



TRANSPower RESILIENCE PROGRAMME

FOCUS ON RESEARCH

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T R A N S P O W E R

22 NOVEMBER 2022

POWERING NEW ZEALAND TODAY + TOMORROW







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Resilience threats and major hazards

Our investment plans




Our view on research

RESILIENCE THREATS AND MAJOR HAZARDS 1/2









THREATS		GRID MAJOR HAZARDS
NATURAL HAZARDS	 Seismic	Substation buildings, equipment, and bus structures Transmission lines, HV and underground communication cables Access ways
	 Volcanic	Insulator flash over from ash Mechanical line loading damage Disruption to electronics, AC systems Lahar impacting sites, lines, access ways Pyroclastic density current flows impacting stations, lines, and access ways
	 Tsunami	Towers and poles Substations Subsea cables and cable stations
	 Space Weather	Transformer damage due to geomagnetically induced currents Reduced security: voltage control, protection and GPS clocks







THREATS		GRID MAJOR HAZARDS
NATURAL HAZARDS WEATHER RELATED RISKS	 Land Stability	Towers and poles, and communication cables Access ways Landslides damaging buildings and structures
	 Flooding	Towers, poles, access ways and communication cables Towers and poles in braided rivers Substations, control equipment and cables
	 Severe wind and tornadoes	Substation asset damage Transmission lines and optical ground wire failures Increased bush fire risk
	 Snow & ice	Increased mechanical loading on lines and optical ground wires Increased mechanical loading on buildings
	 Increased temperatures	Derating of all current carrying assets and a shift to a summer peak Insufficient cooling of control equipment particularly at stations
	 Bush fire	Bush fire encroaching assets Transpower starting bush fire

RESILIENCE THREATS AND MAJOR HAZARDS 2/2

	THREATS	GRID MAJOR HAZARDS
ASST RISKS	 Common mode failure	Overhead earth wires (OHEW) failures HV power cable joint and termination failures Critical tower foundations understrength HVDC converter station control system failures Synchronous condenser auxiliary plant failures
	 Third party activities	Malicious attacks: cyber and physical Non-malicious activities: unauthorised entry, third party utility asset risk and poor housekeeping Physical impacts with our assets: land, air, and water
	 Significant Asset fires	Substation building Switchyard

INVESTMENT PLANS

	THREATS	RCP4 RESILIENCE PROPOSAL
NATURAL HAZARDS	 Seismic	Seismic Strengthening of Buildings Equipment spares for the new seismic hazard model (sites exceeding IEEE693 'high')
	 Volcanic	Hardening transmission lines for a volcanic ash event
	 Tsunami	
	 Space Weather	Space weather mitigations for transformers Mitigation for loss of time synchronisation within the network due solar storms
ASST RISKS	 Common mode failure	Pre-enabling works for major failures of non-air bushings/GIS Eliminate overhead station earthwire – common mode failure
	 Third party activities	
	 Significant Asset fires	Fire stopping and detection upgrades to substation buildings
	 Response to multiple threats	Acquire portable switchroom for South Island and run emergency exercise Emergency exercises for tower restoration

	THREATS	RCP4 RESILIENCE PROPOSAL
NATURAL HAZARDS WEATHER RELATED RISKS	 Land Stability	Slope stability works for towers and poles Hardening bridges and access tracks against land instability and flooding
	 Flooding	Flood-hardening critical and vulnerable towers in braided rivers Flood-resilience solutions at substations Hardening HVDC towers against wind and flood damage Hardening bridges and access tracks against land instability and flooding
	 Severe wind and tornadoes	Hardening HVDC towers against wind and flood damage
	 Snow & ice	
	 Increased temperatures	
	 Bush fire	

RESEARCH – NATURAL HAZARDS

NATURAL HAZARDS

THREATS

RESEARCH STATUS/PARTNERS



Seismic

Mature – need to fully digest implications of new seismic hazard model and likely changes to building codes etc



Volcanic

Mature – partnered with UC and Prof Tom Wilson
One **question** still on our minds: Effect of insulator orientation
Opportunity - Lahar risks and our line alignments through Central NI



Tsunami

Mature – 2018 NIWA work. 7 high risk, 4 medium risk, 6 lower risk substations



Space Weather

Mature, developing our response – partnering with Otago Uni and Prof Craig Rodger



Land Stability

Developing – connecting with landslide national advisory group, and data sharing with UoA, Liam Wotherspoon
We have good data where our Service Providers have identified issues – next step to overlay our assets with a geospatial view of risk

THREATS

RESEARCH STATUS/PARTNERS



Flooding

Towers in braided rivers – **mature**, engagement with NIWA and Beca
Substation flooding – **reasonable** view from Beca report. **Opportunity** to have a national geospatial view of flood risks under different RCP scenarios



Severe wind and tornadoes

Reasonable view of current risks (NIWA dataset)
Opportunity to have a national geospatial view of 'probability of exceedance' of various windspeeds under different RCP scenarios



Snow & ice

Limited. Ability to forecast (short and long term) weight of snow loading / ice accretion on conductors would be of value. Understand NIWA research underway into ice accretion



Increased temperatures

Unsure. Would be of value for us to understand regional variation in likely temperature rise (by season) under different RCP scenarios (how to model underclearance, high temp low wind)







Bush fire

Limited internal focus to date (especially compared to peers overseas). Use of 2011 Scion VH+E days to inform environmental criticality. Recent engagement with FENZ on their work to update Wildfire risk analysis.

WEATHER RELATED RISKS

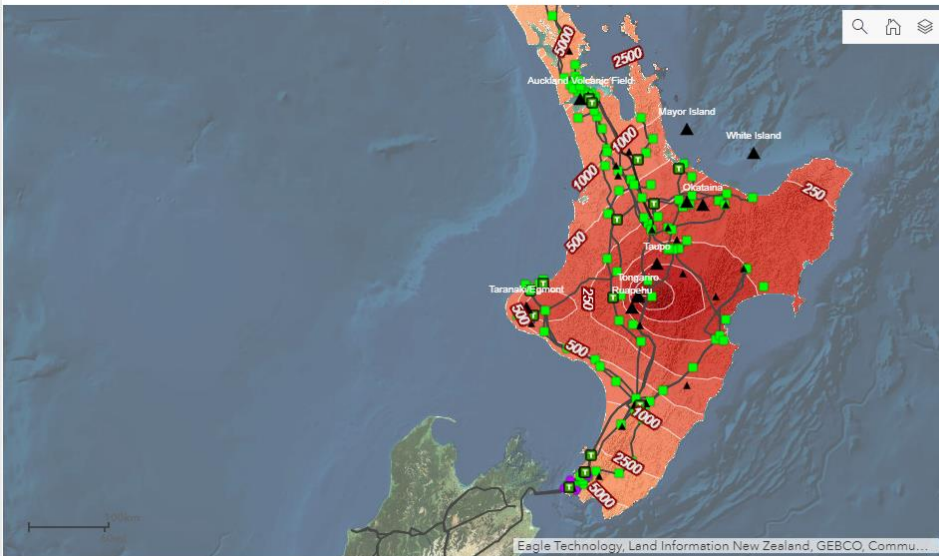
RESEARCH - OTHER

	THREATS	RESEARCH STATUS/PARTNERS
ASST RISKS	 <p>Common mode failure</p>	Interested in any research into techniques to uncover potential latent common mode failures
	 <p>Third party activities</p>	
	 <p>Significant Asset fires</p>	<p>Working on synthetic transformer oil strategy to mitigate transformer fire risk</p> <p>Interested in any other novel fire hazard elimination/mitigation mechanisms</p> <p>A challenge for us is around managing (detection and suppression) unattended critical building fire risks</p>
	 <p>Response to multiple threats</p>	<p>Focus on developing decision making frameworks to prioritise and justify resilience investments</p> <p>How to engage with community on resilience</p> <p>How to leverage distributed energy resources for resilience</p> <p>Encouraged by joined up work underway with Lifelines groups and NEMA</p>

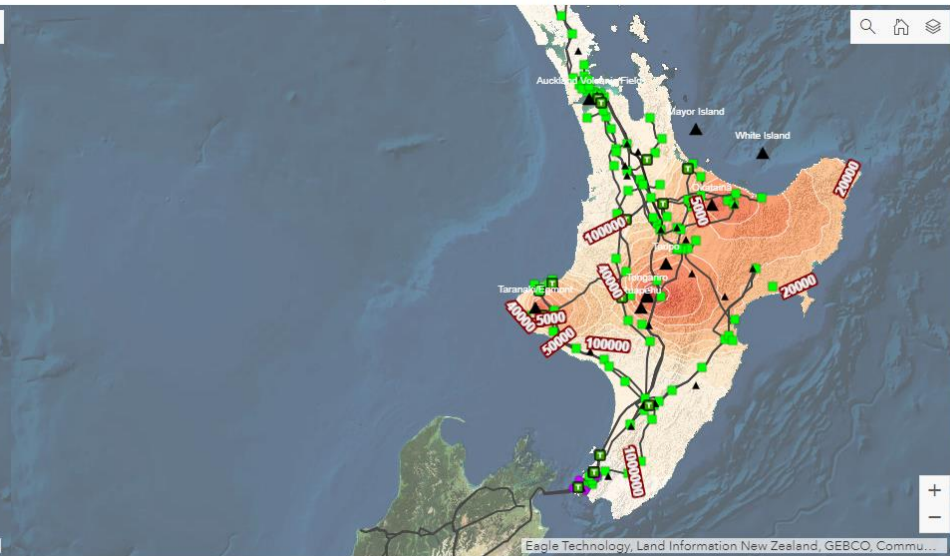
EXAMPLE

Natural Hazard Spatial Viewer – Volcanic Ash Analysis

Average Return Period of 3mm Ashfall



Average Return Period of 200mm Ashfall



Return Period

10 25 50 100 250 500 1000 2500 5000 10000 20000 30000 40000 50000 100000 1000000 10000000

Years

REFERENCE

RCP4 Consultation Document :

<https://www.transpower.co.nz/our-work/industry/regulatory-control-periods/rcp4/consultation-our-draft-rcp4-proposal>

