Orkney Active Network Management system

Technical Session 1

Accessing capacity in a constrained network – *Active Network Management*

David MacLeman

Distribution R&D Manager

Scottish and Southern Energy
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Learning Outcomes

- **Understand the concept of ANM**

- **Identify and assess opportunities to apply ANM**

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What is Active Network Management?

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Lesson content

- **Introduction to Orkney**
- **The Orkney network – problem definition**
- **Why Active Network Management?**
- **Design of an ANM scheme for Orkney**
- **Interactive session 1**
  - What makes Orkney suitable for Active Network Management?
  - Where else could you apply ANM?
- **Review of sessions**
- **Lessons learnt**

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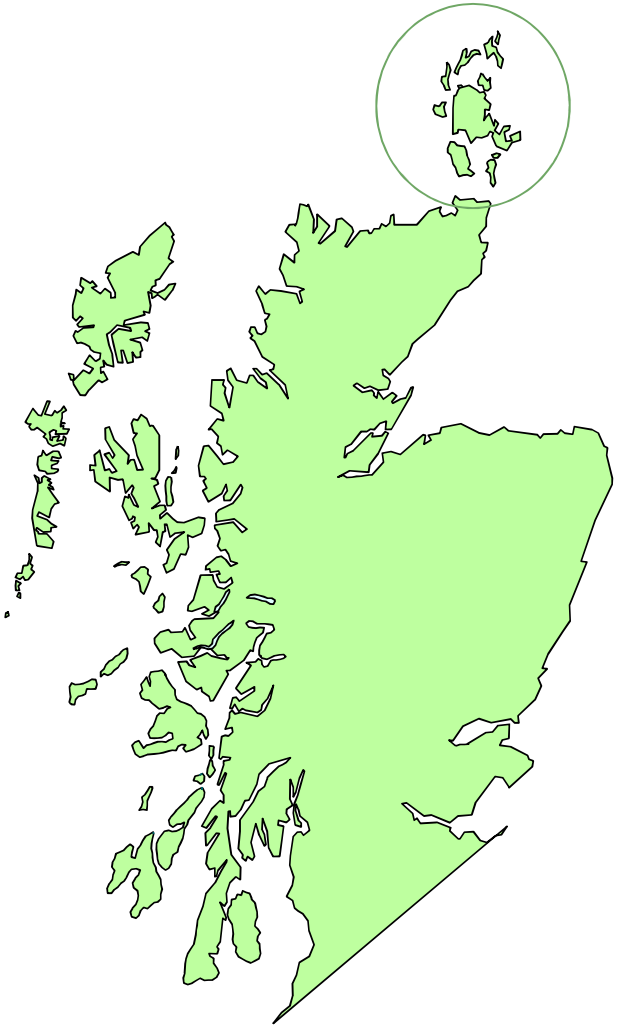
Introduction to the Orkney

- High interest in further renewable generator connections
- Traditional reinforcement solution would be very expensive
- Spare capacity available due to patterns of load and generation
- Ofgem incentives:
  IFI and DG
  Registered Power Zone (RPZ)



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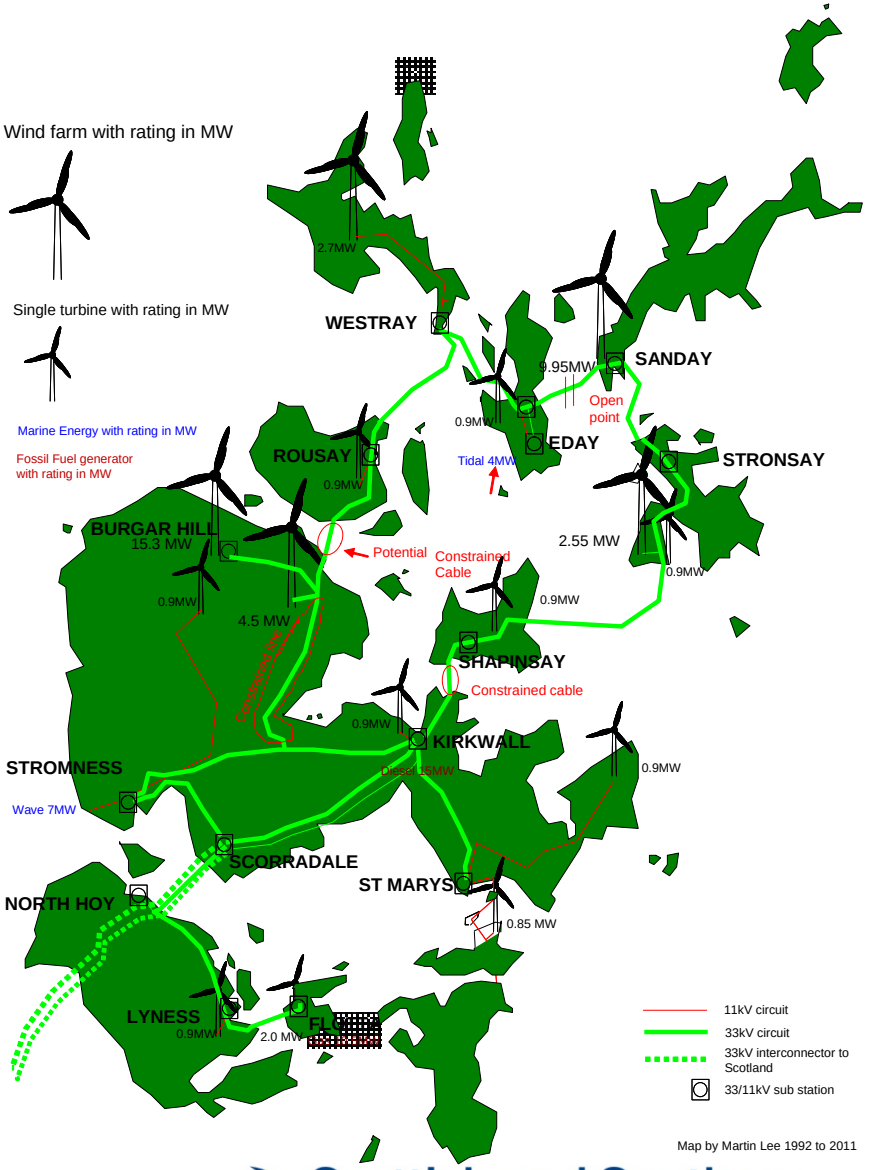
Orkney electrical network

- 6 miles off north coast of Scotland
- 11,500 customers
- Min/Max demand: 6/31 MW
- 33 kV submarine cables: 2 x 20 MW import/export
- Existing generation a mix of wind, wave and gas
- Existing reactive compensation equipment
- Existing protection-based network management:
  - Firm Generation (FG)
  - Non-Firm Generation (NFG)
  - Load shedding



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American Superconductor DVAR

- Initial Purpose

- To provide continuous reactive power locally on Orkney in order to maximize the real power (MW) transfer capability of the sub sea cables from the mainland.

- -To provide voltage support for transient conditions such as those caused by trips and reactor switching.

- -Through maximizing the transfer capability, help minimize the need for running peak generation.

- The solution consists of a ±8 MVAR D-VAR and 2 X 7 MVAR, 33 kV switched shunt capacitors.

- The D-VAR solution in place protects the Orkney Islands' power supply from critical contingency events such as the loss of one of the two 33 kilovolt (kV) underwater power cables that serve the islands.

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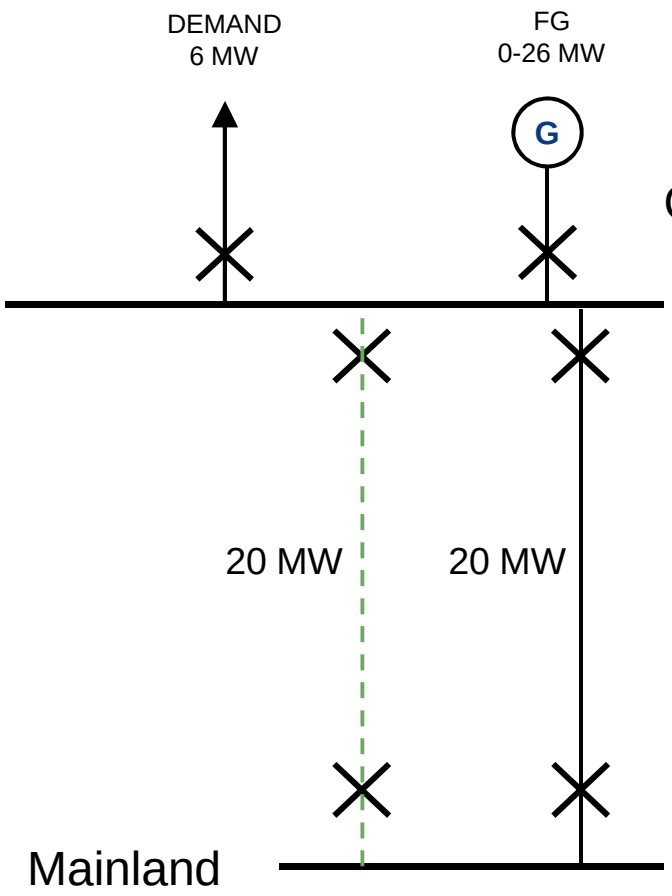
Existing generator capacity on Orkney - Firm Generation



FG = (N-1 circuit capacity) + (local minimum demand)

FG = 20+6 = 26 MW

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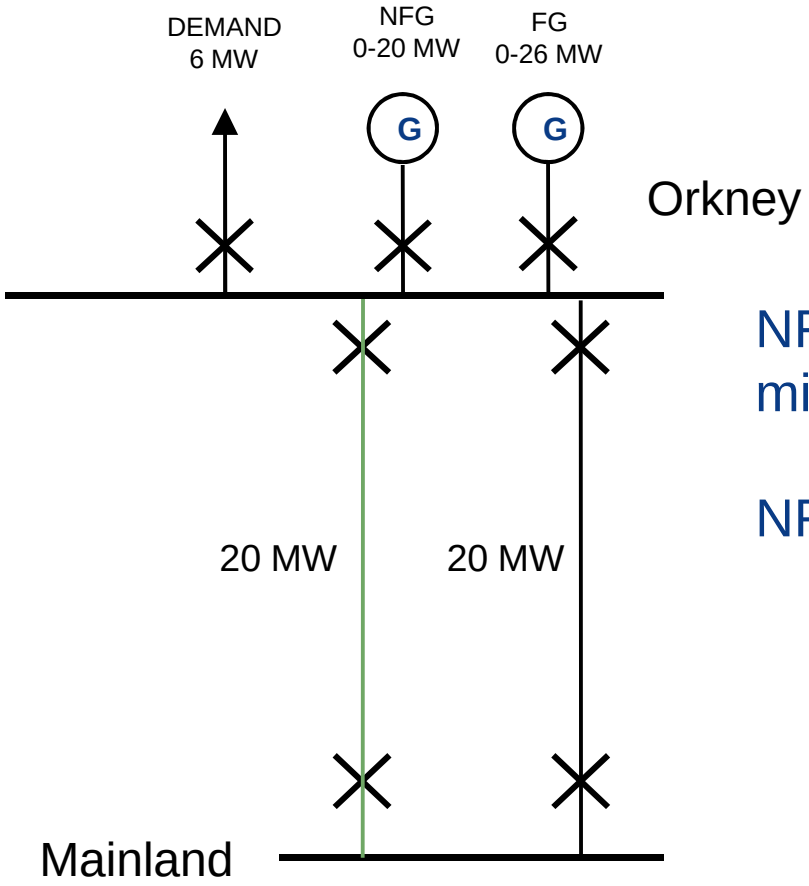
Post-fault inter-trip - Non Firm Generation



NFG = Capacity of both circuits + local minimum demand - FG

NFG = 20+20+6-26 = 20 MW

Inter-trip NFG for N-1 contingency

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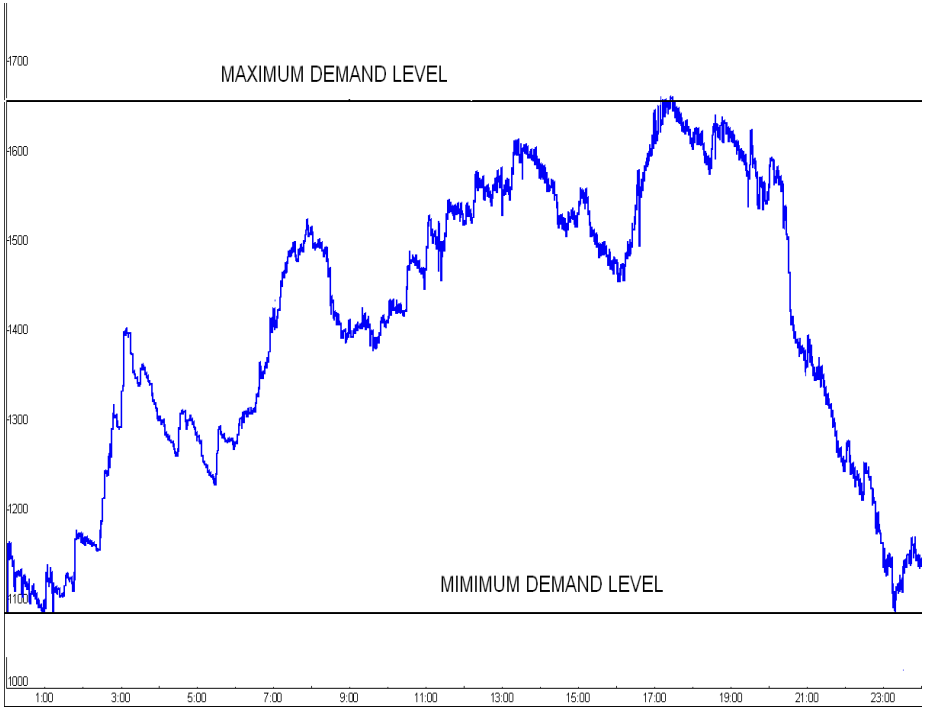
Why Active Network Management?

- Local electrical network capacity has limits
- Existing planning rules require unconstrained output of contracted generation capacity at all times
- Variations in customer demand and output from renewable generators changes minute by minute
- Affects network capacity available to accommodate DG output



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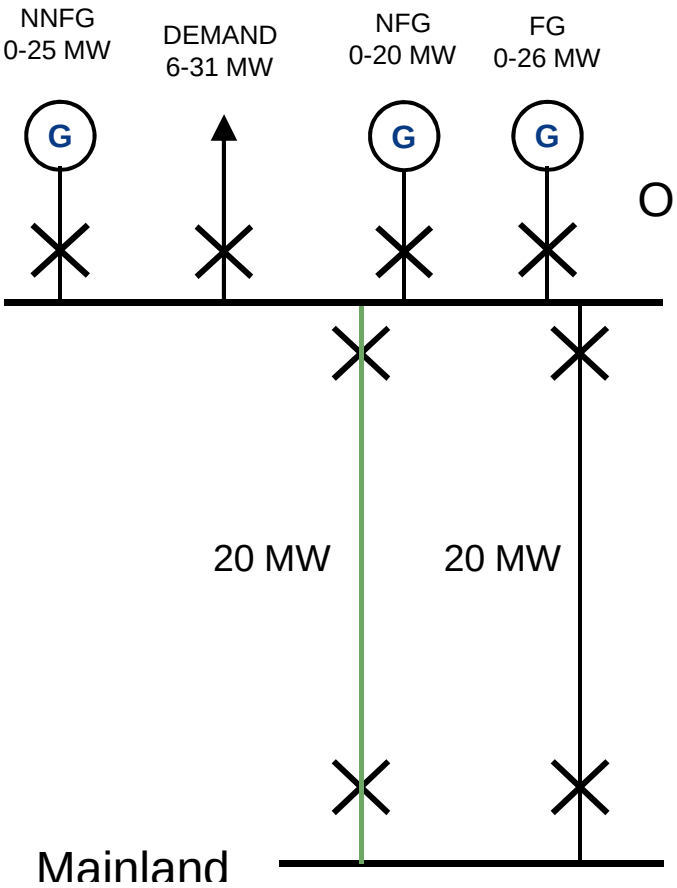
Active Network Management – New Non Firm Generation



NNFG = Capacity of both circuits + local maximum demand - FG - NFG

NNFG = 20+20+31-26-20 = 25 MW

NNFG enabled by new ANM scheme

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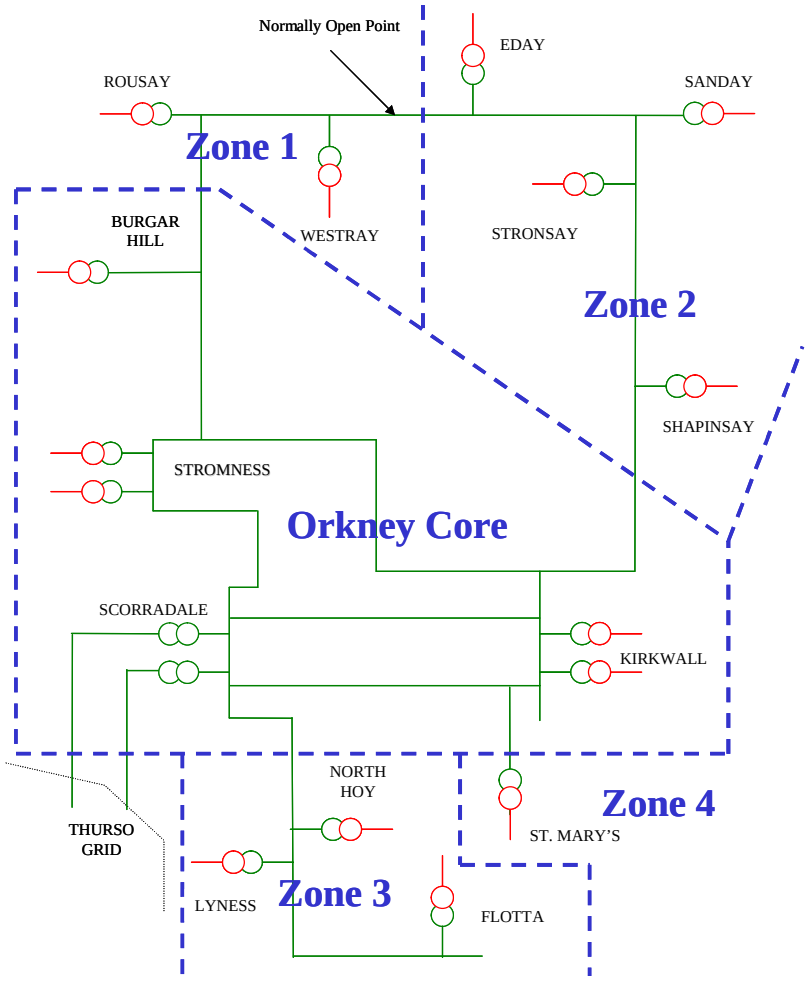
Design of the ANM scheme

- Reactive compensation equipment solves almost all voltage problems
- Each zone has a thermal limitation on generation output at any given time
- Whole Orkney system has a further thermal limit on generation output
- Real time control of wind generation units based on measurements and control logic.
- Existing generation unaffected
- Operating margins are introduced to ensure network security



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Interactive session 2

- **What makes Orkney suitable for Active Network Management?**

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Interactive session 3

- **Where else can these principles be applied?**

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Review of interactive sessions

- What is Active Network Management (ANM)?
- What makes Orkney suitable?
- Where else can these principles be applied?

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Review

- **What is Active Network Management?**
- **The Orkney Registered Power Zone**
- **Where/when ANM can be a suitable solution**
  - The network is constrained (thermal, fault level, voltage)
  - Where conventional reinforcements costs are high
  - There is variation in demand
  - There is diversity in the generation portfolio

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Lesson 1 ends

david.macleman@sse.com

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Activity results

- What is Active Network Management? Some responses from small group discussion at Knowledge Sharing Event, 18 May 2012

- Balancing generation and demand; Signal from the network in real time; Understanding capability/capacity of network; Lifetime of assets and constraints; Economic/ commercial balance

- Operational events based on network conditions or events; Dynamic line rating; Not passive; Network configuration/re-configuration; Resilience vs complexity

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Activity results

- What is Active Network Management? Some responses from small group discussion at Knowledge Sharing Event, 18 May 2012

- Real time management of constraint; Real time management in whatever form; Not protection - integration with protection; Risk against manual intervention; Avoiding hitting protection

- Near real time information; Understanding of operational boundaries; Optimisation; Increasing network utilisation; Facilitating carbon reduction; Facilitating cost effective network connection; Minimal impact on customer; Quality of supply

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