WESTCOAST NEW ZEALAND ENERGY-COMMUNICATION RESILIENCE ASSESSMENT FACTORING AF8 LIKELY TRAJECTORIES

Presenters: Duncan Kaniaru, Farrukh Latif

Energy-Communication Resilience Research Group

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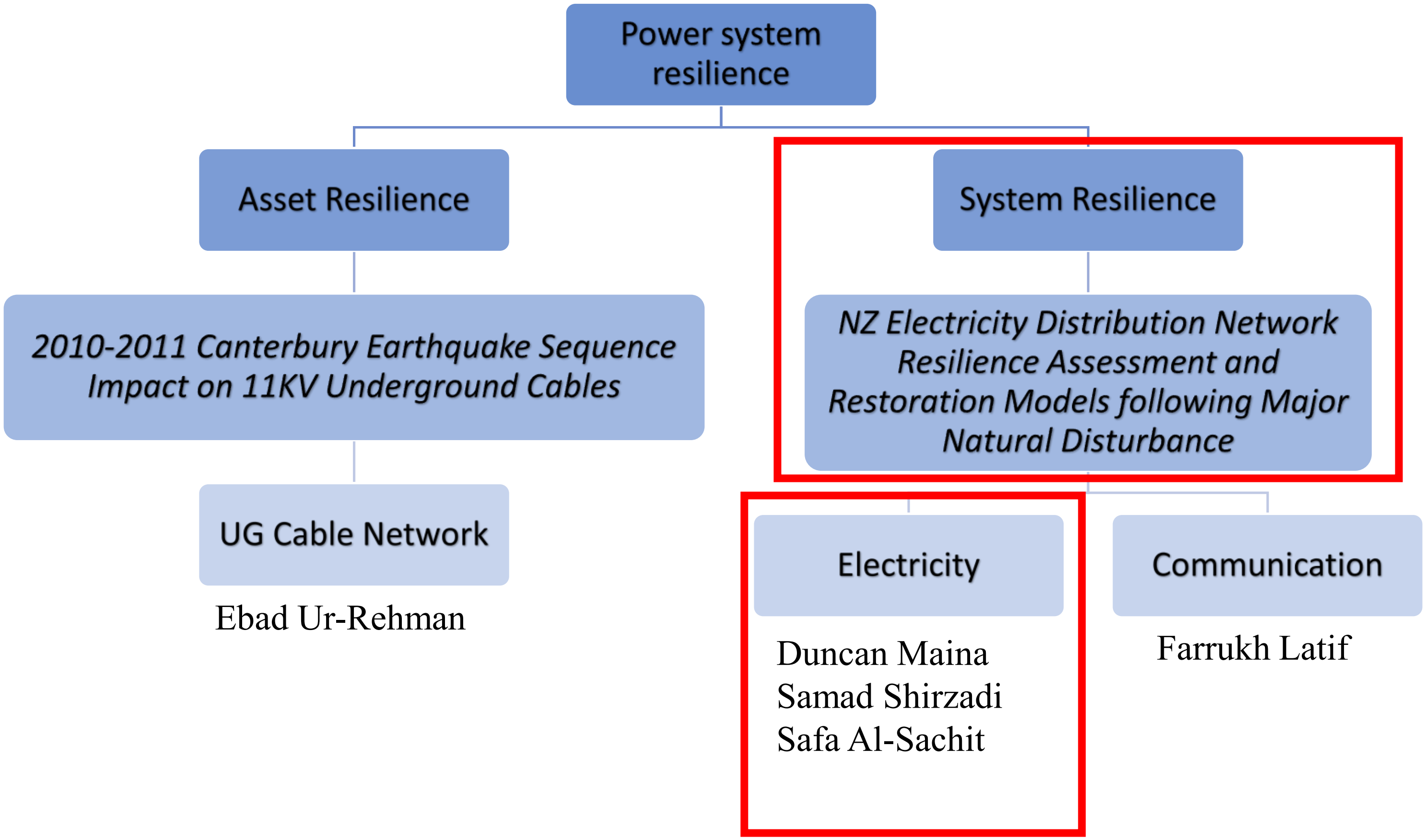
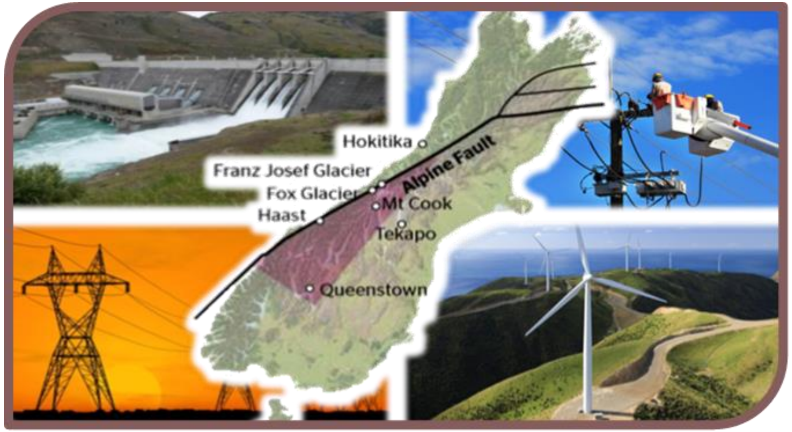
Energy Communication: Resilience group



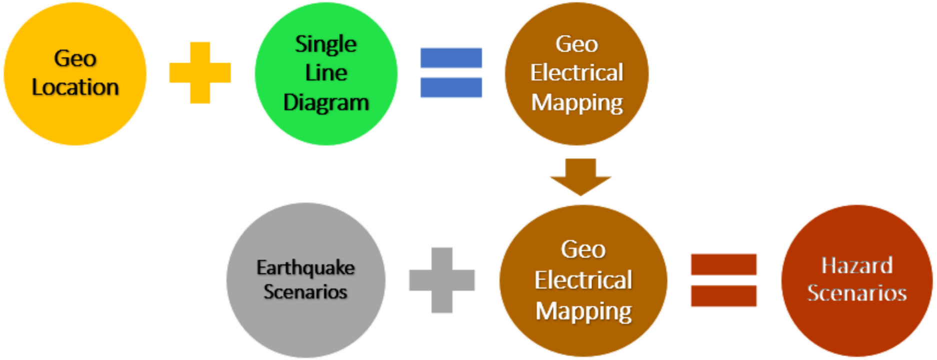
Project Milestones

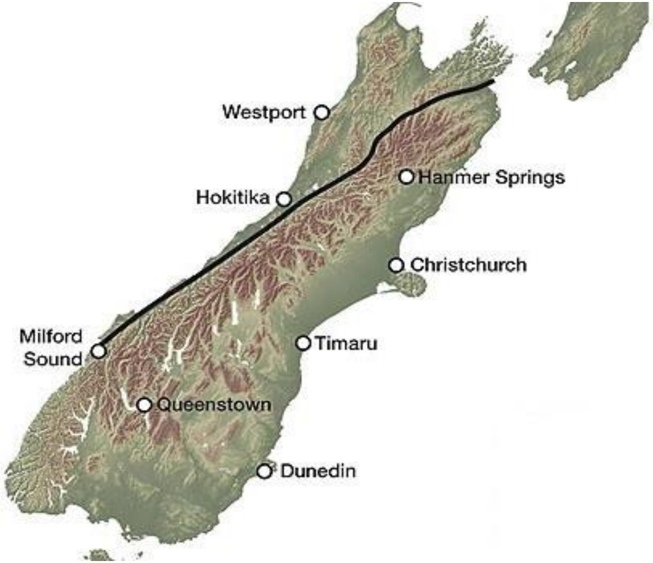
NZ Electricity Distribution Network Resilience Assessment and Restoration Models following Major Natural Disturbance

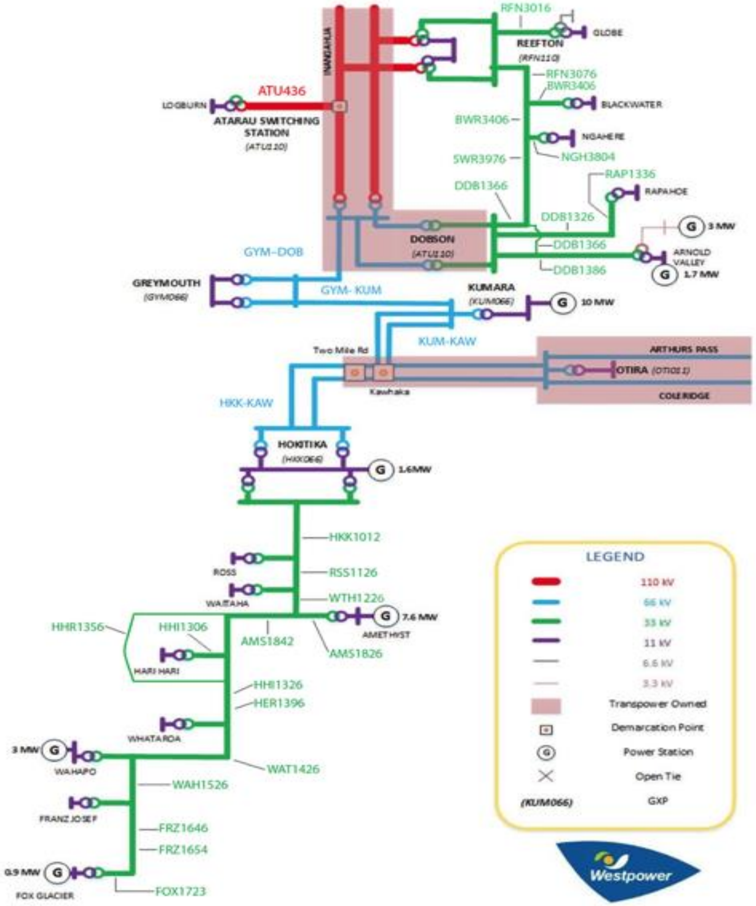


Nov 2017 to May 2018	*Hazard mapping to Infrastructure Impact*
Apr 2018 to Mar 2019	*Communication Infrastructure Provisions*
Jun 2017 to June 2019	*Simulation, Design and Testing for Micro-grid operation of West Coast*
May 2018 to Sept 2019	*Resilient energy-communication Utility Service Framework*

Milestone 1-Hazard Mapping





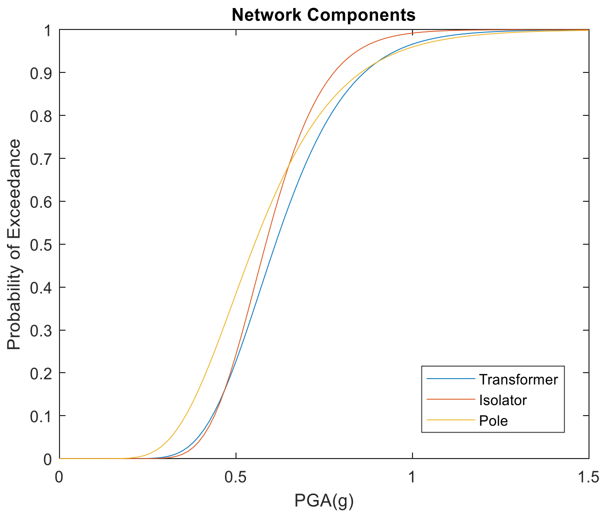


Milestone 1-Methodology

Component Fragility Curves

OR

Component Fragility Assumption



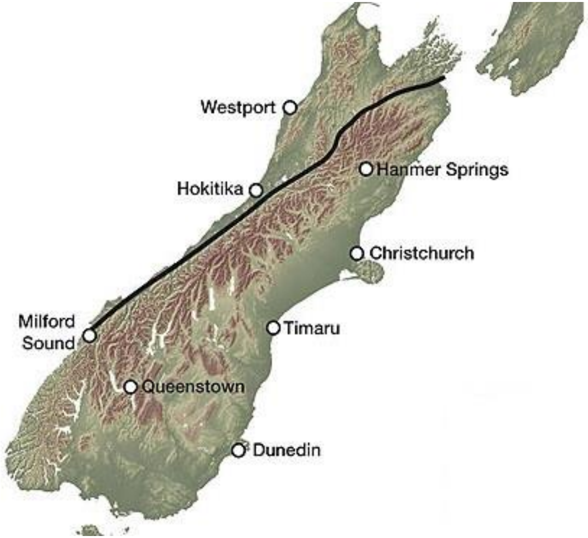
PGA

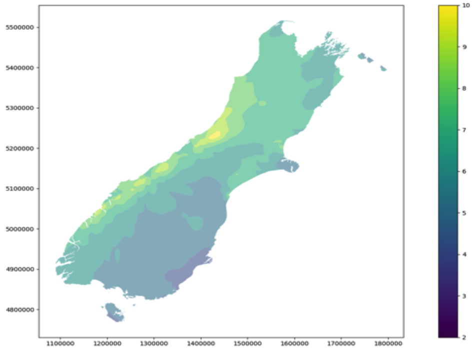
MMI

MMI _1
MMI _2
MMI _3
.
.
.
MMI _10

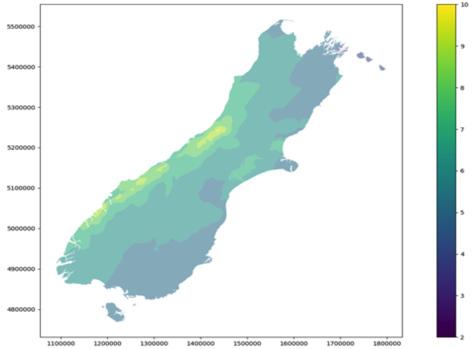
Damage Scenarios

Milestone 1 – Possible trajectories

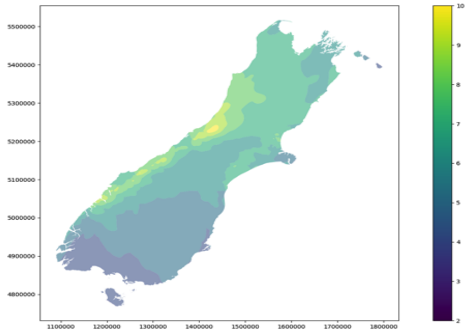




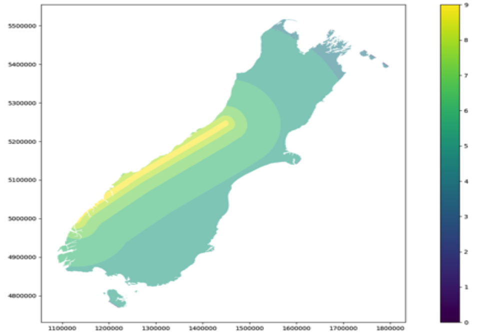
Central Hypocenter



Northern Hypocenter

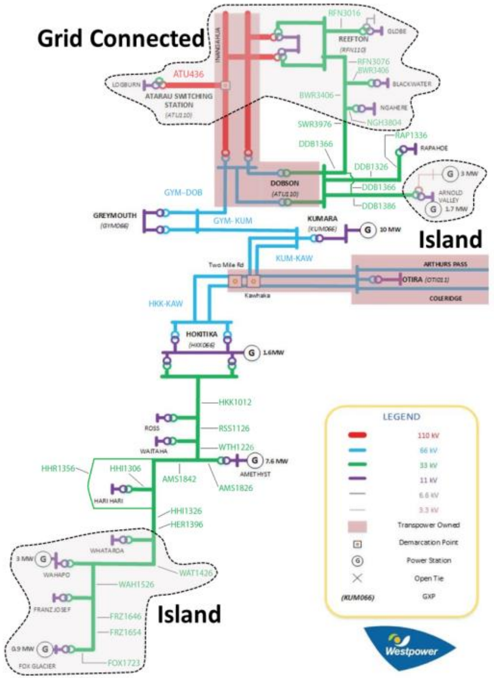


Southern Hypocenter

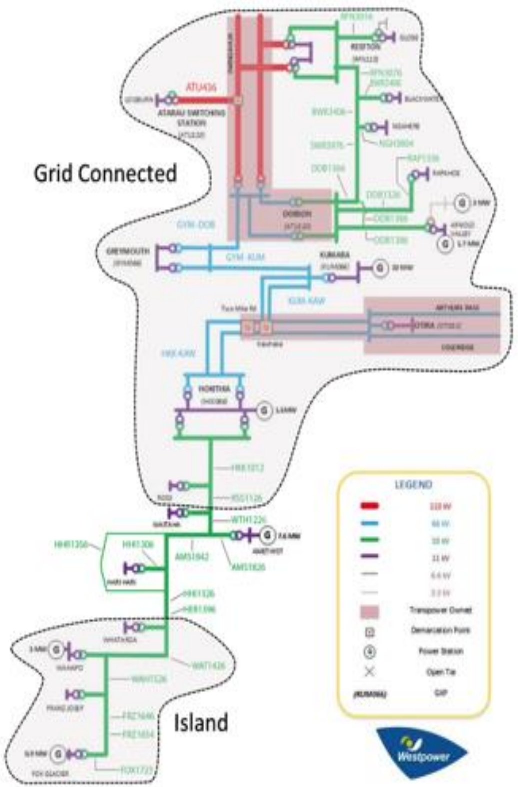


Empirical Southern Hypocenter

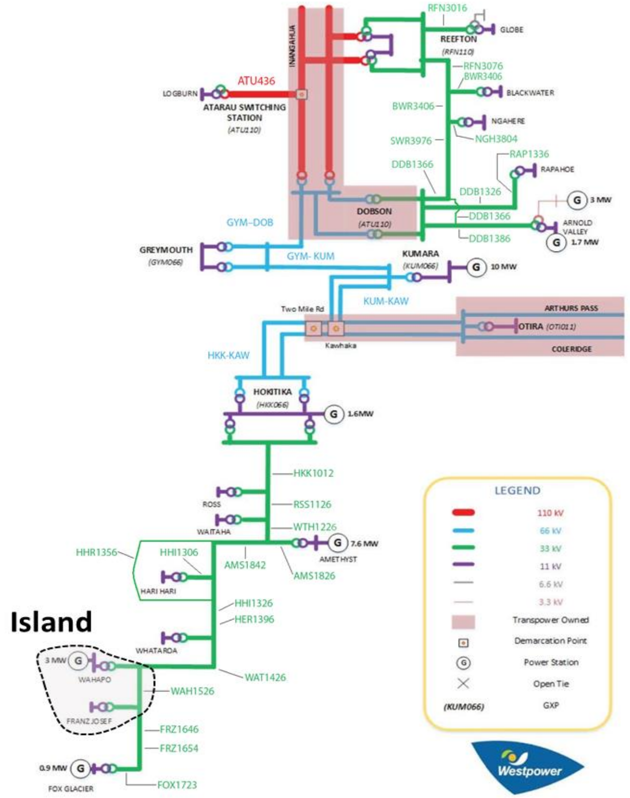
Milestone 1 – Examples of Possible Outcomes



CH MMI 9

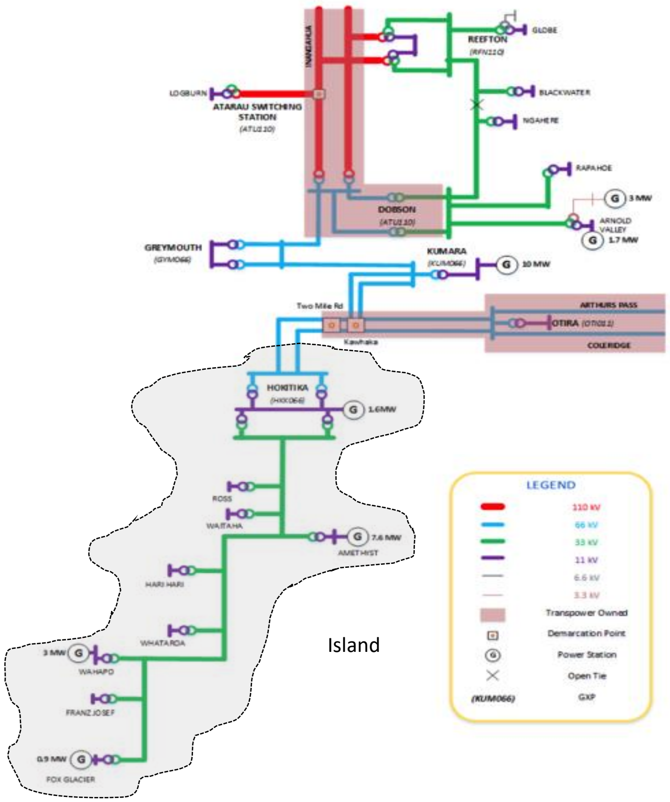


NH MMI 9



CH MMI 8

Milestone 1: Agreed Scenario



POWER OUTAGE

Stage 1: Initial Assessment
- Line Patrol
- Damage Assessment
- Component Status

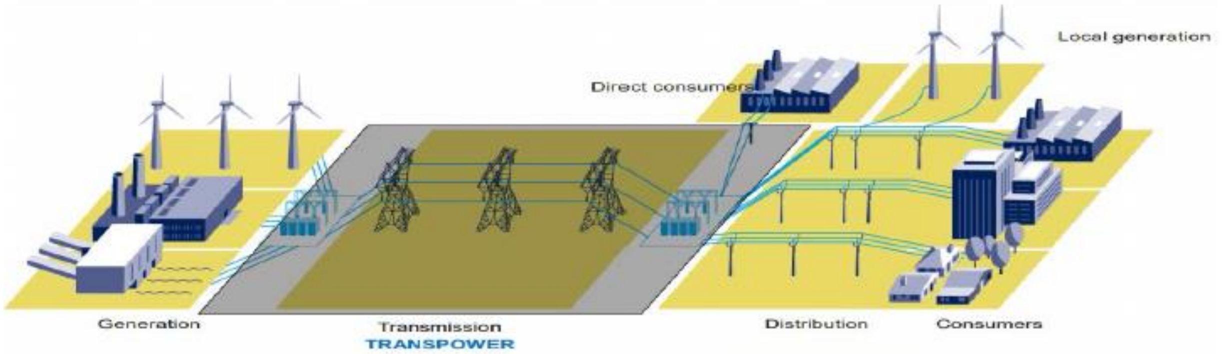
Stage 2: Network Repairs
- Crew Availability
- Vehicle Routing
- Mutual assistance

Stage 3: Network Re-energisation
- Network energisation
- Load Pick-up

Stage 2: Islanding
- Blackstart Planned
- Transitional

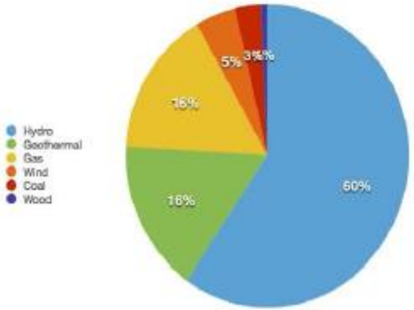
Stage 3: Resynchronization

Recap – NZ Electrical Power System



NEW ZEALAND'S ELECTRICITY GENERATION (12 months to Nov 2014)

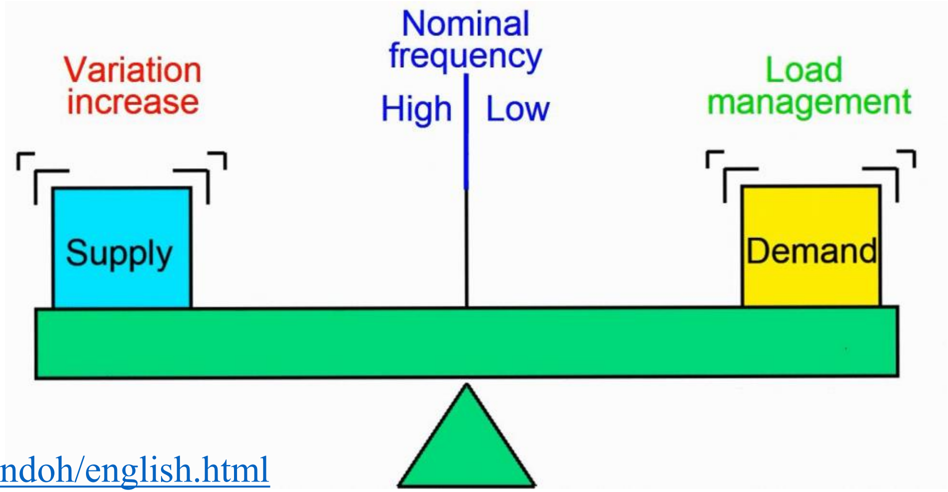
GENERATION TYPE	PERCENTAGE
Hydro	59.6%
Geothermal	16.3%
Gas	15.8%
Wind	4.6%
Coal	3.0%
Wood	0.7%



Recap – Power System Variables

- Voltage: 415V, 11KV, 33KV, 66KV, 110KV, 220KV: Acceptable Limits 0.95-1.05
- Frequency: 50Hz: Acceptable Limits 48.5-51.5Hz

Frequency: Generation = Demand



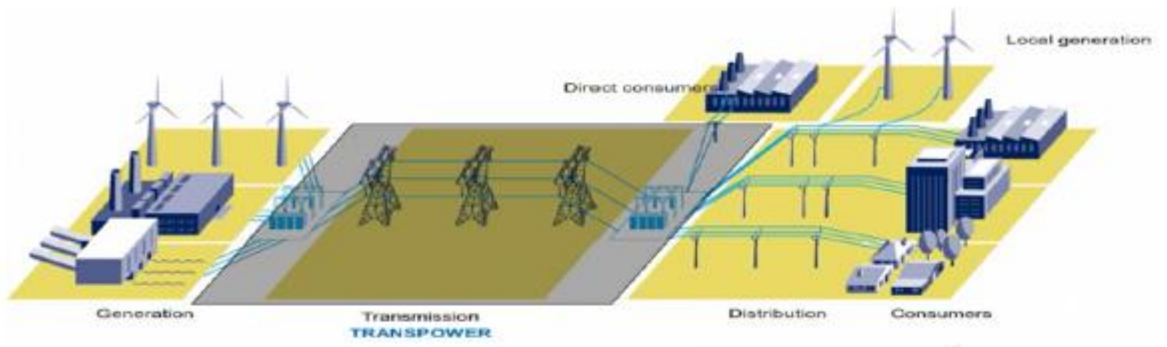
https://www.rs.tus.ac.jp/j.kondoh/english.html

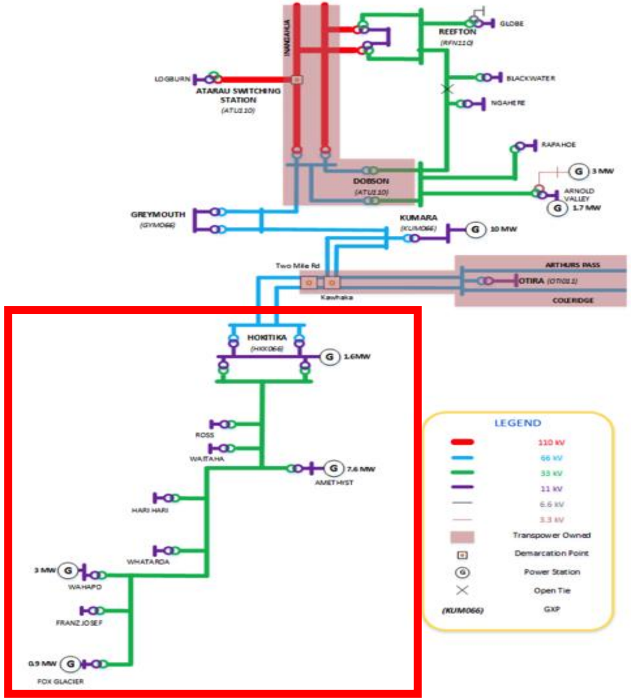
Islanding

- Islanding: Condition in which a section of the grid (transmission or distribution) is energized and operational, whilst disconnected from the main grid (transmission or distribution).

- Formation of islands
  - **Blackstart** - Re-energization of components
  - **Transitional** – Components remain energized after separation from the grid.

- **Blackstart Islanding** is preferred n case of disasters as damage assessment is required to determine status of network components





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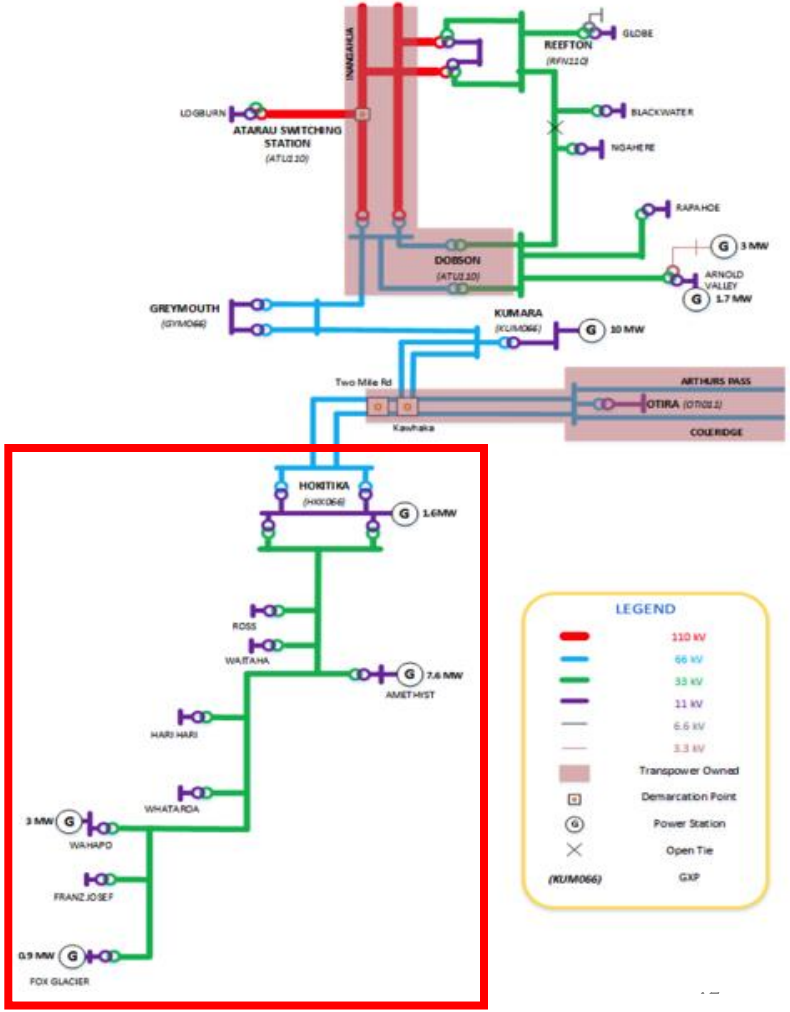
Westpower: SouthWestland Network

Power Station	Power Capacity (MW)	Blackstart Capability
McKays Creek	1.1	No
Kaniere Forks	0.5	No
Amethyst	7.4	Yes
Wahapo	3.1	Yes
Fox	0.5	No

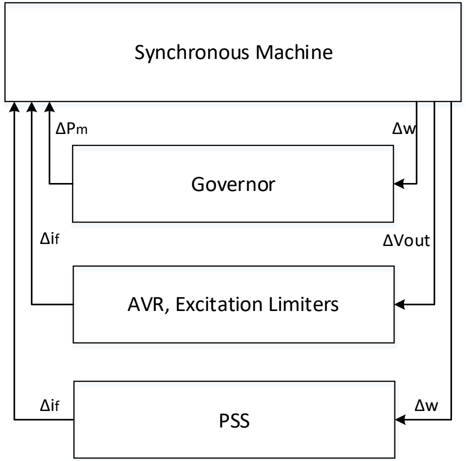
Zone Substations	Peak Demand (MW)
Hokitika*	19.576
Ross	0.500
Waitaha	0.350
Hari Hari	0.980
Wahapo	0.100
Whataroa	0.782
Franz Josef	2.212
Fox Glacier	1.016



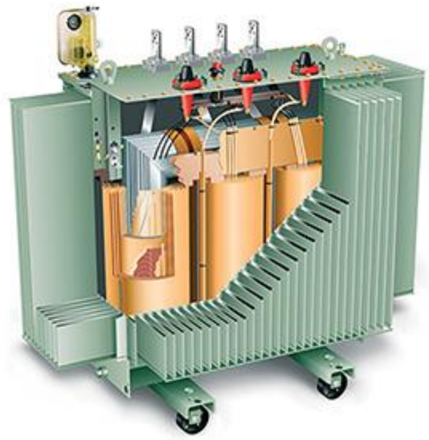
* Load at Hokitika is inclusive of all the loads of the South Westland Network

Component Modelling

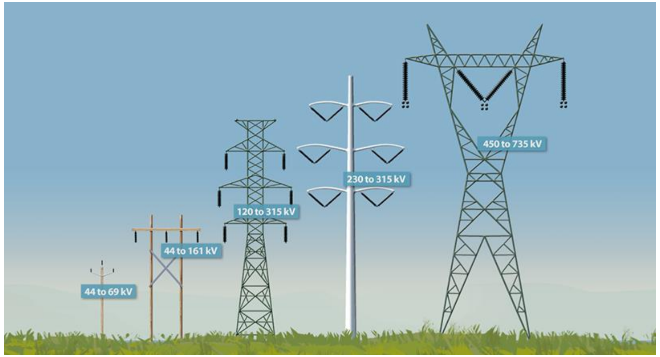
Generator Modelling



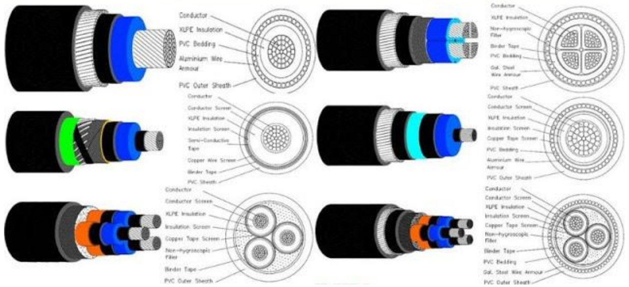
Transformer Modelling



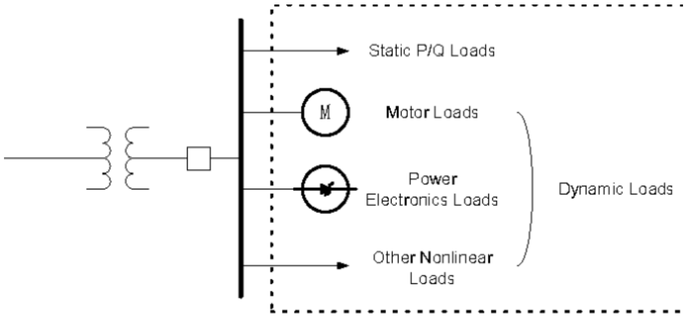
Transmission Line Modelling



General Cable Construction 1kV ~ 35 kV, Copper / Al Conductor



Load Modelling

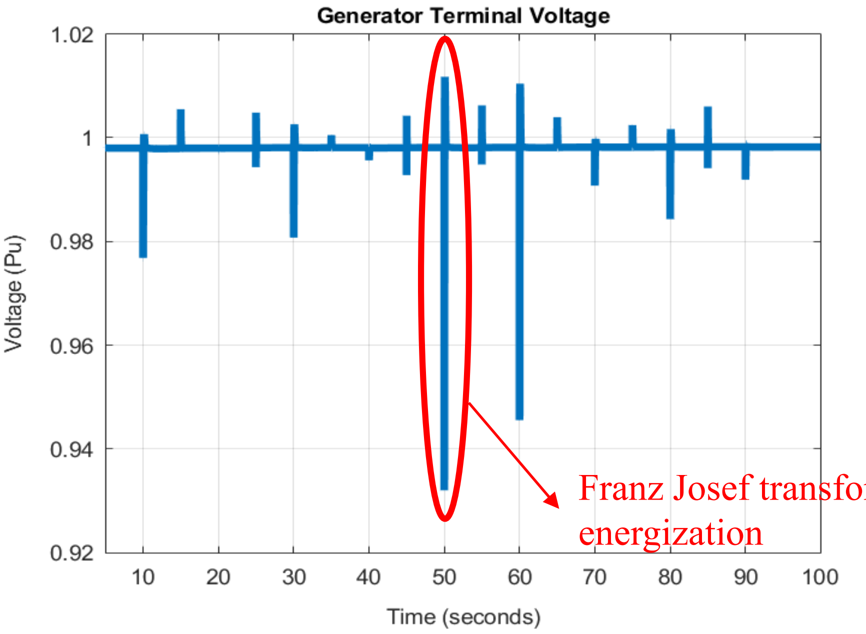


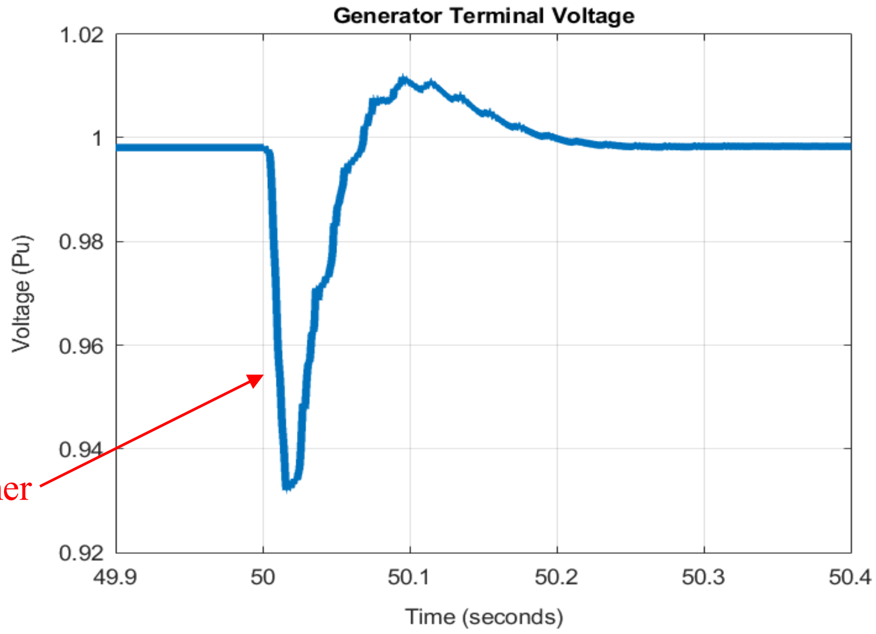
Composite Load

33 kV Network Energization: Voltage

- Sequential energization of zone substation transformers and overhead lines. Voltages are within safe limits

- Example: Energization of Franz Josef transformer





Franz Josef transformer energization

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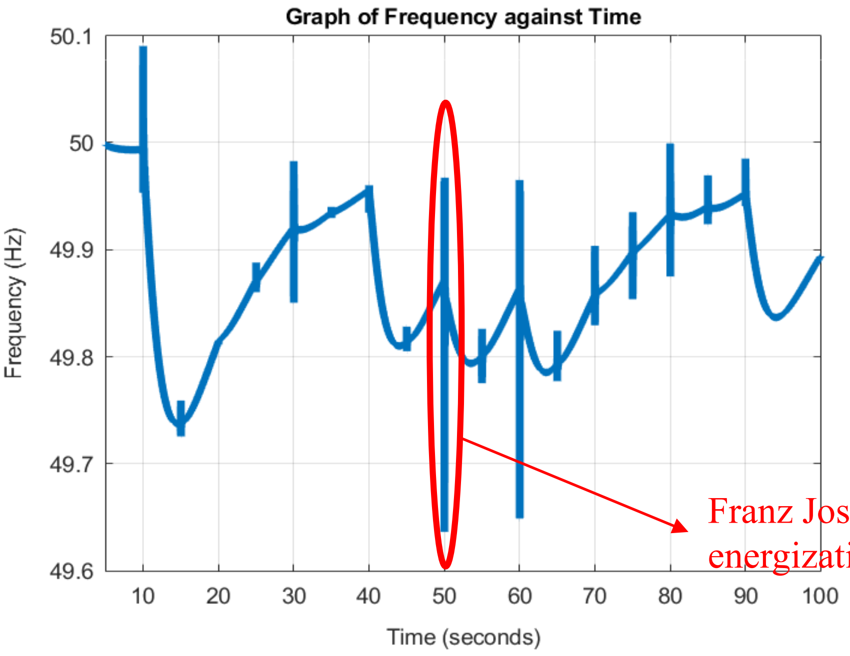
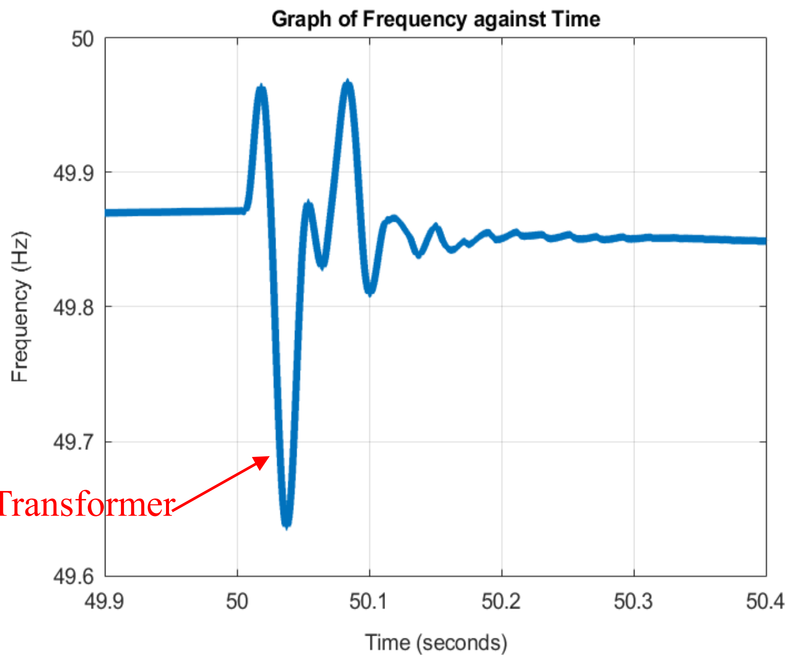
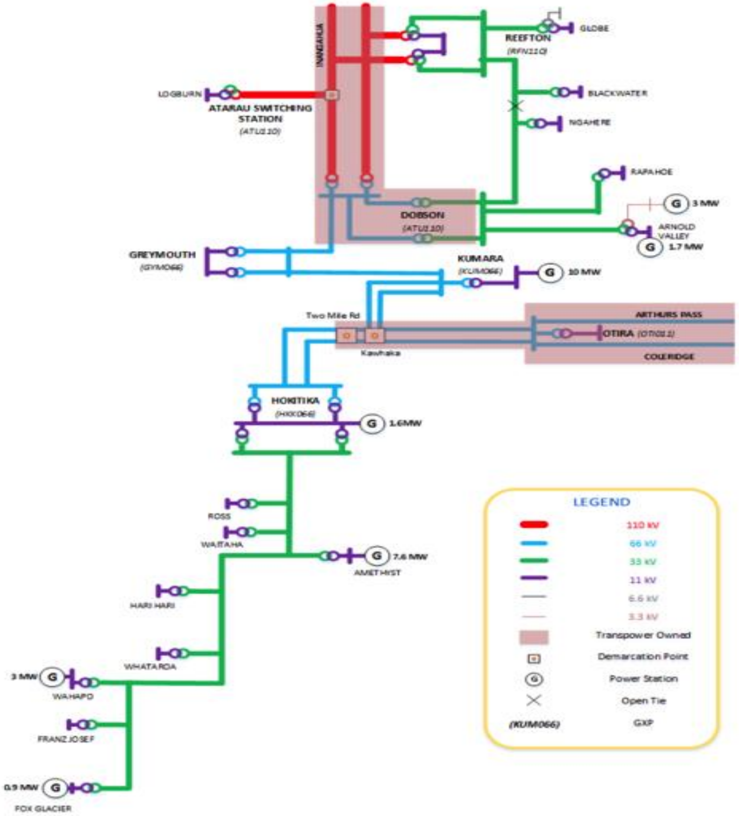
33 kV Network Energization: Frequency

- Frequency drop as a result of large transformer energization but within acceptable limits
- Example: Energization of Franz Josef transformer

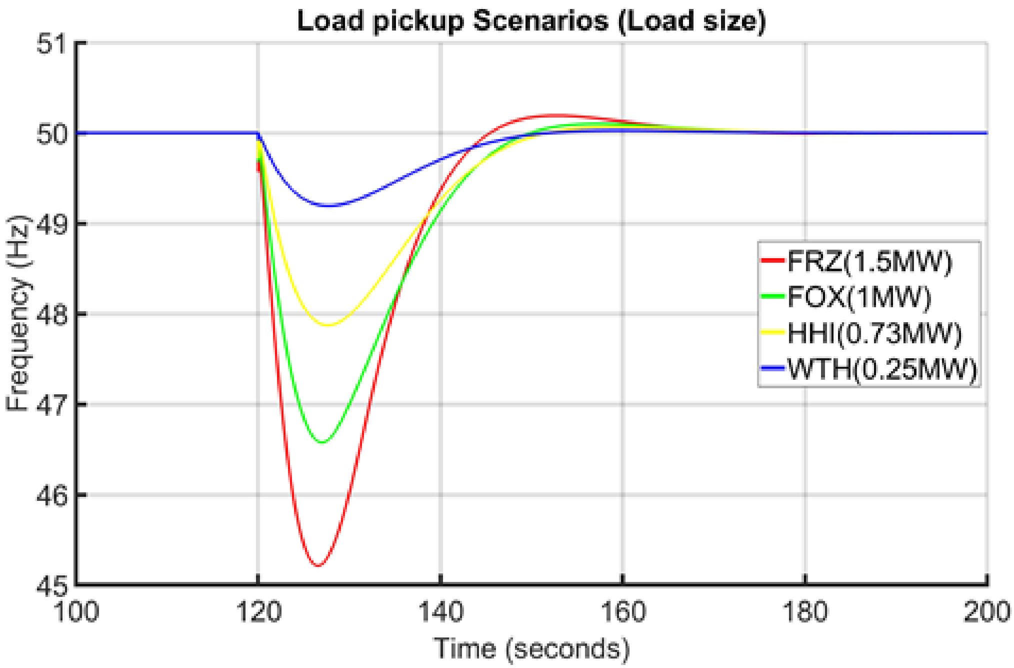




Load pickup



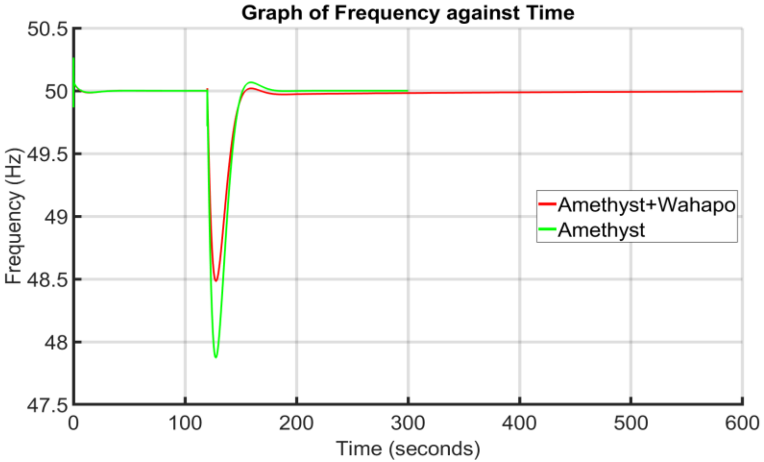
GLOBE
REEFTON
(RFN110)
BLACKWATER
NGAHERE
LOGBURN
ATARAU SWITCHING STATION
(ATU110)
RAPAHOE
3 MW
ARNOLD VALLEY
1.7 MW
DOBSON
(ATU110)
GREYMOUTH
(GYM066)
KUMARA
(KUM066)
10 MW
Two Mile Rd
ARTHURS PASS
OTIRA (OTI011)
COLERIDGE
Kawhaka
HOKITIKA
(HKK066)
1.6MW
ROSS
WAITAHA
7.6 MW
AMETHYST
HARI HARI
WHATAROA
3 MW
WAHAPO
FRANZ JOSEF
0.9 MW
FOX GLACIER
LEGEND
110 kV
66 kV
33 kV
11 kV
6.6 kV
3.3 kV
Transpower Owned
Demarcation Point
Power Station
Open Tie
(KUM066)
GXP

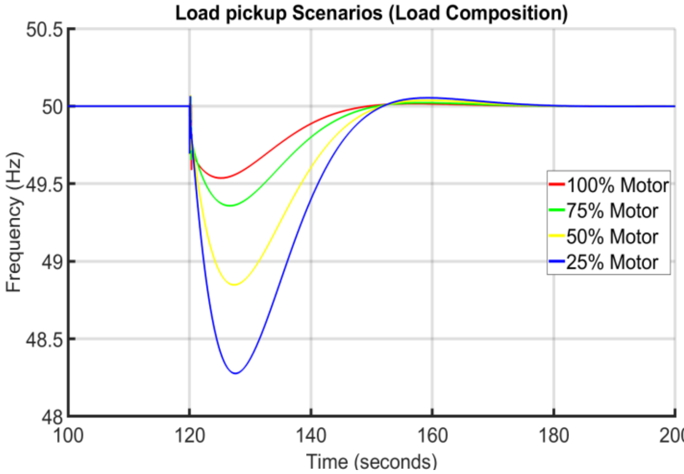


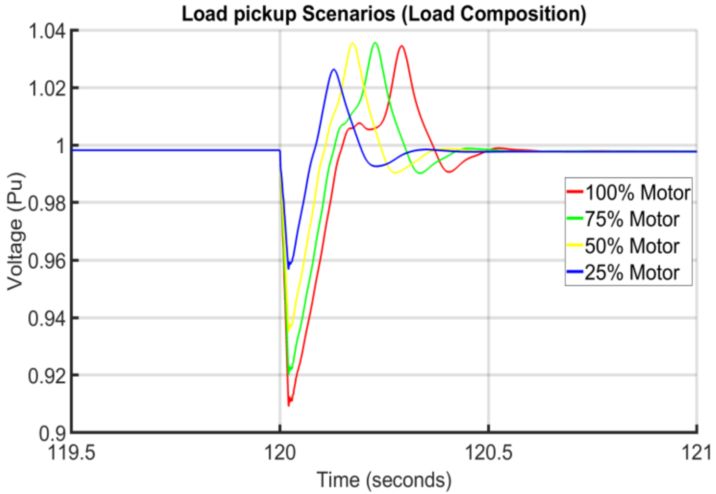
Load pickup Scenarios (Load size)
Frequency (Hz)
51
50
49
48
47
46
45
100
120
140
160
180
200
Time (seconds)
FRZ(1.5MW)
FOX(1MW)
HHI(0.73MW)
WTH(0.25MW)

Load pickup

- Different scenarios at the Hari Hari 11kV feeder .







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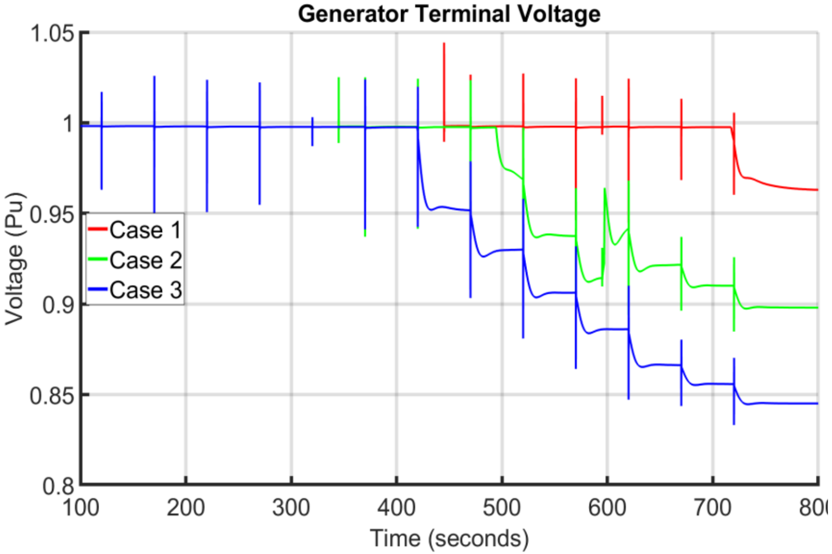
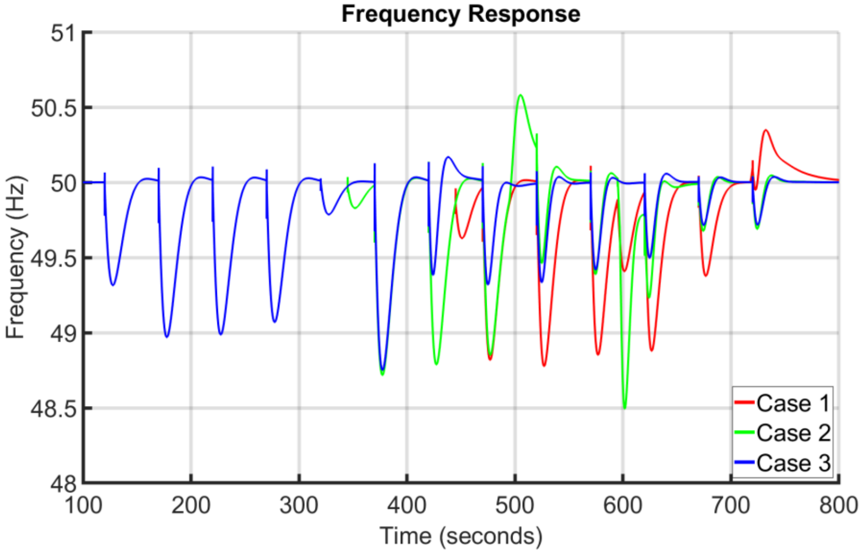
Sequential Load Pickup

- Maximum load step: 0.5 MW
- Load composition: 75% - static, 25% - Motor





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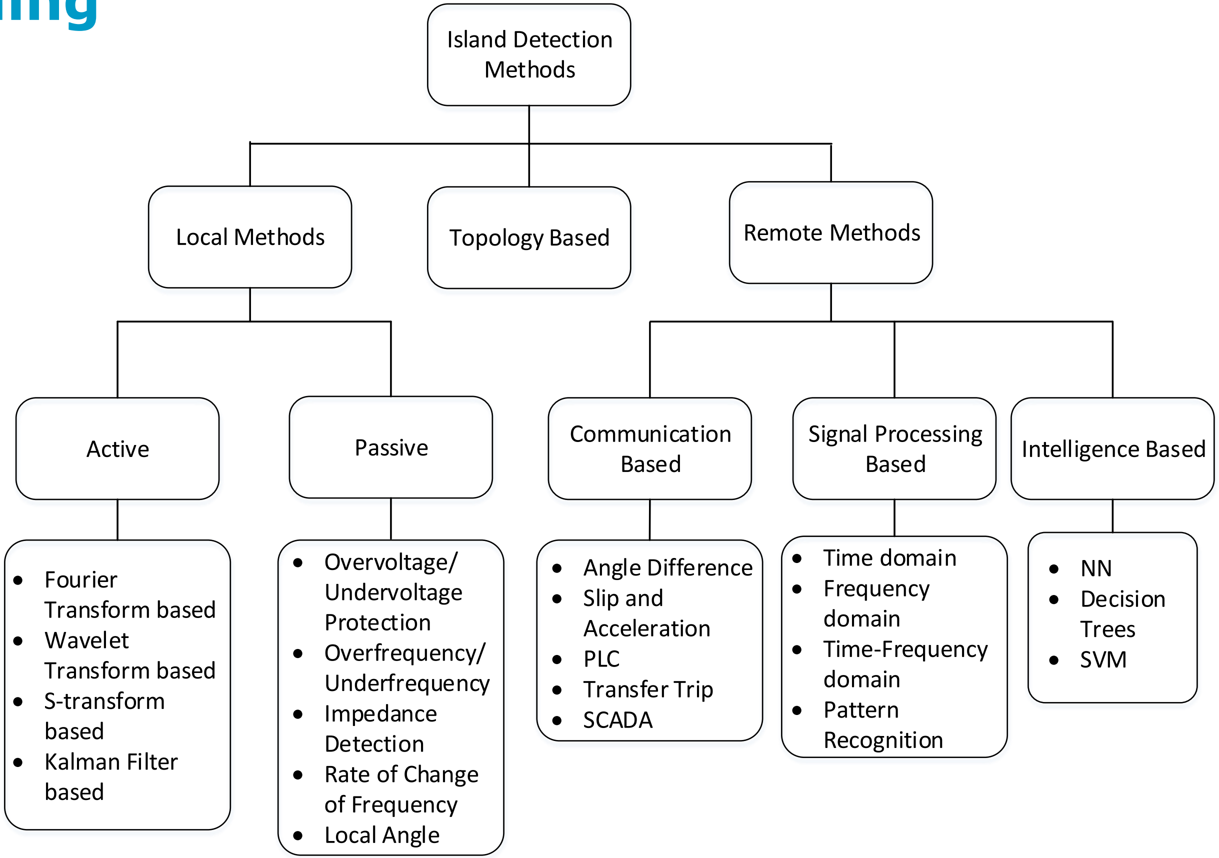
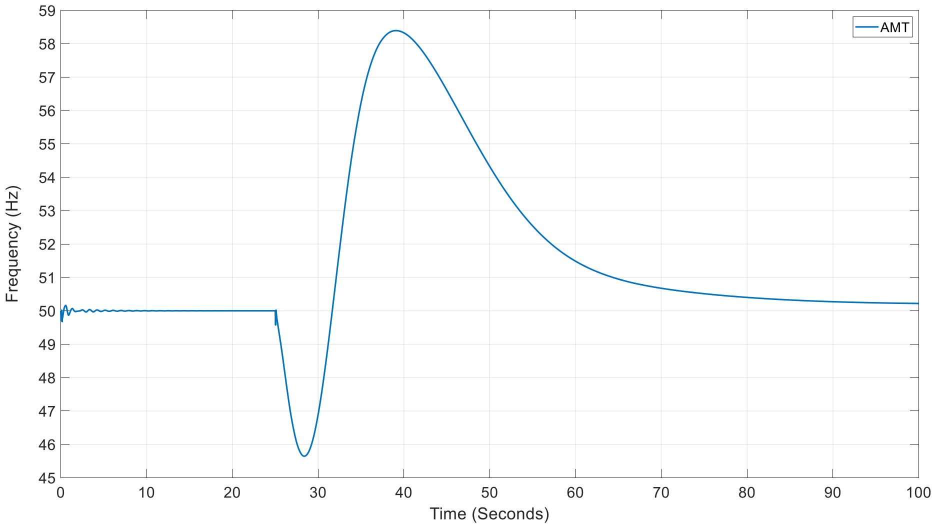
Transitioning to Islanding

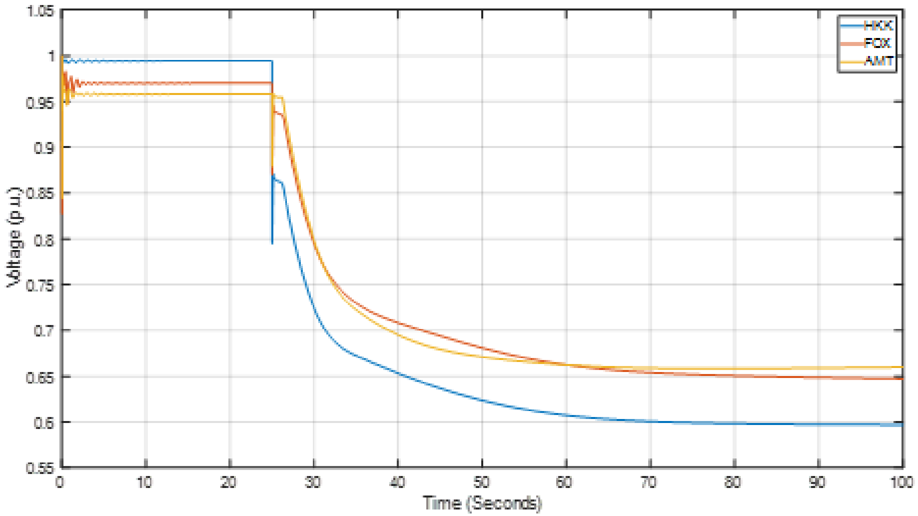
- Island detection necessary mainly for safety and to enable the DER to change operating modes.
- Amethyst uses frequency (Active Power Mismatch) change for islanding detection.
- Voltage and voltage angle will be investigated.
- Amount of Load at Hokitika to be varied.



Transitioning to Islanding

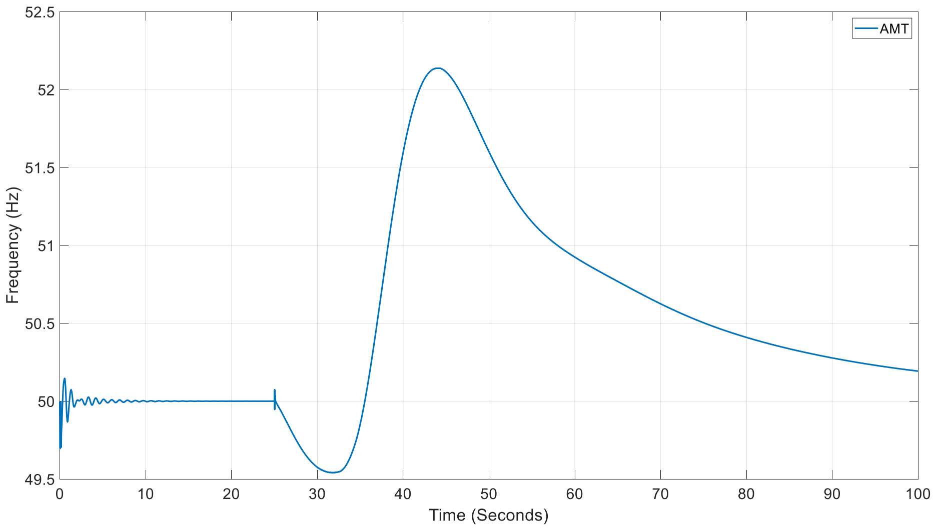
Scenario 1: Hokitika Load – 9MW, 1.28 MVAr

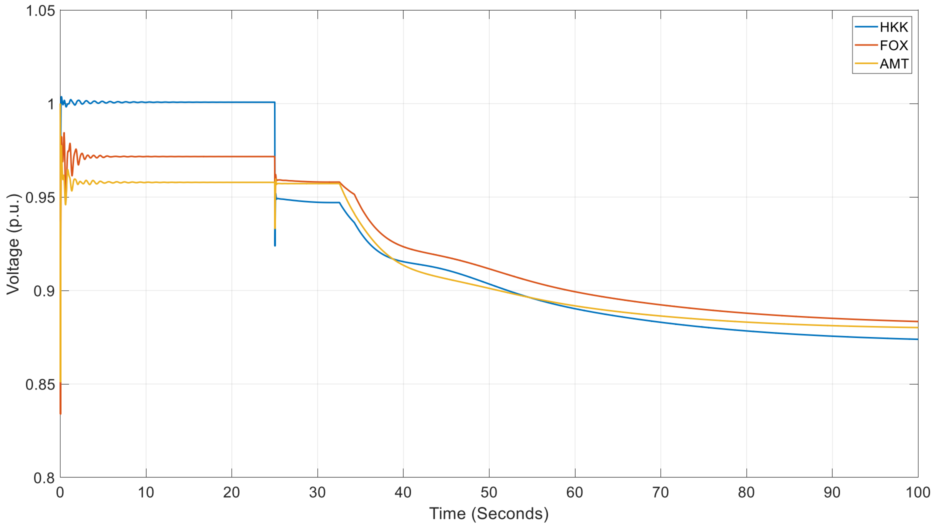




Transitioning to Islanding

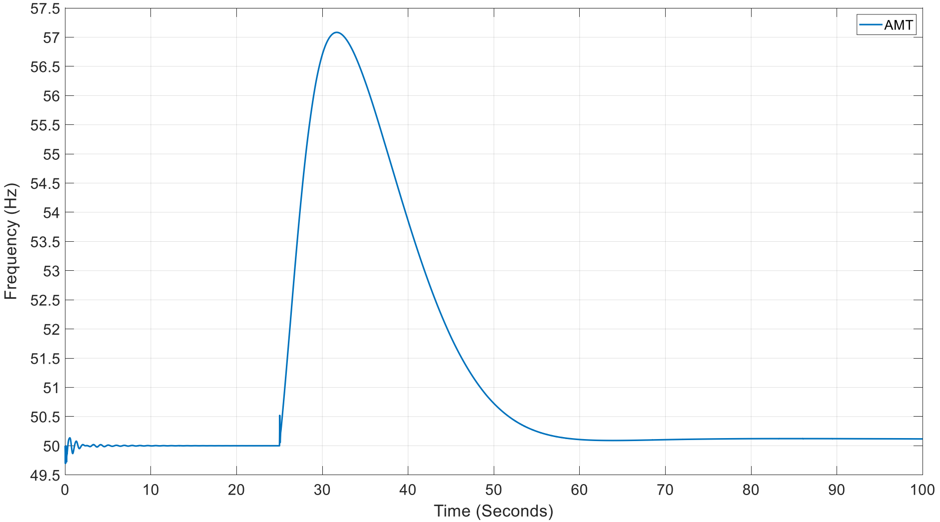
Scenario 2: Hokitika Load – 4.5MW, 0.64 MVAr

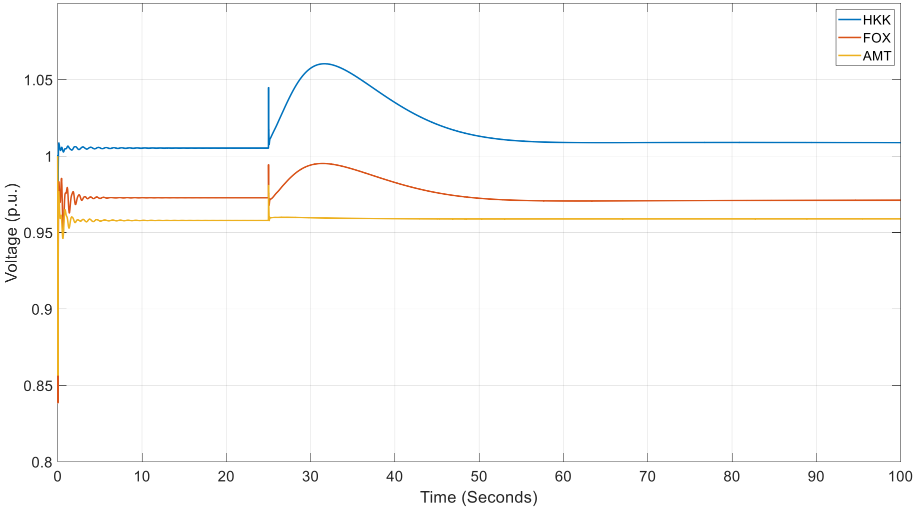




Transitioning to Islanding

Scenario 3: Hokitika Load – 0.99MW/0.14MVAr





In summary

Earthquake scenarios:
- Central Hypocenter
- Northern Hypocenter
- Southern Hypocenter
- Empirical Southern Hypocenter

Westcoast Electricity Network Resilience

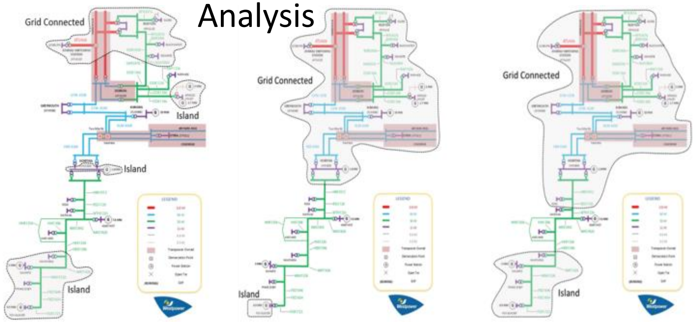
Detailed Modelling

Blackstart Study

Transition to Islanded mode

Protection Assessment

Electrical Analysis



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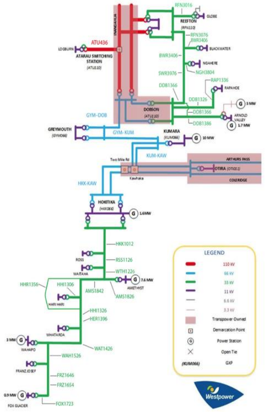
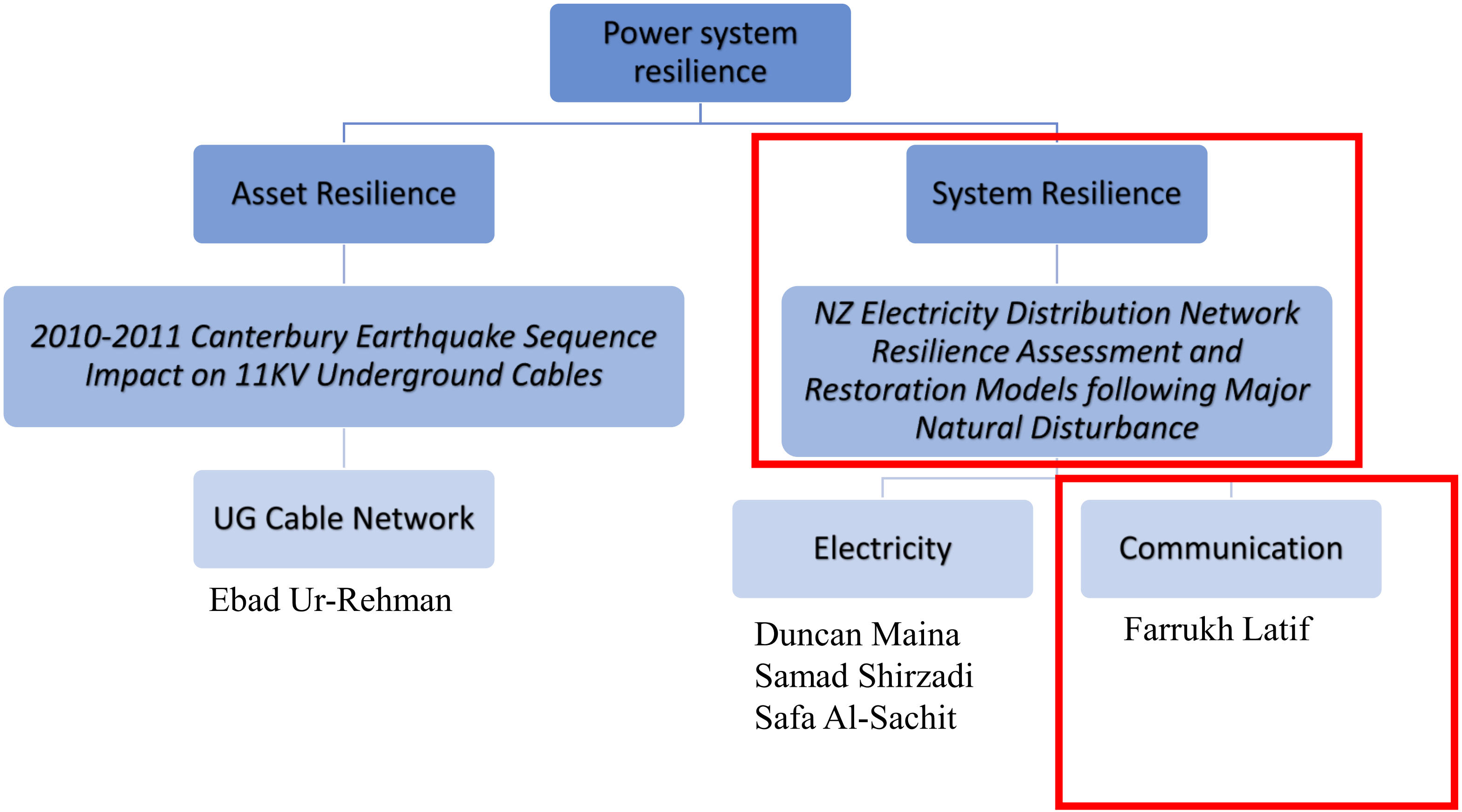
Resilience Framework

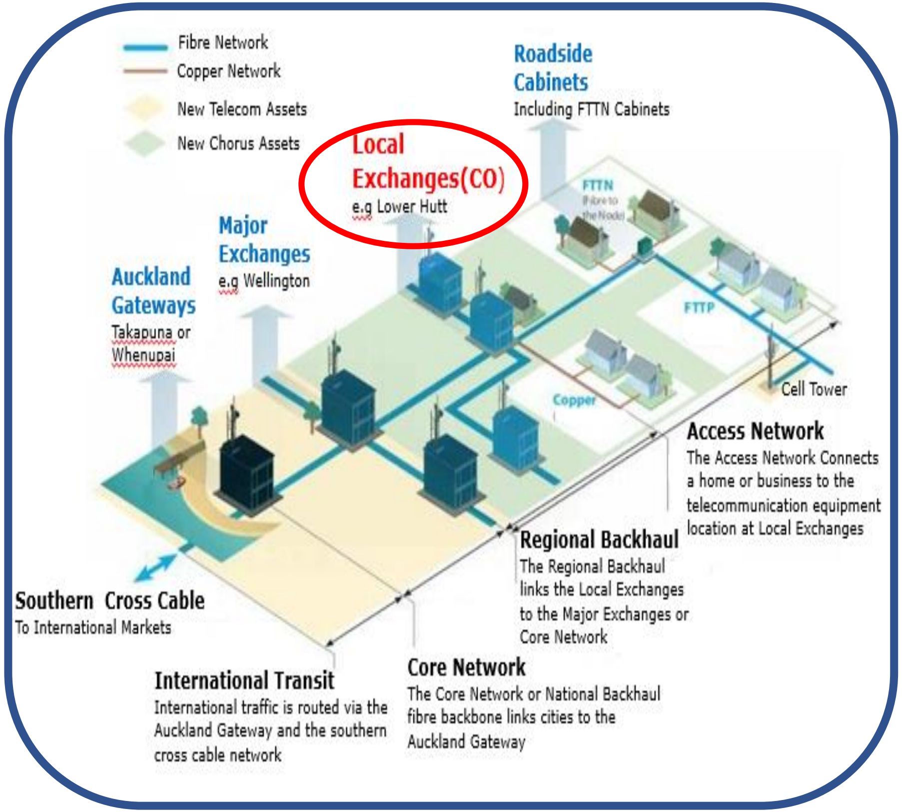
Hazard Mapping

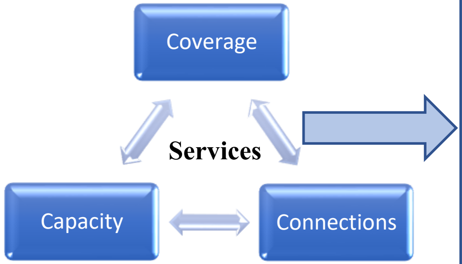


Energy Communication: Resilience group



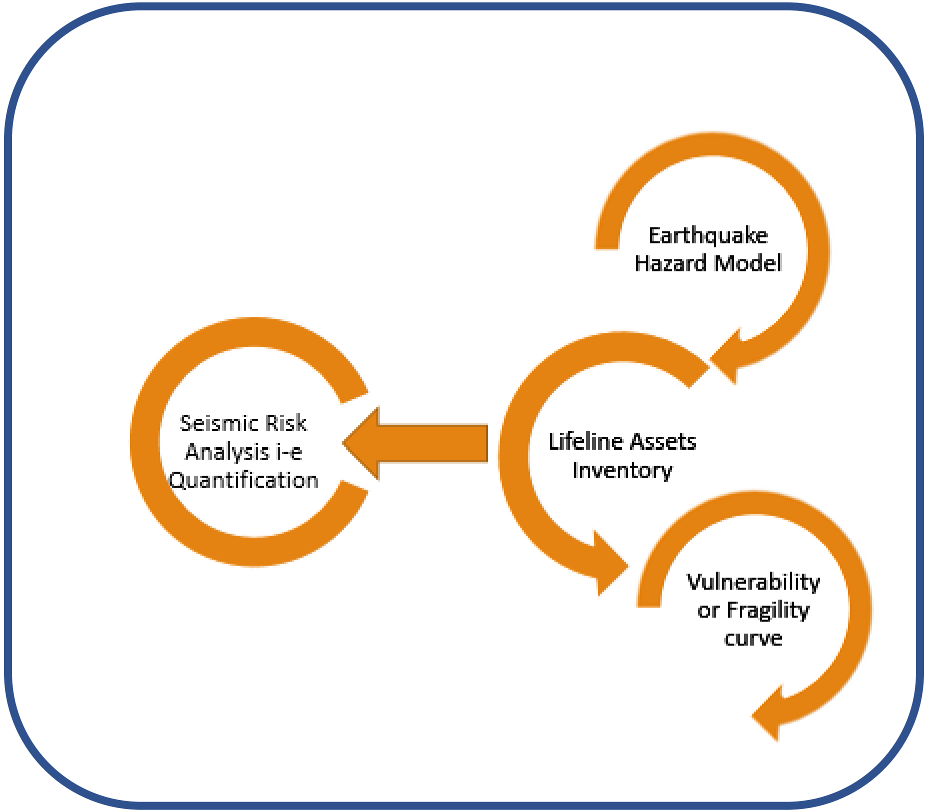
NZ Fixed Communication Infrastructure and Services

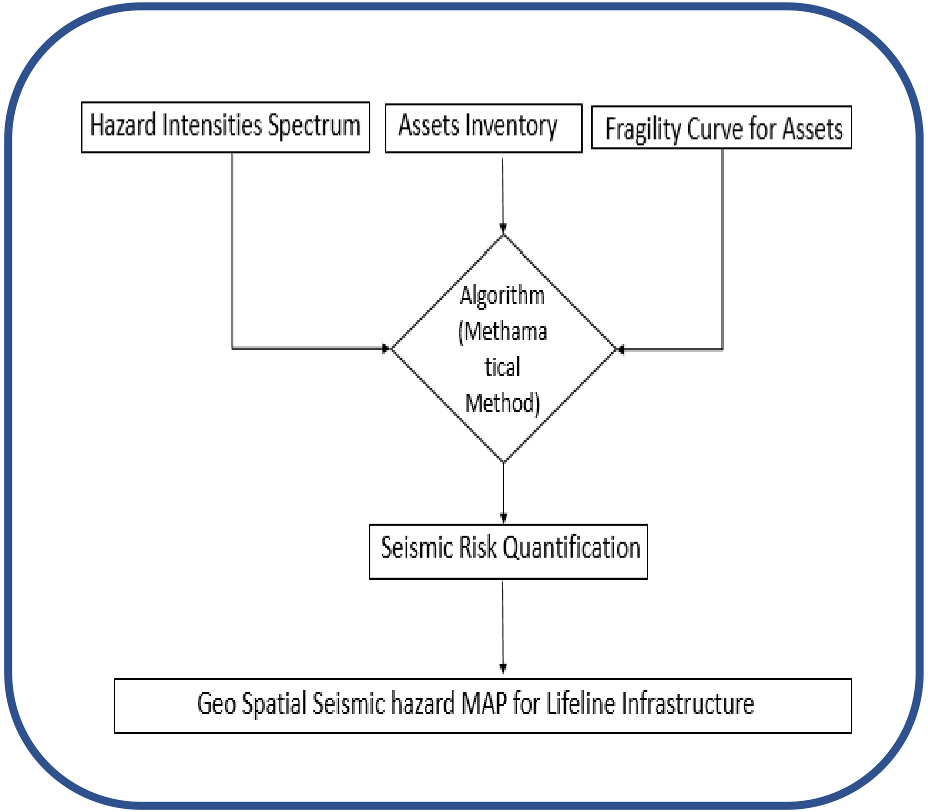




- Voice
- Internet
- Cloud/Datacentres
- Enterprise Services
- Emergency Response Services
- Mission Critical Services
- Defence Services
- IOT
- VR
- AI
- TV/On Demand Content

Method for Seismic Risk Analysis (SRA) and Hazard Mapping





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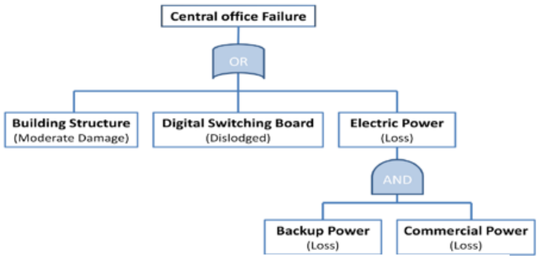
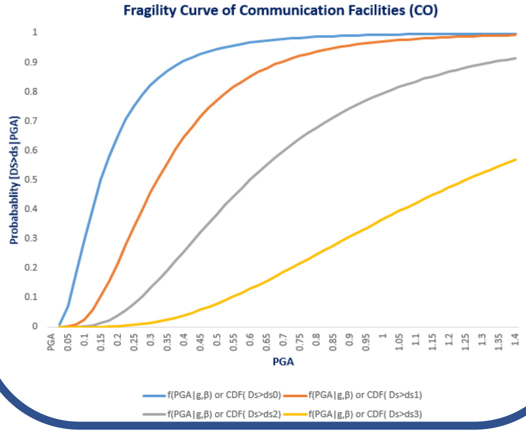
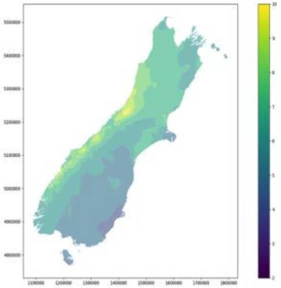
Milestone 2:West Coast Case Study

Fragility Curves for Central Offices

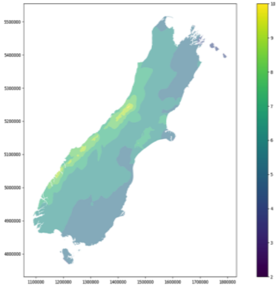




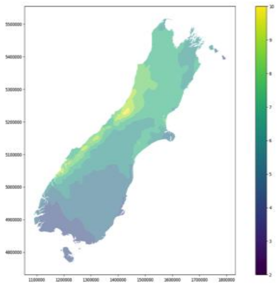
AF8 Earthquake Hazard Scenarios



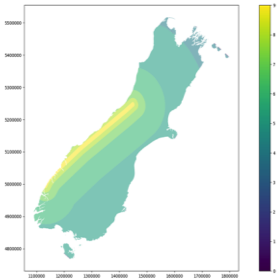
Northern Hypocenter



Southern Hypocenter

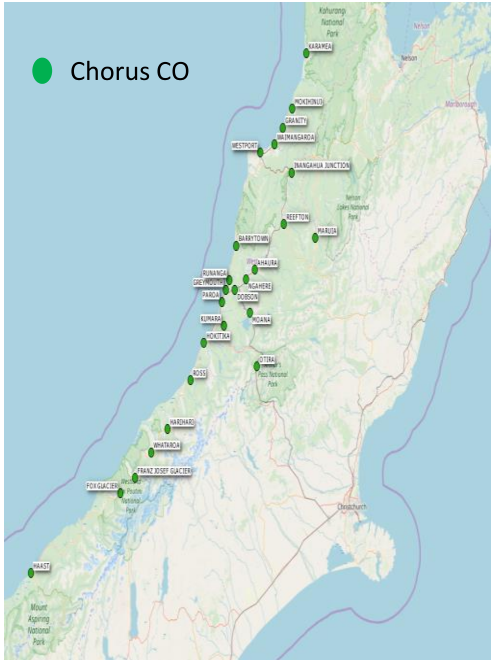


Central Hypocenter



Empirical S. Hypocenter

Chorus Central Offices (Assets)



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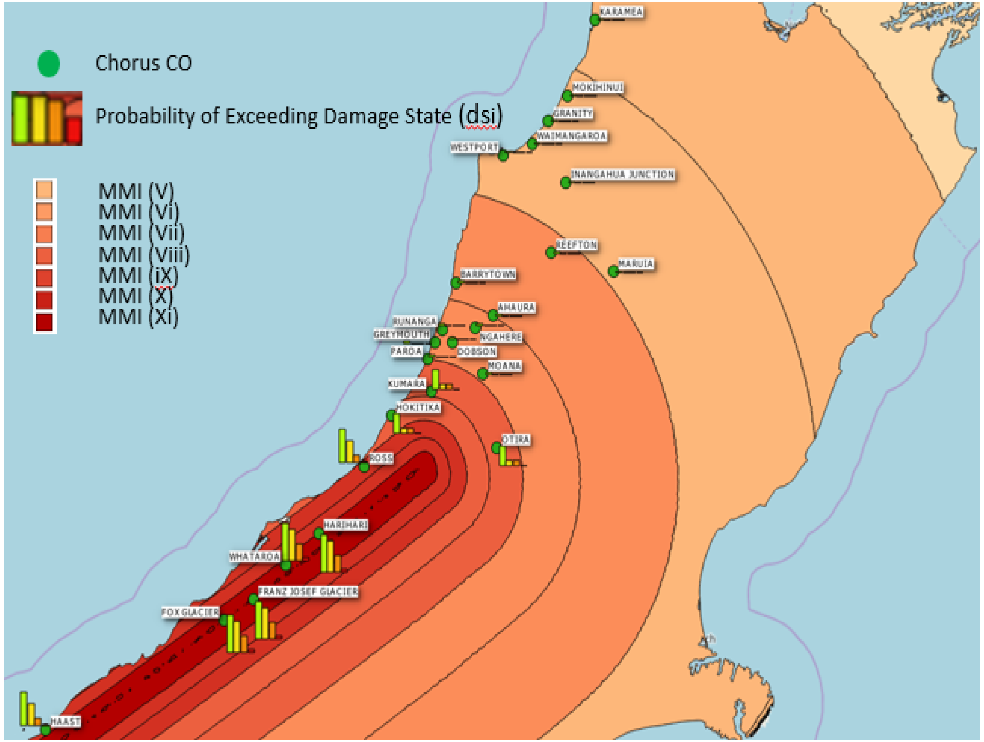
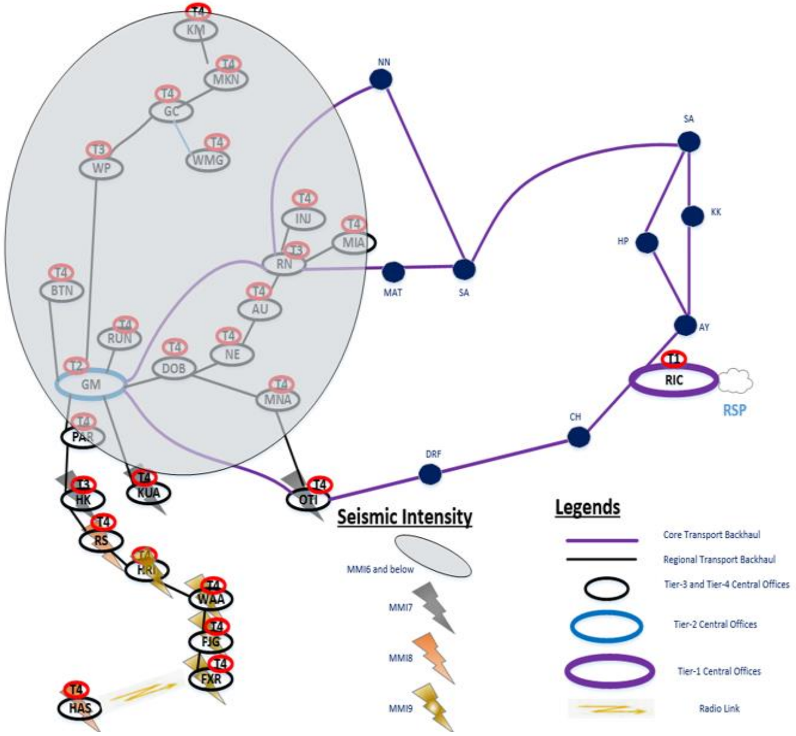
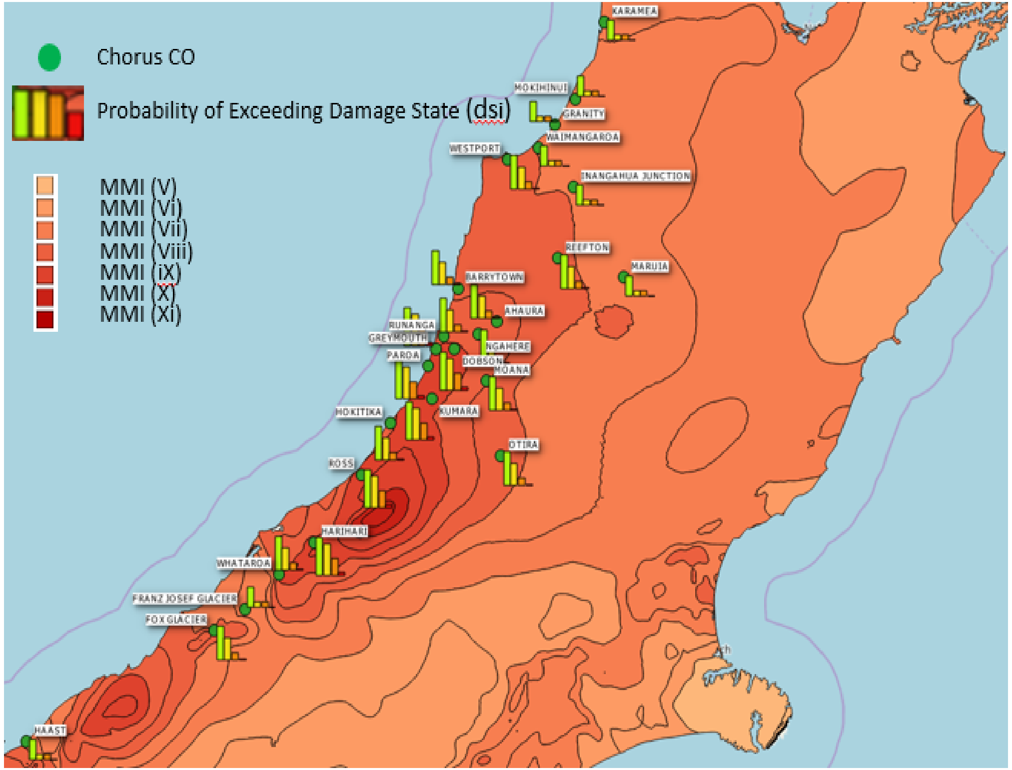
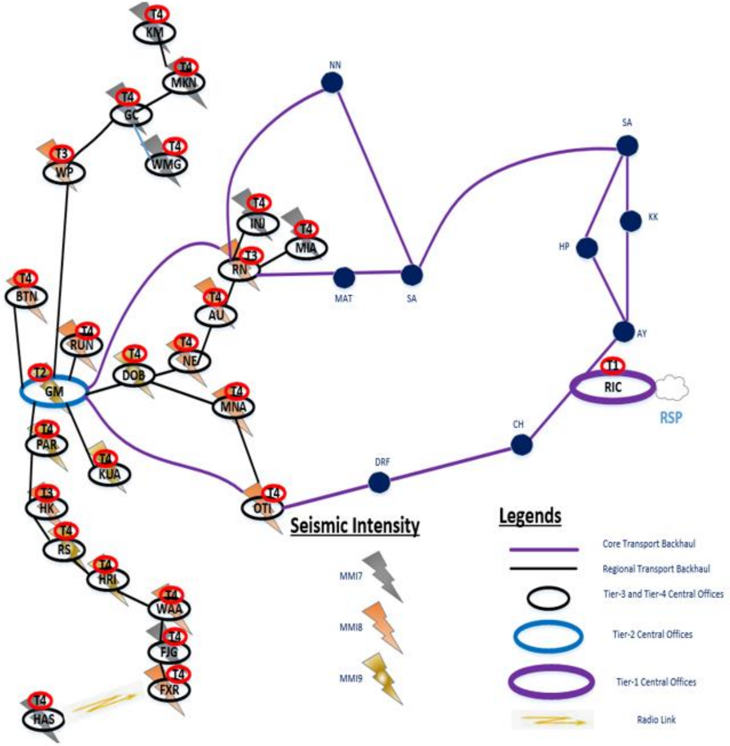
CO Risk Quantification using Geo-Spatial Mapping (AF8 Empirical)





CO Risk Quantification using Geo-Spatial Mapping (AF8 Central)





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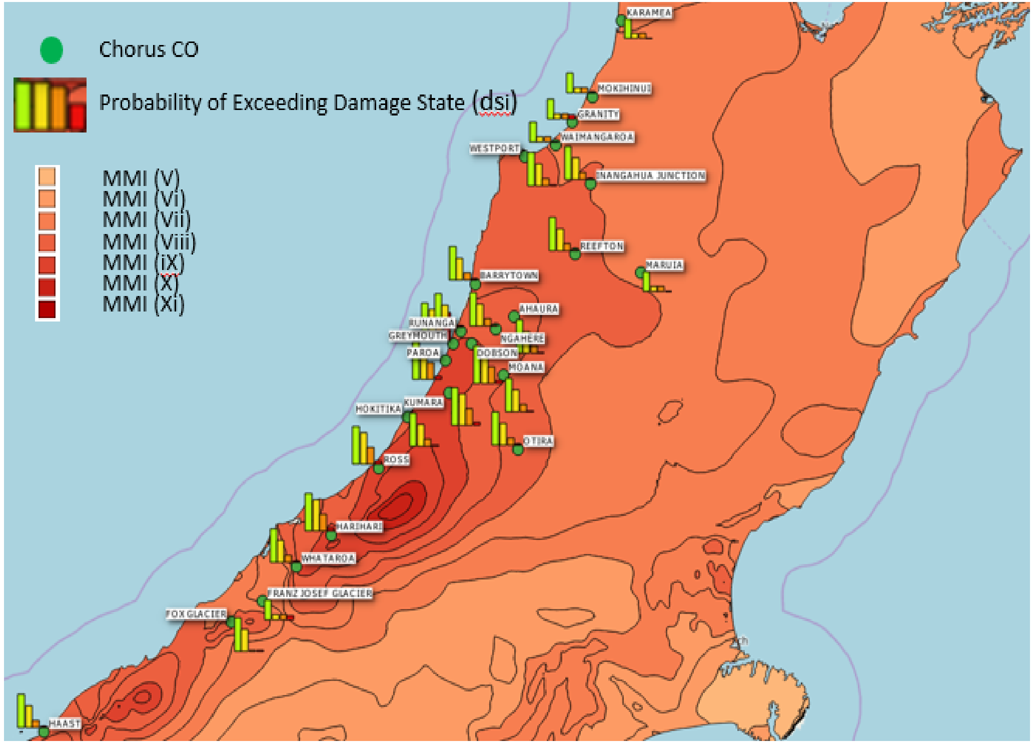
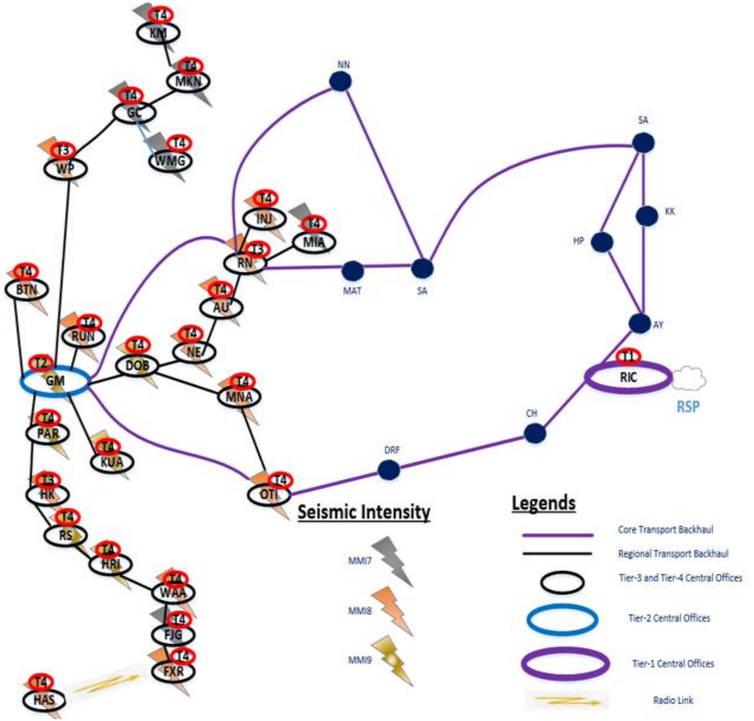
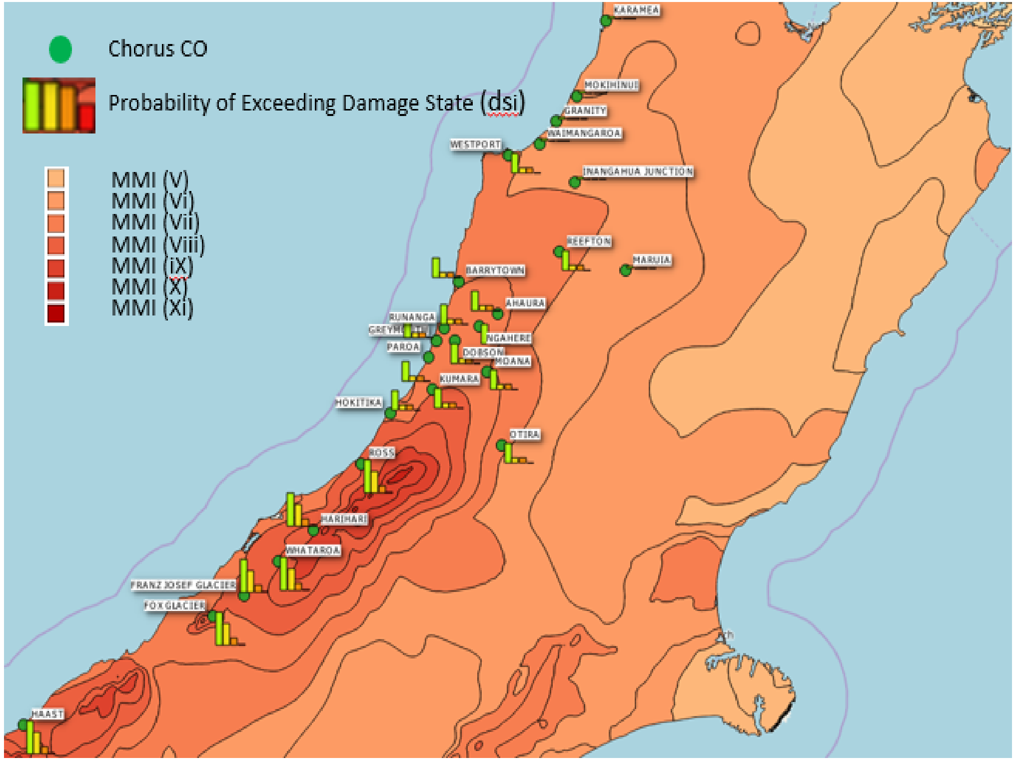
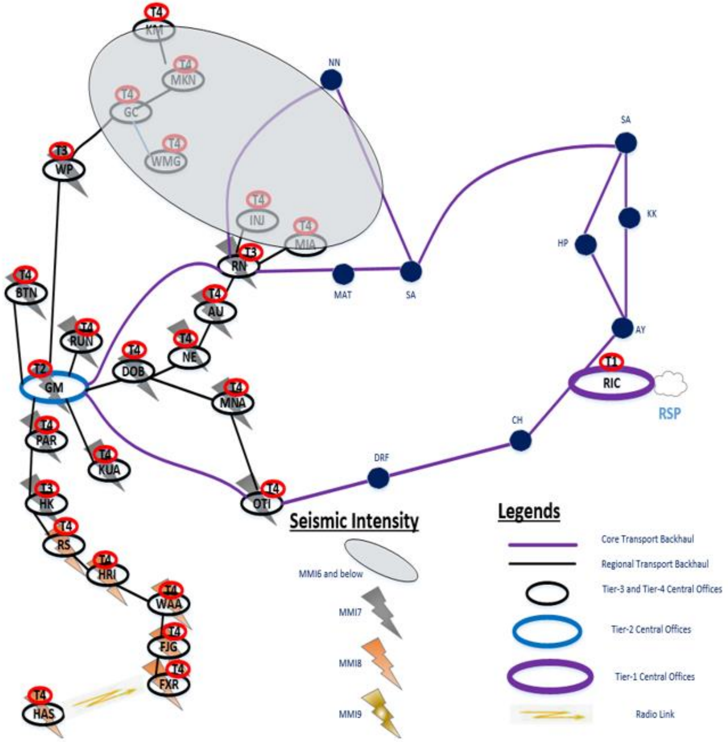
CO Risk Quantification using Geo-Spatial Mapping (AF8 Southern)





CO Risk Quantification using Geo-Spatial Mapping (AF8 Northern)





Milestone 2: Summary Results

AF8 Scenario	MMI	Minor(ds0)	Moderate(ds1)	Extensive(ds2)	Complete(ds3)	Affected Central Ofices/Telco Infrastructure
Central Hypocenter	7	52%	14%	13%	0%	FJG,GC,HAS,INJ,KM,MIA,MKN,WMG
	8	86%	56%	21%	3%	AU,BTN,FXR,HK,MNA,NE,OTI,RN,RUN,WP,WAA
	9	95%	80%	43%	10%	DOB,GM,HRI,KUA,PAR,RS
AF8 Scenario	MMI	Minor(ds0)	Moderate(ds1)	Extensive(ds2)	Complete(ds3)	Affected Central Ofices/Telco Infrastructure
Northern Hypocenter	6	7%	0%	0%	0%	GC,INJ,KM,MIA,MKN,WMG
	7	52%	14%	13%	0%	AU,BTN,DOB,GM,HK,KUA,MNA,NE,OTI,PAR,RN,RUN,WP
	8	86%	56%	21%	3%	FXR,FJG,HAS,HRI,RS,WAA
AF8 Scenario	MMI	Minor(ds0)	Moderate(ds1)	Extensive(ds2)	Complete(ds3)	Affected Central Ofices/Telco Infrastructure
Southern Hypocenter	7	52%	14%	13%	0%	FJG,GC,KM,MIA,MKN,WMG
	8	86%	56%	21%	3%	AU,BTN,FXR,HK,HAS,INJ,MNA,NE,OTI,RN,RUN,WP,WAA
	9	95%	80%	43%	10%	DOB,GM,HRI,KUA,PAR,RS
AF8 Scenario	MMI	Minor(ds0)	Moderate(ds1)	Extensive(ds2)	Complete(ds3)	Affected Central Ofices/Telco Infrastructure
Empirical Southren Hypocenter	5	4%	0%	0%	0%	GC,INJ,KM,MIA,MKN,WMG,WP
	6	7%	0%	0%	0%	AU,BTN,DOB,GM,MNA,NE,PAR,RN,RUN
	7	52%	14%	13%	0%	HK,KUA,OTI
	8	86%	56%	21%	3%	HAS,RS
	9	95%	80%	43%	10%	FXR,FJG,HRI,WAA

Westcoast Central Offices(CO) Resilience and Availability Quantification

AF8 Scenario	Number of CO impacted
Central Hypocenter MMI 7	8
Central Hypocenter MMI 8	19
Central Hypocenter MMI 9	25
Northern Hypocenter MMI 7	19
Northern Hypocenter MMI 8	25
Southern Hypocenter MMI 7	6
Southern Hypocenter MMI 8	19
Southern Hypocenter MMI 9	25
Empirical Southern Hypocenter MMI 7	19
Empirical Southern Hypocenter MMI 8	21
Empirical Southern Hypocenter MMI 9	25

unavailability for AF8 Scenarios

AF8 Scenario	Loss of CO in West Coast Network	Availability of CO in West Coast Network
Central Hypocenter MMI 7	0.47	2.13
Central Hypocenter MMI 8	3.17	0.32
Central Hypocenter MMI 9	Total Loss	0.00
Northern Hypocenter MMI 7	3.17	0.32
Northern Hypocenter MMI 8	Total Loss	0.00
Southern Hypocenter MMI 7	0.32	3.17
Southern Hypocenter MMI 8	3.17	0.32
Southern Hypocenter MMI 9	Total Loss	0.00
Empirical Southern Hypocenter MMI 7	3.17	0.32
Empirical Southern Hypocenter MMI 8	5.25	0.19
Empirical Southern Hypocenter MMI 9	Total Loss	0.00

Loss and Availability Quantification

Milestone 2: Conclusion

From the above analysis, hazard mapping is important to estimate the level of damage that can be caused by the specific disaster. The estimation can then be used to drive policy decisions with regards to network investments. The investments can either be in the form of assets robustness (which has been the common practice) or re-architecture the network topology to improve the end to end resilience of network thus services. From West Coast Communication infrastructure resilience assessment, it can be noted that there is a higher risk of losing Grey Mouth (tier 2 central office) in case of Central and Southern Hypocenter MMI9 AF8 scenarios than the other two AF8 scenarios under study.

NETWORK COMPONENT MODELLING FOR BLACKSTART PLANNED ISLANDING

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Fault Detection in Transmission Lines — A Novel Voltage-Based Scheme for Differential Protection

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Abstract—**Current-based protection schemes such as distance, overcurrent, and differential relays are usually used to protect transmission lines (TL) in power systems where the high fault current plays a key role in detecting faults. The continuous development in the power network and emerging new technologies have made the power grid more complicated and soon will start to affect the reliability of the existing protection schemes. Issues like current transformer saturation, the effect of the mutual coupling impedance of the TL and emerging new power electronic-based technologies have become major challenges in power systems from a protection perspective. To avoid all the current-based problems this paper proposes a new voltage-based relay principle for TL protection to indicate fault occurrences in transmission networks. The proposed scheme is tested under all fault events to show that it is highly accurate when it comes to rapid trip activation during any of the tested cases.**

Keywords: Differential relay, negative sequence voltage, relay modeling, symmetrical components, transmission line protection, unbalanced fault.

I. INTRODUCTION

Transmission lines are subject to many events that might cause small or bulk damage to them and to the other parts of the system. Events which might affect TL include current transformer (CT) saturation issue, zero current mutual coupling, fault current limitations of power electronic based devices (PED), and grid code obligations. As a result, a sensitive, reliable and fast protection scheme is required to reduce expected damage. Many protection strategies have been suggested for TL in high, medium and low voltage parts

scheme depends on measuring the impedance of the protected TL to identify the faulted zone. However, [2] recognized that distance relays have some obstacles regarding the phase shift between voltage and current, fault resistance and third zone maloperation [3]. The CT saturation effect appears prominently in the transmission network using distance protection schemes; hence it results in excessive tripping delay time [4-6]. The high fault current in some cases prevents CTs from sending the actual current value to the relay, and the relay will receive only a relatively low current at the secondary side during severe faults. However, distance protection is recommended for distribution networks due to it having a directional element that increases its ability to deal with meshed networks. The high cost of this scheme might be an obstacle since it requires both voltage and current transformers. However, it is only suitable for a small range of considerations and the correct settings may be more difficult to determine compared to the OCR [1].

Differential relays have also gained a wide recognition because it is a protection scheme rated as highly sensitive, selective, fast and insensitive to the bi-directional flow of current when compared to the distance and overcurrent schemes [1], [7]. The differential relay operational concept is based on calculating currents from the connected CTs across the protected section according to Kirchhoff's law. Differential relays face some issues due to the fault location discrimination besides the effect of CT saturation and CT mismatch on the relay operation [8]. Communication failures because of limited bandwidth channels over long distances also play a major role in reducing the effectiveness of this scheme. However, compared to distance relays it can be

Power system resilience through microgrids: A comprehensive review

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Abstract—**This paper reviews the role of microgrids in power system resilience improvement. Different definitions of system resilience that are addressed in different works are analyzed and summarized. Framework and metrics in power system resilience improvement and assessment are discussed and reviewed. Finally different microgrid based solutions for system resilience improvements are categorized and discussed.**

Keywords—microgrid, power system resilience, reconfiguration, operation, control, protection, hybrid microgrids

resilience. Third section explains the powe framework, resilience metrics and haza characterization. Fourth section covers the role of in power system resilience improvement and si provides a conclusion.

Blackstart of DFIG-based Windfarm

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Nirmal-Kumar C. Nair, Department of Electrical and Computer Engineering, University of Auckland, Auckland, New Zealand

Abstract— **Increased penetration of DFIG-based windfarms demand their use not only in normal operating conditions but also in restorative conditions, if wind is forecasted to be available. This paper explores the possibility of starting DFIG-based windfarms in preparation of network restoration. Analysis of DFIG starting with the help of a diesel generator set is provided. The windfarm substation is assumed to be composed of a diesel gen-set, synchronous condenser and a dump load. Pitch control, different from the one used during high wind speeds, is modeled and incorporated in this scheme to control speed of rotor during switching on of RSC and stator resynchronisation to the grid. Results, from simulation in MATLAB/SIMULINK, show successful starting of DFIG windfarm by use of a standby diesel generator set. Also, the speed of rotor is controlled to achieve the required speed at any stage of the starting process.**

Index Terms— **Autonomous Operation, Blackstart, DFIG, Pitch Control**

I. INTRODUCTION

Many countries are gearing up towards 100% renewables by 2030. The generation portfolio is foreseen to be majorly composed of hydro, wind and solar. Whilst this is ongoing, there has been an increase in power blackouts, either due to natural disasters, increased grid interconnectivity or the changing trend in supply and demand that is leading to increased strain on the already ageing network. Restoration with high penetration of non-hydro renewables is thus an important aspect to be considered when preparing policies with regards to integration of renewables.

There are three stages of restoration: unit blackstart, network re-energization and load restoration. Conventionally, considering only renewable energy sources, large hydro power plants, due to their blackstart capability, have been used to re-energize the network [1]. In a 100% renewable generation portfolio, it is necessary to review and explore the restoration function of non-hydro renewable generation. This study will focus on windfarms as their penetration is higher, and in large scale, as compared to the other non-hydro renewable generation. Their usage during restoration has been restricted to the third stage of restoration (load restoration) after the core grid is stable. This is due to

type of wind energy conversion system (WECS) and its associated dynamics during starting. Research on the use of VSC-HVDC connected windfarms in the earlier stages of restoration, taking advantage of self-restoring capabilities of VSC-HVDC and also enhanced voltage and frequency control, has been discussed in [7, 8]. Blackstart of windfarms have been reviewed in [9] with focus on the available patented techniques of wind turbine blackstart and subsequent windfarm energization. Analysis has not been provided with respect to the blackstart process.

This work seeks to examine the starting process [10] of DFIG-based windfarm and its effect when started using a standby diesel gen-set. Energization using different sources of power has been explored by the same author in [11]. In this study, the DFIGs have been energized simultaneously to speed up the restoration process. Pitch control during start has been designed and implemented to ensure the correct rotor speed during the starting process. The remainder of this paper is organized as follows: Section II defines the models used in the study. Section III describes the step by step process of DFIG starting with different pitch control modes being applied at different stages to ensure smooth starting process under variable wind conditions. Results are discussed in section IV while the conclusion and future works is briefly provided in section V.

II. TEST SYSTEM MODEL DESCRIPTION

The system under study is shown in Fig. 1.

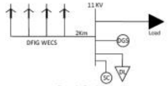

Figure 1. Test System

HOW DO YOU ASSESS AND QUANTIFY RESILIENCE FOR DISTRIBUTION NETWORKS?

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INVESTIGATING TRAVELLING WAVE FAULT LOCATION TECHNIQUES FOR DISTRIBUTION ASSETS

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Recovery Plan for Electric Distribution Networks under Major Impacts

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Abstract—**Power distribution system recovery after typical failures which hardly result in long lasting outages is a common practice. However, network recovery after a major impact such as extreme weather or other natural hazards can be much more complicated and time-consuming. Such events can easily cause costumers to experience an extended power outage which is associate explores and expla evolved a of inform**

Outage management and network task if the blackout is associated w This situation which is mainly ca results in an extended outage. A stati [2] shows an increase in the numbe

VOLTAGE AND FREQUENCY RESPONSE OF SMALL HYDRO POWER PLANT IN GRID CONNECTED AND ISLANDED MODE

Duncan Kaniaru Maina, Mohammad Javad Sanjari, Department of Electrical and Computer Engineering, University of Auckland, Auckland, New Zealand
Nirmal-Kumar C. Nair, Department of Electrical and Computer Engineering, University of Auckland, Auckland, New Zealand

Abstract— **Hydro-based power is gaining more interests as the penetration level of small-scale hydro power plants are being**

operation is reviewed in [6]. General distributed generation islanding techniques are first discussed after which a review of

EFFICIENT DISTRIBUTION NETWORK RECOVERY FOLLOW DISASTERS: NEW ZEALAND CASE STUDIES

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Negative Sequence-Based Schemes for Power System Protection - Review and Challenges

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Nirmal-Kumar C Nair, *Electrical and Computer Engineering, University of Auckland*, Auckland, New Zealand, n.nair@auckland.ac.nz

Abstract—**This paper presents a review of the negative sequence-based protection relays development and their applications on electrical power networks and discusses the related challenges. Recent power system requires selective, reliable, rapid fault detection and clearance mechanisms especially for the transmission line networks, which are highly exposed to environmental incidents. Most of the negative sequence protection techniques and recent challenges are**

especially line-line faults which are considered common events in power systems, in addition tc advantages will be reviewed later in this paper.

II. NEGATIVE SEQUENCE PROTECTION OVERV

Negative sequence Protection (NSP) is a pro scheme used to protect the power system element by of negative sequence component. It was first introd

DFIG-based Windfarm Starting Connected to a Weak Power Grid

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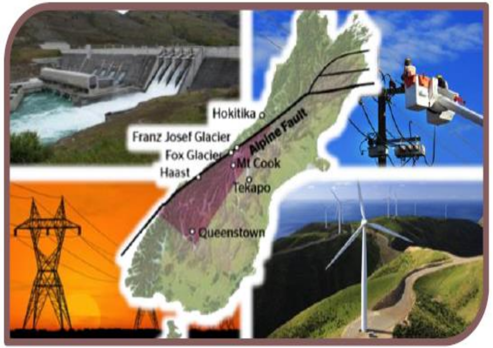
Abstract - **Starting and energization of windfarms has always been done under strong grid conditions. With the increase in blackouts and desire to run parts of the system in island mode, it is necessary to examine the starting of windfarms under different system conditions. This work provides an analysis into the starting of DFIG based windfarms under weak grid conditions including using a diesel gen-set and a hydropower plant. The starting procedure of the DFIG based wind turbine has been explored afterwhich multiple wind turbines have been started simultaneously. It is assumed that the windfarm substation will have a dump load to absorb excess power produced by**

synchronization has been proposed and discussed in [11, 12]. [13] proposes the use of pre-charging resistors and separate rectifier circuit in charging the dc link capacitor. All of the above analysis into DFIG starting and energisation has only been provided under normal grid conditions. Limited work so far has provided analysis on DFIG windfarm starting under different system conditions, other than the normal grid condition. This analysis is important especially in understanding the restoration function of DFIG windfarms after a wide scale blackout.

The proposed work, through analysis of individual

NZ Electricity Distribution Network Resilience Assessment and Restoration Models following Major Natural Disturbance



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This work is supported financially by the New Zealand Ministry of Business, Innovation and Employment under the 'Resilience to Nature's Challenges' (Infrastructure) National Science Challenge.

The 'NZ Electricity Distribution Network Resilience Assessment and Restoration Models following Major Natural Disturbance' project is a joint project led by the Power System Group from the Department of Electrical and Computer Engineering, University of Auckland. Westpower is the distribution utility under study.

This project will contribute to the resilience of the electrical infrastructure of West Coast New Zealand against different natural hazards with focus on the Alpine fault rupture. It aims to introduce appropriate resilience metrics, assess and improve the resilience of electrical infrastructure of the West Coast electrical distribution network.

Project supporters

Primary Funder	Resilience to Nature's Challenges – National Science Challenges
Co - Funder	QuakeCoRE; Westpower
In – Kind Support	Mitton ElectroNet; eea Electricity Engineers' Association
Research lead	The University of Auckland – Faculty of Engineering
Research Partners	Transpower; Chorus; UC University of Canterbury

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University of Auckland, Auckland 1010, New Zealand

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This project will contribute to the resilience of the Electricity and Communication infrastructure of West Coast New Zealand against different natural hazards with focus on the Alpine fault rupture. It aims to introduce appropriate resilience metrics, assess and improve the resilience of Electrical and Communication infrastructure of the West Coast.

Project supporters

Primary Funder	Resilience to Nature's Challenges – National Science Challenges
Co - Funder	QuakeCoRE; Westpower
In – Kind Support	Mitton ElectroNet; eea Electricity Engineers' Association
Research lead	The University of Auckland – Faculty of Engineering
Research Partners	Transpower; Chorus; UC University of Canterbury

DOCUMENTATION SUMMARY

This report presents collaborative work of members from the Power and Communication Systems Group of the University of Auckland for the project titled "Functionality Assessment of West Coast NZ Fixed Communication Infrastructure following Major Earthquake". The contributors to this report are Farrukh Latif, Andrew Austin and Nirmal Nair.

Document:

Functionality Assessment of West Coast NZ Fixed Communication Infrastructure following Major Earthquake

Prepared for:

Ministry of Business, Innovation and Employment, New Zealand

Consolidated by:

Farrukh Latif
RNC1 Group, University of Auckland

Revision	Date	Submission	Reviewer 's Feedback
1	June 2019	Communication Infrastructure Assessment Report	Initial Draft
2	July 2019	Communication Infrastructure Assessment Report	Andrew Austin
3	Aug 2019	Communication Infrastructure Assessment Report	Liam Wotherspoon

DOCUMENTATION SUMMARY

This report presents collaborative work of members from the Power Systems Group of the University of Auckland for the project titled "NZ Electricity Distribution Network Resilience Assessment and Restoration Models following Major Natural Disturbance". The contributors to this report are Duncan Kaniaru Maina, Samad Shirzadi Deh Kohneh, Safa Al-Sachit, Leo Yang Liu and Nirmal Nair.

Document:

NZ Electricity Distribution Network Resilience Assessment and Restoration Models following Major Natural Disturbance

Prepared for:

Ministry of Business, Innovation and Employment, New Zealand

Consolidated by:

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Samad Shirzadi Deh Kohneh
Safa Al-Sachit
Leo Yang Liu
Power Systems Group, University of Auckland

Revision	Date	Submission	Reviewer	Reviewer 's Feedback
1	September 2018	Milestone 1 Report	Daniel Blake (University of Canterbury)	Corrections on methodology explanation
2	July 2019	Milestone 3 Report	Rodger Griffiths (Westpower)	Corrections on network components descriptions

IEEE ISGT-ASIA 2017

CIGRE AUCKLAND 2017

EEA 2019

EEA 2018

CIGRE NZ FORUM 2019

AUPEC 2018

Appreciation

Electricity Distribution Resilience Framework through West Coast Alpine Fault Scenario

Nirmal Nair (PI), Andrew Austin (AI), Farrukh Latif (ME, Chorus), Samad Shirzadi (PhD), Duncan Maina (PhD), Yang Liu (Postdoc), Daniel Blake (Postdoc), Liam Wotherspoon (RNC DI, Lead)

RESILIENCE TO NATURE'S CHALLENGES
Kia manawaroa – Ngā Ākina o Te Ao Tūroa

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CHORUS

WESTCOAST NEW ZEALAND ENERGY-COMMUNICATION RESILIENCE ASSESSMENT FACTORING AF8 LIKELY TRAJECTORIES

Presenters: Duncan Kaniaru, Farrukh Latif

Energy-Communication Resilience Research Group

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