

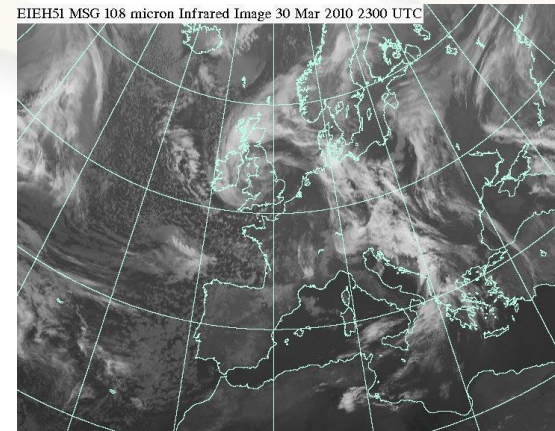
Northern Ireland Snow/Ice Storm

30/31 March 2010



Weather Forecast

- Weather forecast
 - Rain at lower levels will gradually turn to snow above 150m during tonight, and continue through Tuesday and into Wednesday. Accumulations around 30cm with drifting in the strong to gale force winds.
 - High risk of ice accretion above 100m from about 0001 onwards.
- Severe damage to 11kV distribution system
- 138,000 customers off supply
- Up to 6 days to restore





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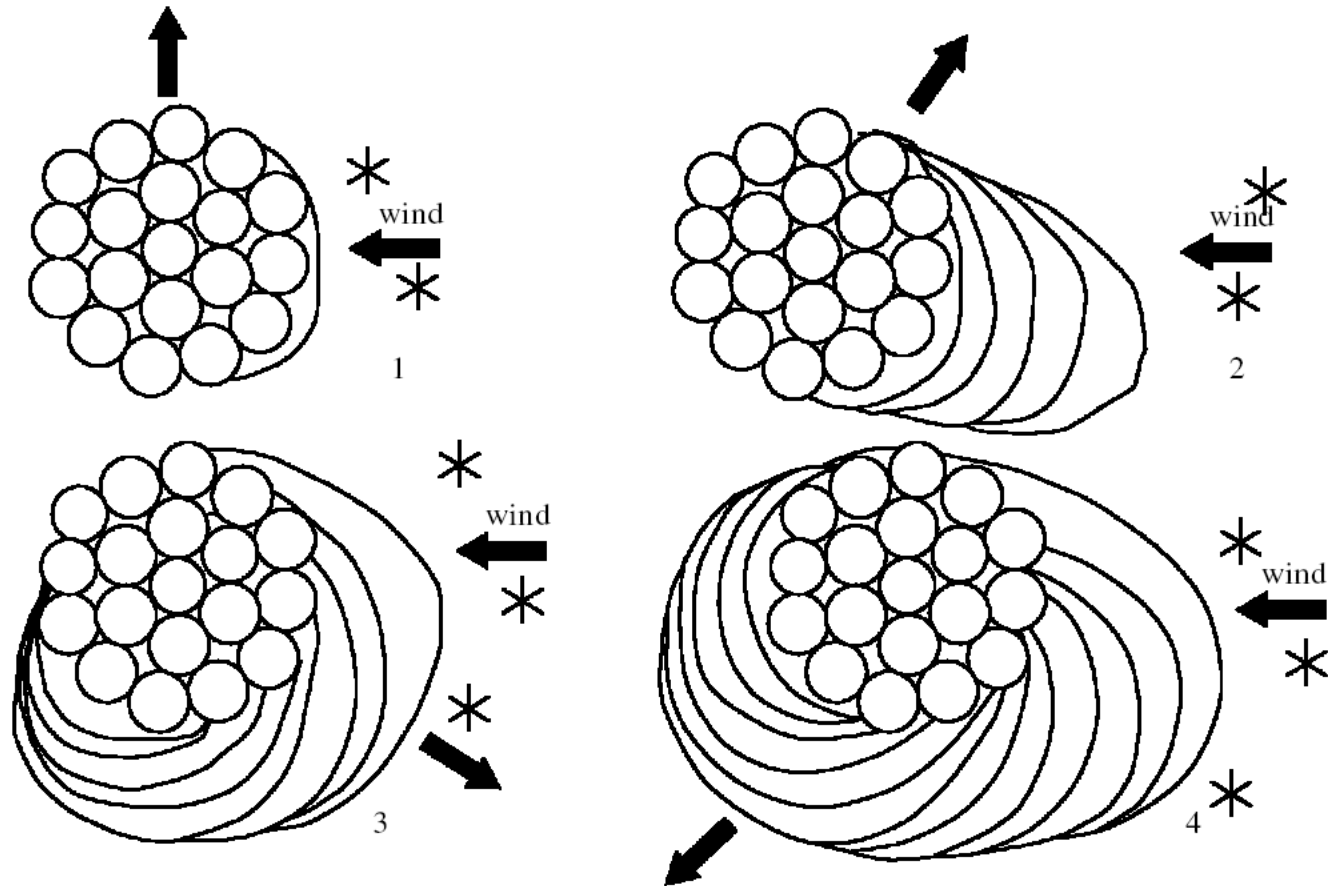
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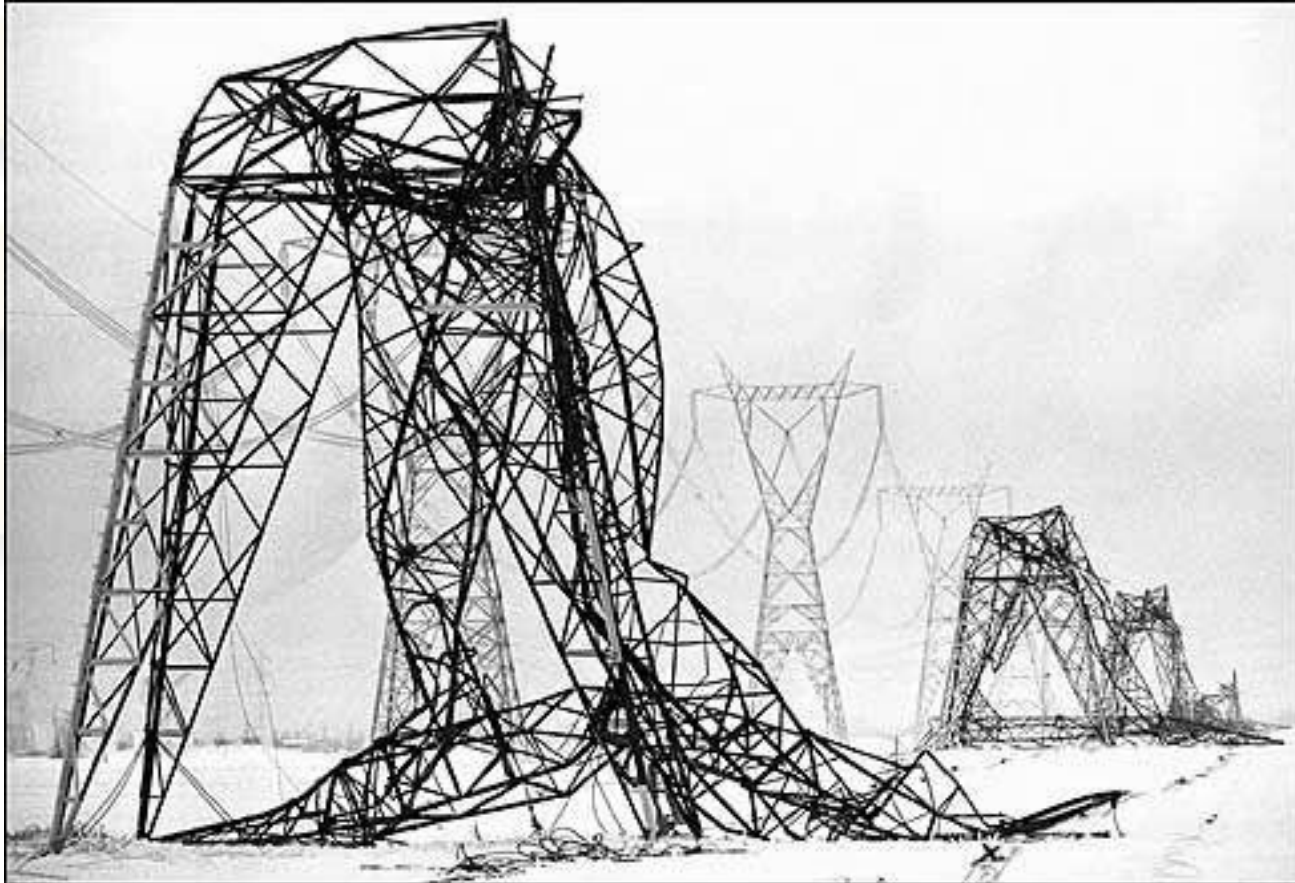
A heavy accumulation of wet snow (up to 150mm diameter) accreted around the conductors and on some spans which did not fail, the conductors were weighted down to within 300mm of the ground. The accumulation of wet snow was worst on conductors running east-west, which were perpendicular to the prevailing wind.



Snow Accretion



Canada 1998



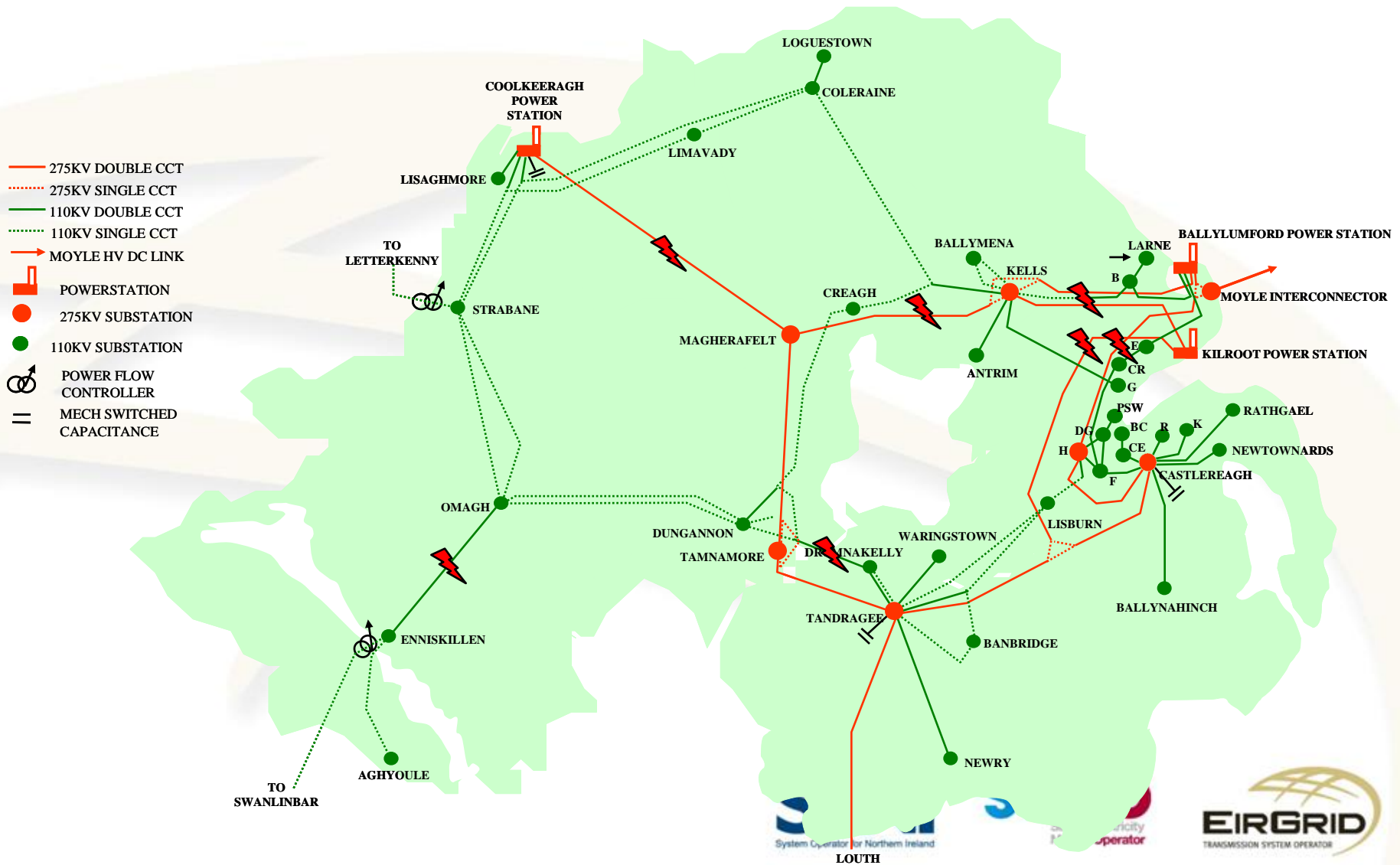
Transmission System

- 136 Transient Faults on 275kV lines in 15 hours
- 400 275kV circuit breaker trip operations
- 3 “Permanent” faults
- Mesh substations with transformer and line shared cause operational problems
- Loss of RTUs in critical locations
- No customers lost due to transmission faults
 - Delayed auto reclose
 - Replacement of air operated circuit breakers
 - New SCADA/EMS with video wall

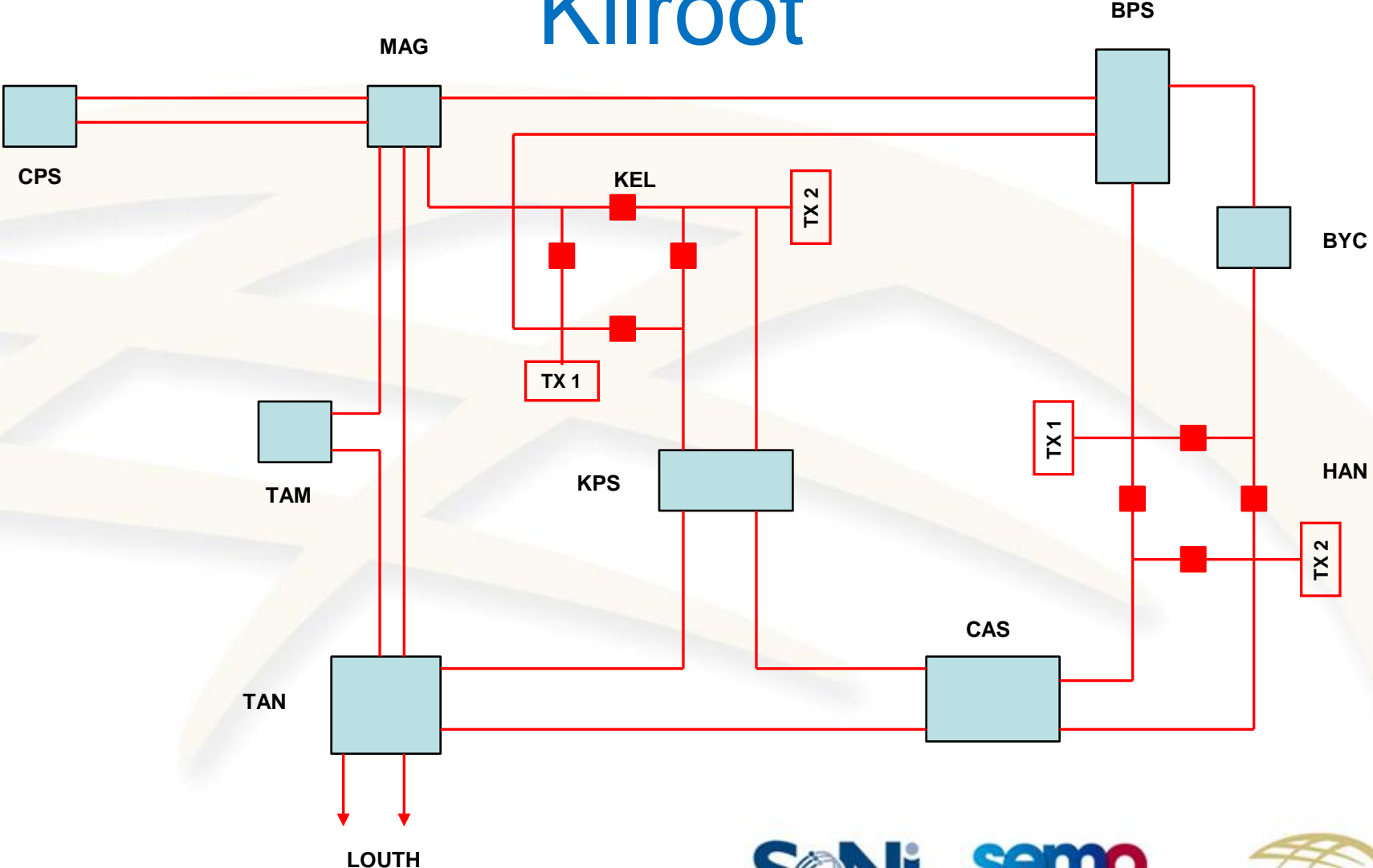
275kV Faults

- 275kV tower lines – double circuit L2 and L8 design with duplex “zebra” conductor
- Excessive sagging due to wet snow accumulating on middle phase – new phenoma on system
- Previous history of galloping due to ice accretion – de-spacing and dog-legging of conductor

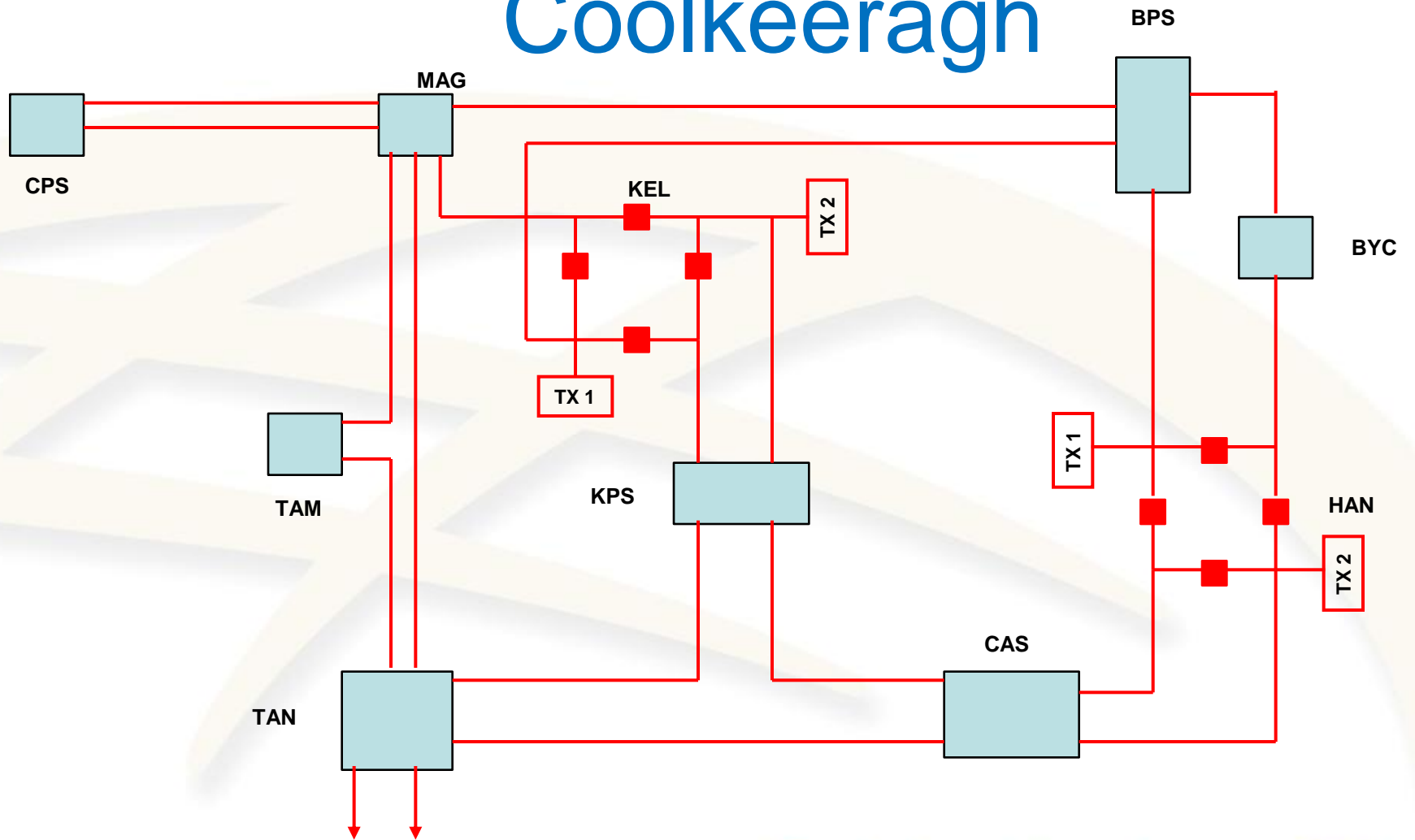
NI Transmission System



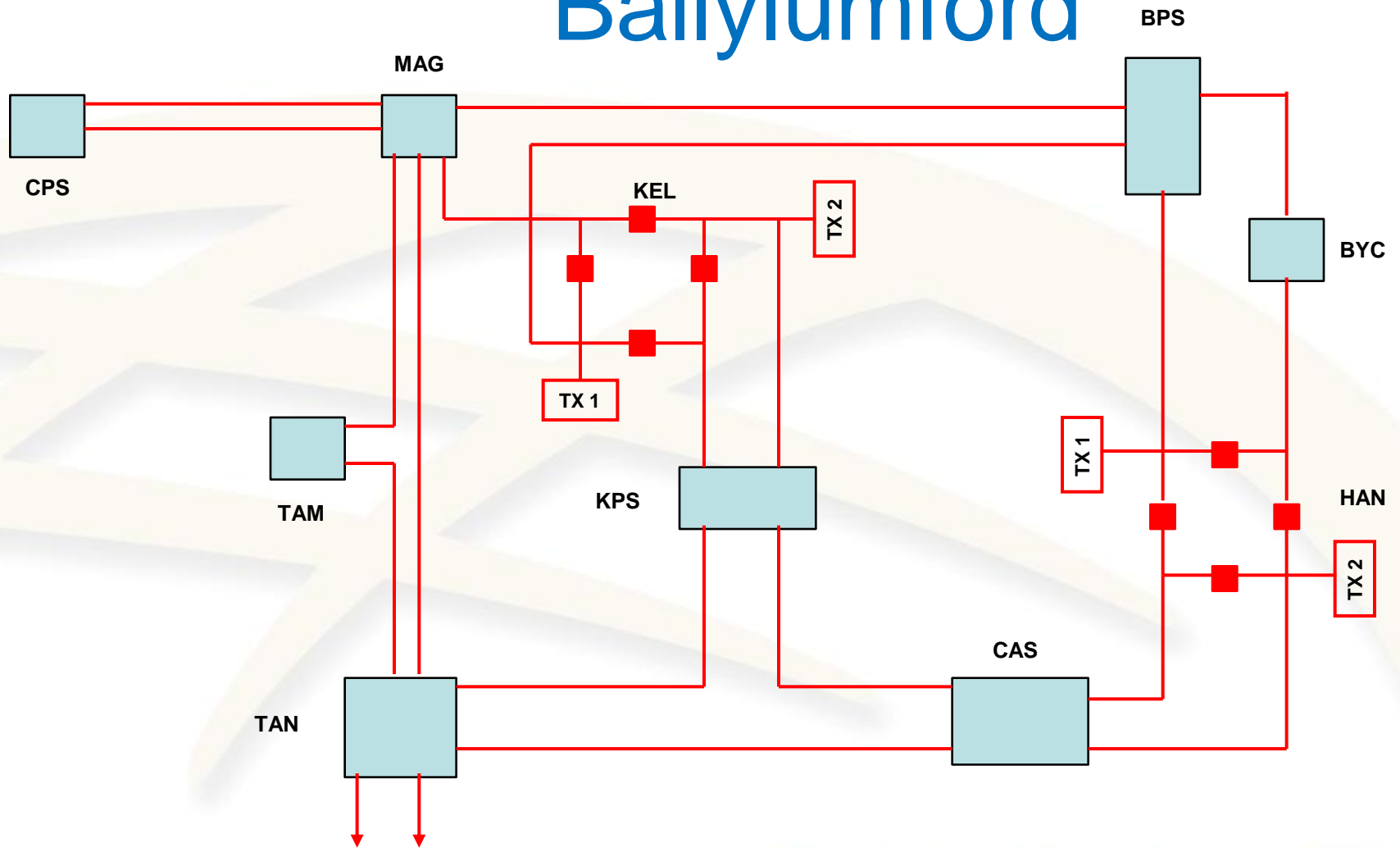
Kilroot



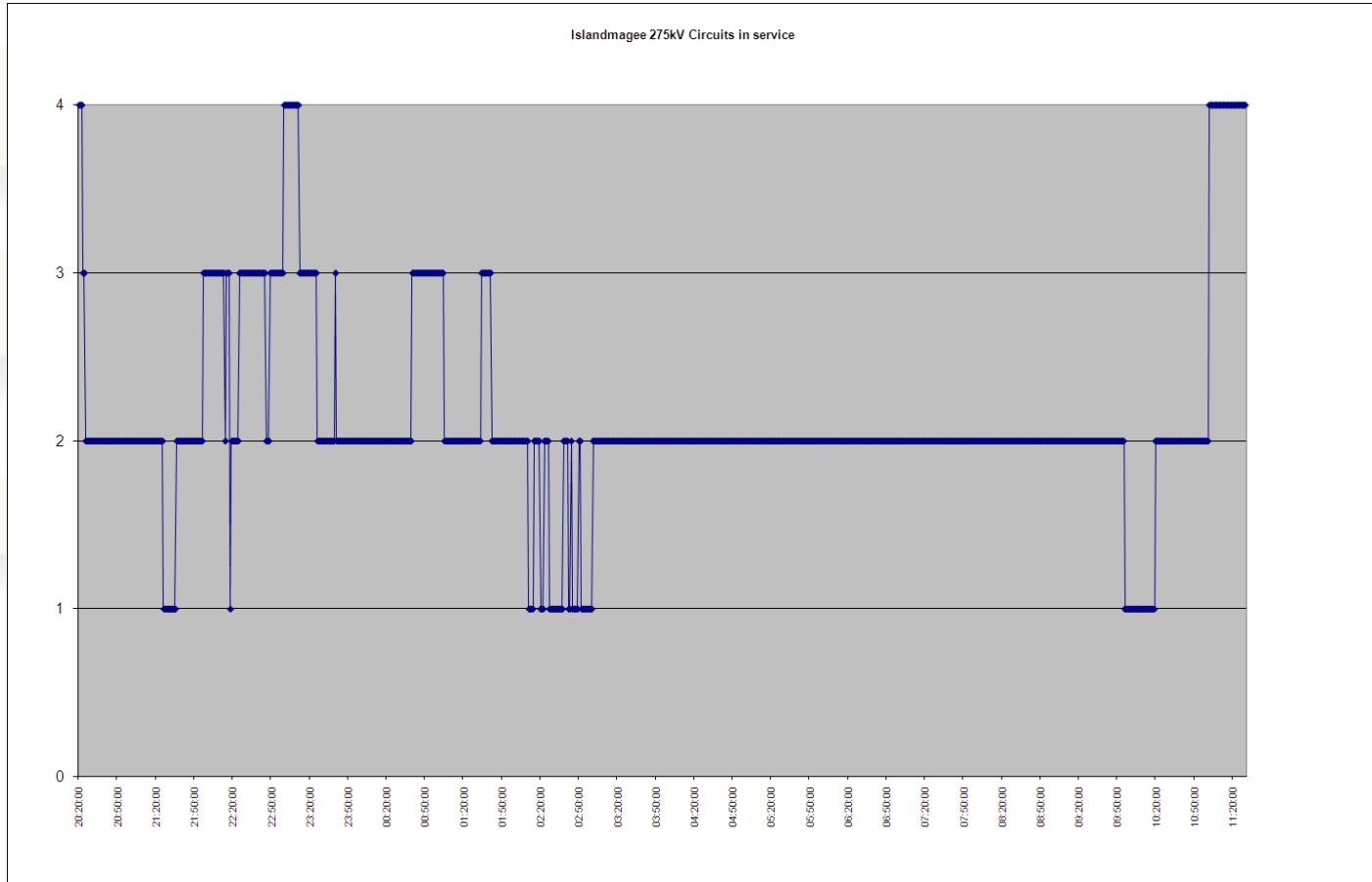
Coolkeeragh



Ballylumford



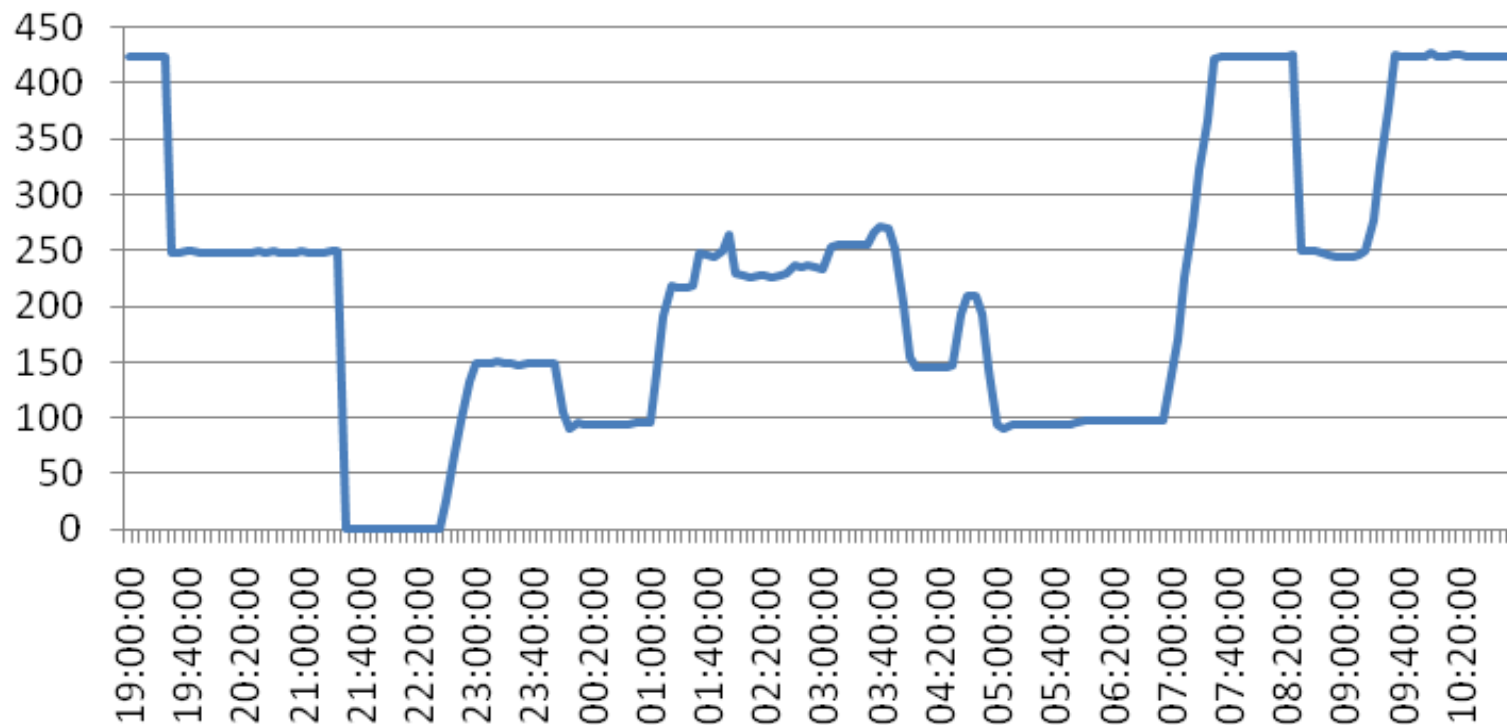
275kV Ccts ex BPS/Moyle



Generation

- First 275kV line fault
 - pole trip on HVDC link caused by commutation failure
 - trip of Ballylumford unit due to voltage dip affecting control system
- Loss of Kilroot unit due to disconnection of 4 275kV circuits
- Loss of 275kV double circuit caused reduced output from CPS
- Total of 6 pole trips on HVDC link due to loss of commutation
- Voltage dips affecting auxiliaries prevented return to service of both generators and caused unavailability of open cycle gas turbines
- Heavy reliance on interconnection

MOYLE TRANSFER MW



North-South MW



Wind Generation



Issues for TSO

- Power supplies for RTUs – to be changed from UPS to substation battery system
- Mesh substations – reconfigure or install mesh-corner automation
- Reset of DAR lockout by SCADA and extension to SCADA control
- Review with power stations the resilience of auxiliary systems to voltage dips