ADVICE FOR POWER TRANSMISSION AND DISTRIBUTION SYSTEM OPERATORS

VOLCANIC ASH IS: HARD, HIGHLY ABRASIVE, MILDLY CORROSIVE AND CONDUCTIVE WHEN WET.

IMPACTS ON TRANSMSSION AND DISTRIBUTION NETWORKS

- **Insulator Flashover** : Ash contamination of station and line insulators can lead to flashover.
  - » Flashover may occur with <3 mm of ash fall provided a significant portion of the insulator creepage distance (>50%) is covered in wet ash;
  - » This is the most common and widespread impact;
- **Loading Damage** : ash accumulation may overload lines, weak poles and light structures, and cause additional tree-fall onto lines. Precipitation will exacerbate the risk;
  - » Typically occurs with >100 mm ash accumulation;
  - » Induced tree fall from ash load may occur with thicknesses >10 mm;
- **Disruption to Control Systems** : ash ingress into heating, ventilation and air-conditioning (HVAC) systems can block intakes leading to reduced performance, and affecting dependent systems;
  - » Possible during any thickness of ash fall;
- **Earth Potential Rise** : Ash may reduce the resistivity of substation ground gravel cover, reducing tolerable step and touch voltages;
  - » Not observed, but theoretically possible.

INSULATOR FLASHOVER

ASH RESISTIVITY AND ASH COVERAGE OF THE PROTECTED LEAKAGE (CREEPAGE) DISTANCE OF INSULATORS ARE THE PRIMARY CONTROLS ON FLASHOVER LIKELIHOOD

- Dry ash is highly resistive. Wet ash can be highly conductive
  - » Light precipitation (dew, fog, drizzle or light rain) wets ash which initiates a leakage current, leading to flashover.
  - » Heavy rain will wash off contaminants, and high winds will clean non-cemented dry ash from insulators.
- Flashover may occur with <3 mm of ash fall provided a significant portion of the insulator creepage distance (e.g. >50%) is covered in wet ash
- Ash adherence is often variable, ranging from non-binding to cementing. Fine grained ash (<0.5mm) typically adheres and cements to insulators more readily.
- Insulator profile, orientation and material will influence its ability to shed or retain ash.
  - » **Material:** Non-ceramic (e.g. polymer) insulators generally outperform ceramic designs and have smaller shed diameters which appear to shed ash more effectively
  - » **Design:** Anti-pollution insulator designs can increase performance
  - » **Orientation:** evidence suggests suspension (vertical) insulator strings are generally more vulnerable, but this depends on the direction of falling ash and weather conditions
- Overseas experience suggests over-insulation (increasing creepage distance) and clean insulators are the most effective mitigation. See **IEC TS 60815 'Selection and dimensioning of high-voltage insulators for use in polluted conditions'.**

3 mm of ash fall cover on a glass insulator string inducing a flashover. Note how the current is tracking through the volcanic ash covered insulator surface

SUBSTATIONS

- Specialist inspection and cleaning procedures may be required for substation insulators, power transformer HVAC systems and control systems;
- Ash may reduce the resistivity of substation ground gravel cover, reducing tolerable step and touch voltages

RECOMMENDED ACTIONS

WHERE TO FIND WARNING INFORMATION

See www.geonet.org.nz for ashfall forecasts in the event of an explosive eruption. www.geonet.org.nz

HOW TO PREPARE

- Cleaning ash contaminated sites and components, especially insulators, is commonly required after an ash fall. Ensure availability of both live-line and de-energised cleanup plans which include:
  - » Priority schedule for inspecting/cleaning essential sites and lines
  - » Standardised ash fall clean-up procedures
  - » Ready access to cleaning supplies and equipment (air compressors, water-blasters, PPT gear, vehicle air filters,)
- Cleaning Guidance: see **IEEE Std 957 'Guide for Cleaning Insulators'. Experience suggests:**
  - » Ensure all insulator surfaces are cleaned, including undersides of weathersheds
  - » Insulator cleaning method will be determined by strength of ash adherence:
- Field crews should use safe operating procedures when operating in an 'ashy' environment. See **www.IVHHN.org** for guidelines for protecting people from ash hazards
- Coordinate with local, regional and national emergency planning, as appropriate

HOW TO RESPOND

- Initiate priority schedule for inspection and cleaning. Increased inspection and preventive maintenance may be prudent.
- A proactive communication campaign for customers/public covering your response, expected outages/restoration times and recommended actions aids awareness and good will
  - » Advise customers not to clean electrical equipment and to be careful when using hoses near electrical equipment.

Ash is cleaned from a 220 kV strain insulator string using pressurised water following the 1995 Ruapehu eruption, New Zealand (Transpower New Zealand)

MORE INFORMATION

THE FOLLOWING RESOURCES PROVIDE FURTHER INFORMATION ON VOLCANIC HAZARDS:

http://www.geonet.org.nz
http://www.gns.cri.nz
http://volcanoes.usgs.gov/ash/index.html
http://www.ivhhn.org

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