Transmission System Development

Karen Creighton
RGLG Meeting - 14th June 2016
Overview

- RIDP Assumptions
- Updated Assumptions
- Study Methodology
- Network Problems Identified
- Solutions considered
- Emerging Development Strategy
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RIDP Assumptions

441 MW onshore wind
300 MW offshore wind
300 MW offshore tidal

2,586 MW TOTAL
660 MW
885 MW

SONI
What has changed?

- Generation assumptions
  - MW Installed
  - Technology type i.e. introduction of solar generation
  - Inclusion of Small Scale Generation (<5 MW)
- Planning Assumptions – seasonal dispatches for RES
- Assumptions of geographic location of renewable generation / Study Area
- Large influx of applications following the removal of planning permission pre-requisite
- DfE midterm review of Strategic Energy Framework
- Early removal of Northern Ireland Renewable Obligation Certificate
- Donegal and Mayo expected wind generation levels
## Comparison of Assumptions
### Large Scale Generation

<table>
<thead>
<tr>
<th>Region of Northern Ireland</th>
<th>Renewable Capacity (MW)</th>
<th>Difference in Assumptions (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original RIDP Assumptions</td>
<td>Updated Assumptions (November 2015)</td>
</tr>
<tr>
<td>North</td>
<td>1,041</td>
<td>888</td>
</tr>
<tr>
<td>West</td>
<td>885</td>
<td>1,467</td>
</tr>
<tr>
<td><strong>Sub - Total</strong></td>
<td><strong>1,926</strong></td>
<td><strong>2,355</strong></td>
</tr>
<tr>
<td>East</td>
<td>N/A</td>
<td>188</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,926</strong></td>
<td><strong>2,543</strong></td>
</tr>
</tbody>
</table>
Small Scale Generation Assumptions

MW

East

North

West

Ballynahinch Main
Banbridge Main
Belfast Central Main
Carnmoney Main
Cregagh Main
Donegal Main North
Donegal Main South
Eden Main
Finaghy Main
Glengormley Main
Knock Main
Larne Main
Lisburn Main
Newry Main
Newtownards Main
Power Station West
Rathgael Main
Rosebank Main
Waringstown Main
Antirn Main
Ballymena Main
Coleraine Main
Limavady Main
Loguestown Main
Aghyoule Main
Coolkeeragh Main
Drumnakelly Main
Dungannon Main
Enniskillen Main
Lisaghmore Main
Omagh Main
Sprintown Main
Strabane Main
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## Updated Assumptions

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>LSG Capacity (MW)</th>
<th>SSG Capacity (MW)</th>
<th>Total Capacity (MW)</th>
<th>Cumulative Total (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connected</td>
<td>647</td>
<td>196</td>
<td>843</td>
<td>843</td>
</tr>
<tr>
<td>2</td>
<td>Contracted/With PP</td>
<td>702</td>
<td>268</td>
<td>970</td>
<td>1,813</td>
</tr>
<tr>
<td>3</td>
<td>Applied with no PP</td>
<td>797</td>
<td>63</td>
<td>860</td>
<td>2,673</td>
</tr>
<tr>
<td>4</td>
<td>In planning process</td>
<td>372*</td>
<td>-</td>
<td>372</td>
<td>3,045</td>
</tr>
</tbody>
</table>

*An amount of this generation may now be in category 3 – assumptions are as per November 2015*
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Study Methodology

Stage 1
- Category 1 generation
- MTP Network in NI

Stage 2
- Category 1 & Category 2 with est. completion date before e/o 2017
- MTP Network & any potential reinforcement options identified

Stage 3
- All Category 1 and Category 2 generation
- MTP Network & any potential reinforcement options identified
- Sensitivity analysis re. inclusion of Coolkeeragh – Trillick

Stage 4
- All Category 1 & Category 2 generation, plus Category 3 & 4 at 20/40/100%
- MTP Network & any potential reinforcement options identified
- Sensitivity analysis re. inclusion of Coolkeeragh – Trillick

At each stage:
- Summer min/max and Winter max studied
- Full N, N-1 and N-DCT contingency analysis
- Each reinforcement option identified is tested for longevity at the next stage
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Network Problems Identified

• Thermal Overloads
  – For a range of contingencies

• Voltage performance
  – Principally associated with loss of Coolkeeragh – Magherafelt 275kV double circuit

• Phase Angle
  – Principally associated with loss of Coolkeeragh – Magherafelt 275kV double circuit
## Thermal Overloads

<table>
<thead>
<tr>
<th>Study Stage</th>
<th>No of Contingency / Overload Combos</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>4.1</td>
<td>79</td>
</tr>
<tr>
<td>4.2</td>
<td>92</td>
</tr>
<tr>
<td>4.3</td>
<td>189</td>
</tr>
</tbody>
</table>

- 4.1 (20% of batch) (some overloads seen under N)
- 4.2 (40% of batch) (some overloads seen under N)
- 4.3 (100% of batch) (some overloads seen under N)
Voltage Performance

• Existing proposal to install reactive power devices in Northern Ireland
  – Coleraine
  – Omagh
  – Tamnamore

• Stage 3 and beyond, requires additional voltage support is required due to the increased capacity of RES
Phase Angle

- Due to terrain DCT is a credible contingency (treated as N-1 in all seasons)
- Check Sync setting on auto-reclose 20°
- If scenario shown was to occur, auto-reclose would not operate
- Critical circuit unavailable for long period of time
- Re-dispatch of plant (wind in NW and CPS)
- Circuit would have to be reclosed manually
Phase Angle

- Phase Angle > 20° following CPS-MAG DCT

  - Phase Angle Difference = 4.5°  
    - ✅
  - Phase Angle Difference = 8.6°  
    - ✅
  - Phase Angle Difference = 43°  
    - ❌
This analysis was carried out for an installed capacity of 1,360 MW of renewable generation (less than total of connected and committed generation) – percentage of time we could exceed 20° will increase as installed capacity increases.
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Network Solutions Considered

- Combinations of the following network solutions were considered:
  - 2nd Kells – Rasharkin
  - New Coolkeeragh – Magherafelt circuit (110 kV & 275 kV)
  - 4th circuit in southern corridor (Omagh/Omagh South – Tamnamore)
  - Uprates
    - Coleraine – Coolkeeragh – Limavady triangle
    - Coolkeeragh – Killymallaght – Strabane triangle
    - Omagh – Omagh South
    - Tamnamore - Turleenan

- Additional voltage support
Solution Packages Considered

Package 1
- MTP Network
- Additional voltage support (stage 3+)

Package 2
- MTP Network
- Additional Voltage Support (stage 3+)
- 110 kV & 275 kV uprates
- 2nd Kells – Rasharkin circuit

Package 3
- MTP Network
- Additional Voltage Support (stage 3+)
- 110 kV & 275 kV uprates
- Coolkeeragh – Magherafelt 110 kV circuit

Package 4
- *Stage 2 only
- MTP Network
- Additional Voltage Support (stage 3+)
- 110 kV & 275 kV uprates
- 4th Omagh / Omagh South – Tamnamore

Package 5
- MTP Network
- Additional Voltage Support (stage 3+)
- 110 kV & 275 kV uprates
- 2nd Kells – Rasharkin circuit
- Coolkeeragh – Magherafelt 110 kV circuit

Package 6
- *Stage 4 only
- MTP Network
- Additional Voltage Support (stage 3+)
- 110 kV & 275 kV uprates
- 2nd Kells – Rasharkin circuit
- Coolkeeragh – Magherafelt 275 kV circuit

This graphic does not show a timeline, it is demonstrating the staged approach used in the analysis.
Coolkeeragh – Trillick

- Normal flows will be from Donegal into NI (circa 100 MW)
- Under CPS-MAG double circuit contingency flows into NI reduce substantially
- Operational scenarios studied following DCT
  - Circuit fitted with PFC to maintain pre-fault flow into NI
  - Circuit fitted with PFC to reverse post-fault flow into ROI
  - No control equipment fitted to circuit
- Potential for flows to be directed into Donegal to be investigated further
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Emerging Development Strategy

- Reinforcement in Kells / Rasharkin corridor
- Reinforcement between 275 kV ring and the NW
  - 110 kV or 275 kV
- Uprating existing circuits
  - 110 kV and 275 kV
- Coolkeeragh – Trillick to remain as part of the optimal ROI/NI development
  - ROI/NI implications to be fully assessed
- Voltage Support
Conclusions

• Substantial body of study work completed
• Further transmission system development will be needed beyond MTP
• CBA is on-going to finalise optimal development strategy
  – Define the individual projects to be taken forward
• Overall development plan will be prepared and will be subject to SEA