

Grid Lessons

from the Spain / Portugal Outage



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2025 GENERATION SYMPOSIUM

UTILITY CONSULTING SESSION

Sequence of Events

35 minutes

- 01 | Local oscillations between Spain and Portugal (4 min)
- 02 | Inter-area oscillation followed by rising voltage due to DER tripping (15 min)
- 03 | Slow voltage rise (16 min)

27 seconds

- 04 | Overvoltage tripping and lack of voltage response 355 MW loss (19 sec)
- 05 | Spanish PV loss 727 MW (1 sec)
- 06 | Spanish wind farm loss 834 MW (2 sec), runaway voltage rise
- 07 | France import reached 4.6 GW, frequency event, loss of synchronism, automatic load shed (2 sec)
- 08 | AC lines trip between France and Spain (3 sec)
- 09 | Spain & Portugal Grids collapse



Fundamentally, Why?



What it Wasn't

- Too hot, record load (25 GW vs. 34 GW peak)
- Renewable penetration **too high** & lack of inertia
- Purely operator error

What it Was

- Oscillatory initiation
- Untuned operational procedures
- Mostly a voltage control problem

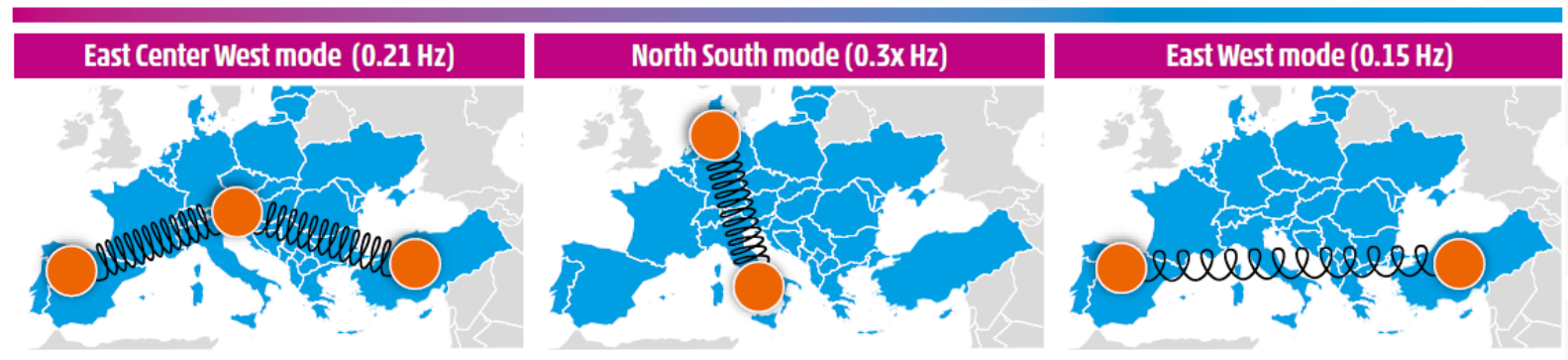


Figure 2-35: Inter-area modes representation with equivalent spring mass mechanical analogy

Are We Next? Yes & No.

Different Regulatory Regimes

- NERC Standards keenly focused on model validation & more to come

Same Problems

- Voltage regulation
- Controls complexity

Different Problems

- Distributed decision making
- Changing load dynamics



What Should We Expect?

More Regulatory Requests

- > FERC Order 901
- > NERC alerts
- > NERC Standards updates in both assessment & monitoring

More Analysis & More Expertise Needed

- > Load interconnection drivers
- > New operational insight
- > Prepare workforce, trusted partner



Key Takeaways



The Spain outage was a **fast-acting** event that in many ways can happen anywhere but not necessary for the same reasons.



Fundamentally, it was a **voltage control** problem which could highlight need for reactive and/or voltage control value streams.



A robust **regulatory regime** is already in place but will continue to grow as more changes both in generation and load profiles come.



A focus on **new insight**, new expertise and more assessment is not on the horizon, it's here.