



Reactive Technologies

Oscillations – A Global Perspective on Behaviour and management

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Visibility before Vulnerability®



Reactive is enabling many of the world's leading power grid operators to operate their grids at **higher performance** by measuring new critical grid parameters like **grid inertia, oscillations and system strength** to achieve Net Zero safer and faster.



📍 Sales and project delivery teams

Trusted by...



Oscillations becoming more common

Decline in Synchronous Damping

- Results in higher propensity for all types of oscillations – from SSO to 100Hz+
 - Higher resolution scanning plus fast detection and removal

Rise in Weak Grid or Complex Oscillations

- Increased controller-controller interaction – can appear to be forced when instead it is complex
 - Exploiting natural resonances in an electrical region

New Assets and Software updates

- Rapid increase in number and type of inverter-controlled devices being connected
 - Every controller software update carries risk and needs assurance

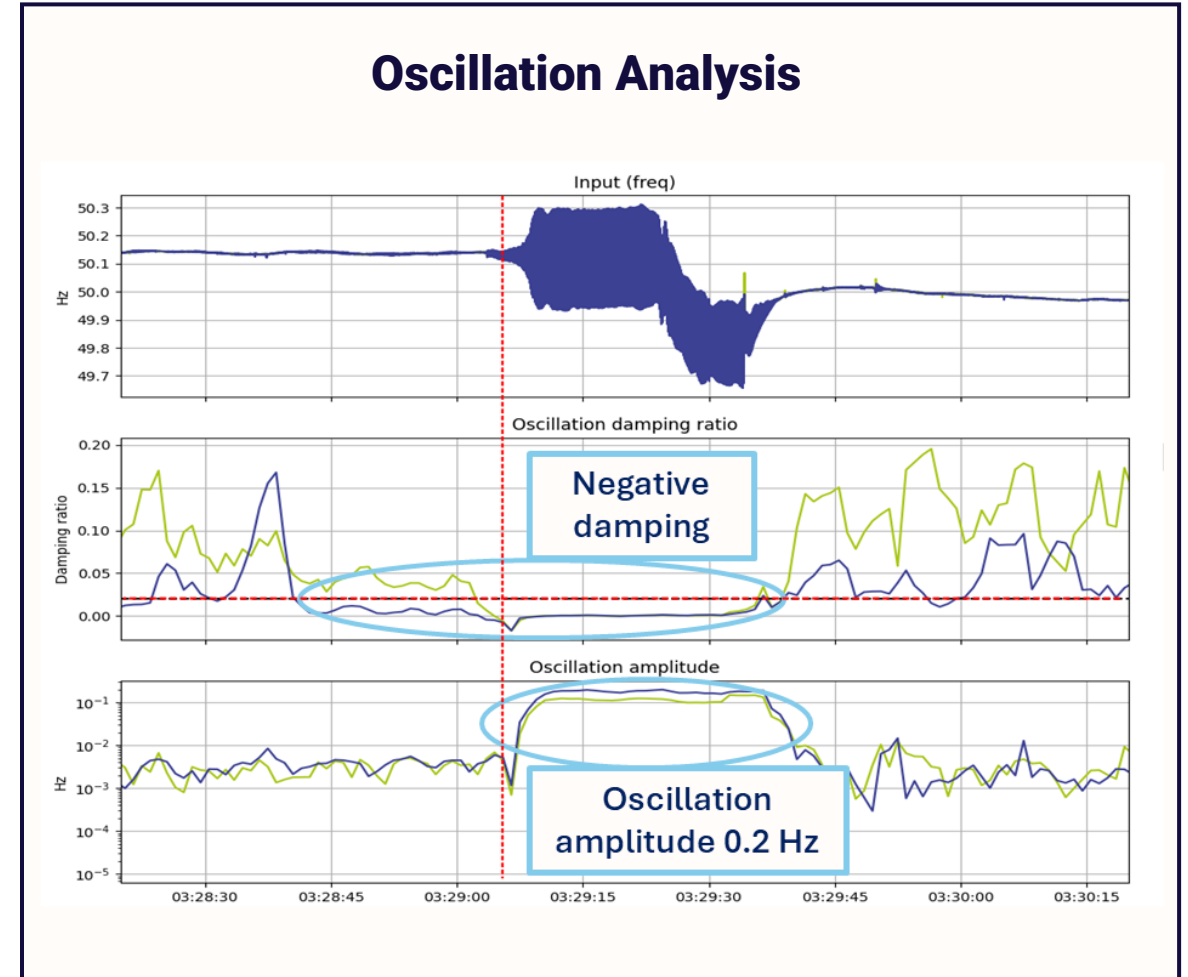
Oscillations – Example 1

Weak grid oscillations with some forcing/resonance rising rapidly to significant Oscillation, tripping large generators

Historic analysis identifies multiple micro-oscillations linked to natural system resonance and low damping

ACTIONS

1. Operate electrical region to minimum, system strength, damping ratio – redispatch is necessary to maintain system strength and ratio
2. Ensure controllers do not oscillate in natural resonance range



Oscillations – Example 2

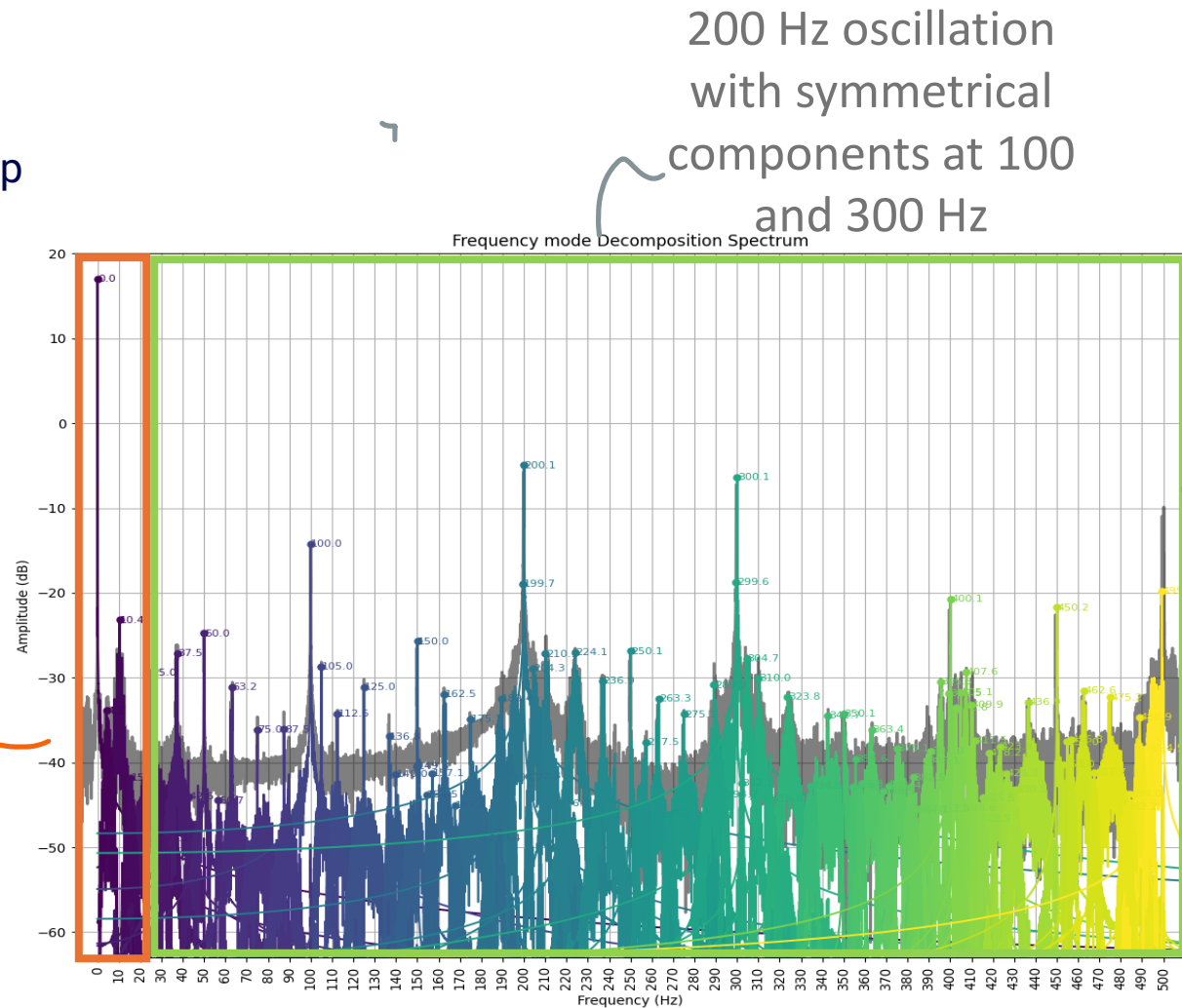
Multi-spectrum Weak Grid Oscillation linked to low SCL and inverter controller performance – 1-500Hz

Presents as Sub-5Hz oscillation on PMU data - map spectrum to help identify route cause

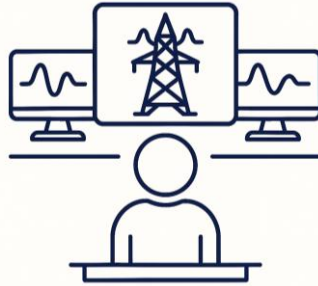
ACTIONS

1. Increase Short Circuit Level and/or
2. Re-tune controllers to perform at lower but acceptable SCL

Visible with PMUs



UK Oscillation Management - NESO



Control Room Team

- Master system for monitoring and alarms for oscillation in NESO National Control Room.
- Oscillations identified and traced using oscillation and local data. **Time to disconnect faulty asset reduced by 99% from 2-3 months --> 2-3hours**
- Scotland managed continuously using minimum damping ratio of 0.1 as oscillation security limit

REACTIVE & NESO

BEFORE: 2-3 months

**AFTER: 2-3 hours
99% Improvement**



Post Event Analysis Team

Detailed event analysis and procedural improvements. Investigates root causes, such as misconfigured assets (e.g., BESS with incorrect inverter settings).

Coordinates with stakeholders (e.g., Distribution utilities) to resolve issues efficiently—reducing investigation time from months to hours, and to help set future policy parameters.

Monitor at Higher resolution

- Inverter-heavy systems up to at least 100Hz, preferably up to 1kHz
 - Data Centers present similar spectrum challenge

Zero Tolerance approach

- Monitoring and detection process to immediately identify and remove cause
- Process to avoid and/or de-energise mis-configured BESS/controllers

Manage Damping and SCL

- Understand local regional resonances and monitor for micro-events – set minimum damping/SCL where needed
 - Use full spectrum analysis up to 1kHz to assist root cause analysis