Noise Interference

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NZCCPTS Noise Interference Guide

- Good pragmatic overview
- Due to high variability in nature of:
  - noise sources within power systems (frequencies, levels and time variation)
  - coupling to telecommunications plant
  - susceptibility of telecommunications plant

  need to approach each problem with an open mind

  a formularised approach will not always work.

Electromagnetic Fields around Power Lines

Below several hundred kHz

- Structure attached
- Quasi-static
- Decompose into separate
  - magnetic,
  - electric (capacitive) and
  - conductive coupling mechanisms.
- Earth return component of current is the primary concern

Weak Coupling Assumption

- Ignore the affect of telecommunications plant on current distribution in the power line
- Allows us to decompose problem into
  - Calculate current distribution on power line independently of telecommunications plant using standard tools
  - Calculate induced voltage at site of telecommunications plant $E = C \times L \times I \times K$

Coupling of Noise to Telecommunications Plant

- Inductive coupling approximately linearly proportional to frequency at road width separations
- Susceptibility of telecommunications plant to noise is technology and frequency dependent
- For telephone services a 2000 Hz noise current is approximately 40,000 x worse than a 50 Hz current of the same magnitude
- Very small noise currents in power lines (10s of milliamps) can cause significant problems

Electromagnetic Compatibility

- Electromagnetic compatibility issue
  - Responsibility of source to limit magnitude of interference
  - Responsibility of receiver to limit susceptibility of their system to interference.

Noise Conversion Mechanisms

- Telecommunications cables use transverse signals over twisted pair cable
- Telecommunications plant has very high symmetry to prevent induced longitudinal noise causing audible transverse noise
- Balance > 60 dB if properly maintained – reject 99.9% of induced longitudinal voltage.

Noise Investigation Techniques

- Survey longitudinal voltages on telecommunication cables
- Measure spectrum of induced noise
- Rule in/out conductive coupling mechanisms
- Obtain power system distribution plans, notes of recent changes
- “Measure” current magnitude and flow in power network

Psychological Aspects

- Take telecommunications company time to recognise that there is a widespread problem
- Telecom customers are not good at complaining to Telecom!
- Telecommunication customers expectations are rising

Case Studies

- Dismantling of 110kV lines north of Temuka – 47th Harmonic Zero Sequence resonance
- Lower Waitaki – interconnection of 110 kV network to upper Waitaki stations
- HVDC Link
  - 1965 – Toll circuits over 10 mile long between Benmore and Haywards
  - 1965 – ripple control interference as far away as Blenheim
  - 1980s – noise in Fairton when in earth return mode

Case Studies

- Tiwai point 23rd and 25th harmonic causing noise at Omarama and ripple control problems in Otago and Southland.
- Kataia CBD broken neutral
- Westport and Cape Foulwind loss of one phase in interconnecting line
- Ngahere Gold Dredge
- Tuamarina ripple relay signal problem

Case Studies

- Taupo SWER lines