Topic : Network Modelling

EIRGRID SONI

DOCUMENT DISCLAIMER

This manual is intended as a guide only. Whilst every effort is made to provide information that is useful, and care is taken in the preparation of the information, EirGrid plc and SONI limited give no warranties or representations, expressed or implied, of any kind with respect to the contents of this document, including, without limitation, its quality, accuracy and completeness. EirGrid plc and SONI limited hereby exclude, to the fullest extent permitted by law, all and any liability for any loss or damage howsoever arising from the use of this document or any reliance on the information it contains. Use of this document and the information it contains is at the user's sole risk.

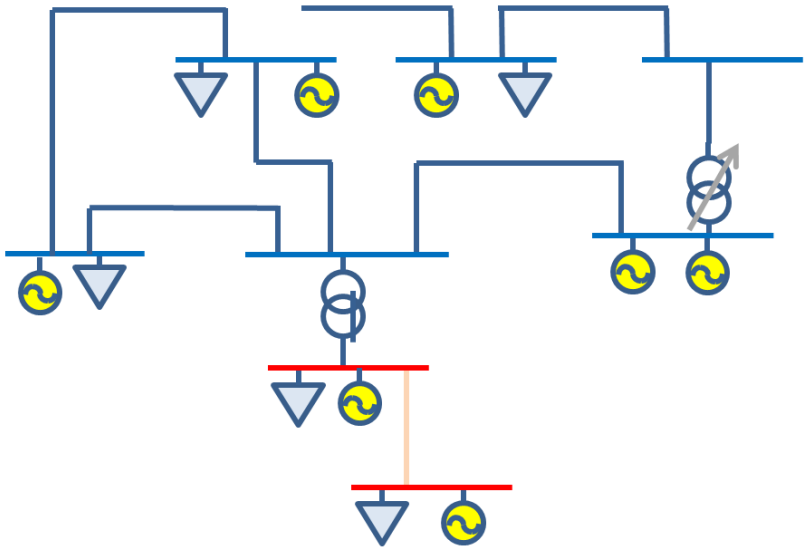
EIRGRID SONI

Presentation Overview

- Securing the system against thermal overloads

- Function and operation of the Network Security Monitor (NSM) in the scheduling and dispatch process.

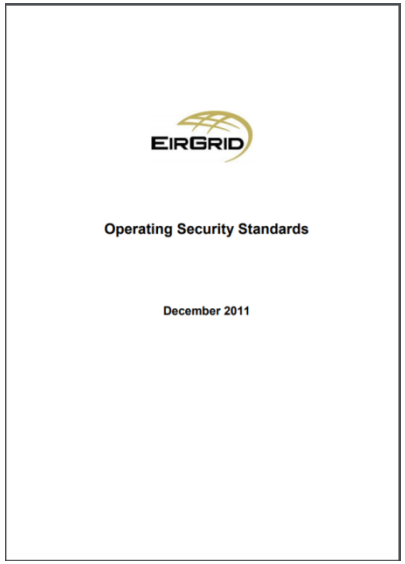
- Interaction of NSM constraints with other constraints and a regional look at constraint issues.



EIRGRID SONI

System Security & Thermal Limits

- The control centres are responsible for securing the system in real time in accordance with the ***Security Standards*** including respecting thermal limits.



- Each transmission line and transformer has a rated current which must not be exceeded.
- High current could lead to thermal damage to equipment or excessive sagging threatening the power system or public safety.

EIRGRID SONI

System Security & Thermal Limits

- In general CHCC/ NCC can't directly change the flow on a individual line.

- The main remedial action is to redispatch generation which is contributing to the problem. This will usually impact flows across multiple lines.

- Rebalancing of supply will ultimately be needed (although this will often be subsumed by the general task of matching supply and demand)

- Redispatch is done on the basis of minimising the cost of deviation from PNs while ensuring **system security** and respecting **priority dispatch**.

EIRGRID SONI

System Security & Thermal Limits

- The Security Standards specify that ratings may not be exceeded for **N-1 contingency events**. For the loss of any single piece of transmission equipment, the resultant flows must observe limits.

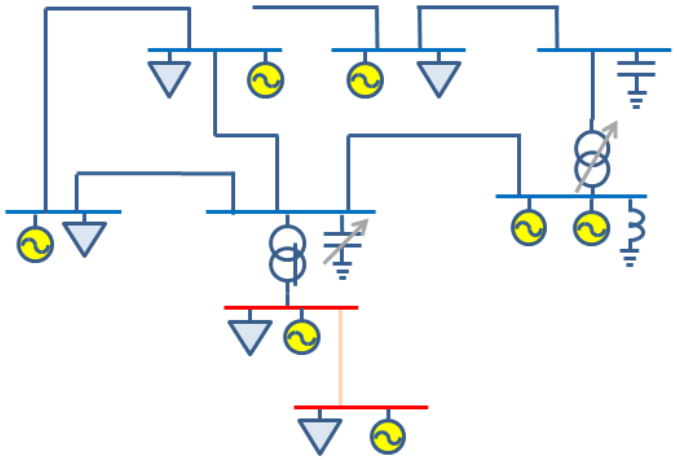
- **N-1** is the industry standard and ensures that **cascade** trippings don't bring down large portions of the system

- *A note on ratings*: Limits vary seasonally – equipment ratings are higher in colder months due to a lower average ambient temperatures

EIRGRID SONI

Network Security Monitor

- In real time possible remedial actions may be more limited or not possible and so analysis in the scheduling timeframe required.



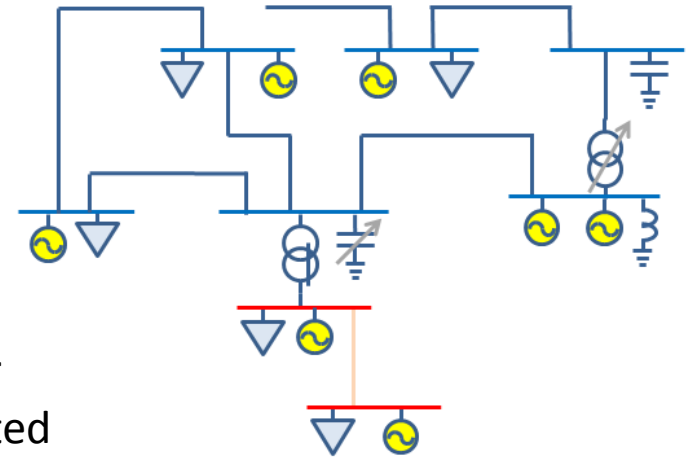
- New for ISEM is the incorporation of a ***Network Security Monitor*** into the Scheduling and Dispatch process. This aims to ensure that the schedule meets security standards for each interval.

- The Network Security Monitor uses a mathematical model of the power system. It specifies the ***electrical properties*** of each element and how these ***elements are configured***.

EIRGRID SONI

Network Security Monitor

- The ***Inputs***
  - Scheduled generator outputs
  - Forecast demand at each distribution node



- The ***Outputs***
  - The current flowing on each circuit or transformer compared against the rated value.

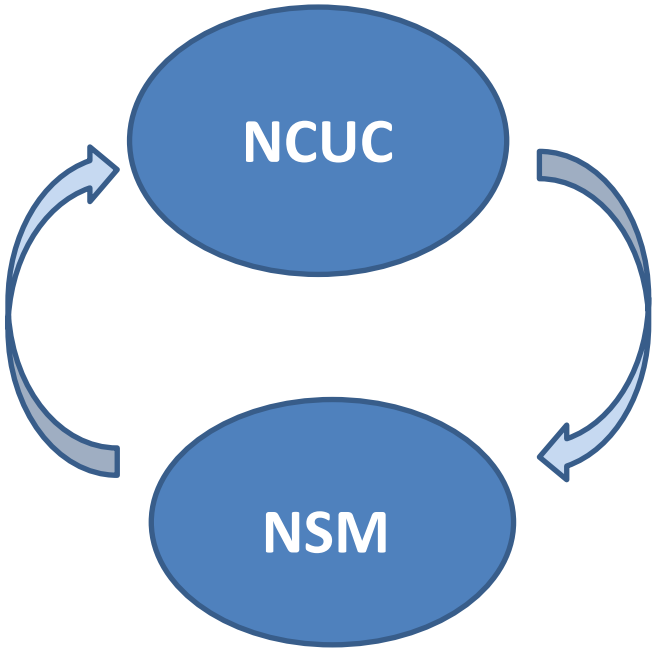
- For ***N-1 analysis***
  - Each circuit element is removed in-turn, resulting in hundreds of powerflow studies.

- This process is automated and repeated for each scheduling interval. (30 min for LTS, 15 min for RTC and 5 min for RTD)

EIRGRID SONI

Network Security Monitor

- This whole process iterates between the Unit Commitment solver (NCUC) and NSM.



1. NCUC determines an initial schedule based on PNs, commercial and technical offer data, constraints etc.

2. Using this schedule NSM performs N-1 powerflow analysis

EIRGRID SONI

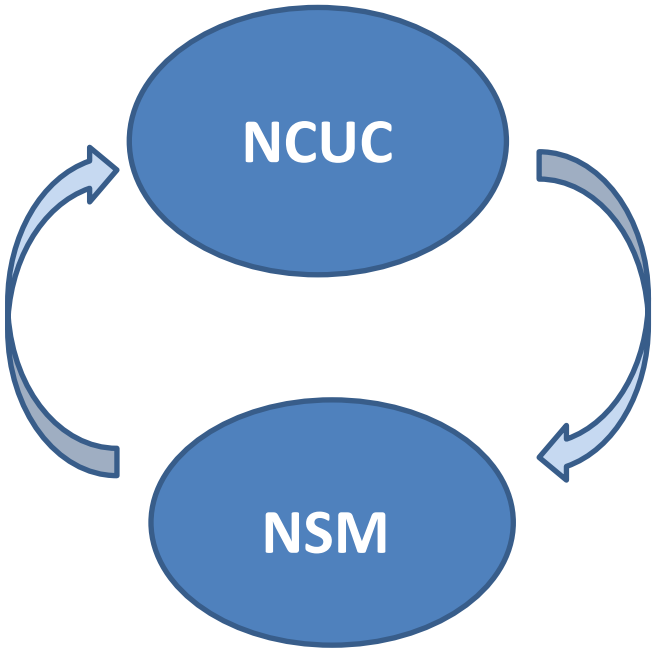
Network Security Monitor

3. Any violations are reported back to NSM along with associated 'Shift Factors' – i.e. the contributory factor for each generator and associated penalty cost.

4. NCUC reruns using the new information.

5. NSM reruns using the new schedule.

6. The process will iterate until a secure schedule is determined

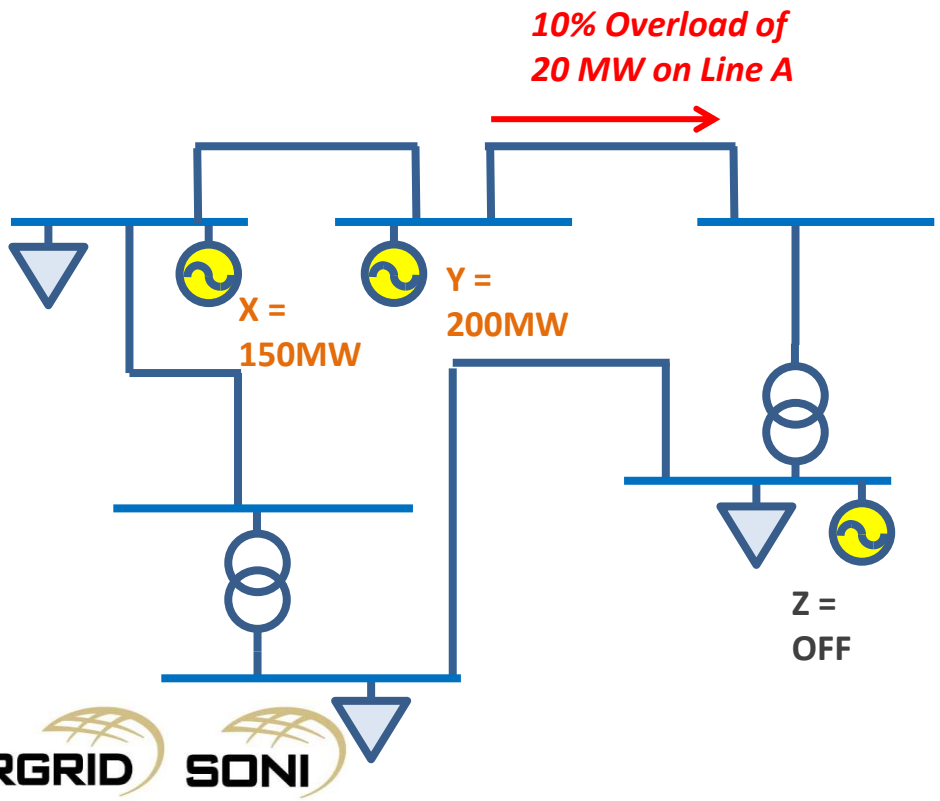


EIRGRID SONI

Simple Example

- Initial *NCUC* schedule for 3 unit system for scheduling interval 13:30 to 14:00. Long notice unit Z is OFF.

	13:30 – 14:00
X	150 MW
Y	200 MW
Z	OFF



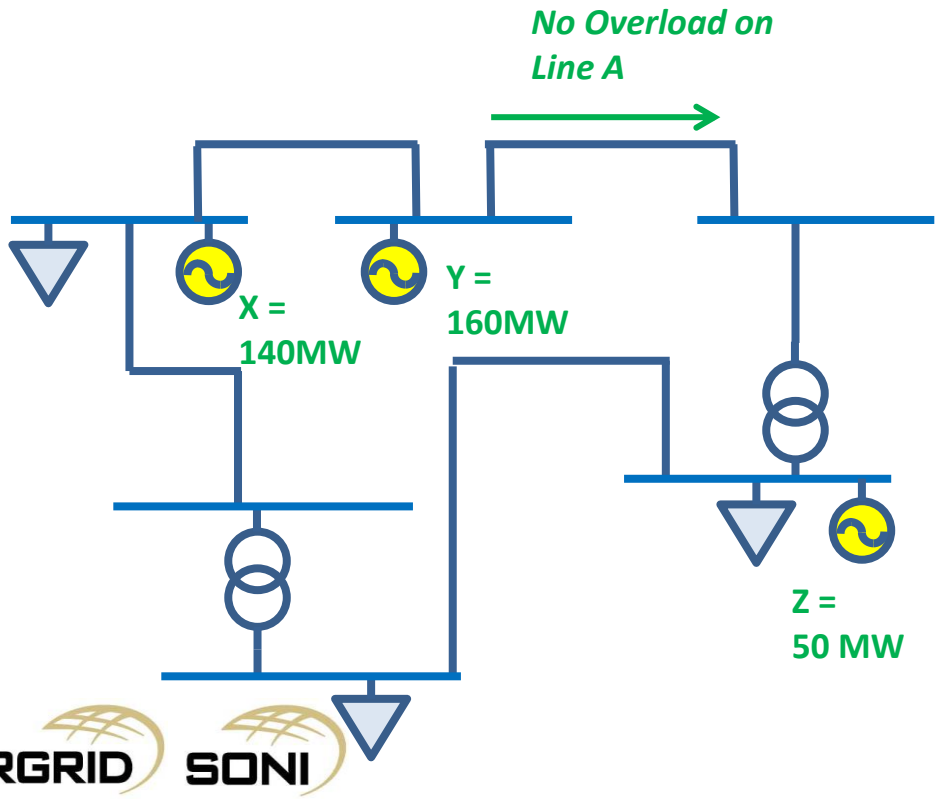
- NSM determines that the schedule will cause overloads on Line A. 'Shift Factor' for all units passed back to NCUC.

EIRGRID SONI

Simple Example

- NCUC now moves Units X and Y down according to their COD and TOD. Unit Z will now be committed.

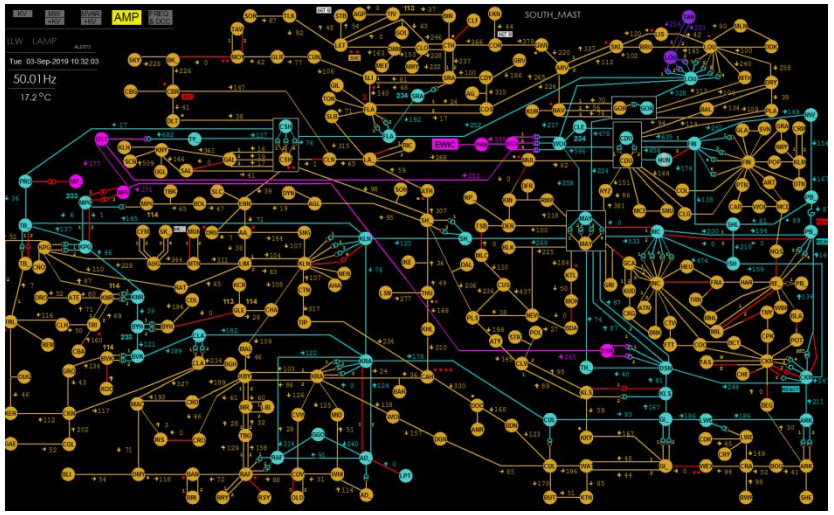
	13:30 – 14:00
X	**140 MW**
Y	**160 MW**
Z	**50 MW**



- NSM rechecks the schedule. Overload on Line A is resolved.
- Note that in this example 50 MW of generation had to be constrained to resolve a 20 MW overload. This is due to the meshed nature of the Transmission System.

EIRGRID SONI

Network Security Monitor

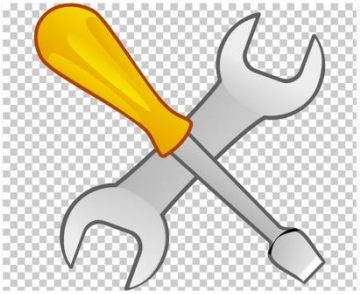


- The Network Model is kept in tight alignment with the primary Energy Management System model used by the Control Rooms.
- Both models are updated every three weeks to account for physical changes to the system.
- *The current operational configuration is then layered on top of this default network model as follows:*

LTS	RTC & RTD
Default Network Model + Planned Outages + Planned Operational Switching	Default Network Model + Live System Information

EIRGRID SONI

Network Security Monitor



- The Network Security Model utilises a simplified DC loadflow approximation. Analysis is limited to ***Thermal/ Overload*** issues.

- In addition weekly lookahead constraint studies are performed for selected regions and are used as an input for the Unit Commitment solver. Thermal violations are examined but ***voltage, short circuit and transient issues*** can also be identified at this stage.

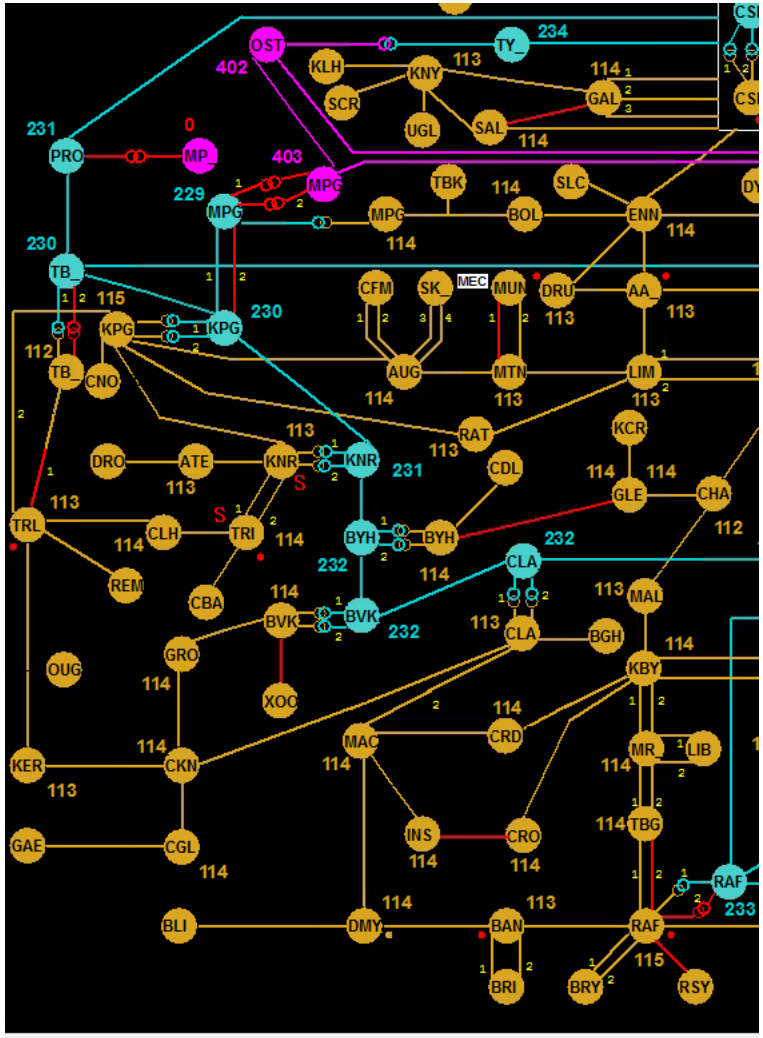
- Weekly constraint studies are performed for assumed system conditions. As a result outputs are widened to allow the Network Security Model to act as primary tool for determining thermal constraints.

- Weekly constraint studies are subject to ongoing review for revision in light of the development of new tools e.g. lookahead WSAT, voltage trajectory tool etc.

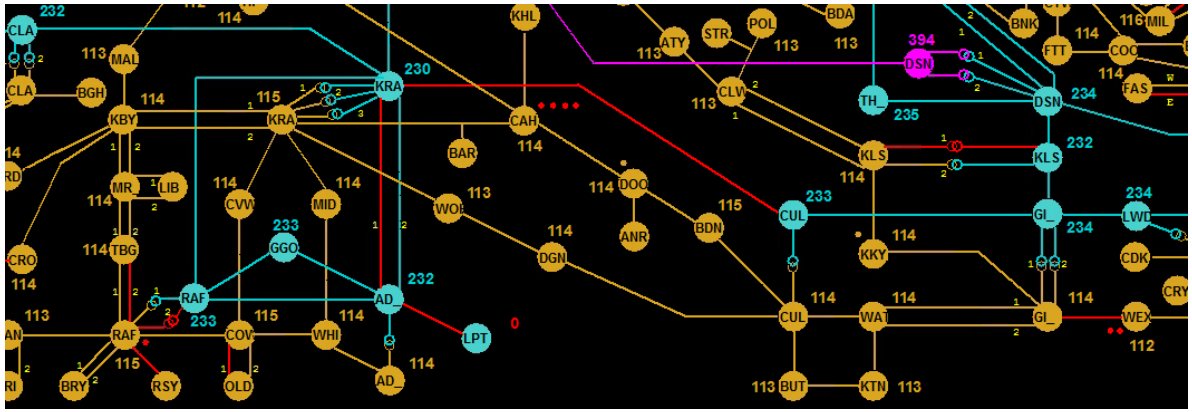
EIRGRID SONI

Specific Network Issues – South West/ West

- Constraints in SW currently driven by:
  - Projects to reconfigure the stations at Moneypoint and Kilpaddoge and associated outages.
  - 220kV Line uprates between Kilpaddogge and Knockraha and associated outages.
  - In 2019 – Forced outage of Moneypoint T4201. An important link between the 400kV and 220kV network. (Due to be resolved following transfer of T4202 in late October)
  - General West to East constraints across the country exist as well as more local constraints.



Specific Network Issues – Cork



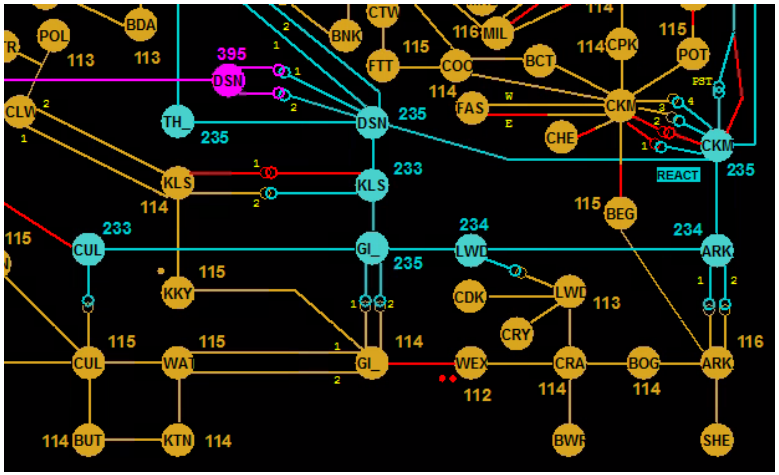
- Constraint exists in Cork Harbour for an intact Network and are compounded during 220kV or 110kV outages.
- Possibility constraints may be alleviated somewhat by reconfiguration of Aghada 220kV Substation
- Significant works planned for Knockraha 220kV Substation 2020 to 2022. Large duration 220kV outages anticipated.

EIRGRID SONI

Specific Network Issues – South East

- Station uprate projects in Wexford and Kilkenny driving constraints.

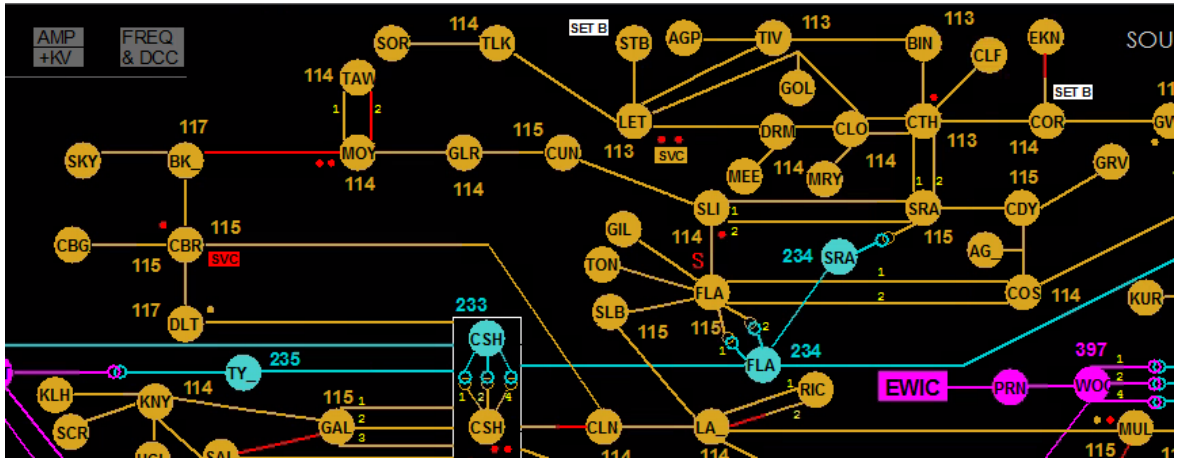
- Generally not heavily constrained for intact network.



EIRGRID SONI

Specific Network Issues - Northwest

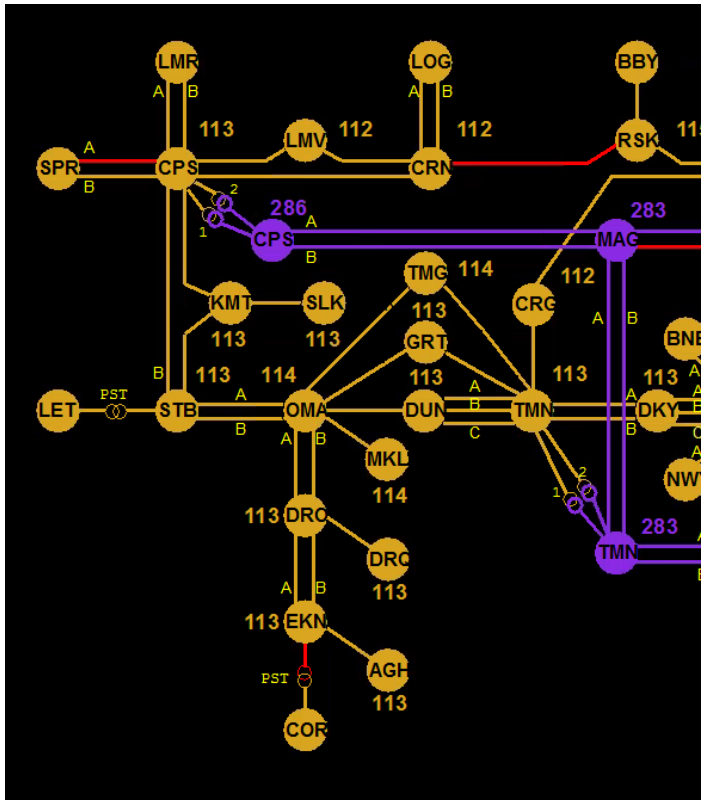
- Constraints common in Donegal and NW particularly during outages.
- Periods of low load generally worse as more wind generation needs to be exported from the region.
- Specific constraint boundary south of Clogher 110kV managed through CRU defined Donegal constraint group.



EIRGRID SONI

Specific Network Issues – Northern Ireland

- West to East constraints generally seen during 110kV outages.
- Level of constraints affected by running of CCGT in the west.
- During certain weather warnings Coolkeeragh Magherfelt 275kV double circuit treated as single N-1 contingency. System operated more defensively.



EIRGRID SONI

Questions