FACILITATING FLEXIBILITY PROVIDERS WHILST PROTECTING THE DISTRIBUTION SYSTEM

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Irish Wind Energy Research Network Presentation – Thursday 22/03/18
# NIE Networks Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Figure</th>
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<tbody>
<tr>
<td>Customers</td>
<td>880,000</td>
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<tr>
<td>Annual Electricity Demand</td>
<td>8 TWh</td>
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<tr>
<td>Transmission Network</td>
<td>2,200 km</td>
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<tr>
<td>Distribution Network</td>
<td>47,000 km</td>
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<tr>
<td>Substations</td>
<td>300 major</td>
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<tr>
<td>Price Control Overall Total</td>
<td>£1.2bn</td>
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<td>Expenditure (October 17–March 2024)</td>
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<tr>
<td>Staff</td>
<td>1,250</td>
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Background

Growth in Renewable

Policy Drivers

• “Northern Ireland will seek to achieve 40% of its electricity consumption from renewable sources by 2020” (Strategic Energy Framework, 2010)

Renewable Generation Figures

- RES-E currently at 34.8%
Growth in Renewable Generation

“1.21 gigawatts! 1.21 gigawatts! Great Scott!”
Background

Heat Pumps

Electric Vehicles
Background

The Challenge

- Security
- Sustainability
- Affordability

Energy Trilemma
SONI’s DS3 Programme

System Services

- **Reserve**
  - Primary Operating Reserve
  - Secondary Operating Reserve
  - Tertiary Operating Reserve 1
  - Tertiary Operating Reserve 2
  - Ramping Reserve Synchronised

- **Ramping**
  - Ramping Margin 1
  - Ramping Margin 3
  - Ramping Margin 8

- **Fast Acting**
  - Fast Frequency Response
  - Fast Post Fault Active Power Recovery
  - Dynamic Reactive Reserve

- **Inertia**
  - Synchronous Inertial Response

- **Reactive Power**
  - Steady State Reactive Power
System Services

- It is expected that the majority of these services will be located on the distribution system.
- What impact will these System Services have on the distribution System?

Impact of System Services

- Voltage Step
- Voltage Rise
- Thermal Loading
- Protection Issues
- Reactive Power Management
Voltage Step

Engineering Recommendation P28

\[ \Delta V_{\text{Steadystate}} \leq 3\% \]
Voltage Rise

![Graph showing Voltage Rise](image.png)
Thermal Loading

Site at Reverse Power Flow Limit
7.5MVA

- 0.75MW Flexible Demand
- 0.75MW

1MW

10MVA

Site exceeding Reverse Power Flow Limit
9MVA

- Demand Side Response

1MW

10MVA
Traditional ‘Static’ Instruction Set

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<tr>
<th>Instruction Set</th>
<th>Weekdays</th>
<th>Weekends</th>
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- Industry wants to see improvements!
Protection Issues

- Interface Protection (G59/1/NI) required in NI to prevent electrical islanding

- Frequency & voltage control will increase the risk of islanding

- System Services incentivise faster response

- One way that this risk can be managed is to set a threshold on how fast the response can be

- Emphasises the need for Neutral Voltage Displacement (NVD) protection
Reactive Power Management

Transmission Control Centre

Distribution Control Centre

ICCP

Nodal Controller

110kV Cluster Substation

OLTC

T&D Boundary

110kV

33kV

WF1

WF3

WF2
Conclusion

- Northern Ireland currently at 34.8% RES-E.
- System Services will help achieve energy trilemma
- DNO is required to manage:
  - Voltage Step
  - Voltage Rise
  - Thermal loading
  - Protection issues
  - Reactive Power Management
- Currently managed through an instruction set process
- Future Developments required to make this process more dynamic.
- Ultimately DNOs will need to evolve to DSOs.