System Services for High Levels of Renewables

Niamh Delaney
Transforming the Electricity Industry
Evolving flexibility needs across the world

Source: World Energy Outlook 2018
DS3 – Delivering a Secure Sustainable Power System

System Services

- Improvement in System Performance (both mandatory and incentivised)
- Changes in System Policies (Frequency, Voltage)

System Tools enabling operational change (RES forecasting, control centre tools)
DS3 – Delivering a Secure Sustainable Power System

System Services

Services for a flexible and resilient high RES power system
System Services for Frequency

- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery

- Ramping Margin
...and for Voltage

• Dynamic Reactive Response

• Steady-state Reactive Power
<table>
<thead>
<tr>
<th>Service Name</th>
<th>Abbreviation</th>
<th>Unit of Payment</th>
<th>Short Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous Inertial Response</td>
<td>SIR</td>
<td>MWs²h</td>
<td>(Stored kinetic energy) * (SIR Factor – 15)</td>
</tr>
<tr>
<td>Fast Frequency Response</td>
<td>FFR</td>
<td>MWh</td>
<td>MW delivered between 2 and 10 seconds</td>
</tr>
<tr>
<td>Primary Operating Reserve</td>
<td>POR</td>
<td>MWh</td>
<td>MW delivered between 5 and 15 seconds</td>
</tr>
<tr>
<td>Secondary Operating Reserve</td>
<td>SOR</td>
<td>MWh</td>
<td>MW delivered between 15 to 90 seconds</td>
</tr>
<tr>
<td>Tertiary Operating Reserve 1</td>
<td>TOR1</td>
<td>MWh</td>
<td>MW delivered between 90 seconds to 5 minutes</td>
</tr>
<tr>
<td>Tertiary Operating Reserve 2</td>
<td>TOR2</td>
<td>MWh</td>
<td>MW delivered between 5 minutes to 20 minutes</td>
</tr>
<tr>
<td>Replacement Reserve – Synchronised</td>
<td>RRS</td>
<td>MWh</td>
<td>MW delivered between 20 minutes to 1 hour</td>
</tr>
<tr>
<td>Replacement Reserve – Desynchronised</td>
<td>RRD</td>
<td>MWh</td>
<td>MW delivered between 20 minutes to 1 hour</td>
</tr>
<tr>
<td>Ramping Margin 1</td>
<td>RM1</td>
<td>MWh</td>
<td>The increased MW output that can be delivered with a good degree of certainty for the given time horizon.</td>
</tr>
<tr>
<td>Ramping Margin 3</td>
<td>RM3</td>
<td>MWh</td>
<td></td>
</tr>
<tr>
<td>Ramping Margin 8</td>
<td>RM8</td>
<td>MWh</td>
<td></td>
</tr>
<tr>
<td>Fast Post Fault Active Power Recovery</td>
<td>FPFAPR</td>
<td>MWh</td>
<td>Active power (MW) &gt;90% of pre-disturbance output within 250ms of voltage &gt;90% of nominal voltage</td>
</tr>
<tr>
<td>Steady State Reactive Power</td>
<td>SSRP</td>
<td>Mvarh</td>
<td>(Mvar capability) * (% of capacity that Mvar capability is achievable)</td>
</tr>
<tr>
<td>Dynamic Reactive Response</td>
<td>DRR</td>
<td>MWh</td>
<td>Mvar capability during large (&gt;30%) voltage dips</td>
</tr>
</tbody>
</table>
Changing the Market Design for Investment

- Financial Mix moving to higher capital lower variable cost technologies
- Provide incentives for performance that matches the system requirements
Payment Basis

Tariff \times \text{Scalars} \times \text{Available Volume} = \text{Payment}

- Performance
- Product
- Locational
- Scarcity

EIRGRID
SONI
Different Elements of DS3 System Services

- Qualification Trial Process:
  - Proving new technologies
  - Defining measurement standards

- Regulated Arrangements:
  - Defining technical criteria/contracts for all technologies
  - Establishing and refreshing qualification system

- Fixed Contracts:
  - Auction for new-build provision of reserve services

EIRGRID & SONI
Operational Impacts

- **Wind**
  - • Reduced start-up times, notice to sync, load-up rates, min loads
  - • Faster ramp rates

- **Battery Storage**
  - • 26 DSUs providing services including reserves

- **Demand Side**
  - • 67 WFPS contracted for services including reserves

- **Thermal**
  - • Significant interest in investment in storage
Which Technologies are providing which Services?

- Wind
  - FFR
  - POR
  - SOR
  - TOR1
  - SSRP

- Storage
  - FFR
  - POR
  - SOR
  - TOR1

- Thermal
  - FFR
  - POR
  - SOR
  - TOR1
  - TOR2
  - RRD
  - RRS
  - RM1
  - RM3
  - RM8

- HVDC
  - FFR
  - POR
  - SOR
  - TOR1
  - TOR2
  - RRD
  - RM1

- Demand Side
Service Volumes from non-conventional units

Percentage total service volumes contracted from non-conventional units

DS3 System Services

% of non-conventional volumes to overall volumes
Using System Services

Technical Scarcities

New Services and Technologies

Proof of Service Provision

Control Centre Changes

Safe and Secure System Operation