

Managing Seismic Risk

2008 National Lifelines Forum

Ian Burgwin

Grid Maintenance Manager

TRANSPower



Civil Defence and Emergency Management Act

Compliance with Act is based upon the 4 R's

- Reduction
- Readiness
- Response
- Recovery



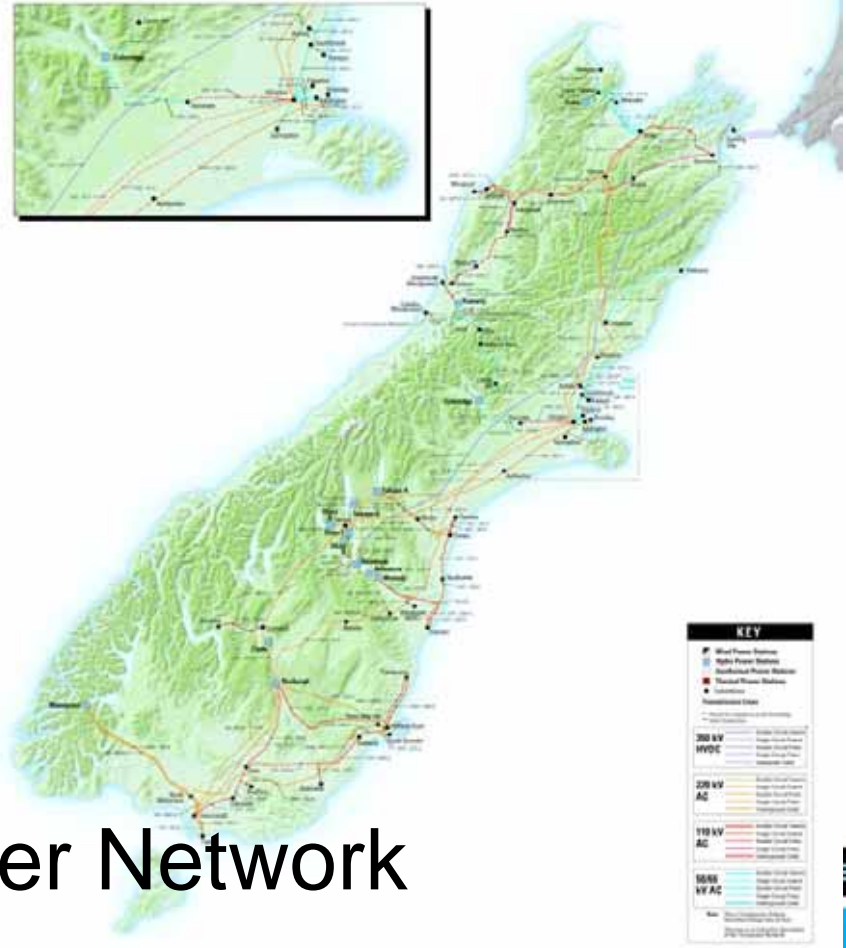


KEY

- Wind Power Station
- Hydro Power Station
- Geothermal Power Station
- Nuclear Power Station
- Transmission Lines
- Transmission Lines

300 kV HVDC	300 kV AC
220 kV AC	110 kV AC
66 kV AC	33 kV AC

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The Transpower Network



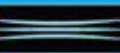
Business Continuity Management

- Executive Crisis Management Plan
- Business continuity plans for core functions
- Emergency response procedures for asset management and system operation
- Contingency Plans for specific events
- Exercises



Risk Reduction

- New equipment to latest standards
 - Accelerating asset replacement programme
- National vulnerability review programme
- Programme of works developed as review programme progresses



Review Programme

- Each substation is assessed at approximately three yearly intervals
- Substations assessed at component level for vulnerability from damage as a result of major hazards
- A vulnerability chart is completed for each site and explanatory photographs taken
- Remedial actions recommended



Typical Vulnerability Chart

Utility: Transpower Regional/Local Asset: Taumarunui Substation . E 2711940 N 6254500 10 May 2008 .

Component	Vulnerability to Hazard										Impact of Damage			Comments	Date Actioned	Date Completed
	Importance	Ground Shake	Liquefaction	Landslide	Vulcanic Eruption	Severe Flooding	Snowstorm	Windstorm	During Earthquake	Immediately After	Period Following	Return to Normality	1			
Overall building	4	1	0	0	1	0	0	1	2	2	3	1	m	control building . Glue laminated timber portals light timber framed/metal clad walls - Ok		
Control cabinets and panels	4	2	0	0	1	0	0	1	2	2	3	1	m	Outbuildings LTF (unable to confirm the hold down system for equipment shed)		
Suspended ceilings	5	1	0	0	0	1	0	1	3	2	3	2	d	OK bolted down to unistrut false floor (braced against walls) P49,P69 and P74 remove loose paper P57 loose equipment		
Phones/Intercom.	1	2	0	0	0	0	0	1	2	1	1	N/A	Gib connected to purlins - OK Chain brace hanging fluos (swing hazard during earthquake)			
Emergency generator	5	2	0	0	0	0	0	0	1	3	2	1	d	Restrain test equipment on shelf . Restrain desk, glass top, book shelves, fax land other loose furniture.		
Generator	5	2	0	0	1	0	0	0	3	3	1	1	m	Main switchboard does not appear to be robustly secured - check (moves when pushed)		
Inside Cabling	5	1	0	0	1	1	0	0	3	2	1	2	d	Generator and battery restraint ok		
Cranes														OK under false floor with timber lids.		
Batteries														N/A		
Discharge device	5	2	0	0	0	0	0	1	3	2	1	1	d	Unistrut/ RHS stands. All batteries need packing to prevent sliding and possible terminal damage		
Storage spares	4	1	0	0	1	0	0	1	3	2	1	2	wks	Enclosed discharge device on light angle / flat stand		
33 kV yard	4	3	0	0	0	0	0	1	1	3	1			Outside spares bolted to concrete pad - good. Old frame loose, remove or bolt down. Inside on shelves with up stands - good.		
L/S Transformer.	4	3	0	0	0	0	0	1	1	3	1			N/A 50 kV see above		
Access	5	1	0	0	0	0	0	1	1	3	3	3	d	Doesn't appear to be held down Check/restrain		
	4	1	1	1	1	2	2	2	1	3	3	TBC	Two laned sealed side road off of SH 3 then north and south			

Taumarunui 08 Power Point.xls

Assess Importance. 1 to 5.
Assess Vulnerability. 1 to 3.
Assess Impt of Dmge. 1 to 3.

5 most important.
3 most vulnerable.
3 most impact.



Utility: Transpower

Regional/Local

Asset: Taumarunui Substation . E 2711940 N 6254500

10 May 2008 .

Component	Vulnerability to Hazard								Impact of Damage				Comments <i>Red Text Denotes Recommended Action</i>	Date Actioned	Date Completed
	Importance	Ground Shake	Liquefaction	Landslide	Vulcanic Eruption	Severe Flooding	Snowstorm	Windstorm	During Earthquake	Immediately After	Period Following	Return to Normality			
Transmission lines	5	1	0	1	2	1	1	1	3	2	1	3 d	Galvanised steel RSA lattice towers		
Termination towers	5	1	0	0	2	0	0	1	3	2	1	3 d	Galv steel RSA lattice gantries / towers ok		
Gantries	5	1	0	0	1	0	0	1	3	2	1	3 d	Galv steel RSA lattice portal frames		
Buswork	5	1	0	0	1	0	0	1	3	2	1	2 d	Pipe bus on tall insulators - <i>bit vulnerable</i> Aluminium with slip joints Good.		
Circuit breakers (external)	4	1	0	0	2	0	0	1	3	2	1	2-4 d	LV channel cantilevered frames. Heavy cold rolled steel Disconnectors on conc posts HV Robust steel lattice frames - but <i>heavy insulators at top makes vulnerable (top heavy)</i>		
CTs/VTs	4	1	0	0	1	0	0	1	3	2	1	2wks	VT's on sturdy conc poles (LV). HV CVT's on sturdy lattice stands CT's on slender pipe stands, <i>ck capacity for current EQ requirements</i> . HV CT's sturdy lattice frames		
Line Traps	4	1	0	0	1	0	0	1	3	2	1	1 wk	HV on usual standard insulators on angle and flat lattice stands - Ok		
Water storage tanks	2	2	0	0	0	0	0	3	1	3	2	2 d	Plastic unrestrained on wooden table - <i>Water tank restraint light avoid being blown into switchyard if empty</i>		
Power transformers	5	1	0	0	1	0	0	0	3	3	3	2 yrs	T5 Wilson 1 Ph (1998) 73 tonnes. Good robust hold down. 220/ 50kV (NIMT) T8 OEL 1 ph 41 tonnes 220/50kV on steel plinths. <i>Hold down as robust as T5 but may be ok.</i>		
Underground cabling	5	1	0	0	1	0	0	0	3	2	1	1-2d	Std concrete ducts & lids with steel cross over sections		
Communications towers	5	1	0	0	1	0	0	0	3	3	3	3 d	Steel post		
Disconnectors	5	1	0	0	0	0	0	1	3	2	3	2 d	On folded plate channel beams on concrete posts. <i>May be weak torsionally. Check seismic capacity</i>		
Oil Storage Tanks.													N/A		

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Transmission line feeding Gisborne



Termination tower and H poles



Older lattice and newer pipe gantries



Newer type RHS and pipe gantry



GEG CB's on sturdy steel stands



Note CB's and CT's etc on well grouted base plates

Example of photos taken for each site





CT's on sturdy pipe stands



VT's on sturdy pipe stands



Reactors on lattice stands



Neutral Earthing Resistor bolted down to transformer pad



Older single phase transformers well restrained



Newer three phase transformer well bolted down





Capacitor banks on post insulators



Traditional cast insitu reinforced concrete control building and crane room



Crane room looking north west



Cabinets in the relay room



Typical cabinet hold down. Note manuals and paper should not generally be left in cabinets due to potential fire hazard



Restrained desk, book shelving and fax, excellent practice





Restrained cabinet good practice



Restrain cabinet and manuals



Batteries properly packed out at end.



Spares restrained on spares pad



33 kV area showing gantry and switchgear



Three phase CB inside cabinet on cantilevered legs





CB's on sturdy lattice stand



VT's on sturdy pipe stands



Airconditioning units restrained



Storage in crane room



Retaining wall has moved in the past and should be monitored



Oil Separator unit well restrained



Hazards Assessed

- Seismic
- Liquefaction potential
- Landslide
- Volcanic Eruption
- Severe Flooding
- Severe Snow Storms
- Severe Wind Storms
- Tsunami (where applicable)
- Fire Hazards
- Any other relevant Hazard



Acting on the Reports

- Reports provided to Transpower Maintenance Managers for action.
- Action generally undertaken through maintenance contractors
- Progress tracked to verify implementation
- Remedial Options
 - Mitigate
 - Manage
 - Eliminate



Some examples of vulnerabilities





Back up batteries not as secure as they could be

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Unsecured wheeled furniture in relay room

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Paper on equipment potential fire hazard

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Light unframed garden sheds in switchyard

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Equipment vulnerable on shelving

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Unsecured furniture including fax's etc

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Some older equipment vulnerable to major earthquakes

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Some transformer hold down not as robust as could be

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Insecure storage

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Issues

- Many examples of best practice, but ...
- Vulnerabilities vary across the network
- Treatments for vulnerabilities inconsistent
 - Good practice in one area not found in another
 - Failing to share
- Three year cycle of reporting provides
 - Assurance of implementation
 - Continuous learning
 - Continuous improvement
 - A war of attrition



Some examples of best practice





Transformer bank well restrained

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Robust transformer restraint

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Modern three phase transformer built to current standards

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Robust hold down systems

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Equipment on robust support stands

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Example of seismic strengthening of an existing building





Back up batteries well packed and strapped down

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Even small Comms batteries restrained

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Small equipment within cabinets restrained

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Important manuals restrained within shelving

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Furniture and equipment restrained (Gisborne prior to earthquake)

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Restrained furniture in relay room (Gisborne prior to earthquake)

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Computer equipment restrained on desk

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Secure storage

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Secure storage

TRANSPower

