-	-	-	-	-
Tasahe	-	PV	2000	657.4	0.95	-	-	-	-	-
Tanagai	-	PV	1000	328.7	0.95	-	-	-	-	-
Total PV			22220	7303.4	0.95	-	-	-	-	-
White River	-	BESS	-4000	0.0	1.00	500	125.3	0.97		
Lungga BESS	-	BESS	-4000	0.0	1.00	500	164.3	0.95		
Total BESS			-8000	0.0	1.00	1000	289.7	0.96		
Tina 1	1	Hydro	4886	-593.3	0.99	5021.9	-607.1	0.99		
Tina 2	2	Hydro	5000	1643.4	0.95	5000	1643.4	0.95		
Tina 3	3	Hydro	-	-	-	-	-	-		
Total Hydro			4886	-593.3	0.99	10022	-	-		
Total Generation			25556	6762.0	0.91	11022	289.7	0.96		
Load			19219	6317.1	0.95	10800	3549.8	0.95		
Losses			6336	-444.9		270	-2166.3			

3 Methodology for Grid Integration Study

Steady state studies were completed to determine system performance following the integration of all proposed PV power plants and BESS at the specified locations with projected load growth for the year 2021, 2025, and 2030. Load flow studies, contingency analysis studies, and short circuit calculations were performed to assess equipment loading and the voltage profile along the power grid. The study follows the requirements outlined in the Australian Standards as shown in Table 3.1 given that SP does not strictly adhere to any one particular set of standards, regulations, or grid codes. This study sets voltage limits of 0.9 p.u. and 1.1 p.u. under normal conditions and an N-1 contingency event. Anything value these limits would constitute an overloaded element and a potentially unstable power system.

Table 3.1. Study Assessment Criteria

Assessment	Criteria
Thermal capacity (not derated)	Equipment thermal loading \leq Equipment thermal rating
Thermal capacity (derated)	Equipment thermal loading \leq 80% of Equipment thermal rating
Bus Voltage Limits	0.9 p.u. (9.9kV) \leq Bus Voltage \leq 1.1 p.u. (12.1kV)
AVR Maximum Loading Limits	3MVA (1 p.u.)
Bus Fault Levels	50kA at 0.415kV / 13.1kA at 11kV / 25kA at 33kV / 25kA at 66kV

3.1 Short Circuit Current Calculations

Simulations and assessments carried out in this study seek to show that calculated fault levels are within the circuit breaker withstand limits. These have been assessed for both three- and single-phase faults and calculated using the IEC 60909 standard procedure. Results from this procedure may be higher than actual recorded fault levels giving a safety buffer for plant and equipment ratings. Maximum loading scenario was considered with all diesel generators in service to simulate the highest fault contribution. These were calculated based on normal running arrangement and compared to the circuit breaker and switchboard ratings.

3.2 Dynamic Analysis

While this study only focuses on steady-state analysis, a later stage will focus on conducting dynamic analysis to understand generator response and ability to return to stable operation following severe disturbance to the power grid. These responses would be simulated based on the disturbances outlined in the table below.

Table 3.2. Disturbances considered for Dynamic Analysis

Disturbance	Description
1	Increase the highest load by 80%
2	Loss of highest load
3	Loss of Generator 5 at Bikenibeu power station

Power grid recovery during the disturbance will be assessed using the following indices:

- Rotor angle stability
- Frequency deviation
- Active and reactive power recovery
- Voltage profile recovery

4 Study Results

The steady-state analysis was completed for all years considering integration of PV and BESS. Proposed PV and BESS systems have only been included in steady-state analysis for the year 2025 and 2030 to assess power grid system responses based on the current maximum and minimum load conditions. This is important should integration of these systems to the power grid be completed by 2030. The PV plants were operated at the maximum generation capacity recorded to date and put in service to offset diesel fueled generation. Diesel generators were operated at the maximum derated capacities as advised by SP as shown in Table 2.1. The results of this study are presented in the following subsections.

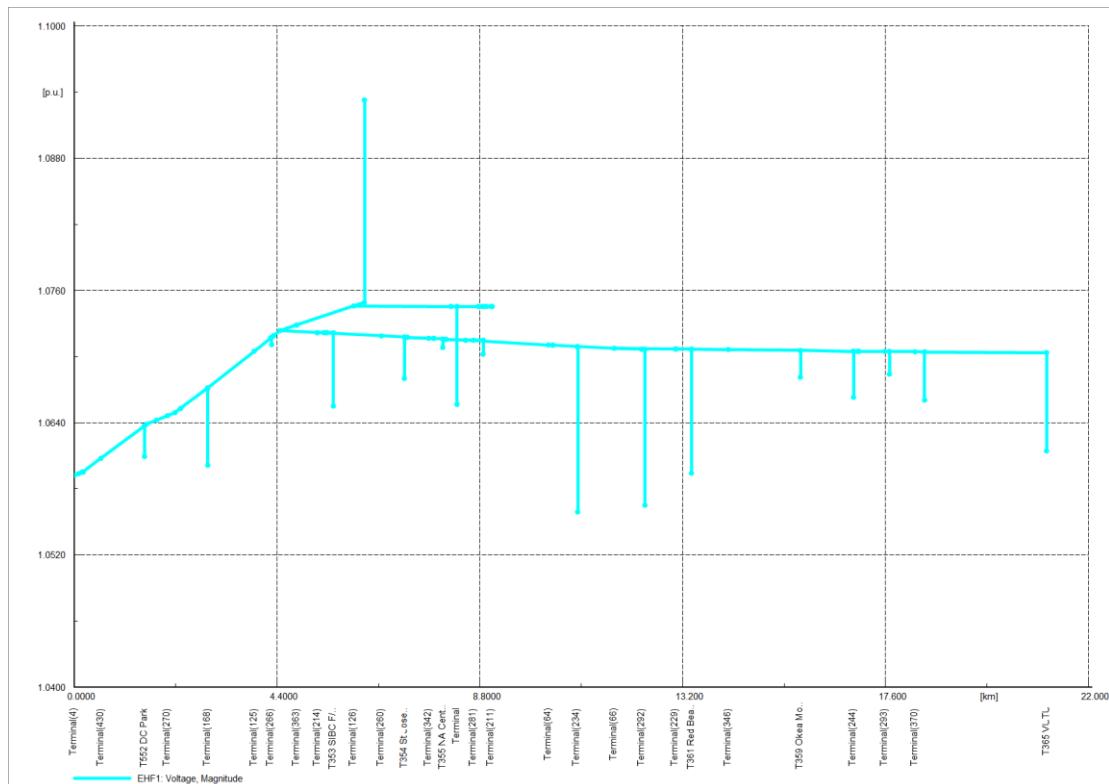
4.1 Load Flow Results

4.1.1 System Operation – Year 2021

System operation during the day considers all available diesel generation and PV systems to be in service. Generator H1 and H2 at Honiara PS were treated as backup and kept out of service. System operation at night considers only generators L1, L2, L8, and L9. This scenario does not include any hydro or BESS systems connected to the grid.

The meshed structure of the SP power grid always favors a centralized supply from Lungga PS minimizing voltage drops experienced on the long lines. The voltage profile of all feeders show a voltage drop of no more than 10% in the positive or negative. The existing 11kV cable along this area and on other parts of the feeder are shown to have sufficient capacities to transfer required power over the required distances.

Figure 4.2 shows overloading upstream of the East Honiara Feeder 2. It is suggested that all existing 11kV HDC 7/1.00 cable (69A current rating) on this feeder be upgraded to the 11kV ACSR/GZ Apple type cable (209A current rating) in preparation for the proposed PV plants to be integrated to the SP grid through this feeder. The 3 overloaded units shown on Figure 4.2 require upgrades to ensure optimal loading at 50%-60%. The same upgrade is proposed for all other overloaded transformer units.



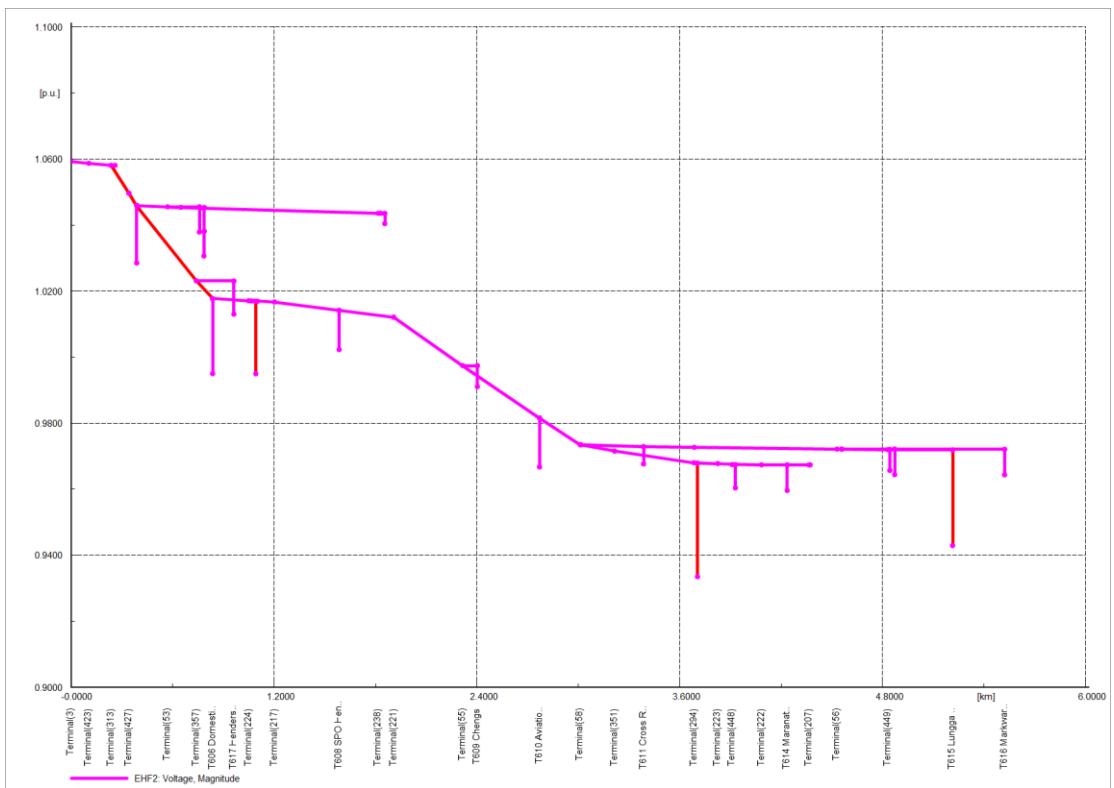


Figure 4.2. East Honiara Feeder 2 Voltage Profile at Day Peak Load within permissible limits.

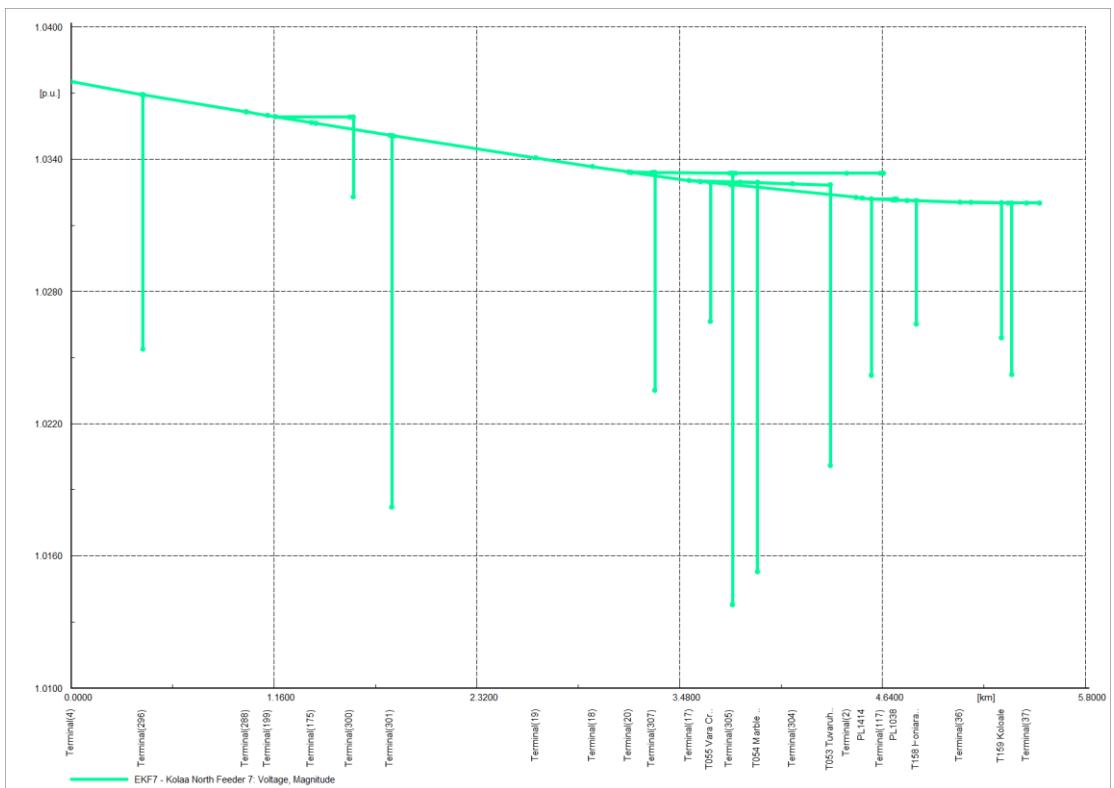


Figure 4.3. Kolaa North Feeder 7 Voltage Profile at Day Peak Load within permissible limits.

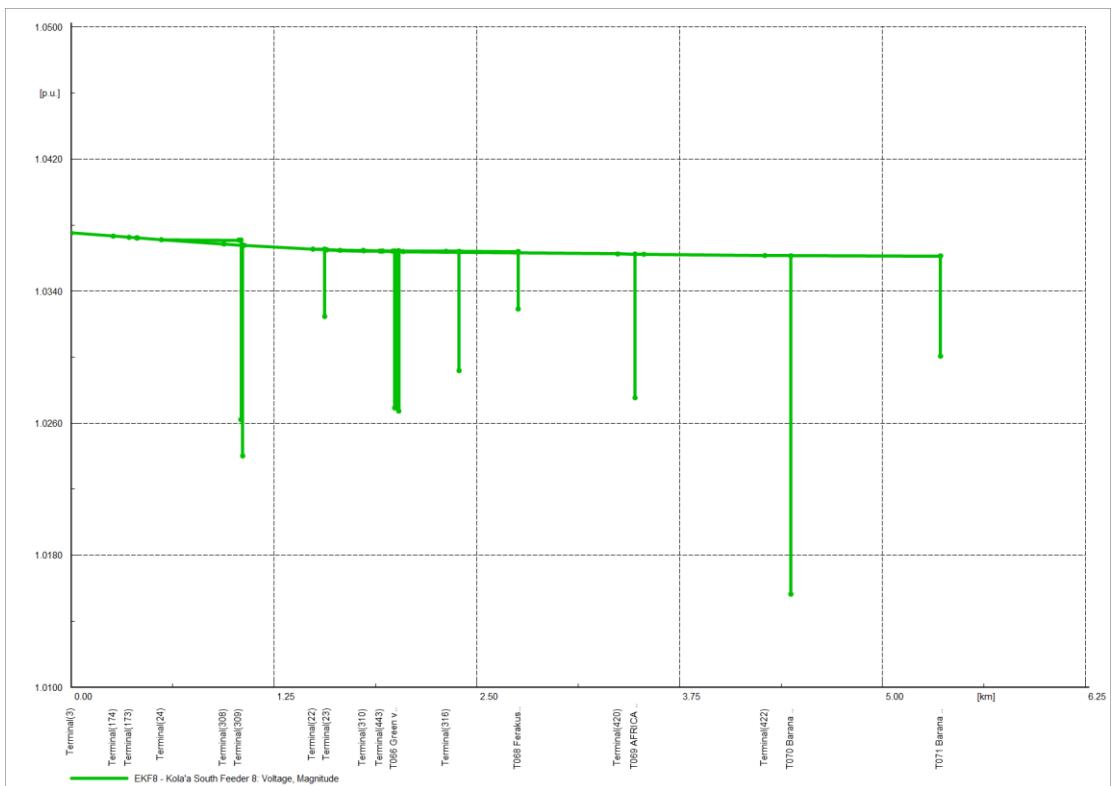


Figure 4.4. Kolaa South Feeder 8 Voltage Profile at Day Peak Load within permissible limits.

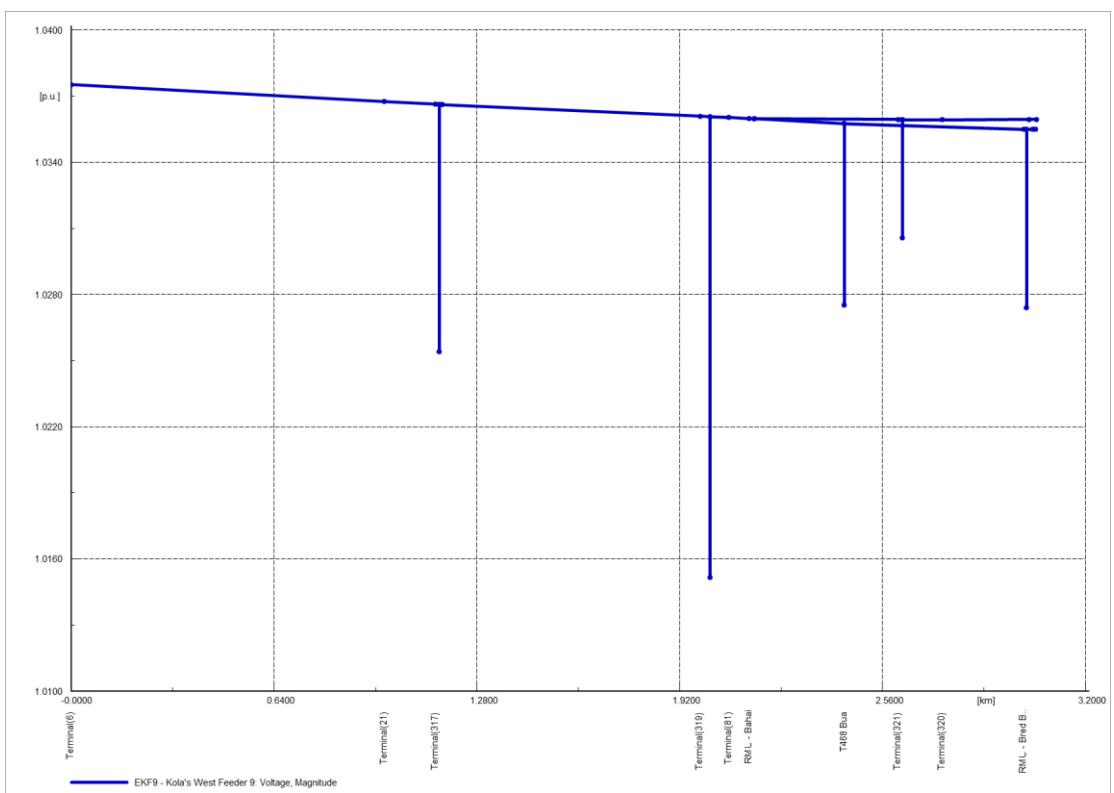


Figure 4.5. Kolaa West Feeder 9 Voltage Profile at Day Peak Load within permissible limits.

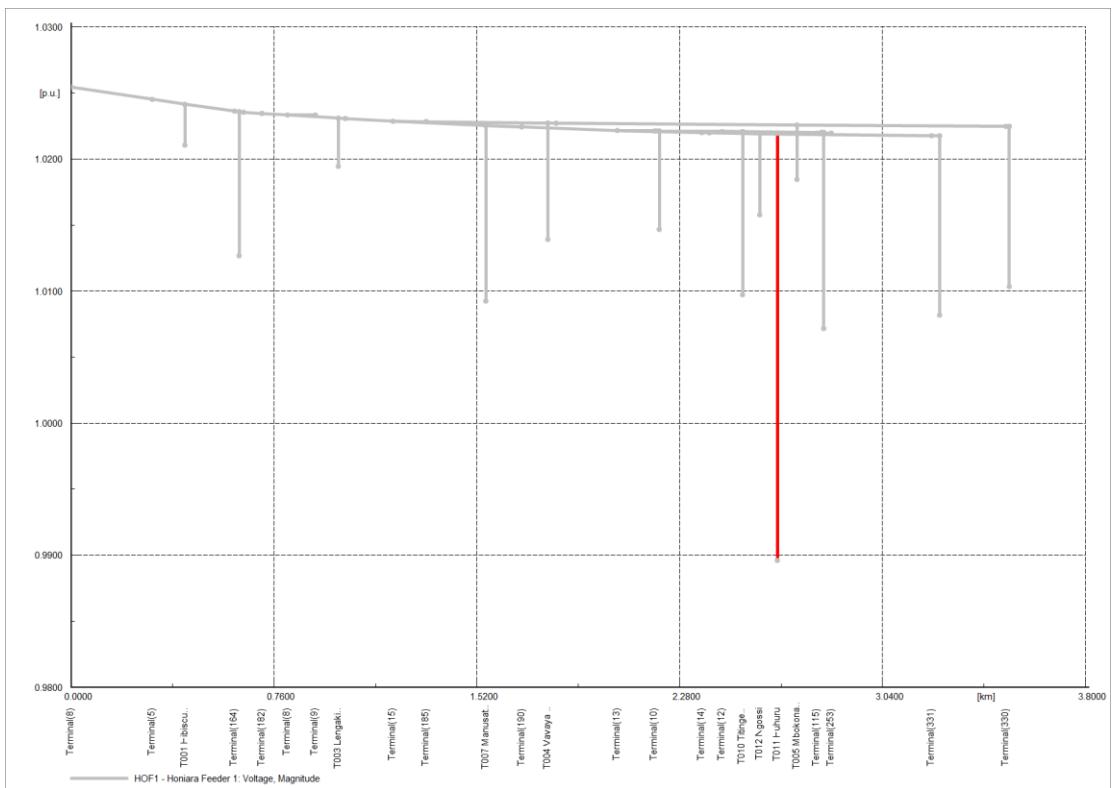


Figure 4.6. Honiara Feeder 1 Voltage Profile at Day Peak Load within permissible limits.

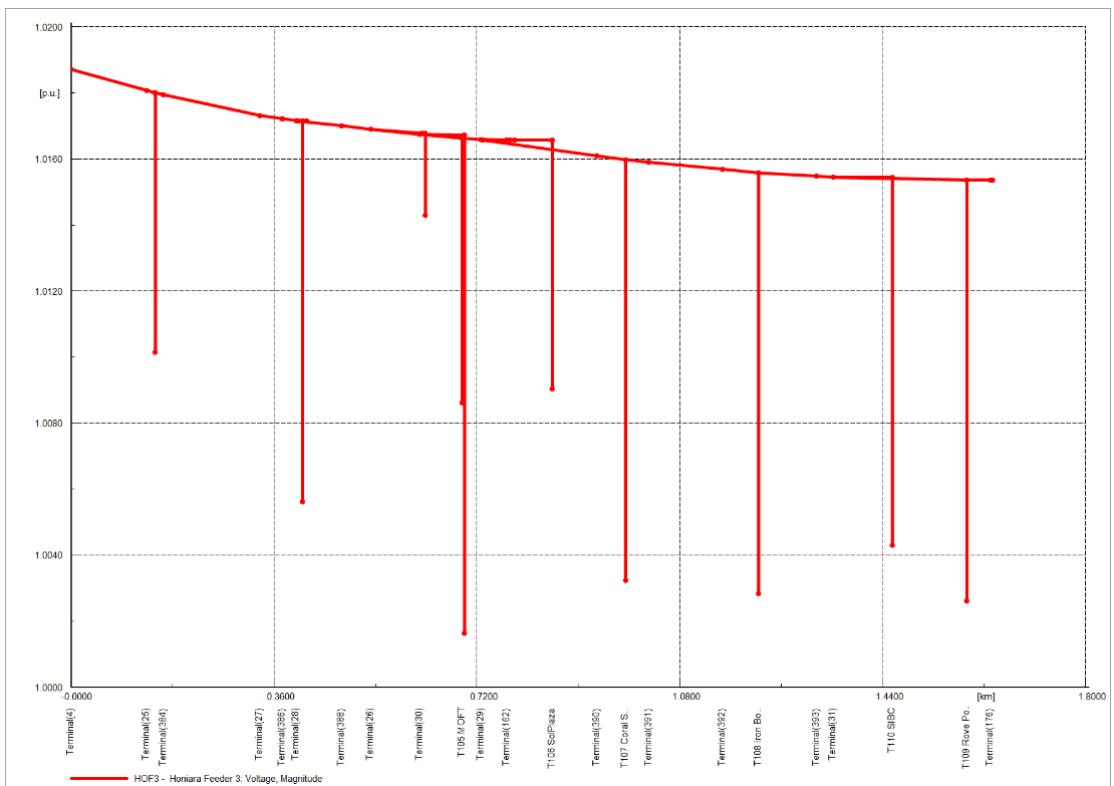


Figure 4.7. Honiara Feeder 3 Voltage Profile at Day Peak Load within permissible limits.

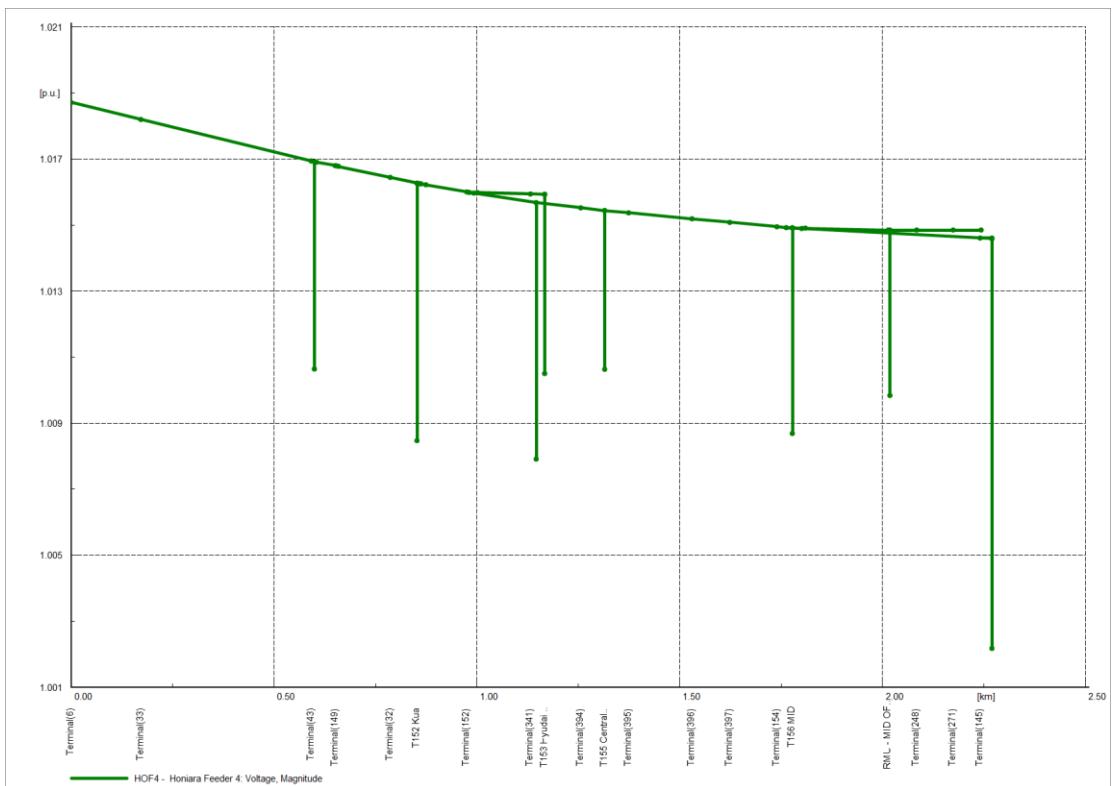


Figure 4.8. Honiora Feeder 4 Voltage Profile at Day Peak Load within permissible limits.

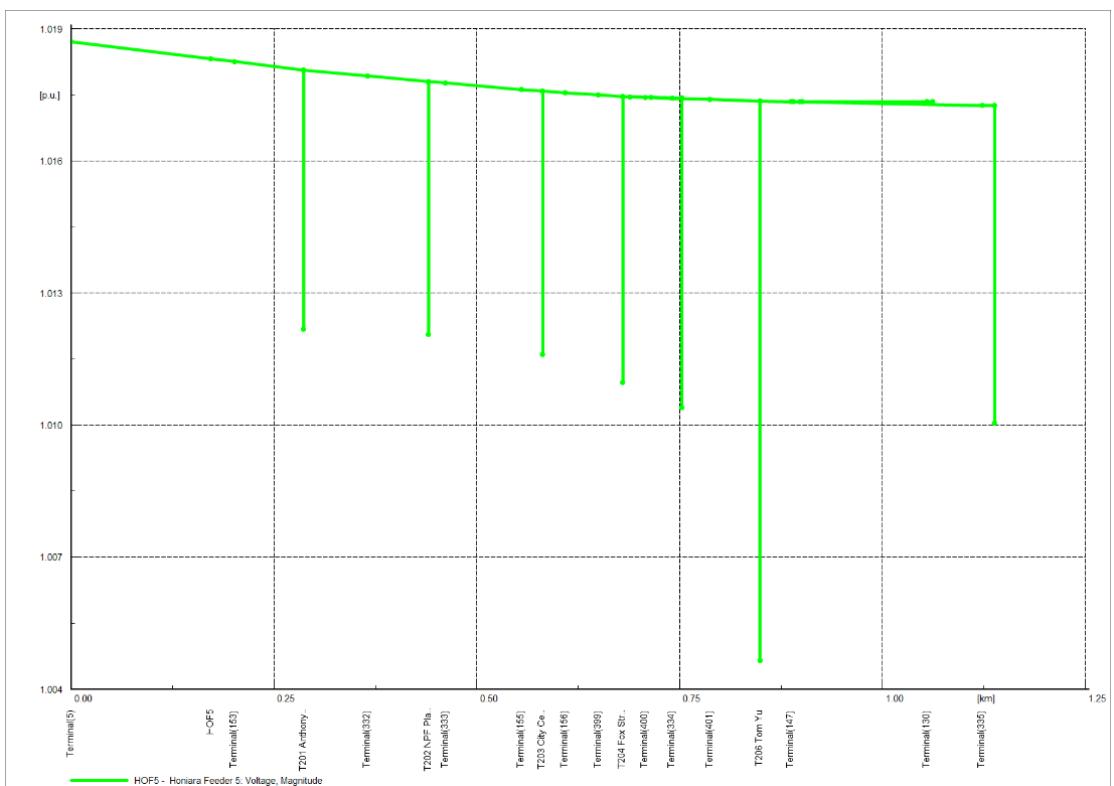


Figure 4.9. Honiora Feeder 5 Voltage Profile at Day Peak Load within permissible limits.

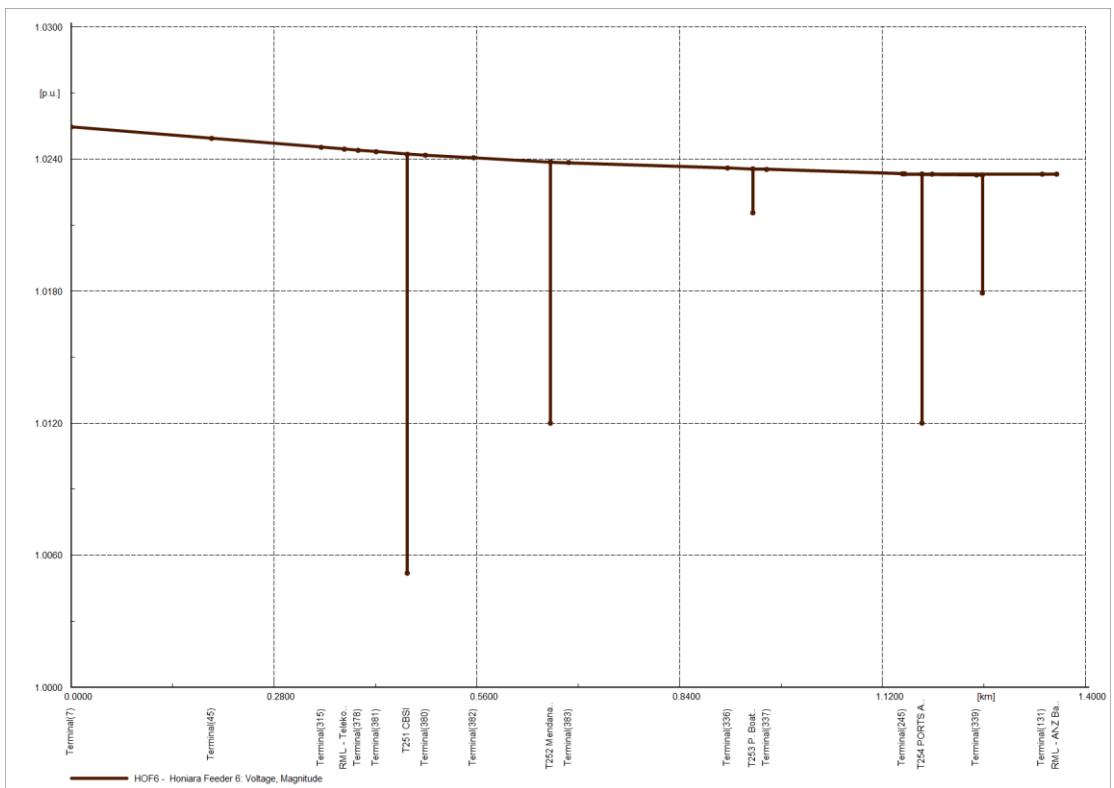


Figure 4.10. Honiara Feeder 6 Voltage Profile at Day Peak Load within permissible limits.

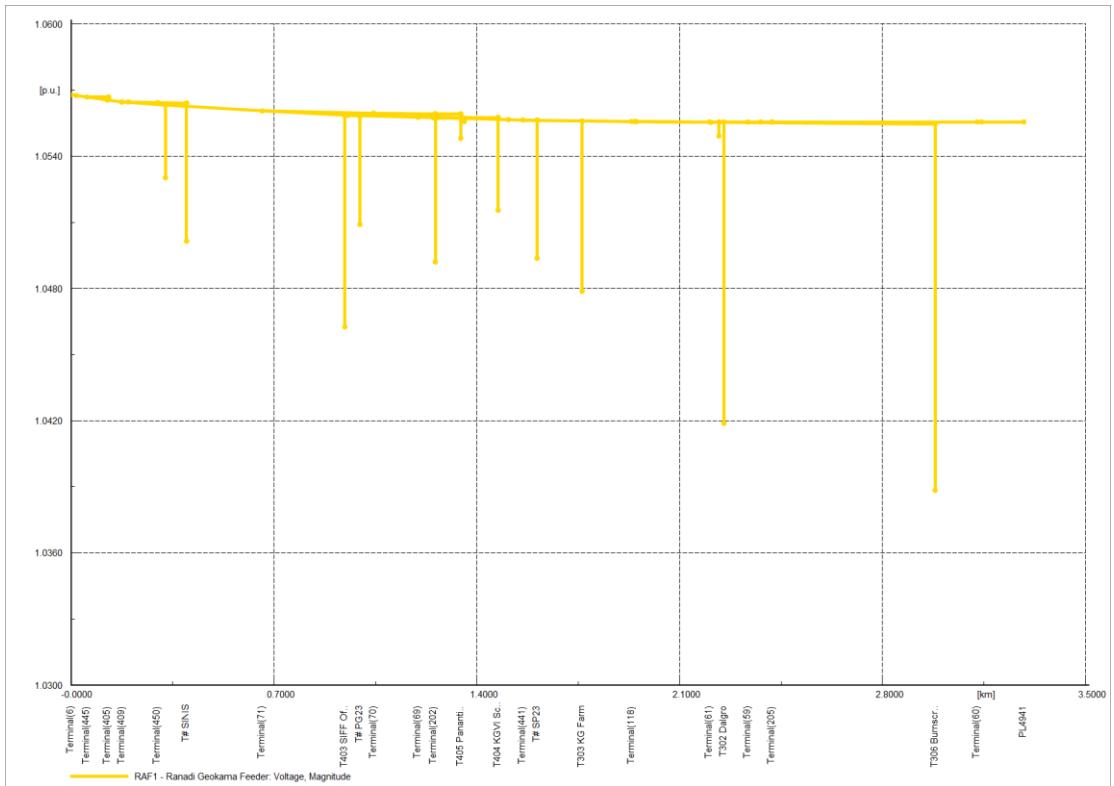


Figure 4.11. Ranadi Geokama Feeder Voltage Profile at Day Peak Load within permissible limits.

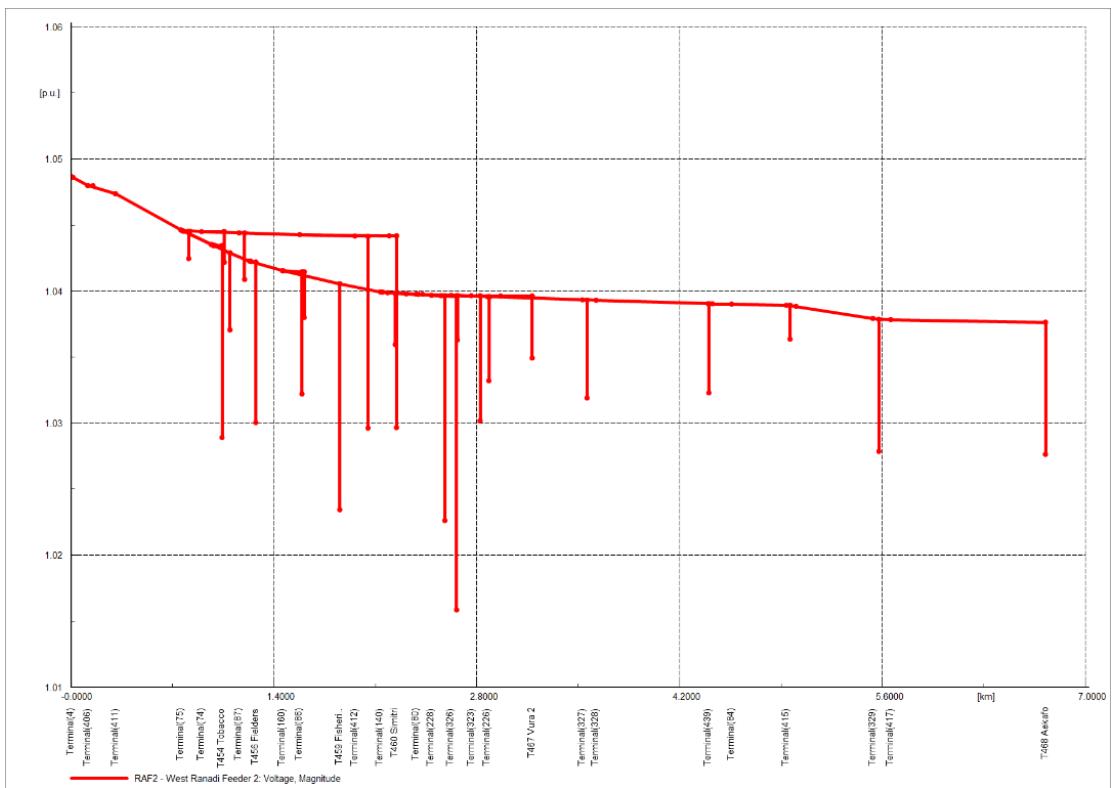


Figure 4.12. West Ranadi Feeder 2 Voltage Profile at Day Peak Load within permissible limits.

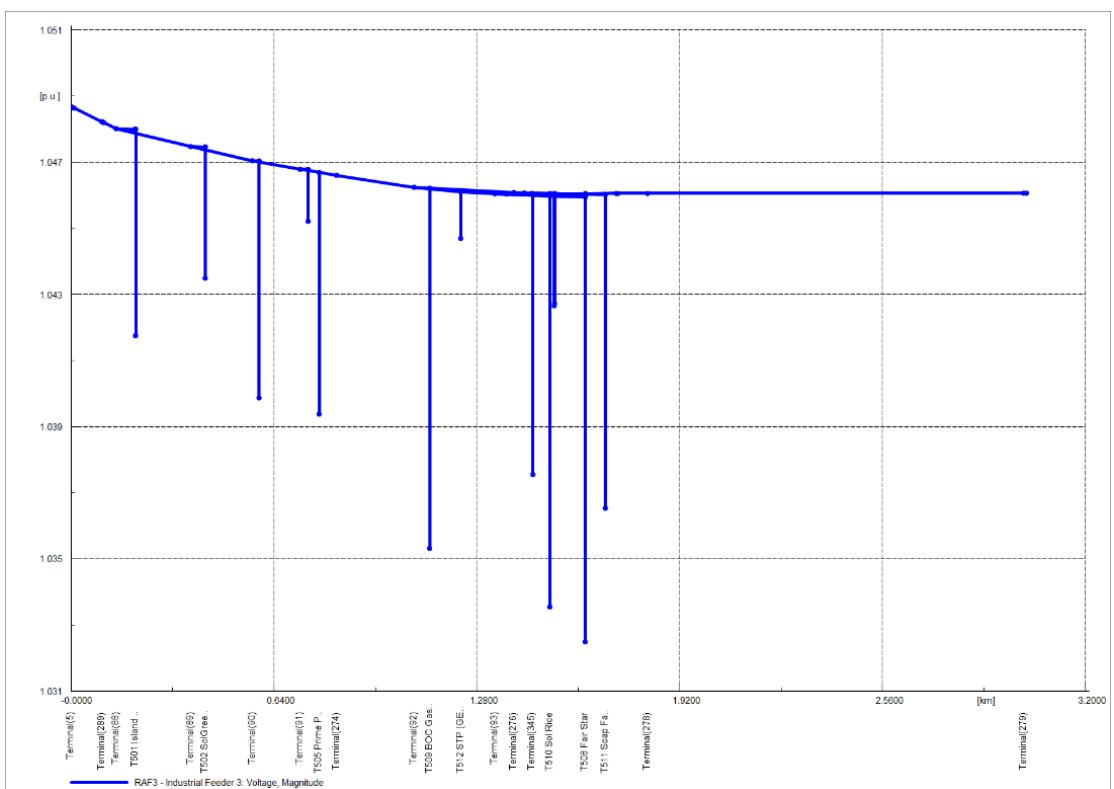


Figure 4.13. Industrial Feeder 3 Voltage Profile at Day Peak Load within permissible limits.

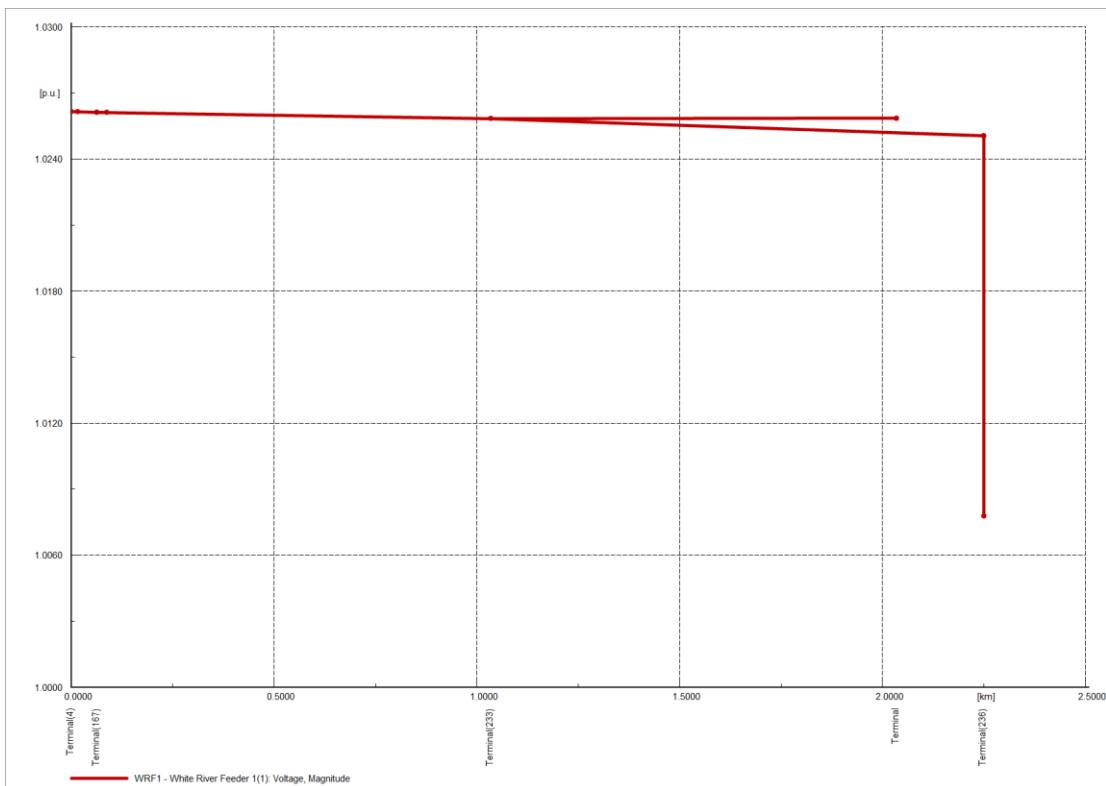


Figure 4.14. White River Feeder 1 Voltage Profile at Day Peak Load within permissible limits.

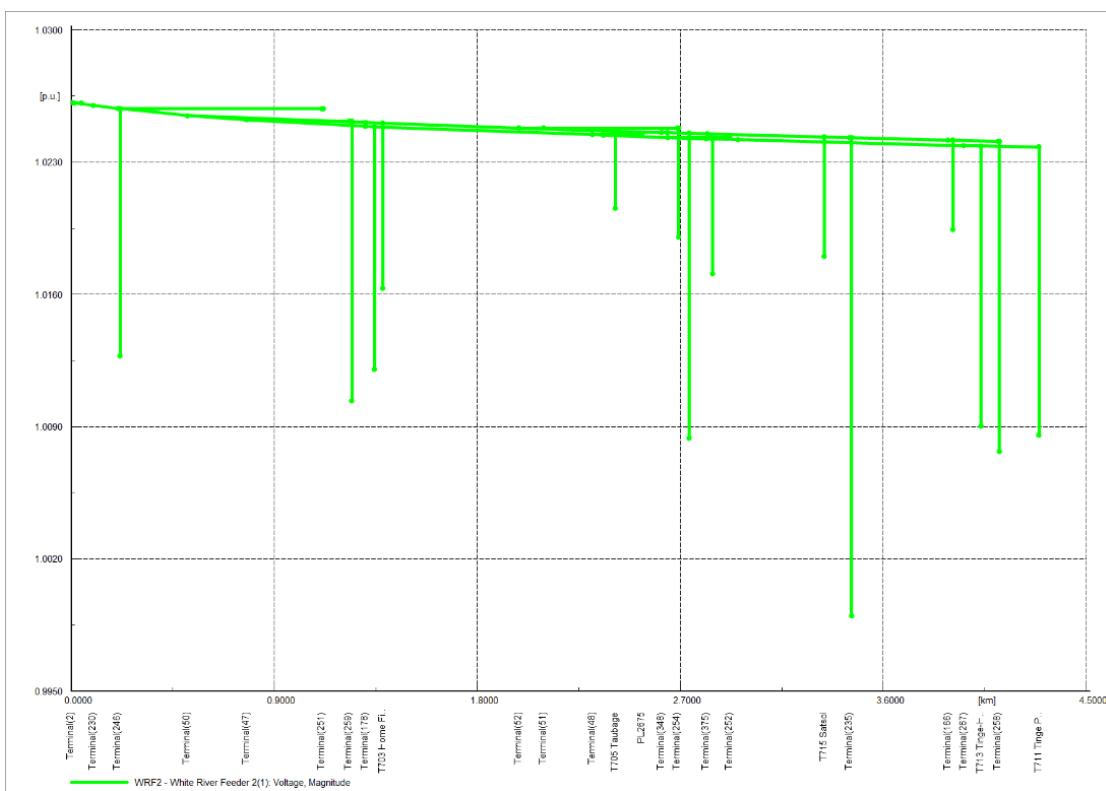


Figure 4.15. White River Feeder 2 Voltage Profile at Day Peak Load within permissible limits.

All 2021 voltage profiles shown for all 15 feeders are all within the permissible operation limits and indicate a stable and secure power grid. Aside from the Henderson 1MW solar PV, electricity generation is entirely sourced from diesel generators. The shift to 100% renewable energy through extensive solar PV connections by 2030 is expected to introduce instability to the grid as more diesel generators are taken offline and reserved for backup services. Also expected is a

higher voltage profile on the feeders where PVs are integrated to the system. The impending overloading and instability these new systems introduce will require SP to implement necessary system reinforcements to the SP grid. This will be critical to securing secure system stability following the integration of the proposed PV and BESS units to the grid.

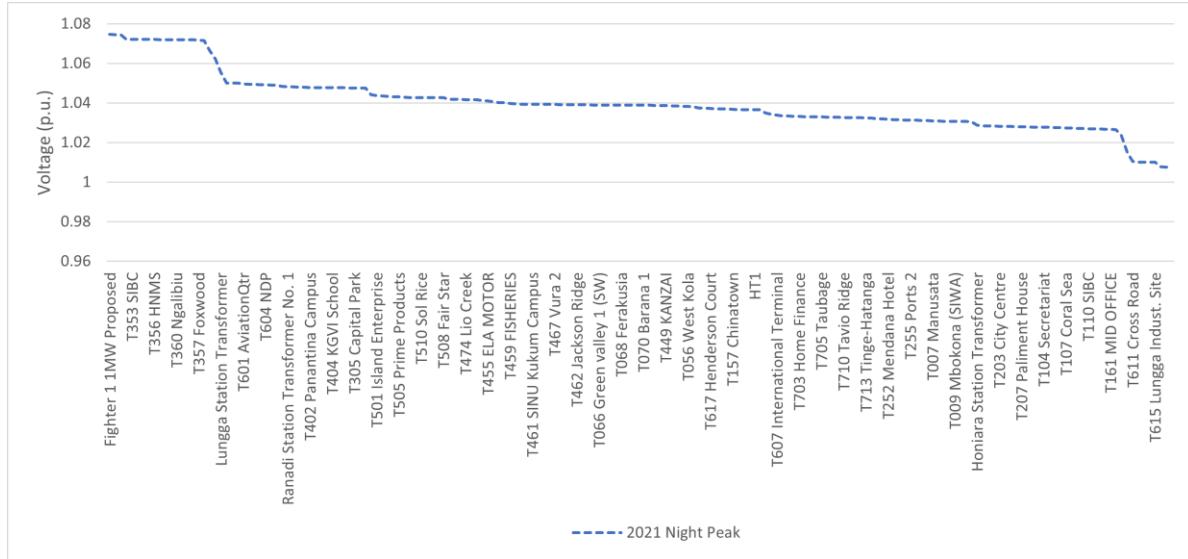


Figure 4.16. Year 2021 System Voltage Profile at Night within permissible limits.

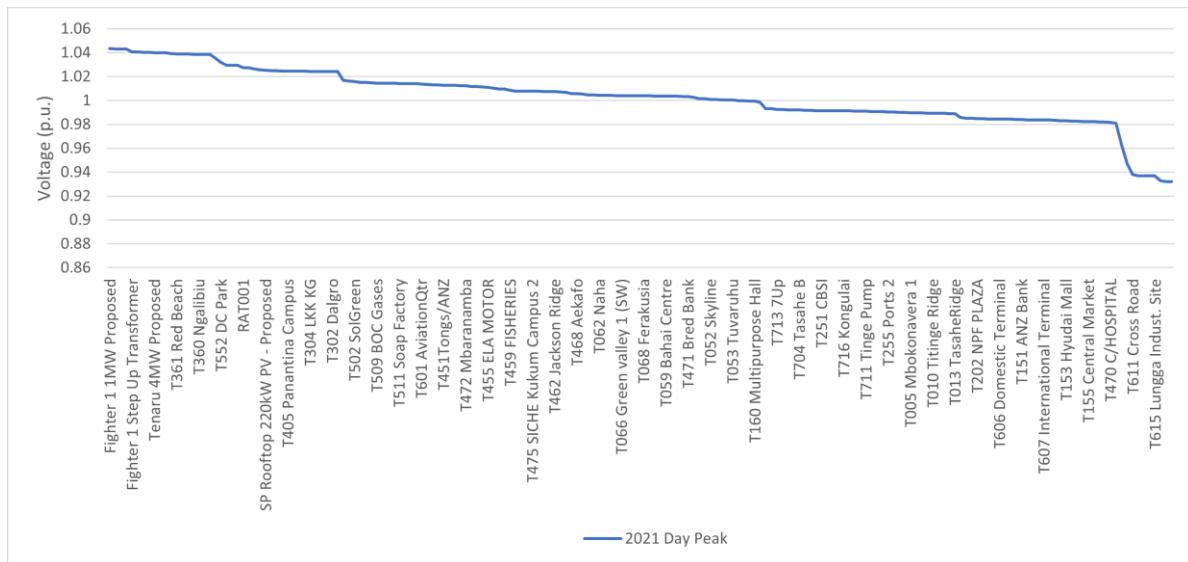


Figure 4.17. Year 2021 System Voltage Profile at Day within permissible limits.

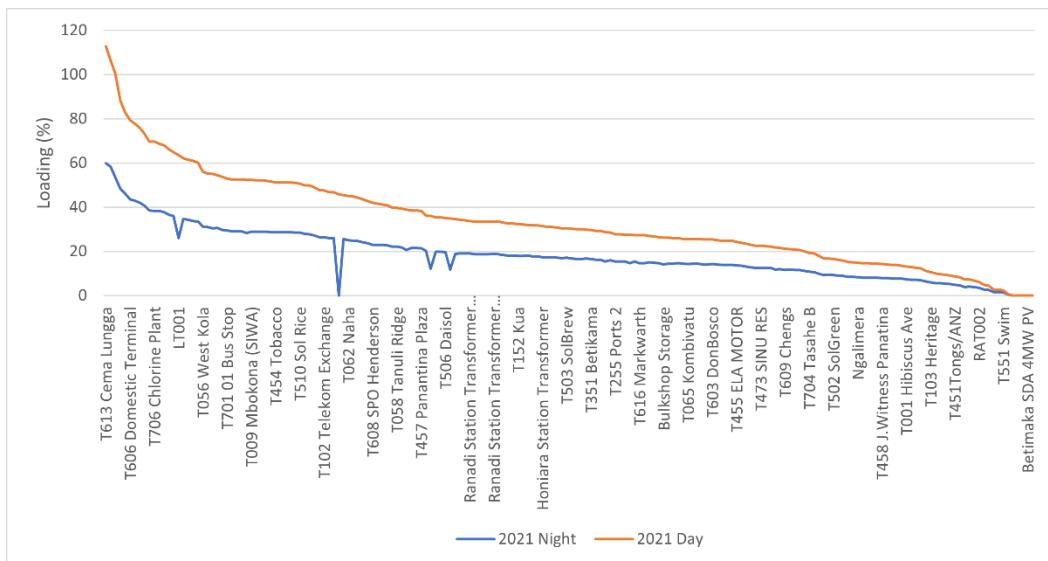


Figure 4.18. 2021 System Loading

Table 4.1. Year 2021 - Most Loaded Elements

Year 2021	Day		Night
	Name	Loading %	Loading %
T613 Cema Lungga		112.7665	-
T011 Huhuru		106.3697	-
T615 Lungga Indust. Site		100.4734	-
T607 International Terminal		88.16705	-

The current loading conditions indicate adequate system reinforcements implemented by SP to secure system stability. It would be best for these investments to continue given the expected increases in demand throughout the grid by 2030.

4.1.2 System Operation – Year 2025

Based on changes to the operation status proposed by JICA, the PV contribution to system balance increased from a peak of 1MW to 6.68MW. The PV projects included were the 2MW Henderson extension, the 220kW Ranadi rooftop PV, the 1MW Tanagai PV, and the Lungga SDA PV. Also included were the charging and discharging of the 4MW/2MWh and 4MW/24MWh BESS for short-period fluctuation smoothing and for long-period fluctuation control, respectively. The 33/11kV 3.5MVA power transformer at East Honiara SS was upgraded to a 10MVA rated transformer in anticipation of increased loading from the new PV integrations.

Results show that voltages remain within permissible limits as shown in Figure 4.5 while overall equipment loading as shown in Figure 4.6 were well below the 100% maximum loading. The overall load growth resulted in an increase in the number of overloaded transformers. These have been upgraded to support the 2030 load.

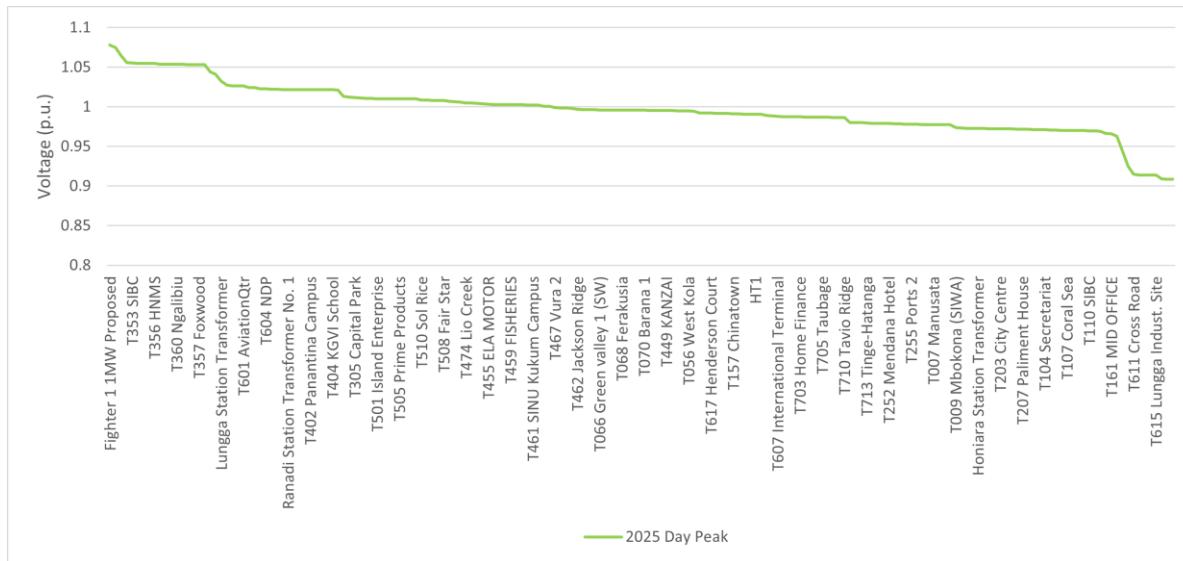


Figure 4.19. Year 2025 System Voltage Profile in the Day within permissible limits

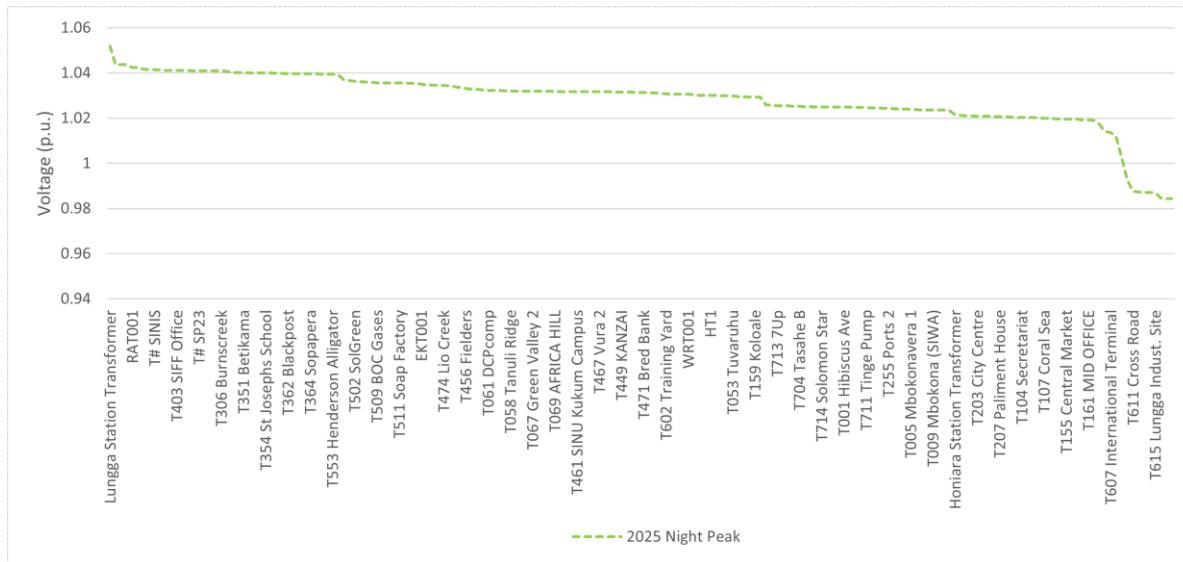


Figure 4.20. Year 2025 - System Voltage Profile at Night within permissible limits

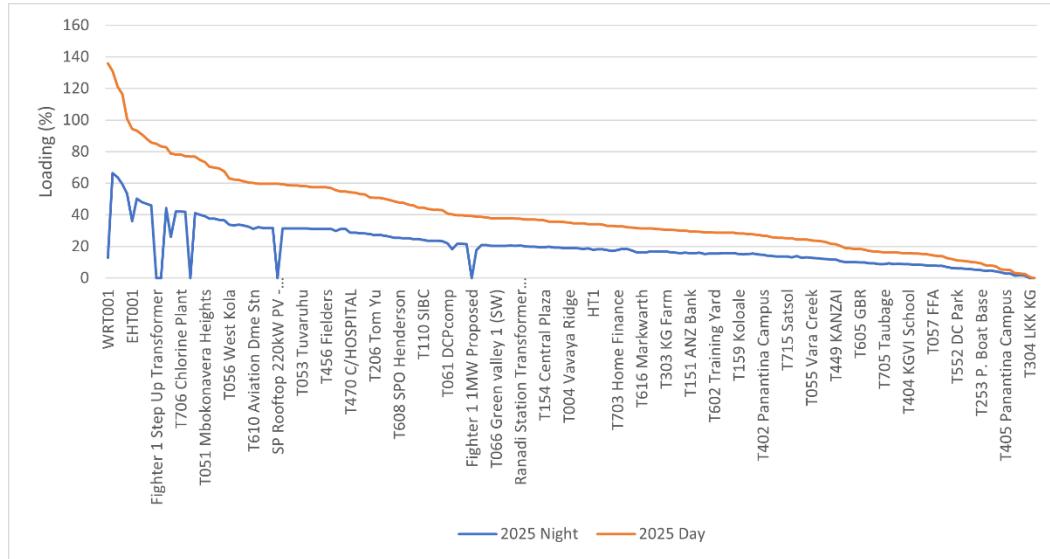


Figure 4.21. Year 2025 – System Loading

Table 4.2. Year 2025 - Most Loaded Elements.

Year 2025	Day	Night
	Name	Loading
		%
T613 Cema Lungga	135.8658	12.84884
T011 Huhuru	131.0924	66.34752
T615 Lungga Indust. Site	121.102	63.7221
T607 International Terminal	116.5302	59.4048
EHT001	94.49669	36.0073
T465 Kwaimani Bldg	93.35289	50.33689
T606 Domestic Terminal	90.82292	47.97413

4.1.3 System Operation – Year 2030

Finally, system performance for the year 2030 showed the voltage profile of the East Honiara Feeder 1 to go beyond the 10% upper limit owing to the integration and operation to full capacity of all proposed PVs. All other feeders had voltage profiles within the $\pm 10\%$ permissible limits. The increases in voltage profile also led to the overloading of the transmission lines along the East Honiara Feeder 1 and other low-capacity rated transmission lines in need of system reinforcement.

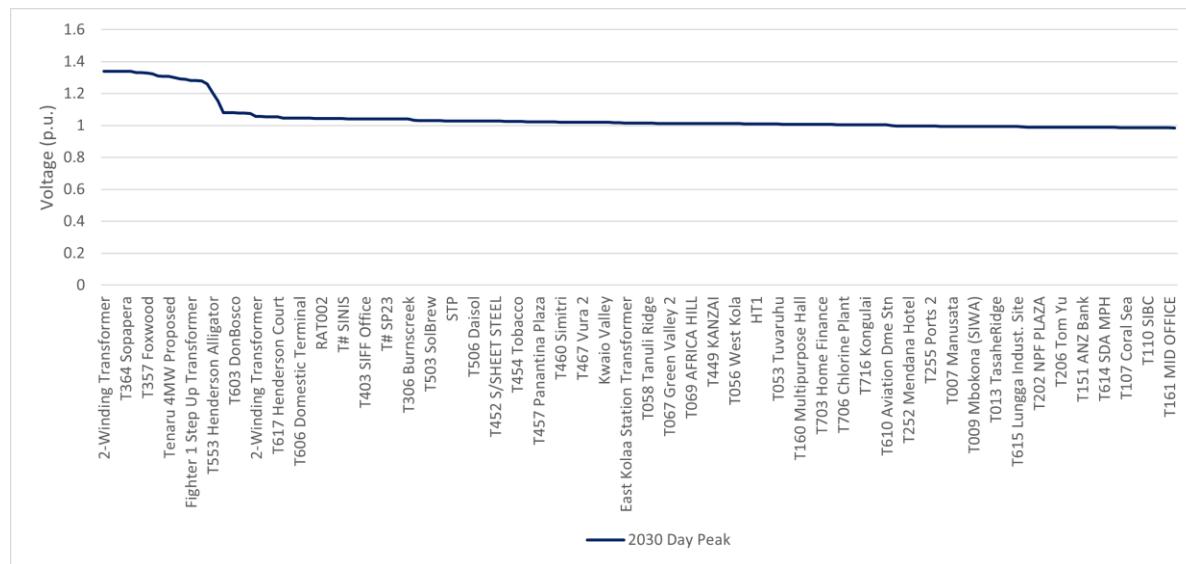


Figure 4.22. Year 2030 System Voltage Profile.

Following complete integration of all proposed PV power plants to the SP grid, the East Honiara Feeder 1 voltage profile had exceeded the 10% upper limit with peak of 1.348 p.u. (14.83kV) and a minimum at 1.09p.u. (11.99kV). The increase in voltage level is also attributed to the small number of distribution load centers along the feeder. Transmission lines close to feeder source were also loaded beyond rated capacity. These are of the Cherry ASCR overhead type conductors rated to 364A. Modelling of a parallel circuit for EHF1 did little to lower voltage levels.

This study proposes PV curtailment to ensure voltage levels stay within the $\pm 10\%$ voltage limits. To fulfill these conditions, the following PV power plants were placed out of service: Foxwood Makira PV (3MW), Okea PV (4MW), and Tenaru PV (4W). In addition, Betikama PV output was curtailed from 4MW to 1.5MW. Reduction of the system voltage setpoint from 1.05p.u. to 1.025p.u. at the reference machine (L2) further reduced voltage towards nominal level and maintained the voltage profile within permissible limits.

Given the current grid layout, the maximum power export through EHF1 to Lungga PS or East Honiara PS was seen to be 5.5MW. Beyond this limit would see feeder voltage profile exceed the upper voltage limit and consequently introduce system instability. It is proposed that a separate 11kV distribution line be constructed to connect the curtailed PV power plants to Lungga PS or East Honiara PS.

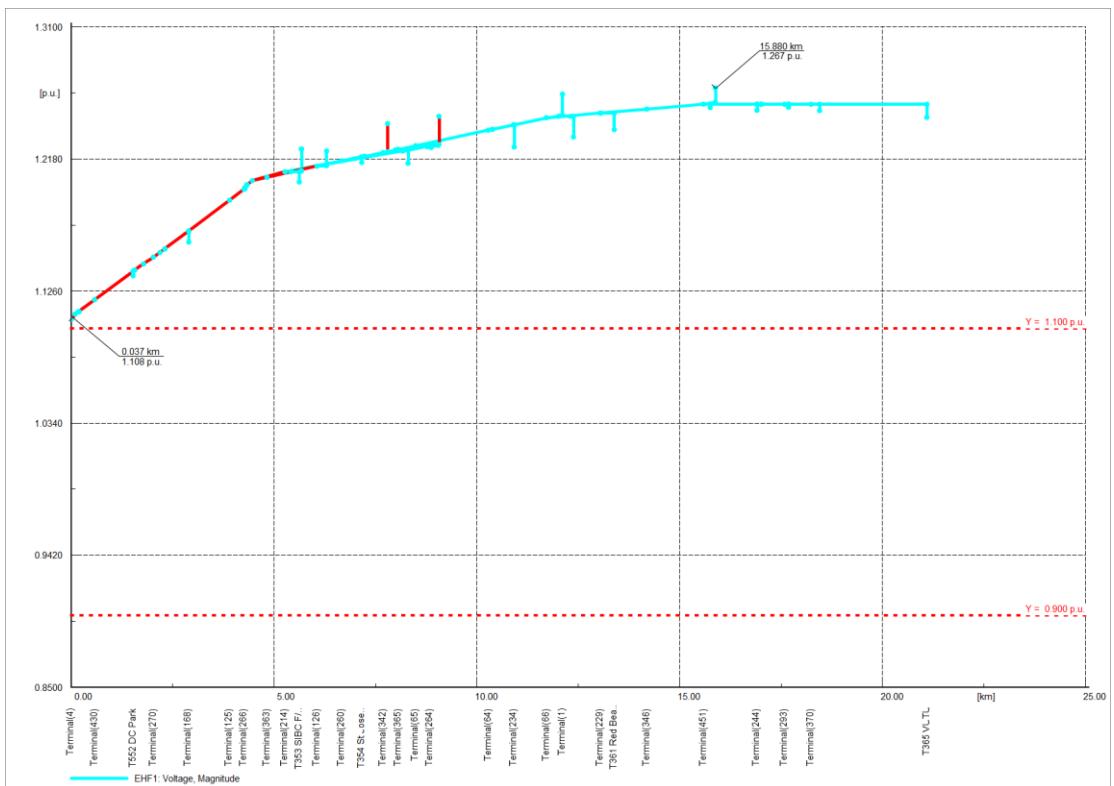


Figure 4.23. East Honiara Feeder 1 voltage profile beyond permissible limits.

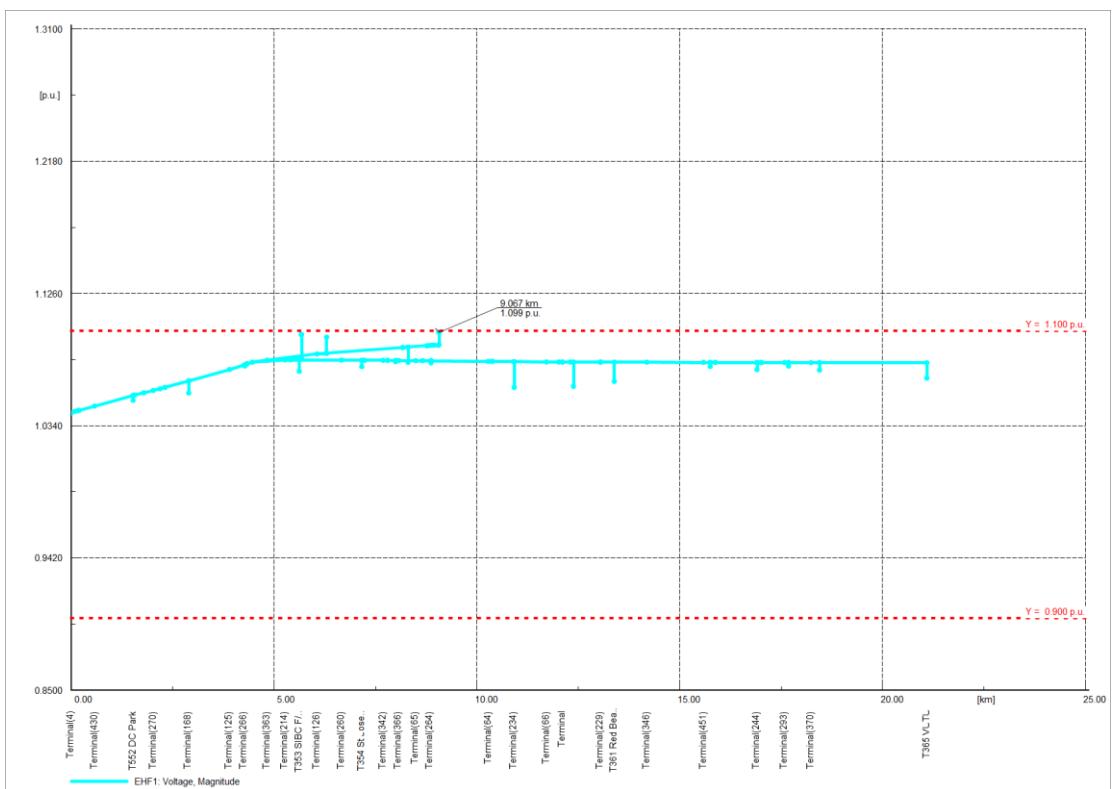


Figure 4.24. East Honiara Feeder 1 voltage profile within permissible limits post PV curtailment.

System loading at the 2030 projected load demands sits below 100% maximum loading at night. However, the projected 2030 loads lead to overloading of transformers along select feeders. These are as shown in Figure 4.25 and Table 4.4.

Near-term investments directed towards system reinforcements required on heavily loaded transformers should assist in securing system stability for the year 2030.

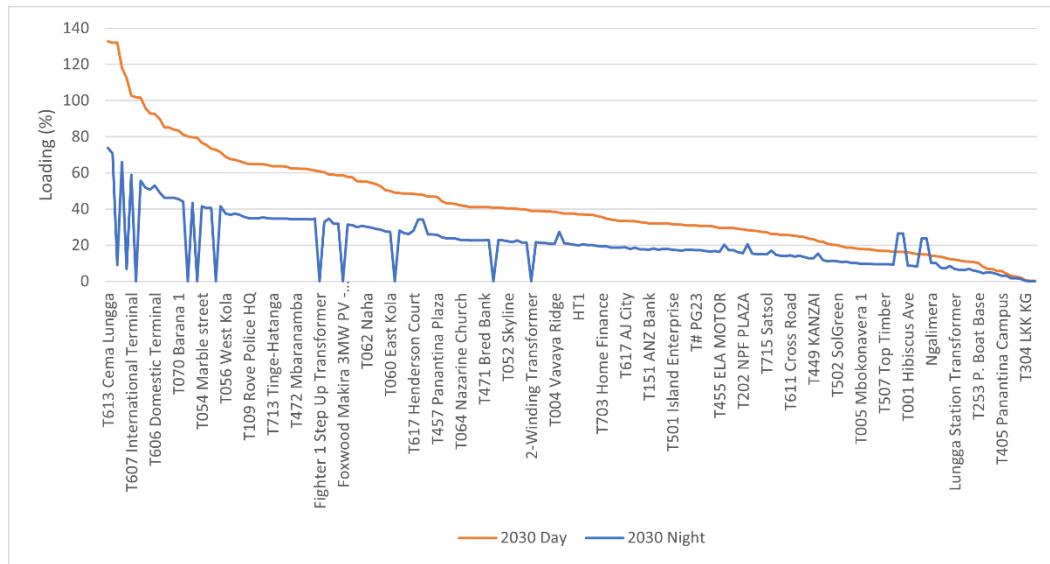


Figure 4.25. Year 2030 - System loading profile.

Table 4.3. Year 2030 - Most Loaded Elements.

Transformers	Loading (%)
T613 Cema Lungga	132.7698
T011 Huhuru	131.8975
WRT001	131.8679
T615 Lungga Indust. Site	118.1033
EHT001	112.4575
T607 International Terminal	102.7939
Tanagai 1MW PV - Proposed	101.7905
T465 Kwaimani Bldg	101.507
T251 CBSI	95.98272
T714 Solomon Star	92.94694
T606 Domestic Terminal	92.51953

4.2 Short Circuit Current Results

The three phase and single line to ground fault levels were calculated for normal system operation, at maximum loading conditions, and at maximum diesel generation. The results for all years were seen to be well below the maximum allowable short circuit current rating for 0.415kV, 11kV, 33kV and 66kV rated equipment and require no further mitigation. The network fault level profiles for each year are shown in the figures below. The fault level profiles for only the 11kV voltage level is presented due its extensive coverage of the SP grid. As expected, the highest fault levels were recorded at Lungga PS for each modelled year and at Tina Hydro PS in 2030 owing to centralized generation at these locations on the SP grid.

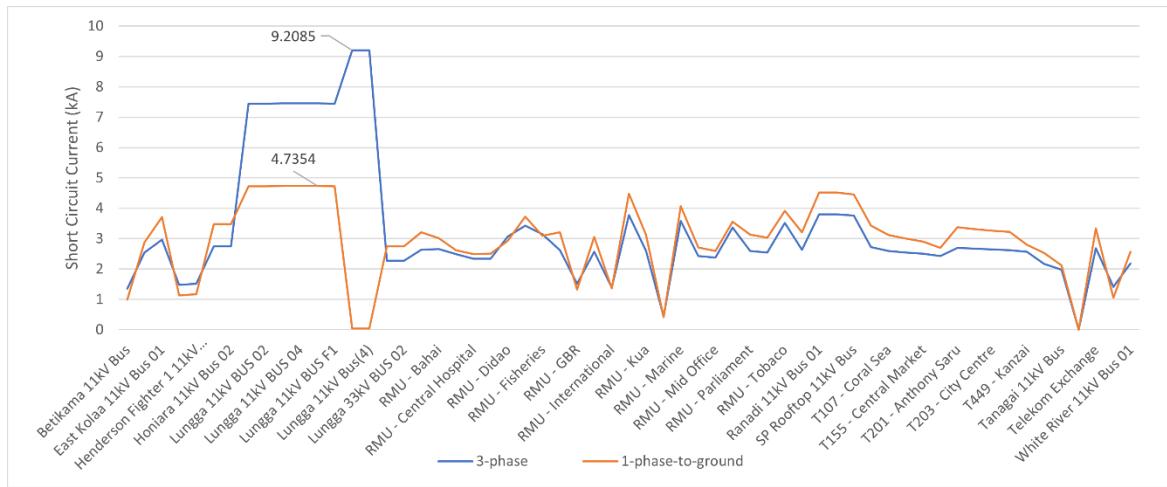
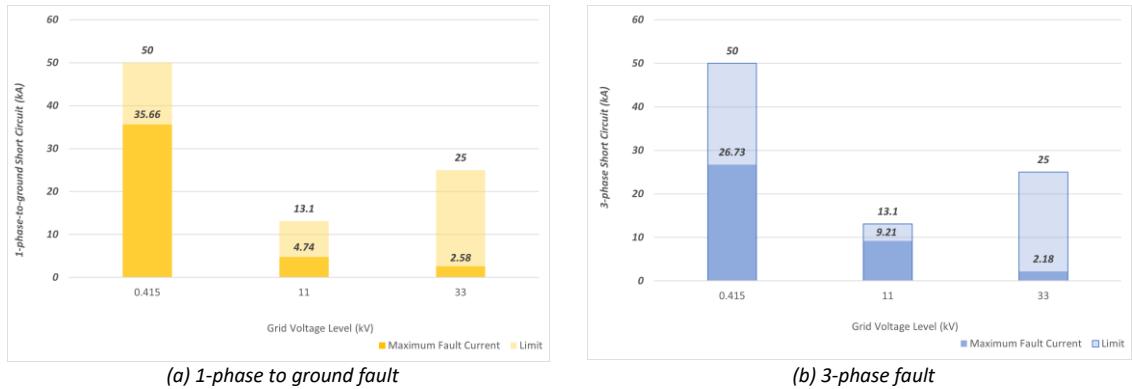


Figure 4.26. Short circuit current results at 11kV distribution voltage level - Year 2021



(a) 1-phase to ground fault

(b) 3-phase fault

Figure 4.27. Short circuit current results against limits at all voltage levels - Year 2021

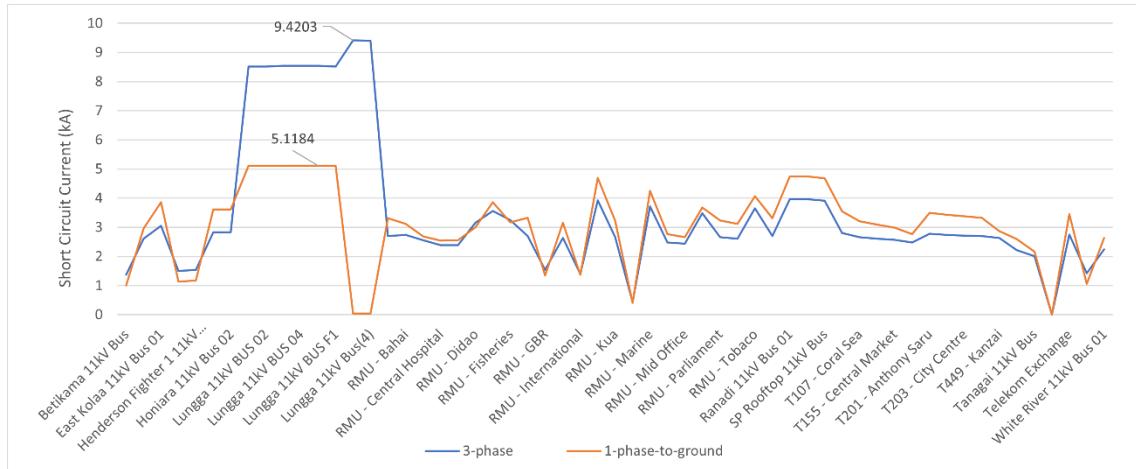


Figure 4.28. Short circuit current results at 11kV distribution voltage level - Year 2025

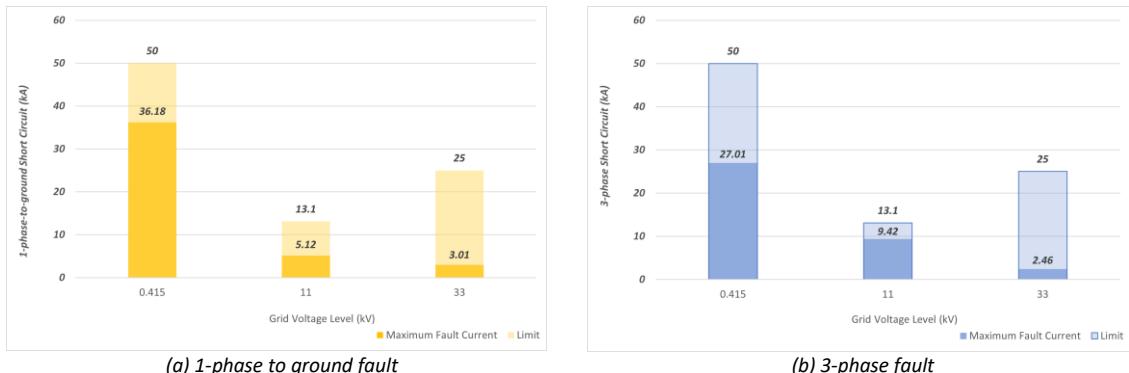


Figure 4.29. Short circuit current results against limits at all voltage levels - Year 2025

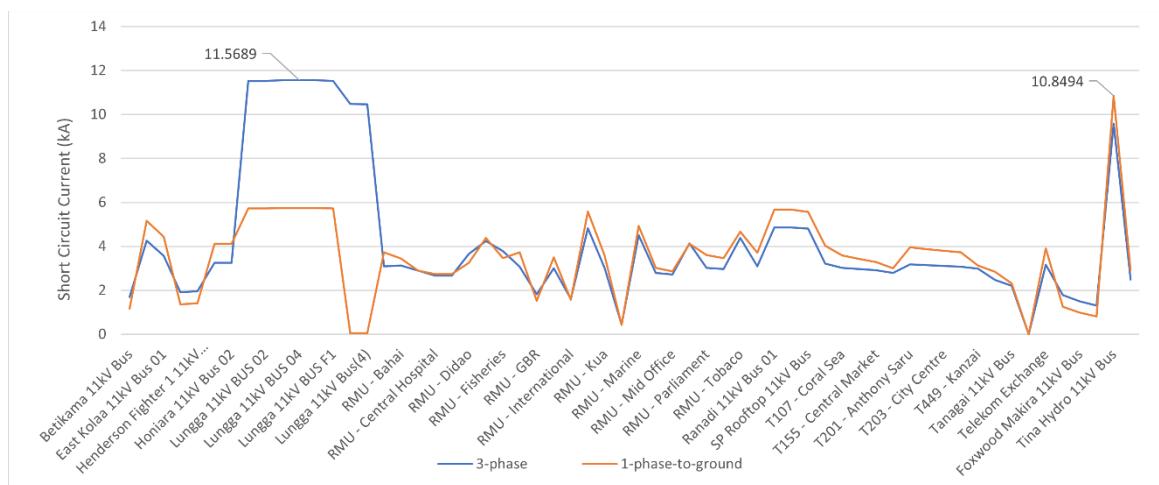


Figure 4.30. Short Circuit Results - Year 2030

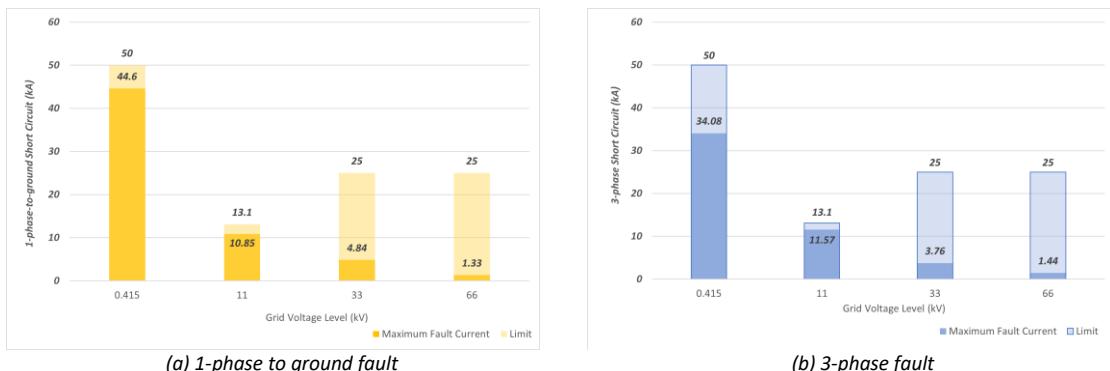


Figure 4.31. Short circuit current results against limits at all voltage levels - Year 2030

5 Recommendations and Conclusions

The completed steady-state studies analyze the SP electrical system post connection of the proposed PV systems at Betikama, Henderson, Tenaru, Foxwood, Tasahe, Okea, Tanagai, and Ranadi, and the connection of the proposed 15MW Tina Hydro Station. This study sought to determine the maximum PV penetration into the grid based on the Honiara Roadmap and SP plans to achieve 100% RE by 2030. The proposed connection points on the East Honiara Feeder 1 were provided by the Planning Department of Solomon Power. Suggested actions based on the studies incorporating the proposed plans to the Solomon Power grid at Honiara are presented in the tables below.

Table 5.1. Summary of Suggested Actions and Network Modifications

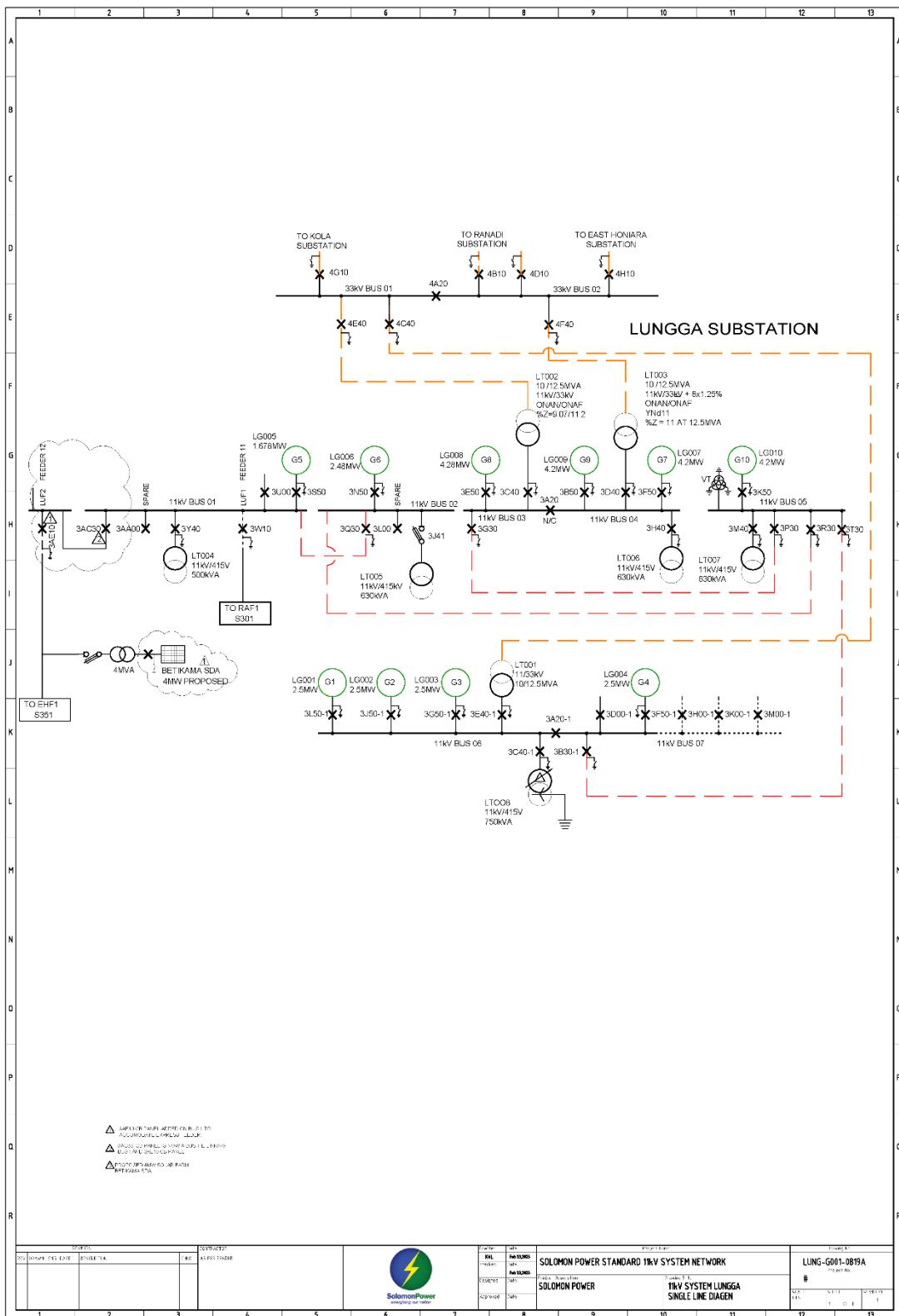
Equipment	Action	Time
T613, T011, T615	Experience overloads up to 112% of rated capacity. Upgrade each transformer to ensure load is at 50-60% of rated capacity for optimal performance. Alternatively, install additional transformer units at high demand load centers to lower transformer rating to within 50-60% of rated capacity. It is suggested that this be implemented for these 3 transformers.	2021
HDC 7/1.00 overhead conductors on East Honiara Feeder 2	Experience overloads that range up to 173% of rated capacity at maximum projected demands for 2030. Limited transmission capacity on these lines (69A) along EHF2 to high demand load centers. It is suggested that these cables be upgraded to 11kV ACSR/GZ Apple 6/1/3.00 (209A).	2021-2030
WRT001, T613, T615, T607, EHT001, T465	Experience overloads up to 136% of rated capacity. Upgrade each transformer to ensure load is at 50-60% of rated capacity for optimal performance. Alternatively, install additional transformer units at high demand load centers to lower transformer rating to within 50-60% of rated capacity. It is suggested that this be implemented for these 6 transformers.	2025
T613, T011, WRT001, T615, EHT001, T607, T465, T251, T714, T606	Experience overloads up to 132% of rated capacity. Upgrade each transformer to ensure load is at 50-60% of rated capacity for optimal performance. Alternatively, install additional transformer units at high demand load centers to lower transformer rating to within 50-60% of rated capacity. It is suggested that this be implemented for these 6 transformers.	2030
4MW/2MWh BESS Connected at Lungga Power Station	As proposed by JICA to provide short-cycle fluctuation control to stabilise small fluctuations introduced to the grid by connected PV systems. This would be connected direct to the 33kV network to form the backbone system.	2021-2030
4MW/24MWh BESS Connected at White River Substation	As proposed by JICA to provide long-period fluctuation control for peak shifting purposes and would be connected to the 11kV grid in order to limit the flow of BESS charging current through the network.	2021-2030
Tenaru 4MW PV, Foxwood 3MW PV, Okea 4MW PV,	Integration to the SP grid on East Honiara Feeder 1 led to the voltage profile exceeding the 10% upper limit and introducing system instability. Curtailment of these PV systems by taking them out of service returned the voltage profile on EHF1 to acceptable levels. It is suggested that these be connected to Lungga PS via a separate feeder.	2025-2030
Betikama 4MW PV	Integration to the SP grid on East Honiara Feeder at rated capacity contributed to the voltage profile exceeding the 10% upper limit and introducing system instability. Curtailment to 1.5MW returned the voltage profile on EHF1 to acceptable levels. It is suggested that these be connected to Lungga PS via a separate feeder.	2025-2030
Setpoint voltage of 1.05 at Generator 2, Lungga PS	The 1.05 setpoint resulted in elevated voltage profile on EHF1. A reduction to 1.025 allowed the connection of the Betikama PV but at rated capacity of 1.5MW.	2025-2030

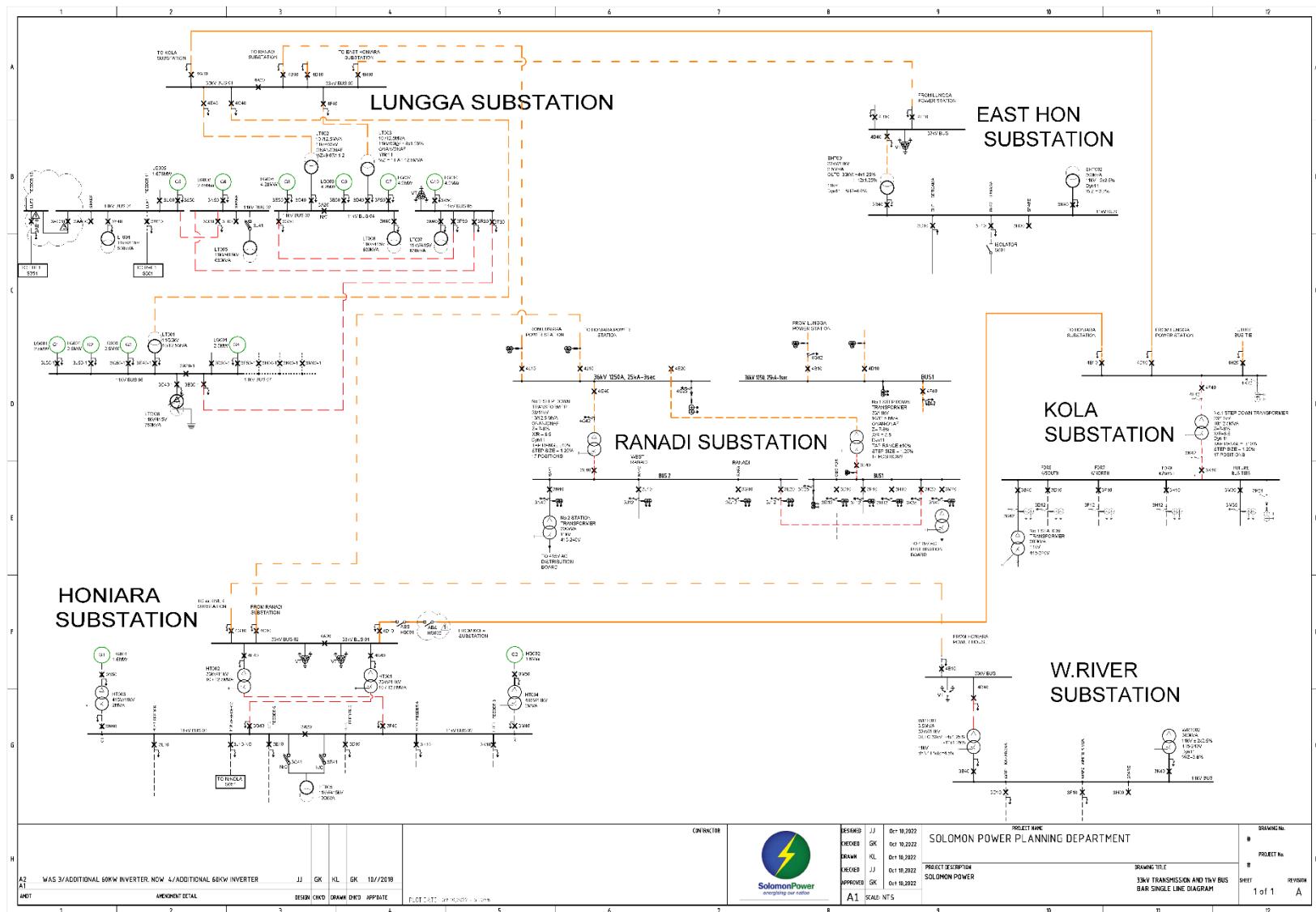
6 References

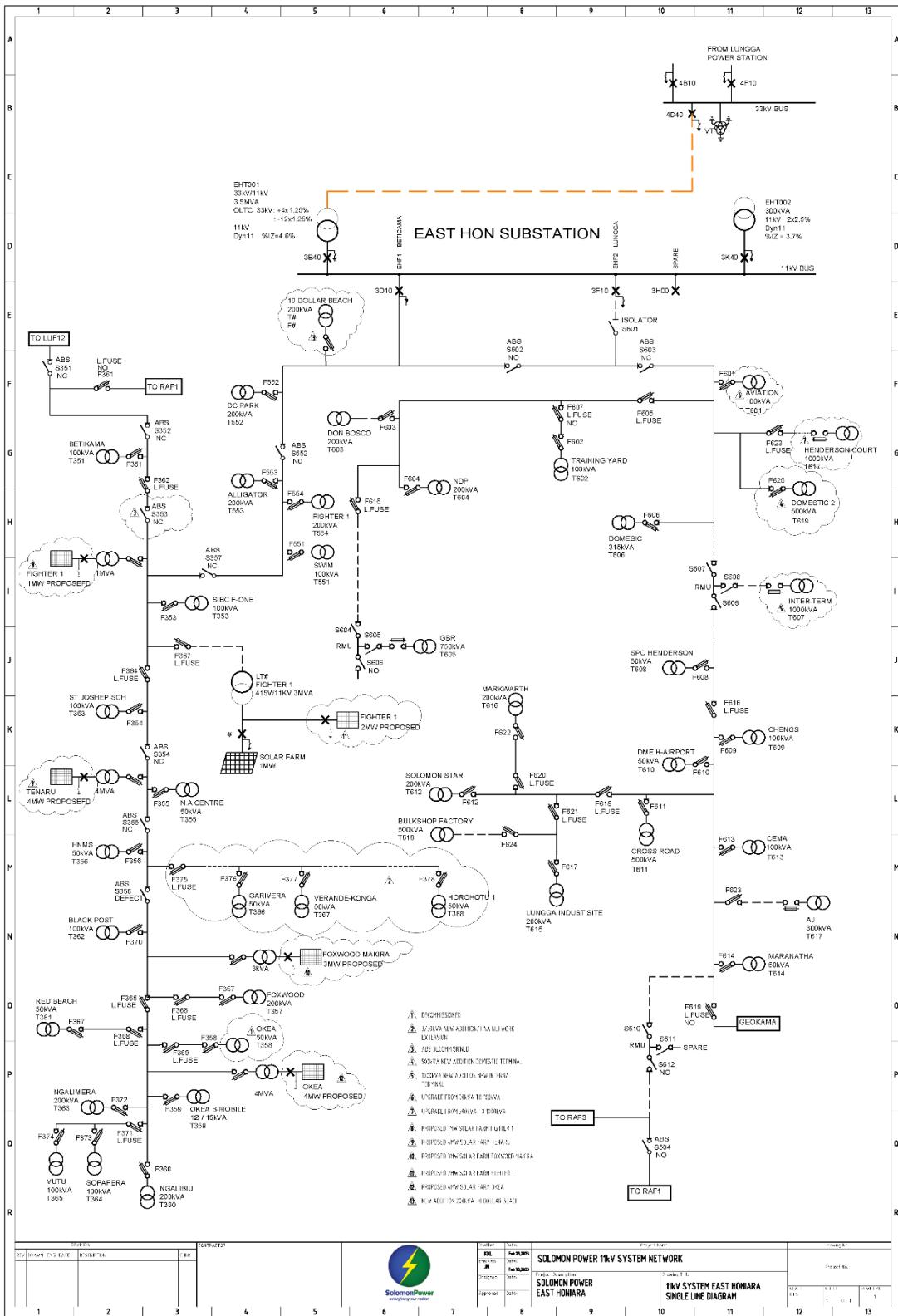
No	Document	Description
1	The Project for Formulating Renewable Energy Road Map in Solomon Islands, May 2021	Roadmap formulated by JICA outlining plans for the Solomon Islands to achieve 100% RE by 2030.
2	Protection Review for Solomon Power, January 2022	Protection review conducted by PRDC, India
3	Honiara Power System operation with Tina River Hydro, 30 June 2022	An analysis and modelling of the generation dispatch with the connection of Tina Hydro to the grid.
4	33kV and 11kV single line diagram	Single line diagram of the Honiara grid transmission and distribution network

7 Appendices

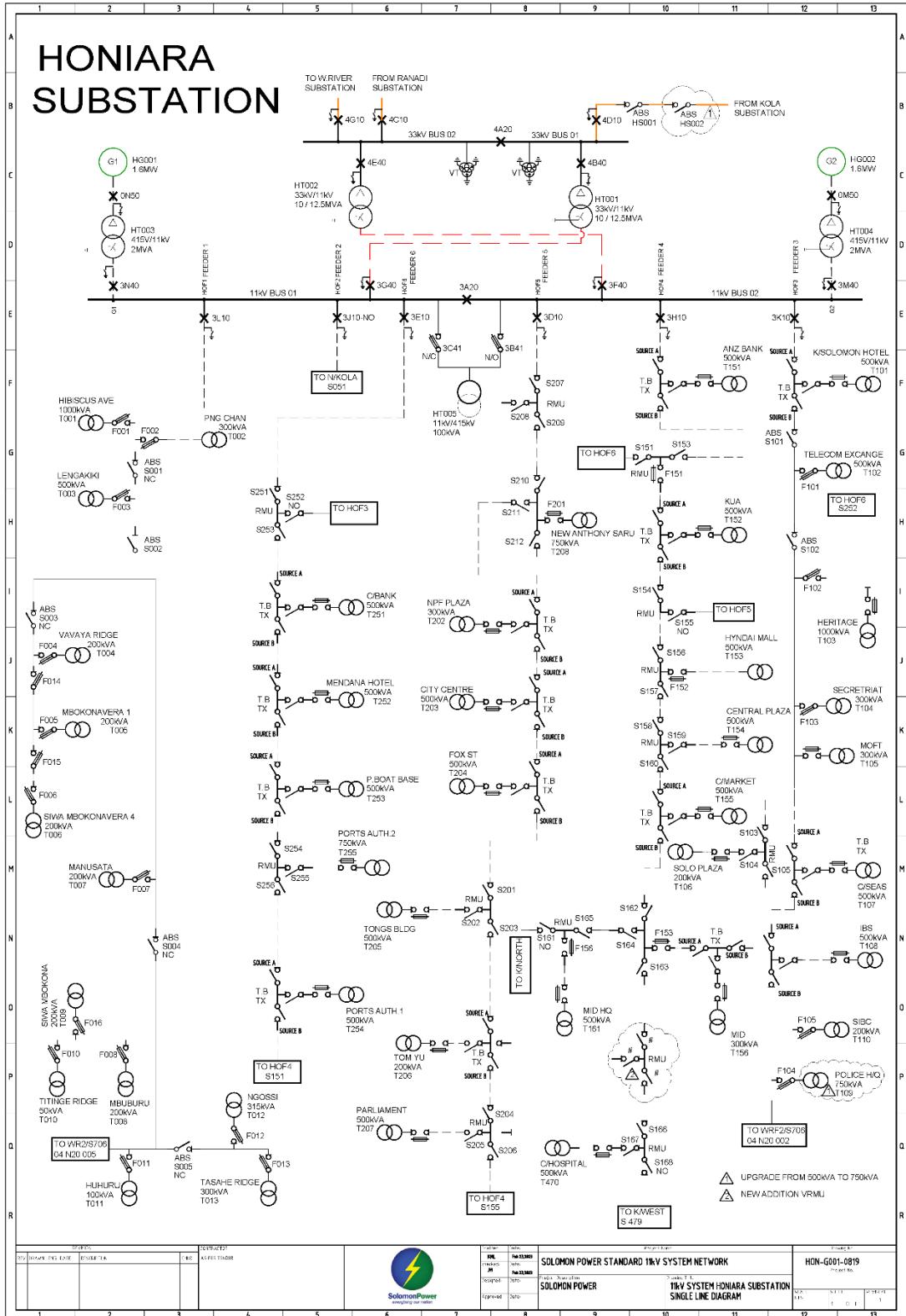
7.1 Network Single Line Diagram

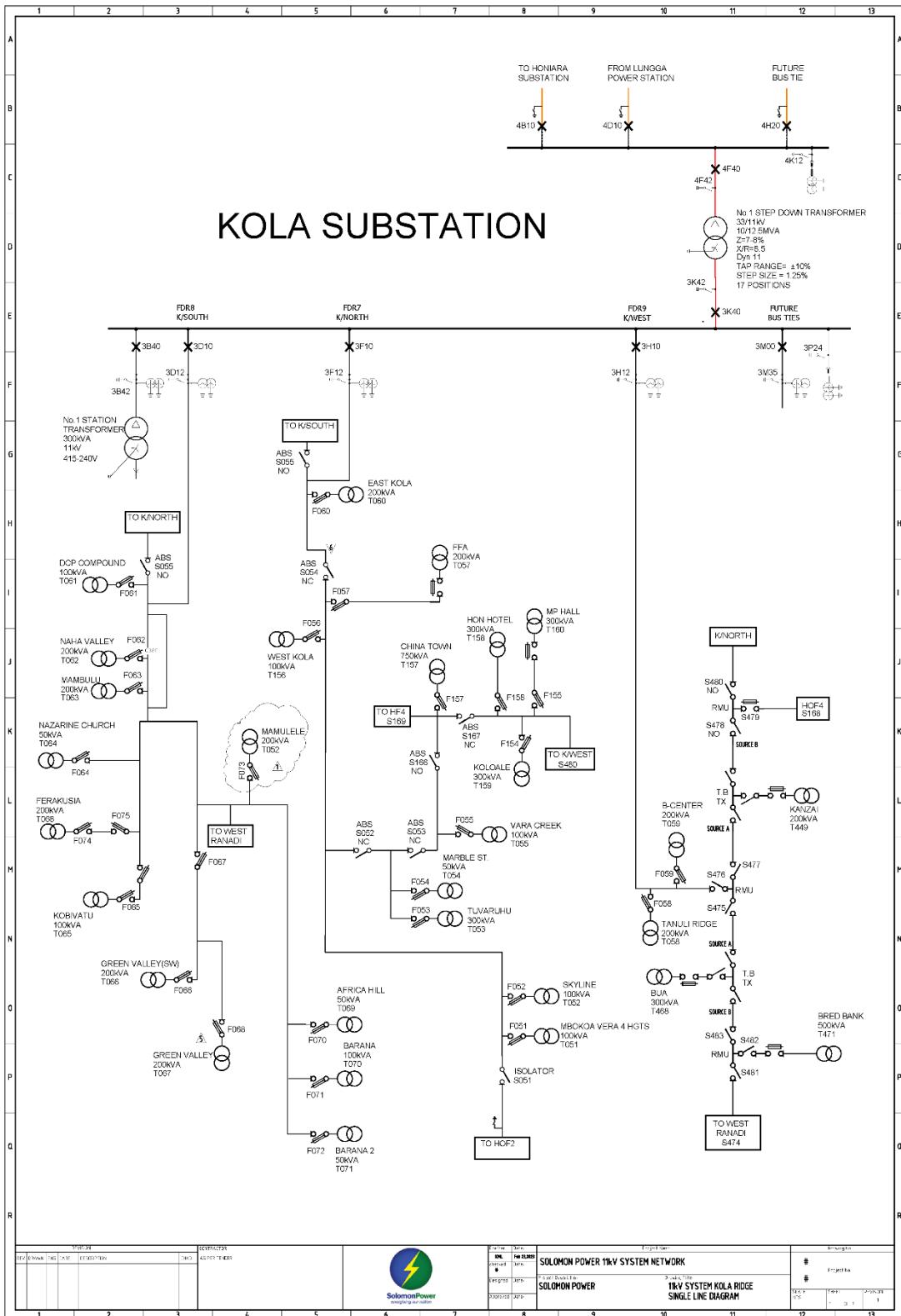


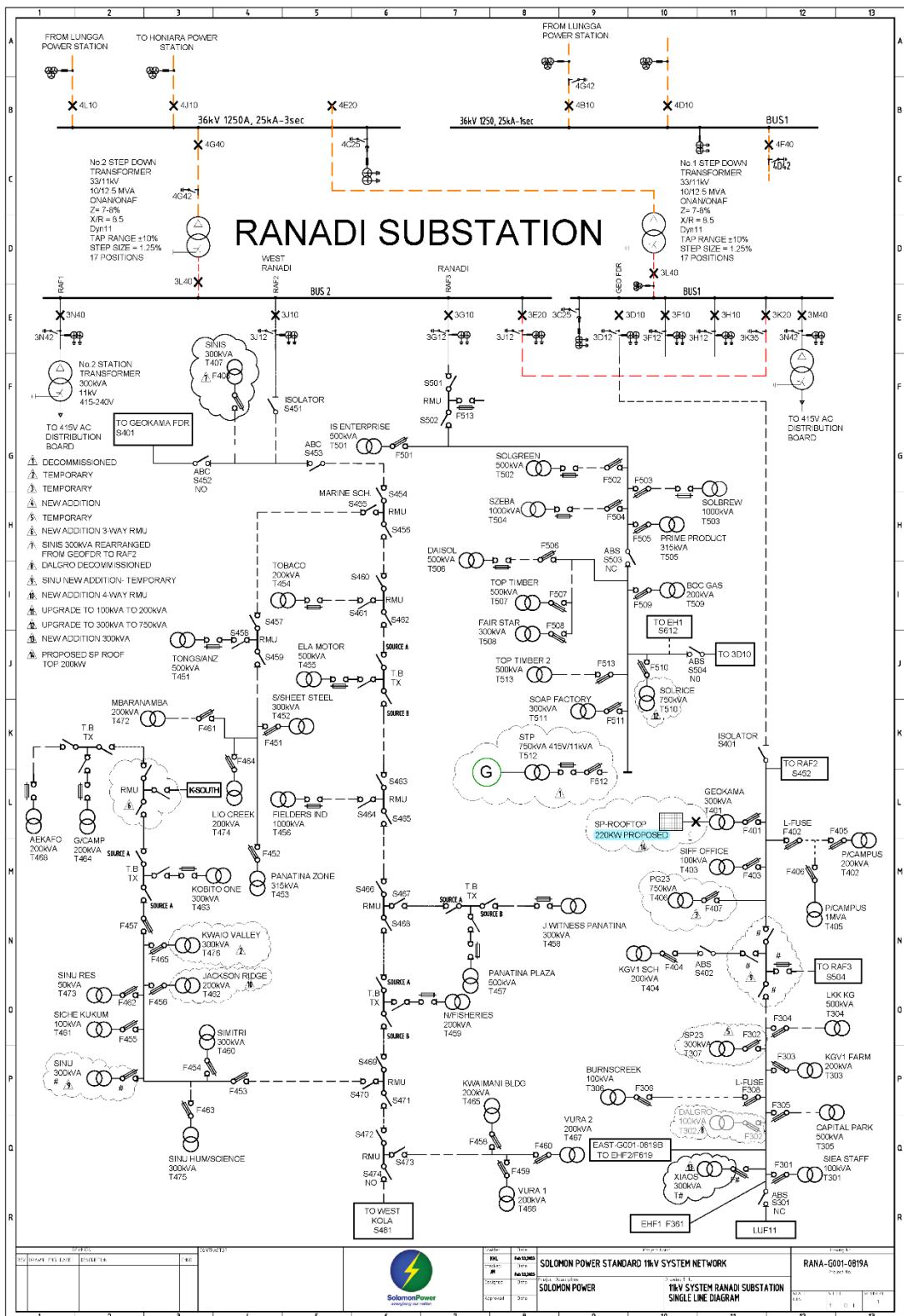




HONIARA SUBSTATION

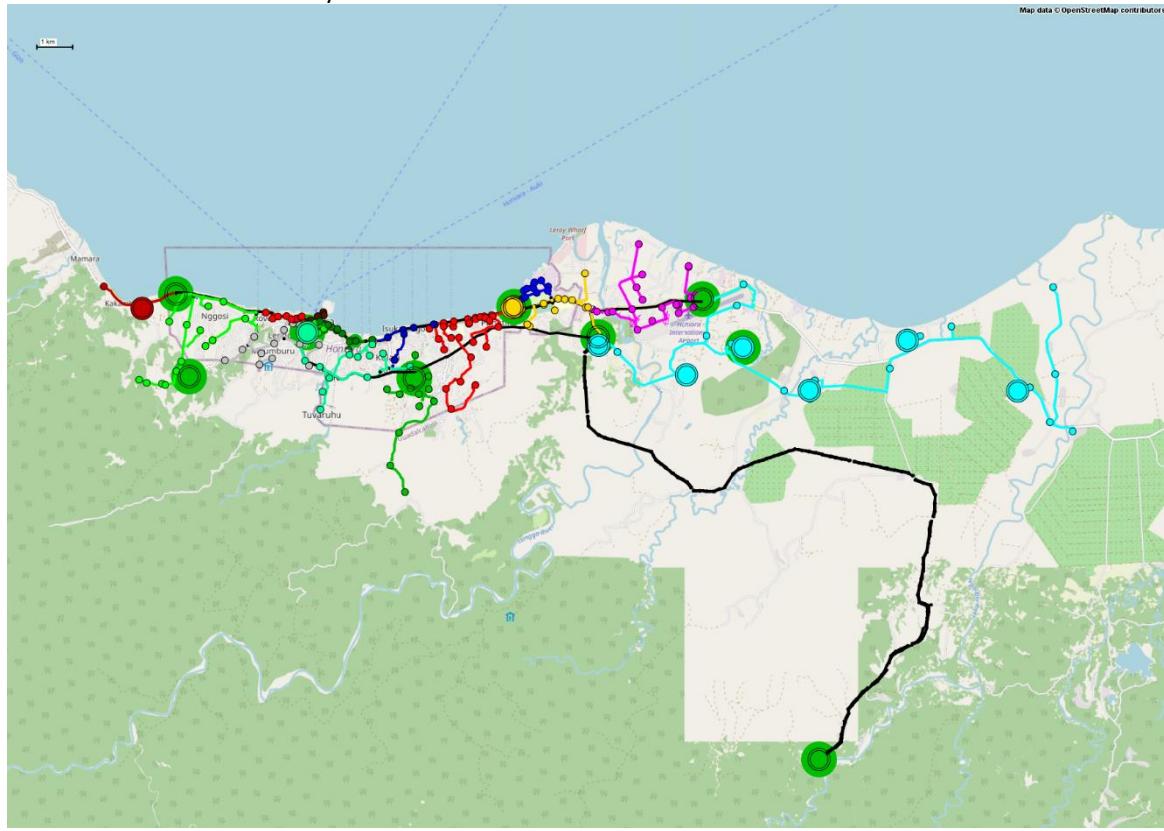




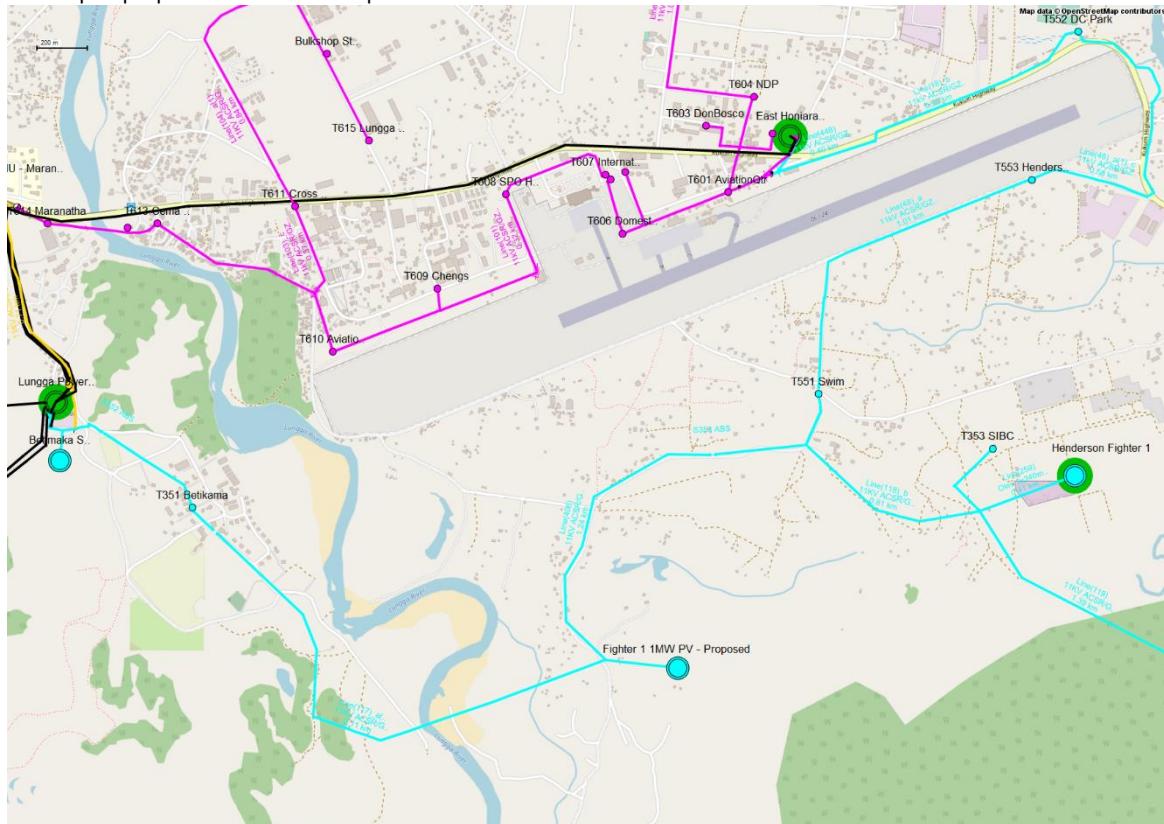


7.2 Software Network Model

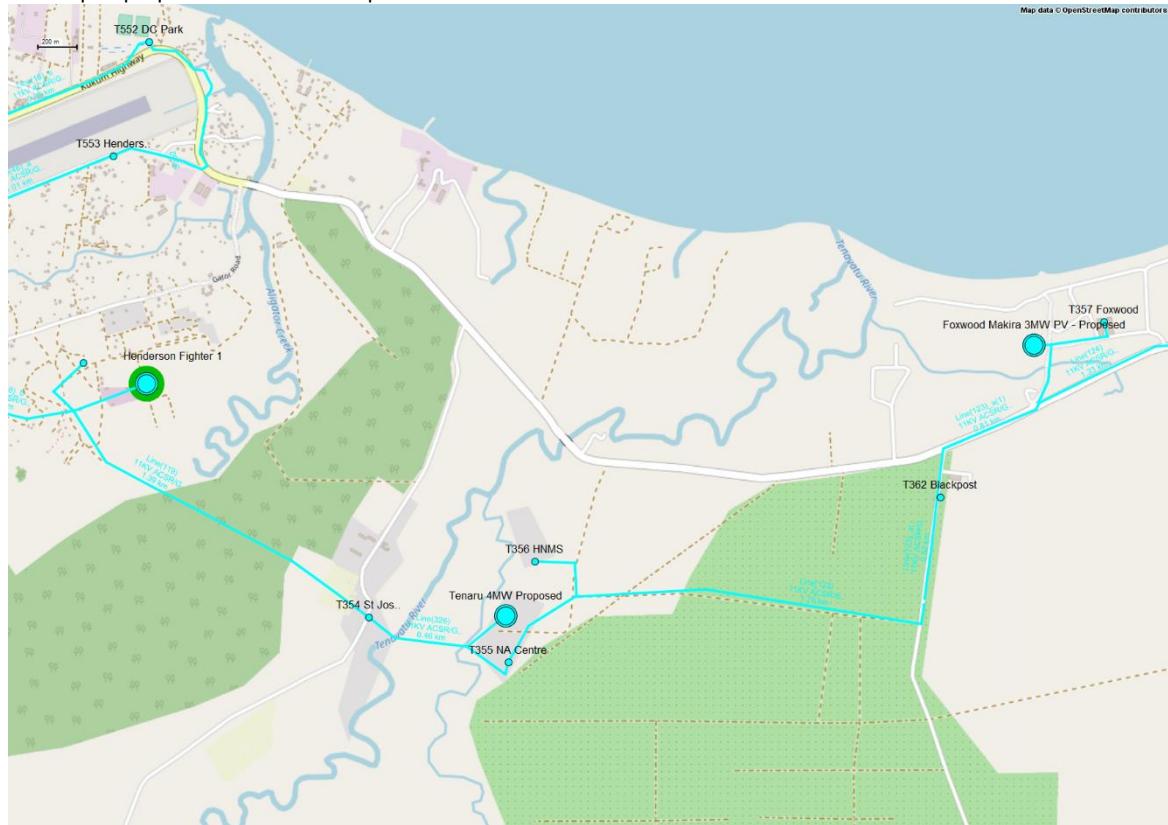
Model of Honiara Grid in the year 2030



Close-up of proposed PV connection points on EHF1 – Part 1



Close-up of proposed PV connection points on EHF1 – Part 2



Close-up of proposed PV connection points on EHF1 – Part 3

