## **ADVICE FOR POWER TRANSMISSION AND DISTRIBUTION SYSTEM OPERATORS**

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

- 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:
- » Loading damage 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

**IMPACTS ON** 

AND

**TRANSMSSION** 

DISTRIBUTION

**NETWORKS** 

## 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'.

# 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.

## **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, etc.)
- Cleaning Guidance: see IEEE Std 957 'Guide for Cleaning Insulators'. Experience suggests:
  - » Ensure all insulator surfaces are cleaned, including undersides of



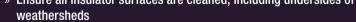


3 mm of ash fall cover on a glass insulator string inducing a flashover. Note how the current is tracking through the volcanic ash covered insulator surface

## 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.





- » 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

#### **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









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

## DRAFTED BY TOM WILSON, CAROL STEWART AND JOHNNY WARDMAN.

28 May 2013