G-PST Session on Grid Forming Inverters

Dechao Kong, ESO
G-PST Research Workshop
London, UK; 10th November, 2022
Key Messages

Evolution of GB electricity system towards 2050
- Decarbonised
- Decentralised
- IBR-Dominant
- Significant decline in thermal power plants
Grid Forming Capability to Meet GB Operability Challenges

Key Messages

1. Key Challenges for Future IBR-Dominant GB Electricity Tx System:
   • Declining Inertia
   • Declining System Strength
2. As suggested in ESO’s Operability Strategy - Grid Forming capability is considered to meet these operability challenges.

Figure 1: Inertia Trend to 2030, System Operability Framework (SOF): “Operating a Low Inertia System”, Feb 2020

Figure 2: National Short Circuit Level 2019-2030, SOF: “Impact of Declining Short Circuit Levels”, Dec 2018
ESO’s Current Strategic Roadmap for GB Grid Forming Development

**Business Case**
- ESO Operability Strategy Report
- System Operability Framework (SOF) Article on GFM/VSM

**Collaboration with External Stakeholders**
- VSM Expert Group (Completed).
- GC0137 GB Grid Forming Working Group (Completed).
- GB Grid Forming Best Practice Group (To be completed by end 2022)

**Feasibility Studies**

**Tech Spec & Best Practice**

**Innovation Projects:**
- Virtual Synchronous Machine (VSM) Demonstrator (Completed)
- Hybrid Grid Forming Converter (Completed)
- Demonstration of Virtual Synchronous Machine Control of a Battery System (Completed)


The penetration and proportion of Grid Following (GFL) based IBRs on the GB energy system will increase hugely into the foreseeable future.

A number of challenges are foreseen below. How best can we address these issues?

• Q1: How much Grid Forming (GFM) capability will be required on the system to manage operability issues?

• Q2: Should GFM capability be mandated?

• Q3: How can we assess interoperability issues between GFL/GFM-based IBRs and Synchronous Machines?
## ESO’s Future Strategic Roadmap for GB GFM Development

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Key Activities</th>
<th>Term</th>
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<tbody>
<tr>
<td>1</td>
<td>To further update GC0137 in line with key findings/suggestions of GBGF Best Practice Group.</td>
<td>Short</td>
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<td>2</td>
<td>To understand how to <strong>quantify the GFM capability</strong> as required on the system to manage operability issues (in line with Q1).</td>
<td>Middle</td>
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<tr>
<td>3</td>
<td>To <strong>set flexible entry requirements</strong> for potential players in the GB Grid Forming markets (in line with Q2).</td>
<td>Middle</td>
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<td>4</td>
<td>To <strong>understand how to assess interoperability issues</strong> among GFL-based IBRs, GBGF-Inverter/Synchronous and conventional Synchronous Gens (in line with Q3)</td>
<td>Middle</td>
</tr>
<tr>
<td>5</td>
<td>To <strong>learn from industrial forums, facilitate international collaborations and implement network innovation projects</strong> for further technical/market developments of GB GFM.</td>
<td>Middle/Long</td>
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On-going and Future Activities in line with ESO’s Prospective on GB GFM

Ref. 1: GC0137 2nd Modification Workstream: Analysis Tool, Pass Criteria, etc.

Ref. 2: Strength to Connect Innov. Project for refined metrics instead of SCL/SCR to deal with Q1

Ref. 3: To promote Innov. Project for GFM Biz Model Design for Q2: GFM without extra Energy Storage (ES) + GFM with Min. ES

Ref. 4: Open to innov. ideas to address the complex issues in Q3 e.g. data-driven, Real-time EMT, etc.

Ref. 5: Learning from Industrial Forums e.g., CIGRE/IEEE; G-PST Collaboration, UK’s Network Innovation

Ref. Key Activities
1. GC0137 2nd Modification
2. GFM capability quantification
3. Flexible market entry requirements
4. Interoperability Issue Assessment
5. Learning from Others, Collaboration and Innovation
Q&A

Thanks for your attention!

Any Question?