Interruptible connections: Lessons from Flexible Plug and Play

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Flexible Plug and Play

Objective: Cheaper and faster connection of DG to constrained parts of the network by trialing smart grid technologies and smart commercial agreements

Duration: 3 years: January 2012 - December 2014

Project Value: £9.7 million (£6.7m funding from LCNF)

Partners and key suppliers:
Distributed generation growth

Heat map of spare generation capacity:

EPN January 2013

EPN March 2014

SPN June 2013

SPN March 2014

132kV Capacity Highly Utilised
Highly Utilised
Capacity Available
Significant Capacity Available
Flexible Plug and Play - Scope

What we set out to do

<table>
<thead>
<tr>
<th>Stakeholder engagement</th>
<th>Principles of Access assessment</th>
<th>Offer flexible connections</th>
<th>Strategic Investment Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication platform</td>
<td>Smart devices</td>
<td>Quadrature Booster</td>
<td>System integration</td>
</tr>
</tbody>
</table>
## Flexible Plug and Play - Scope

### What we have achieved

<table>
<thead>
<tr>
<th>interviewed 20 DG developers</th>
<th>trialling 2 principles LIFO and Pro-Rata Capacity Quota</th>
<th>24 offers made 10 offers accepted 33.88MW</th>
<th>ICL has built and is validating power flow model based investment tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaged with 40+</td>
<td>Smart devices commissioned: DLR, AVC, ANM, Novel Protection Across 12 sites</td>
<td>Installed and commissioned first QB at 33kV</td>
<td>Using IEC 61850</td>
</tr>
<tr>
<td>Commissioned RF Mesh comms platform</td>
<td></td>
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</tbody>
</table>

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Flexible Plug and Play Solution: Interruptible Connection

- Monitor constraints
- Control generation output to avoid reaching operational limits resulting in curtailment
- Active Network Management (ANM) – Control System
- Cheaper and faster connections
How do we make interruptible connections a business as usual practice?

Develop interruptible connections into attractive commercial proposal:

1. **Business case**
   Cost Benefit Analysis that makes sense for both DNO and customer

2. **Reliable technical solution**

3. **Suitable commercial and contractual framework**
   Robust rules that enable project finance
## Business Case

- **Significant Capex savings**  
  Over 70% in most instances

- **Cost of curtailment**  
  9% has been tolerable to date

### CONNECTION OFFERS

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Type</th>
<th>Firm BAU</th>
<th>Interruptible FPP</th>
<th>Saving</th>
<th>% Curtailment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 MW</td>
<td>Wind</td>
<td>£3.5 m</td>
<td>£881 k</td>
<td>75%</td>
<td>2.82%</td>
</tr>
<tr>
<td>10 MW</td>
<td>Wind</td>
<td>£4.8 m</td>
<td>£590 k</td>
<td>88%</td>
<td>1.94%</td>
</tr>
<tr>
<td>1.5 MW</td>
<td>Wind</td>
<td>£1.9 m</td>
<td>£157 k</td>
<td>92%</td>
<td>5.00%</td>
</tr>
<tr>
<td>0.5 MW</td>
<td>CHP</td>
<td>£2.5 m</td>
<td>£117 k</td>
<td>95%</td>
<td>3.30%</td>
</tr>
<tr>
<td>0.5 MW</td>
<td>Wind</td>
<td>£830 k</td>
<td>£61 k</td>
<td>93%</td>
<td>5.33%</td>
</tr>
<tr>
<td>6.3 MW</td>
<td>PV</td>
<td>£4.0 m</td>
<td>£391 k</td>
<td>90%</td>
<td>2.55%</td>
</tr>
<tr>
<td>1 MW</td>
<td>Wind</td>
<td>£2.0 m</td>
<td>£385 k</td>
<td>81%</td>
<td>1.7%</td>
</tr>
<tr>
<td>1.2 MW</td>
<td>PV</td>
<td>£1.0 m</td>
<td>£66 k</td>
<td>93%</td>
<td>2.08%</td>
</tr>
<tr>
<td>9.48 MW</td>
<td>Wind</td>
<td>£8.0 m</td>
<td>£1,966 k</td>
<td>75%</td>
<td>1.83%</td>
</tr>
</tbody>
</table>
Suitable Commercial Framework

Key requirements

Define **Principles of Access**

![Diagram comparing LAST IN FIRST OUT and PRO – RATA principles of access](image-url)
Suitable Commercial Framework
Key requirements

Estimate expected **curtailment**

<table>
<thead>
<tr>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Network Configuration</td>
</tr>
<tr>
<td>○ Demand Growth</td>
</tr>
<tr>
<td>○ Micro-generation growth</td>
</tr>
<tr>
<td>○ Capacity factor for generation connected</td>
</tr>
<tr>
<td>○ Number of constraints</td>
</tr>
<tr>
<td>○ Generation mix</td>
</tr>
<tr>
<td>○ Principles of access</td>
</tr>
</tbody>
</table>

10MW Wind Farm Power Output

Curtailment study assumptions
Suitable Commercial Framework

Key Requirements

Provide **clear and transparent** information

- Flexible Plug and Play Briefing Document
- CURTAILMENT STUDY
- CONNECTION AGREEMENT Terms & Conditions
- Connection Offer £
Connection offers and acceptances (since 01.03.2013)

- 38 customers engaged
- 24 FPP offers sent
- 22 offers March Grid 33.5MW Quota
- 10 offers accepted
- 5 offers March Grid
- 2 offers Peterborough 25.63 MW
- 2 offers Peterborough 8.25 MW
- 10 accepted flexible connections
- 33.88 MW total to be enabled
- +£20m savings for customers
Key learning – Capacity Quota

- Balanced generation mix has a positive impact on curtailment
- Sizing the quota is key for optimising available capacity
- The Quota can only be implemented for specific constraints
- Sharing the constraint could lead to sharing reinforcement costs
Key learning - LIFO vs Quota

- Last In First Out is a **simpler** principle, easy to understand

- Pro-rata (sharing) curtailment allows **more MW** generation to connect for the same curtailment levels

- Both are administratively complex to manage
Key Learning

• Can deliver **significant benefits to the customers**

• Customers are prepared to accept the on-going cost of **curtailment (up to 9%)** provided suitable business case based on lower up-front connection cost

• Interruptible connections based on a **Pro-rata approach are bankable** provided the key requirements are met (business case, commercial & contractual framework, **information provision**)

• **Customer engagement** is paramount (connect and manage)

• **Balance** is required between risk and benefit
Going Forward

- One scheme currently operational (0.25MW Solar PV)
- Working with our customers to connect them by 2014/early 2015
- Continue offering interruptible connections within the FPP area
- Disseminating the knowledge - www.flexibleplugandplay.co.uk

- Incorporating key findings into engineering and commercial policy to offer interruptible connections in other constrained locations in our networks in 2015
Thank you
Exit / Upgrade strategy

1. DNO carries out reinforcement (load-driven) and capacity becomes available. The non-firm generators can apply for this capacity.

2. Another generator triggers reinforcement in the area and capacity becomes available. The non-firm generators can apply for this capacity.

3. The participating non-firm generators collectively fund the reinforcement required to alleviate their constraint.

4. The non-firm offer has been accepted as an interim measure while a network reinforcement project is being completed and this is explicitly written into their connection offer and agreement.