ADVICE FOR POWER PLANT OPERATORS

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

IMPACTS ON POWER GENERATION FACILITIES

GENERAL IMPACTS:

- **Flashover**: Ash contamination of station and line insulators leading to flashover is the most common impact at power plants
  - » See companion poster "Advice for Power Transmission and Distribution System Operators"
- **Step/Touch Potential**: ash may reduce the resistivity of ground gravel cover, reducing tolerable step and touch voltages
- **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
- **Structural damage**: Very thick ash deposits (>100 mm) may create excessive loads on structures
  - » Long span, low pitched roofs are typically the most vulnerable
  - » When ash is wet, static loads may increase by up to 100%
- **Internal gutters**: may block with ash, potentially leading to water ingress to indoor electrical equipment.

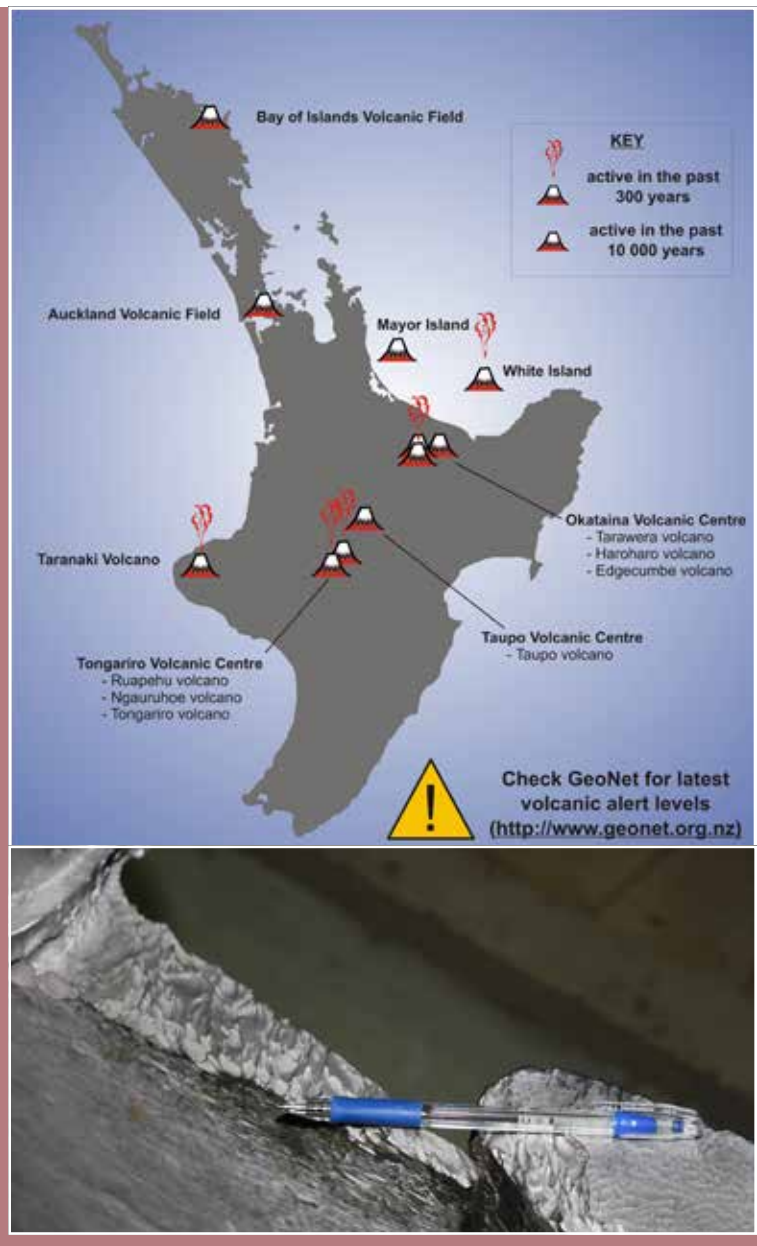
HYDROELECTRIC POWER STATIONS

- Ash suspended in intake water can cause accelerated wear of hydroelectric turbines (e.g. runner blades, labyrinth seals, cheek plates and wicket gates)
  - » Hazard depends on volume of ash deposited in catchment, reservoir size, settling rate of ash, abrasiveness of ash
- Ash may also fill rain gauges in climate stations throughout river and reservoir catchments.

THERMAL POWER STATIONS

There are few case studies to guide possible impacts or advice.

- Ash may block air intakes for gas turbines and boilers, or sub-aerial condenser systems causing blockages, abrasion and creating cleaning difficulties
  - » Ash falls have created airborne particle concentrations of up to 9 g m^{-3}, several times higher than dust- or sand-storms
- Mechanical seals may be vulnerable to abrasion and corrosion by ash
- Fine ash ingested into gas turbines may cause accelerated wear or melt on turbine surfaces (similar to an aircraft turbine)
- Ash may contaminate exposed surface water cooling reservoirs, potentially blocking heat-exchange systems.



Accelerated abrasion damage to wicket grates from Agoyan HEP, Ecuador. Normal design life of turbines at this plant is 6-7 years, but this has been reduced to 5 years due to ashfalls from nearby Tungurahua volcano contaminating reservoir water.

The October 1995 eruptions of Ruapehu volcano deposited 7.6 million m^3 of coarse ash into the Tongariro river catchment, leading to high levels of suspended ash. This catchment feeds the Rangipo power station (120 MW). While generation remained continuous throughout the eruption, two Francis turbines and all auxiliary components that had been in contact with ash-laden intake water were found to have suffered greatly accelerated abrasion damage, with 16 years' damage sustained in 6-7 months. A refurbishment program installed hardened components. Turbidity instrumentation was also installed at the intake point which is closed when thresholds are exceeded.

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

At-risk power generation facilities should develop operational plans for ash fall events, including:

- Install turbidity monitoring instrumentation at intake and identify threshold for intake closure
- Priority schedule for inspecting/cleaning essential sites and components
- Site cleanup may be required following an ash fall. Cleanup plans should include:
  - » Standardised ash fall clean-up procedures, suitable to your local conditions and site
  - » Stock or have access to sufficient supplies and equipment for cleaning;
  - » Clean up and additional maintenance can create significant additional labour and resource demands
  - » Insulators usually require cleaning. See the companion "Transmission and Distribution " poster and IEEE Std 957 "Guide for Cleaning Insulators". Ensure that roofs and similar elevated areas where ash accumulation will need to be removed, have pre-installed fall arrest anchor points and that a safe means of access is identified
- 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
- Transmission/distribution lines feeding the generation site may be disrupted and require additional planning – see "Transmission and Distribution " poster
- Hydroelectric plant (HEP) facilities may consider hardening turbines during design and refurbishment programmes.

HOW TO RESPOND

- Consider increased inspection and preventative maintenance
- Seal key facilities to limit ash ingress.
  See companion "Facilities Managers: Buildings" poster
- Clean up site to reduce remobilisation of ash and thus recontamination of energised components. Use dry methods where possible
  - » Remove ash from gutters to avoid localised flooding
  - » Internal gutters may require suction cleaning
- Be aware of increased electrocution hazard if ash covers the ground. Isolate and earth energised apparatus before entering site
- **Hydroelectric Power Plants** : Monitor the suspended solid load in water intakes. Be mindful of volcanic debris flows (lahars). Consider by-passing turbines, if necessary
- **Geothermal/thermal**: assess ash hazard and consider shut-down if necessary.

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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20 September 2013

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