Smart Solutions for connecting DG:
The Flexible Plug and Play approach

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Setting the context

Scarce capacity
- Extensive reinforcement
- Longer build time
- More expensive connections
Key requirements for integration of DG

- Technical solutions to release capacity in existing assets & manage DG output
- ICT solutions and architectures
- Smart commercial arrangements (interruptible connections)
- New planning and investment appraisal tools

Flexible Plug and Play addresses all four key requirements for DG integration
Solutions for releasing additional capacity
What is a Quadrature-booster transformer & why?

**The Issue**

- P=10.39 MW
- Q=1.74 Mvar
- S=10.54 MVA
- P=29.03 MW
- Q=1.23 Mvar
- S=29.06 MVA
- P=15.13 MW
- Q=0.58 Mvar
- S=15.14 MVA
- U=33.89 kV
- u=1.03 p.u.
- phiu=-46.9°

**The Solution**

- Discrete controllable steps
- Smarter, Flexible
- First on distribution network
- Cost-effective
Solutions for releasing additional headroom
Quadrature-booster transformer

- First of kind
- 33kV/30MVA
- +10MW headroom
- Automatic control

Quadrature-booster, Wissington British Sugar Factory, Norfolk
Operational since August 2013
Solutions for releasing additional capacity
Quadrature-booster transformer – initial results
System integration

System fully commissioned in September 2013
Smart commercial arrangements

- Upfront Capex saving in return for an on-going curtailment
- New framework based on Pro-rata network access (Capacity Quota)
- First proof of concept in mainland UK
- Accepted: 18 MW, Offered and in application: 50.2MW
- Connections going live in 2014

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity</th>
<th>Technology</th>
<th>Business As Usual connection offer</th>
<th>Flexible Plug and Play offer</th>
<th>Savings</th>
<th>Status</th>
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<tbody>
<tr>
<td>Generator C</td>
<td>10 MW</td>
<td>Wind</td>
<td>£4.8m</td>
<td>£590k</td>
<td>87.8%</td>
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<td>Generator D</td>
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<td>£3.5m</td>
<td>£881k</td>
<td>74.9%</td>
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<tr>
<td>Generator E</td>
<td>1.5 MW</td>
<td>Wind</td>
<td>£1.9m</td>
<td>£157k</td>
<td>91.9%</td>
<td>Valid</td>
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</table>
Traditional Fit and Forget solution:
Reinforcing network to provide firm access to DG
Smart Solution #1
Application of QB to reduce network reinforcement by improving utilisation of other assets

Quadrature Booster
Smart Solution #2
Combination of network reinforcement and Active Network Management for DG

Quadrature Booster
Evaluating different options

<table>
<thead>
<tr>
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<th>Network Reinforcement</th>
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<th>Network Reinforcement and ANM</th>
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<td>Additional MVA</td>
<td>Cost (£/yr)</td>
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<td>Line 1</td>
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<td>DG</td>
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<td>TOTAL</td>
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<td><strong>£87,066</strong></td>
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</table>
Summary

• Addressing all key requirements for smart connections of DG

• First two connection projects (wind) to go live by mid 2014

• BAU transition of the key technologies (ANM, QB, DLR) and interruptible connections as part of the trial and roll out in Q1 2015

Successful demonstration of innovative solutions to offer cheaper and faster connections to DG Customers through Flexible Plug & Play
UK Power Networks Innovation Portfolio

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