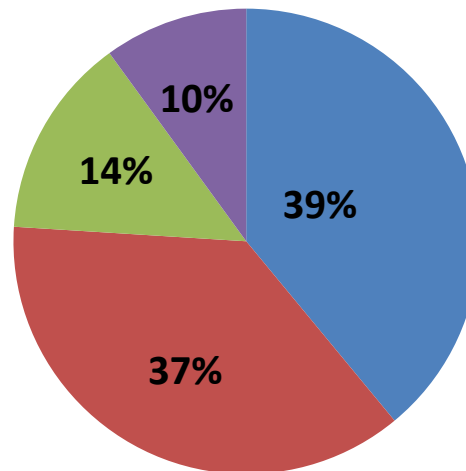


PNG Energy Profile

Total Installed Electricity Capacity: 580 MW

Electrical Energy Sources

■ Hydro ■ Diesel ■ Natural Gas ■ Geothermal



Potential Renewable Energy sources

- Solar Energy
- Wind
- Biomass
- Bio-Gas

PNG Power Ltd

- 100% Government owned.
- PPL manages approximately 300 MW Capacity
- IPPs manages 280 MW
- 3 Main Grids:
- Provincial Power Systems (Diesel)
- No Access to Electricity (85%)
- Vision 2050 Strategic Plan – Every household have access to electricity.

Nauro Brown Hydro Feasibility Study

A Case study of the feasibility of
connecting 2 x 40 MW Hydro
Generator into the Port Moresby
System

Introduction

- This Power System Study was carried out to identify the Feasibility of connecting the NB Hydro to the existing Port Moresby System and its Impact on System Performance.

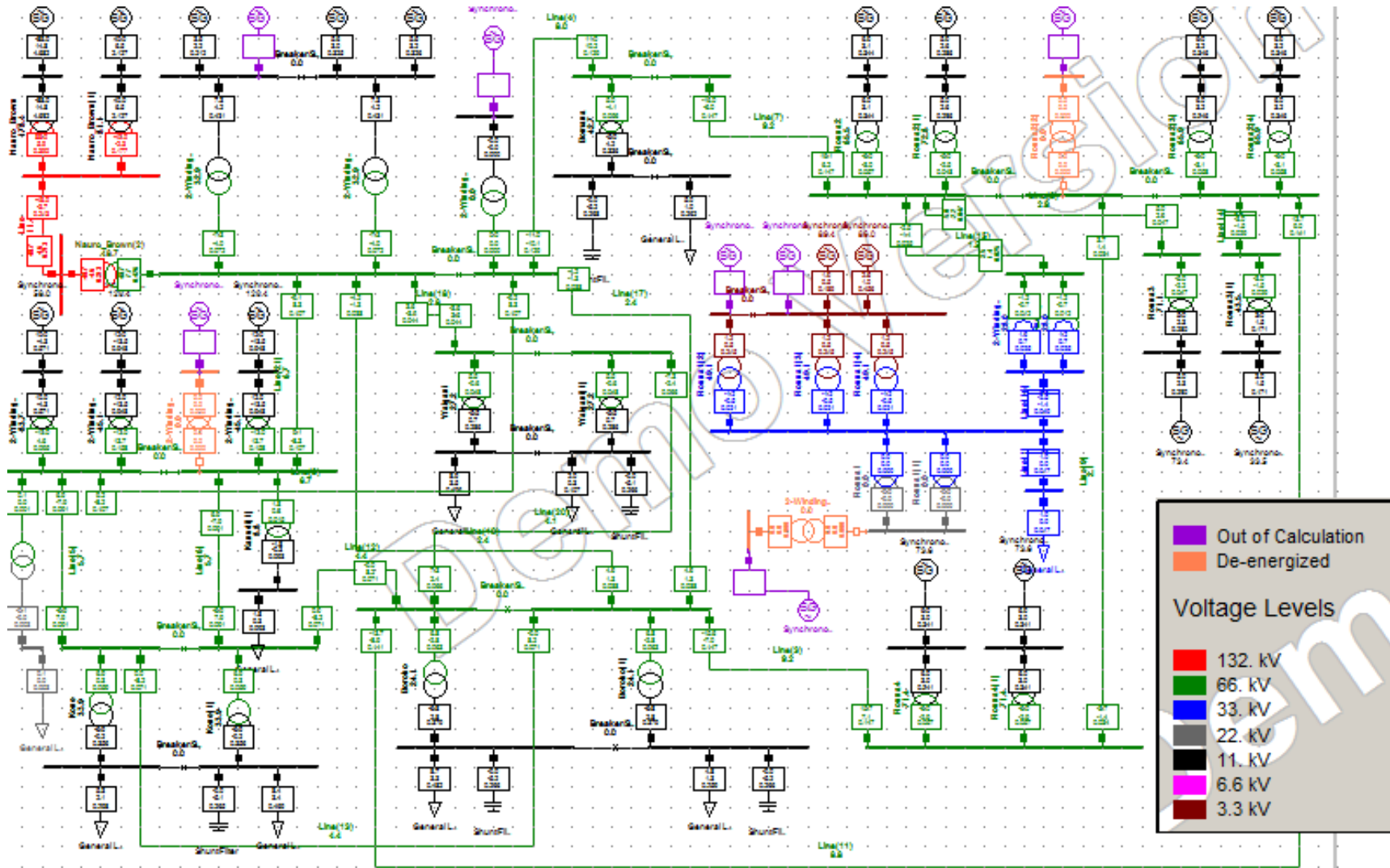
Objectives

- Develop a PowerFactory Network Model for the Port Moresby System
- Investigate the Impact of the Proposed Power Connection on the existing Port Moresby Grid System
- Identify any Limitations or Requirements
- Evaluate the transmission requirement of the plant

Study Methodology

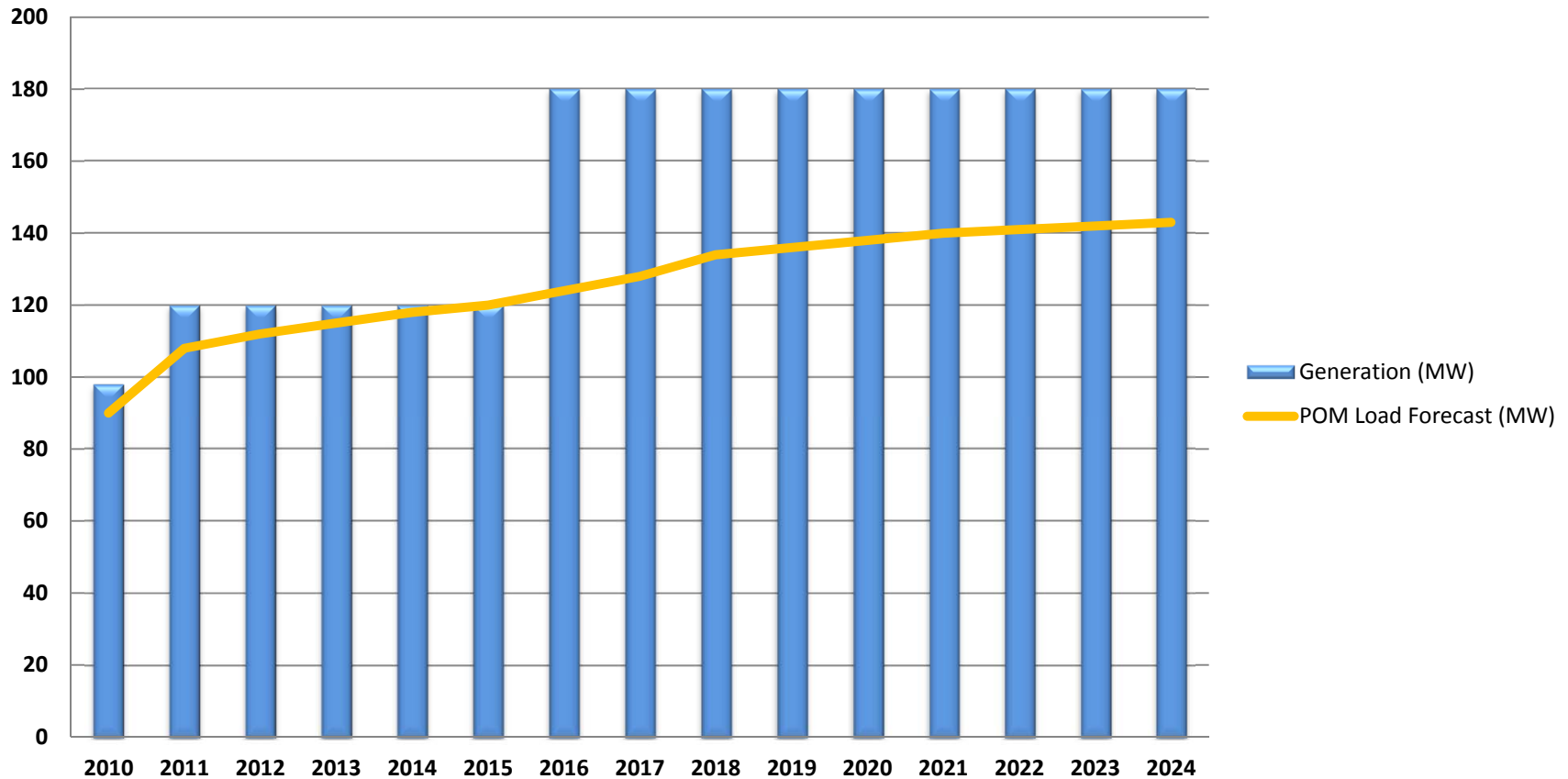
- Develop Load-Generation Curve for the study period
- Develop the Network Study Model using PowerFactory Software
- Build Operation Scenarios using the Network Study Model
- Do Steady State Analysis

Port Moresby System



15 Years Load Generation Curve for Port Moresby

Load Generation Curve for POM System



Study Cases

- Forecasted Load and Future generation Plans are considered to build the study cases

Year	Load Type	POM Load (MW)	System Generation Requirements							Total Max. Online Generation (MW)
			Rouna Hydro	Kanudi Diesel	Moitaka Diesel	Kanudi Gas	Moitaka Gas	NB1	NB2	
Maximum Generation (MW)			40	24	24	20	10	40	40	198
2016	Min	52	18	OFF	OFF	OFF	OFF	40	40	98
2016	Max	120	40	24	18	OFF	OFF	40	40	162
2020	Max	132	40	24	24	10	OFF	40	40	178
2024	Max	142	40	24	24	20	OFF	40	40	188

N-1 Contingency

- Worst Case N-1 Contingency in the System would be the tripping of one of the NB Generators.
- 132 kV line trip (both NB Generator trip) is not considered. **This scenario would require all existing generators to cover for the load-generation imbalance.**
- This study assumes PNG Power will not consider full N-1 Security.

QV Analysis

- Top Three Worst Contingencies

1) **Contingency 1:** Trip branch from bus 20262 (Moitaka) to Bus 20561 (Kanudi)

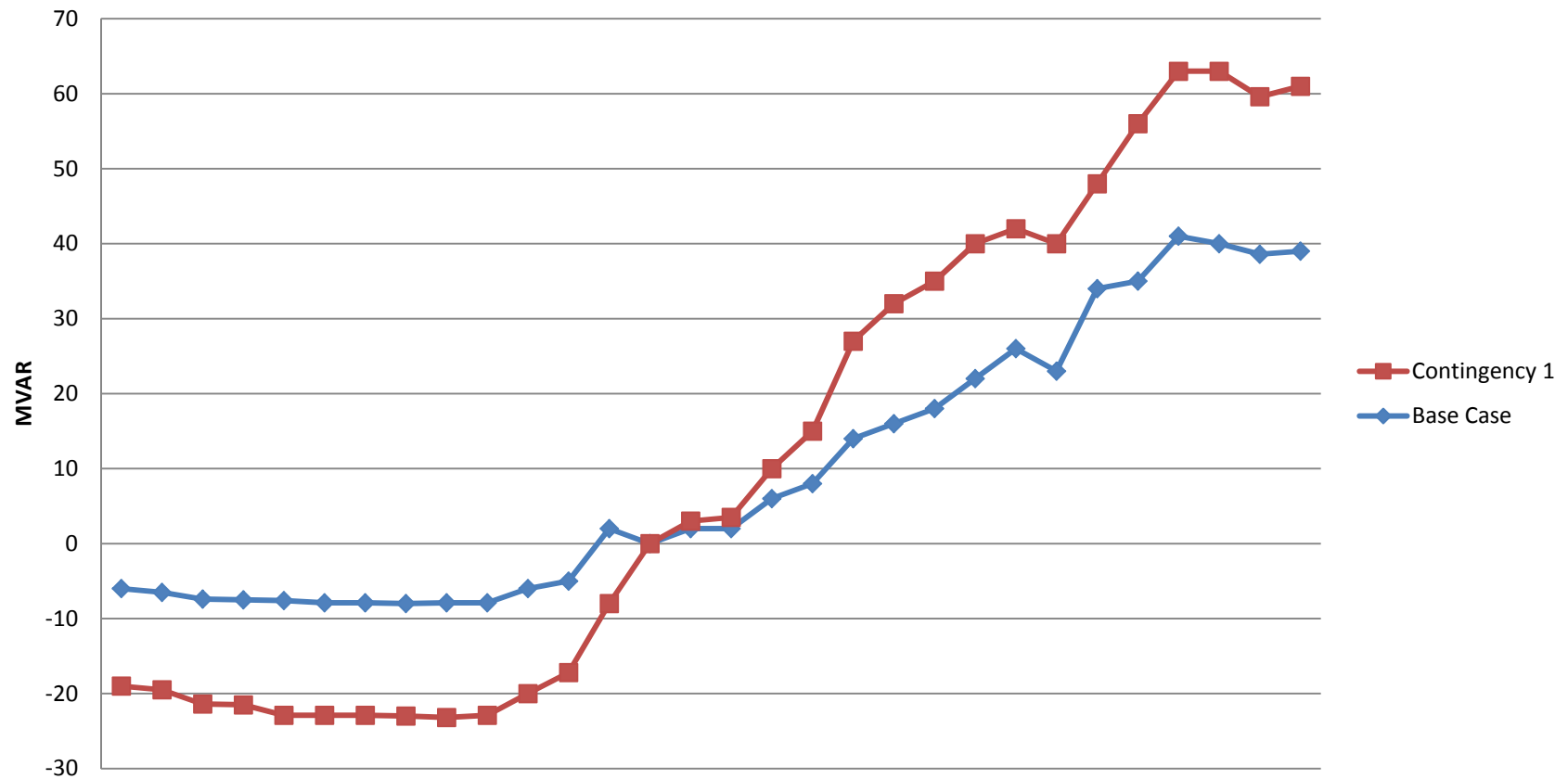
2) **Contingency 2:** Trip Branch from bus 20163 (Rouna 2) to Bus 20761 (Boroko)

3) **Contingency 3:** Trip one of NB machine

Test done using $V_{pu} = 0.72$ to 1.02

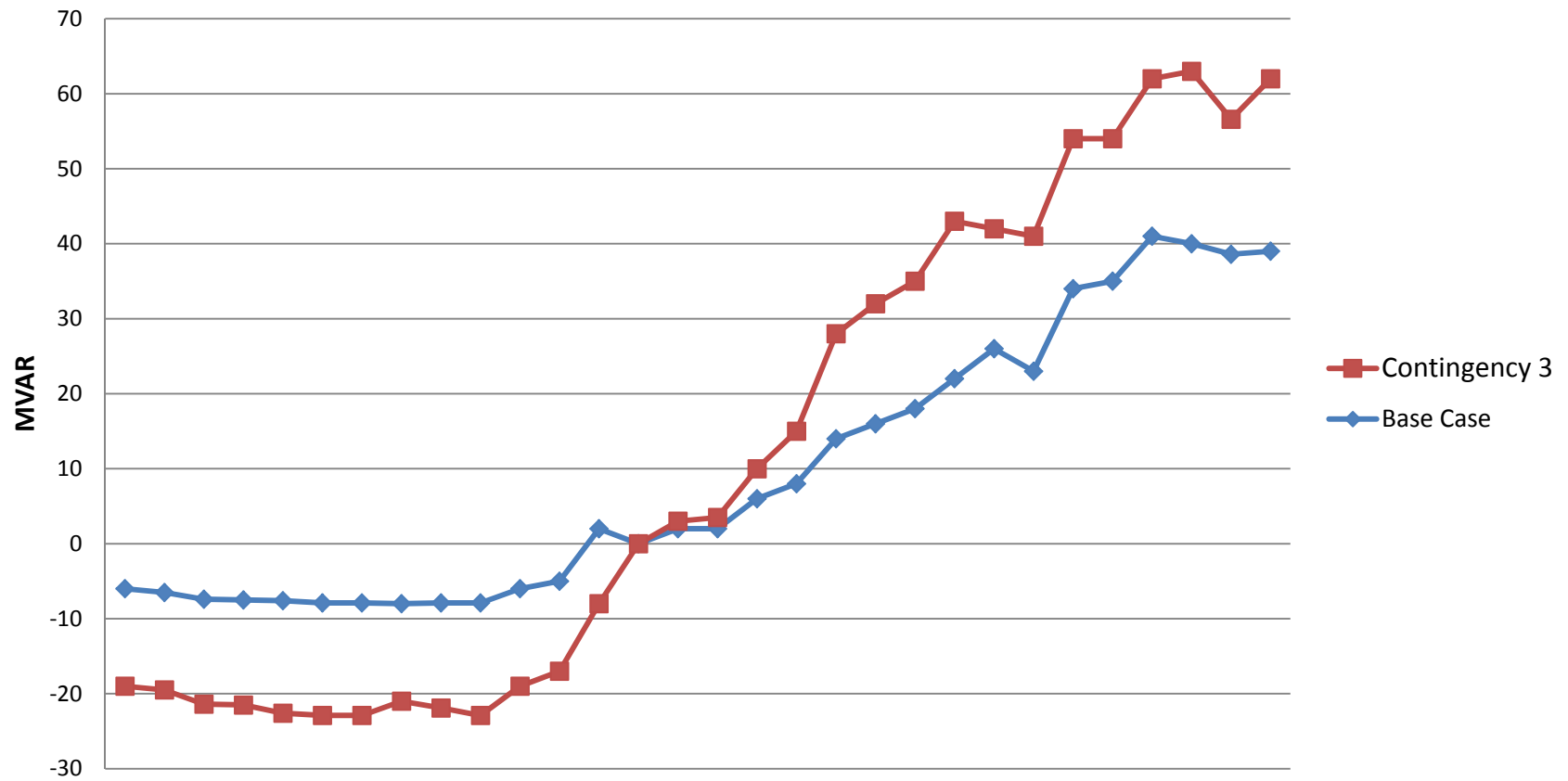
QV Results for all Contingencies for 2020 Minimum Load Scenario

Contingency 1 QV Analysis



QV Analysis

Contingency 3 QV Analysis



Voltage Profile 1

- Steady State Voltage Profile for 2016 Minimum Load Scenarios

Bus Name	Base kV	Steady State Voltage (PU)		
		Both NB Generators in Service	NB_Gen2 Trip	Voltage Variations
NB_Gen1	11	1.05	1.05	0
NB_Gen2	11	1.05	1.012	-0.038
NB_132	132	1.028	1.012	-0.016
MK2D_11A	11	0.971	0.96	-0.011
MK2D_11B	11	0.971	0.96	-0.011
MK2_66A	66	0.971	0.96	-0.011
MK2_66B	66	0.971	0.96	-0.011
MK2_132	132	0.999	0.987	-0.012

Voltage Profile 2

- Steady State Voltage Profile for 2016 Maximum Load Scenarios

Bus Name	Base kV	Steady State Voltage (PU)		
		Both NB Generators in Service	NB_Gen2 Trip	Voltage Variations
NB_Gen1	11	1.05	1.04	0
NB_Gen2	11	1.05	0.995	-0.055
NB_132	132	1.012	0.995	-0.017
MK2D_11A	11	1.03	1.03	0
MK2D_11B	11	1.03	1.03	0
MK2_66A	66	0.999	0.998	-0.001
MK2_66B	66	0.999	0.998	-0.001
MK2_132	132	0.967	0.966	-0.001

Voltage Profile 3

- Steady State Voltage Profile for 2020 Maximum Load Scenarios

Bus Name	Base kV	Steady State Voltage (PU)		
		Both NB Generators in Service	NB_Gen2 Trip	Voltage Variations
NB_Gen1	11	1.05	1.05	0
NB_Gen2	11	1.05	1.008	-0.042
NB_132	132	1.018	1.008	-0.01
MK2D_11A	11	1.05	1.05	0
MK2D_11B	11	1.05	1.05	0
MK2_66A	66	1.018	1.014	-0.004
MK2_66B	66	1.018	1.014	-0.004
MK2_132	132	0.98	0.98	0

Voltage Profile 4

- Steady State Voltage Profile for 2020 Maximum Load Scenarios

Bus Name	Base kV	Steady State Voltage (PU)		
		Both NB Generators in Service	NB_Gen2 Trip	Voltage Variations
NB_Gen1	11	1.05	1.05	0
NB_Gen2	11	1.05	1.008	-0.042
NB_132	132	1,015	1.008	-1013.992
MK2D_11A	11	1.047	1.05	0.003
MK2D_11B	11	1.047	1.05	0.003
MK2_66A	66	1.009	1.014	0.005
MK2_66B	66	1.009	1.014	0.005
MK2_132	132	0.974	0.98	0.006

Fault Level Analysis

- Lack of Software Knowledge.

Losses

Case	Total Power Loss (MW)	New Line Loss (MW)
Without NB	2.5	0
2016_Min	1.2	0.7
2016_Max	3.9	1.6
2020_Max	4	1.7
2024_Max	4.2	1.8

Conclusion

1. POM system be under-generated system without the NB Hydro Plant by 2016.
2. Difficult to maintain full N-1 system security due to 132 kV Line Trip.
3. Recommended 15 MVAR reactive support at connection point.
4. Switching studies acceptable voltage dips during single NB generator trip.