Paris Session 2022

Model Validation of Large Energy Users Protection Systems in Operational Dynamic Assessments

SC C4 PS3 Q14

What are the worldwide experiences in situations where the overall power system model failed to predict an actual system event or ongoing occurrences of abnormal responses, and were the causes could be deterministically identified and rectified?

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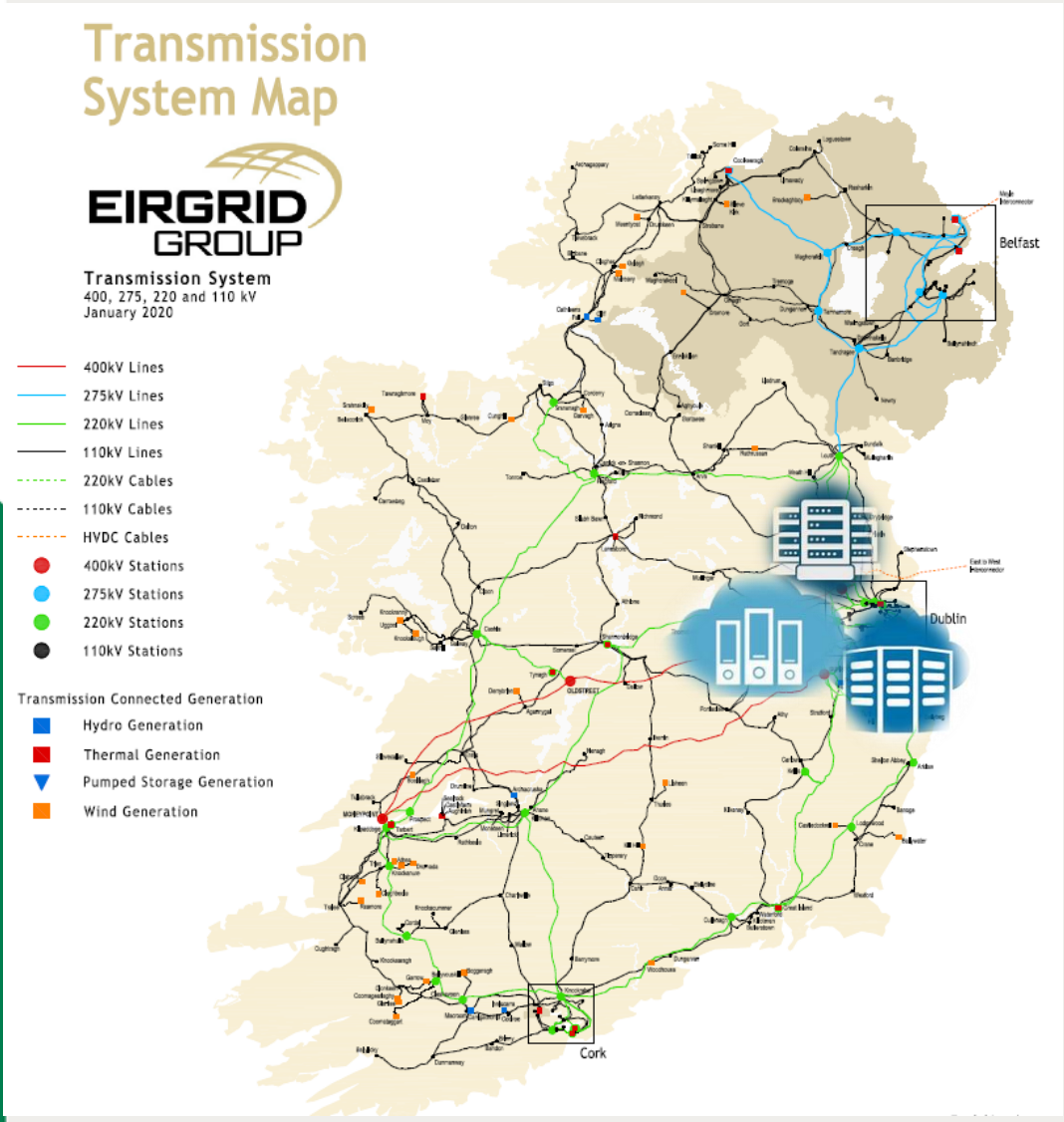
Background



All Island system

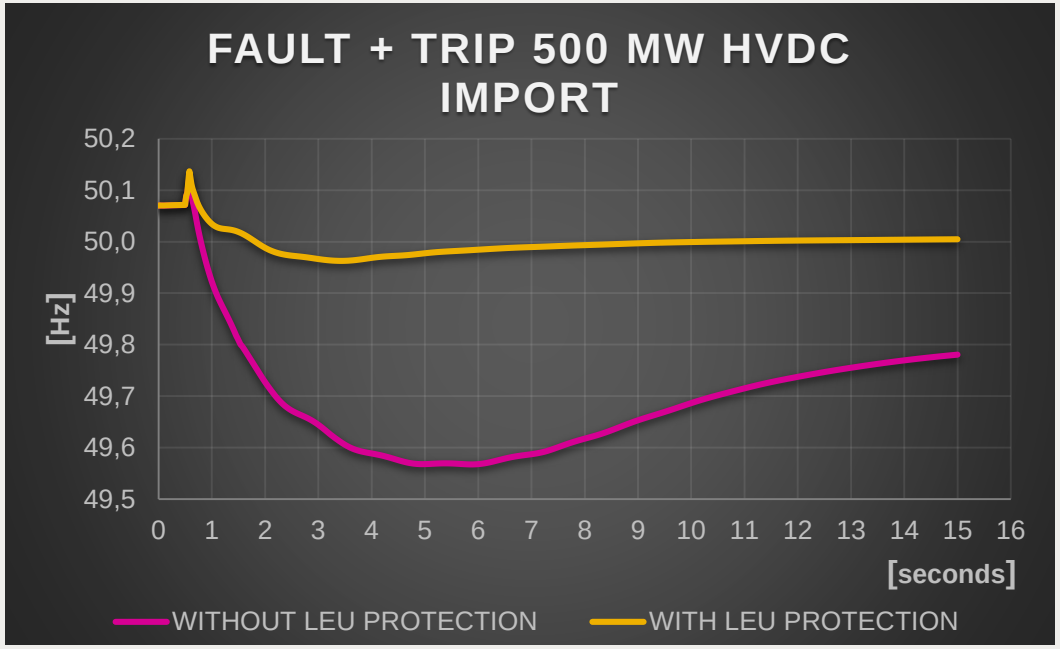
- **Synchronous island**
  - Currently operation with 75% System Non-Synchronous Penetration (SNSP). *Paper C4_PS3_11016_2022*
  - 80% electricity from renewable resources by 2030

- **Large Energy Users (LEU)**
  - 1.6 GW connected or contracted Data Centres (DC)
  - Favourable climate and renewable electricity in Ireland
  - Can account for 30% of peak demand by 2030

- **DC Load Characteristics**
  - Critical IT load
  - Electrical design based on redundancy, including UPS and on-site generation.
  - Protection schemes can switch the source of power from the electricity grid to the backup generators without interruption.
  - Sensitive protection settings: Under/Over Voltage, Under/Over Frequency, RoCoF.

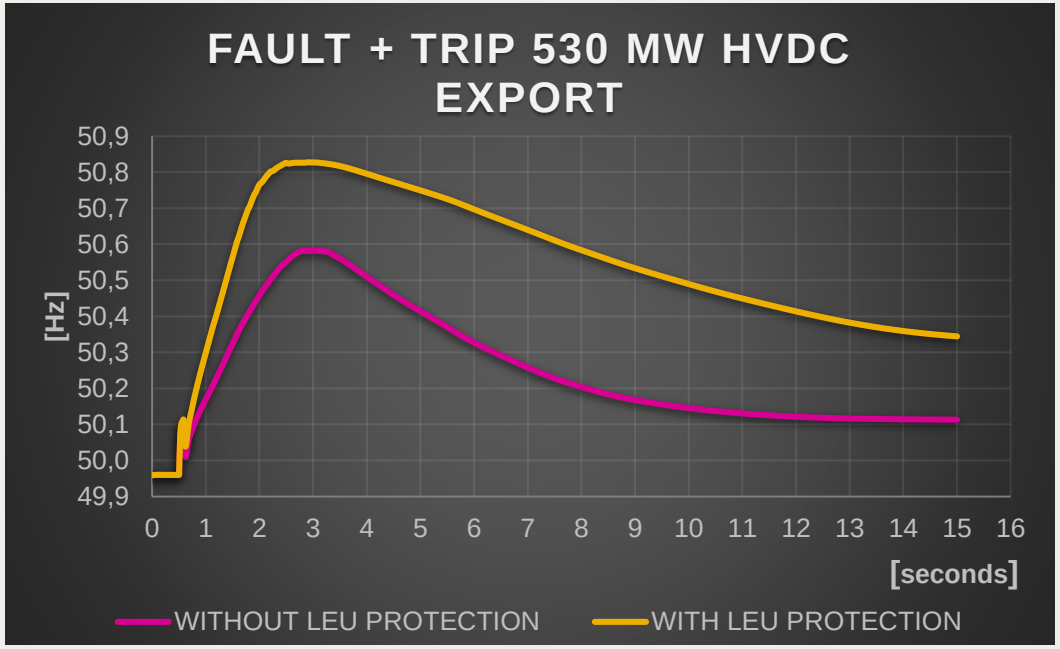
Impact of LEU load reduction during system events

Simulated Contingency 1: HVDC interconnector trip on full MW import



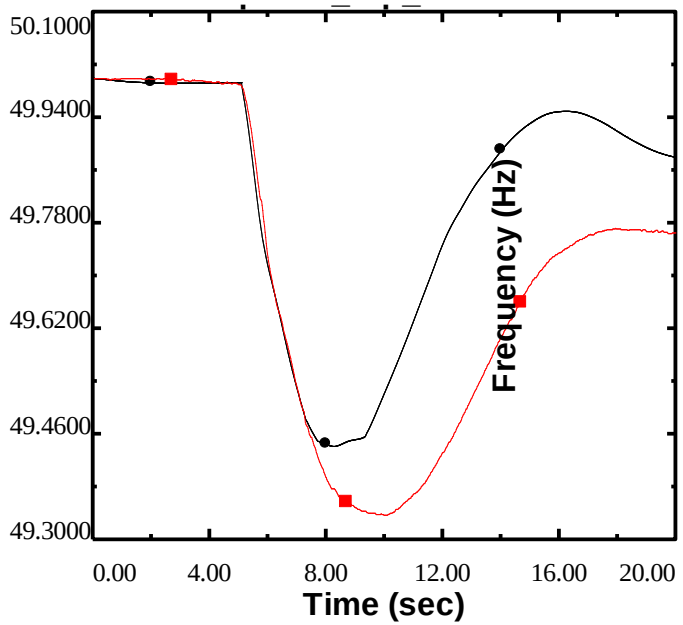
Trip of **365 MW** LEU demand **helps** frequency recovery

Simulated contingency 2: HVDC interconnector trip on full MW export



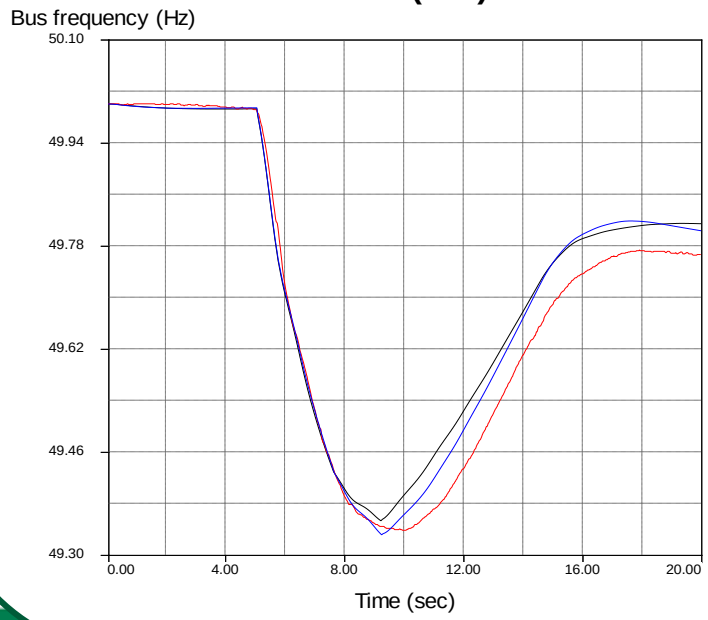
Trip of **365 MW** LEU demand **exacerbates** frequency rise

Dynamic Model Validation



Original model

Simulation results
PMU data



Tuned parameters

Simulation results (1)
Simulation results (2)
PMU data

- **Regular validation of models against system disturbances**
- **Tuned customer protection parameters do not always predict the correct level of load reduction**
- **Lack of visibility of internal load distribution and changes to protection settings is a challenge**
- **Ongoing engagement with customers to understand load behaviour and improve models**