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National Grid ESO response to Ofgem Call for Evidence: Visibility of distributed generation connected to the GB distribution networks

Dear Steve,

We welcome the opportunity to respond to your call for evidence on the visibility of distributed generation connection to the GB distribution networks.

National Grid ESO is the electricity system operator for Great Britain. We move electricity around the country second by second to ensure that the right amount of electricity is where it's needed, when it's needed – always keeping supply and demand in perfect balance. As Great Britain transitions towards a low-carbon future, our mission is to enable the sustainable transformation of the energy system and ensure the delivery of reliable, affordable energy for all consumers.

The ESO holds a unique position at the heart of the nation's energy system. We use our unique perspective and independent position to facilitate market-based solutions which deliver value for consumers. We believe that improved visibility of distributed generation (DG) can greatly assist us in securely and economically managing the national electricity transmission system. Furthermore, we believe that it is critical to supporting DNOs as they transition to Distribution System Operation, facilitating the greater co-ordination needed with the ESO to ensure whole system outcomes including greater system resilience at times of system stress.

In particular we believe it is important to improve the real time visibility of DG, a key conclusion Ofgem made in their 9th August 2019 power outage report. We are already working with DNOs to facilitate such visibility, through initiatives such as Regional Development Programmes which are installing the necessary ICCP communication links, but we recognise there is much more enabling work that needs to be done.

Key points of our response:

- **Improved DG visibility, particularly in real time, is essential to assist National Grid ESO and DNOs in operating secure and co-ordinated electricity networks.**
- **Whilst we are working with DNOs and other stakeholders on projects to improve this visibility there may be a need for additional obligations on parties to ensure necessary DG data is both available and of sufficient quality.**
- **Data format should facilitate interoperability and appropriate funding should be in place to deliver the associated systems and protocols.**

More information on these points can be seen in our response to your questions appended to this letter.

We welcome the opportunity to further discuss the points raised within this response. Should you require further information or clarity on any of the points outlined in this paper then please contact Andy Wainwright in the first instance at andy.wainwright@nationalgrideso.com.

Yours sincerely

Julian Leslie

Head of Networks

Annex 1 – National Grid ESO response to Ofgem Call for Evidence questions

This annex provides initial National Grid ESO views in response to these questions. We would be happy to work with Ofgem and stakeholders to develop these views further.

1. *DCUSA modification DCP350 will provide data on a number of characteristics for DG greater than 1MW. Are there additional characteristics for DG, such as real-time MW/MVAr output, load factors and protection settings, which would aid in the prevention of, live management, and recovery from loss of supply events?*

The following data characteristics would support National Grid ESO and DNOs deliver more efficient and co-ordinated system operation;

- **Additional characteristics for DG.** DG data can be considered to be comprised of two forms.
    - **Static data –** this includes DG machine parameters and associated protection and control arrangements. Changes to these data sources happen infrequently and much of the recent improvements to DG visibility have been associated with this data (e.g. the Embedded Capacity Register and Grid Code modification GC0139). This data can help support improvements in both planning and operational timescales. Whilst many characteristics are available, further technical data could help system analysis including analysis of the system at times of system stress.
    - **Dynamic data –** this includes the data that changes constantly such as MW and MVAr DG output, as well as elements such as power available and state of charge/availability. For most DG this data is not readily available to National Grid ESO, although we are initiating projects to increase visibility of MW and MVAr through our Regional Development Programmes (RDPs). Such data can support our control room in making efficient operational decisions and also support co-ordinated management at times of system stress. Historical dynamic data (and storage of real-time dynamic data) is also of use as this information can be used to facilitate network development, operational forecasting and analysis.
- **Associated data on distribution networks** - Benefits from increased DG visibility can be further increased through associated information on distribution networks. Having both DG information and associated data on distribution networks will enable us to assess the impact on the transmission system and aid its efficient and secure operation. The list below shows several such data items that could be of benefit to the ESO. Through the Regional Development Programmes we are looking to develop much of these data exchanges with DNOs. This is then feeding into the work of the Open Networks project (Workstream 1B, Product 3) with some of it referenced in the recently published report on real time data exchange[1] ;
    - Status of Active Network Management (ANM) zone
    - Relevant substation running arrangement and circuit breaker status
    - DG effectiveness (relative ability of DG to meet a transmission system need)
    - Relevant distribution network flows (MW, MVAr)
- **Other relevant characteristics**
    - **Balancing service provider information.** We also recognise that there is additional data on DG that we could provide to DNOs to support efficient operation of distribution networks. This includes information on active service providers within DNO networks. In accordance with our contractual arrangements we have written to reserve and response balancing service providers to advise them of our intent to share locational details of their assets with DNOs for operational purposes. We will look to share data with DNOs as soon as possible after the window for service provider responses has closed.
    - **DG contact details.** We have been working with DNOs to improve Loss of Mains protection settings for DG. Through facilitating revised protection settings and associated protection changes we have estimated we can improve the reliability of the system whilst reducing the overall cost of our balancing services. Understanding the location and contact details for many smaller DG has

[1] ENA Open Networks WSB P3 - Real Time Data Exchange and Forecasting OTS Functional Design and Data Exchange Requirements

proved problematic, and any mechanism which facilitates improved communication with these parties could be of great assistance to both ourselves and DNOs.

- **Small DG visibility (less than 1MW).** We note that the current focus of the Embedded Contract Register (ECR) is for DG with a capacity of greater than 1MW. We would encourage Ofgem to make improvements to the visibility of smaller DG also. From a National Grid ESO perspective our proposed ICCP links will enable real time data transference in sufficient quantity to also facilitate information from smaller DG, so we see no blocker towards this data being made available also.

2. *What value will these additional characteristics provide to improving the planning, security and real time operation of the GB transmission and distribution systems?*

In our answer to Q1 we listed a number of data characteristics that could support improved system operation. Table 1 below lists benefits for each of these data types in the planning, security and real time operation of GB transmission and distribution systems.

<table>
<tr><th>Data characteristic</th><th>Planning benefit</th><th>Security benefit</th><th>Real time operation benefit</th></tr>
<tr><td>Static DG data</td><td rowspan="2">Helps system analysis including fault level and voltage</td><td>Helps post fault analysis particularly during initial transient phases</td><td rowspan="6">Helps real time contingency analysis Ensures technical deliverability of ESO Balancing Services</td></tr>
<tr><td>Dynamic DG data</td><td>Helps contingency analysis</td></tr>
<tr><td>ANM status</td><td rowspan="2">Helps co-ordinate system outages</td><td>Helps manage any risk of service conflict with DNO services</td></tr>
<tr><td>Network running arrangement</td><td>Helps understand the location of potential black start units and other post-event support mechanisms</td></tr>
<tr><td>DG effectiveness</td><td>Helps ESO procure most efficient DG to meet system need</td><td>Helps us develop a post fault contingency plan</td></tr>
<tr><td>Distribution network flow</td><td>Helps co-ordinate system outages</td><td>Helps contingency analysis</td></tr>
<tr><td>Balancing service provider info</td><td colspan="3">Facilitates efficient and co-ordinated procurement and dispatch of services with DNO</td></tr>
<tr><td>DG contact details</td><td>Helps co-ordinate system requirements</td><td colspan="2">Ensures DG can be contacted in the event of a system emergency</td></tr>
<tr><td>Smaller DG visibility</td><td>Helps co-ordinate system outages</td><td>Helps contingency analysis</td><td>Helps real time contingency analysis</td></tr>
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Table 1 – System operator benefits of additional DG data characteristics

In addition, below we present a number of potential use cases where our operational planning and control room functions can benefit from the improvement in visibility of distributed generation (DG). We also describe some of the initiatives that are helping to facilitate these changes.

- **Demand forecasting.** An improved knowledge of DG would result in improved accuracy of demand forecasting. This has a direct impact on our understanding flows on the transmission system which enables us to provide better guidance to our trading team ensuring efficient procurement of congestion management services. The **Solar PV Monitoring** project and **PEF project** are two examples of the work that NGESO is undertaking in improving its forecasting by having better visibility of various types of DG across the network.
- **Identifying minimum plant requirements.** During periods of low demand we need to ensure appropriate generation is running and the network is configured to manage voltage. Lack of DG visibility provides difficulties in predicting minimum plant requirements for such low demand periods. Traditionally the most onerous period for voltage security has been overnight low demand but with rapid uptake in DG (including PV generation), daytime considerations have become more critical. Better understanding DG output during such periods would better understand their impact on demand. This in turn would allow us to efficiently identify the requirements for running plant and use of voltage control circuits.
- **ANM co-ordination.** DNOs are currently rolling out ANMs across large parts of the distribution network. Enhanced data exchange in relation to both the individual DG units and the current/forecasted actions of an ANM will ensure that the ESO is able to better coordinate service procurement, overall operability requirements and real-time dispatch of plant. Furthermore, enhanced coordination with DNOs on the likely operation of ANMs will ensure service provision is opened up to participants who are currently part of ANM schemes, as a result of their connection conditions. The requirements of better ANM coordination

are being considered as part of our recent ODFM service improvements and an ongoing innovation project with WPD (as the partner DNO).

- **Maintaining frequency.** Visibility of DG helps our control room manage the frequency of the GB transmission system. Improved visibility of DG helps with faster frequency, coordinated response solutions utilising renewables. The **Power Available (PA)** project is one such innovation that helps to do this. It has integrated the PA signal from over 90 renewable generators into our control systems and processes, providing greater visibility to our control room engineers as they balance the system on a second by second basis. This achievement is the result of collaboration between ESO and the wind industry supported by Renewable UK and means the balancing services market for real time frequency response is becoming even more accessible to renewable generators. While only PA for wind power is being integrated initially, work is underway to make PA for solar available later.
- **System stability.** Improved visibility of DG helps the ESO monitor the national and regional levels of DG output and understand the potential impact on system stability should an inadvertent operation of Loss of Mains protection occur. Monitoring of DG export, in real-time, would provide a more accurate representation of the risk of instability and enable the ESO to operate the system more effectively and economically.

3. *What value will the above characteristics provide to improving DSO function delivery by the DNOs or other stakeholders? DSO functions may include network management, flexibility procurement, and service conflict avoidance.*

Through the ENA Open Networks project we have worked with DNOs to define 8 DSO functions. Table 2 below shows which of these functions would be informed by each of our proposed additional characteristics.

Data characteristic	System co-ordination	Network operation	Investment Planning	Connections	System Defence & Restoration	Service & Market facilitation	Service Optimisation	Network charging
Static DG data	X	X	X		X			X
Dynamic DG data	X	X	X	X	X			X
ANM status	X	X	X	X	X	X	X	X
Network running arrangement	X	X	X	X	X	X	X	X
DG effectiveness	X	X	X		X	X	X	
Distribution network flow	X	X	X		X			
Balancing service provider info	X	X	X		X	X	X	
DG contact details	X	X			X	X	X	
Smaller DG visibility	X	X	X	X	X	X	X	X

Table 2 – How the eight Open Networks DSO functions could be improved through each of the data characteristics

To support this table, below we provide a number of use cases;

- **Network Operation:** DG data such as real time MW and MVAr flows and protection settings is essential for a DNO to efficiently and securely operate their networks. In turn better operational understanding of their networks will enable more informed co-ordination with the ESO allowing us to more efficiently manage the national transmission system.
- **System Co-ordination:** Collectively this data will also enable us to better co-ordinate our activities. This includes the planning of system access as well as the co-ordinated procurement and dispatch of DG. It will also facilitate greater co-ordination in the event of an unplanned incident affecting transmission and distribution systems. This can in turn lead to a more efficient response in system emergencies, such as black start. Our NIC project Distributed Restart with SPEN is testing such a use case.
- **Service Optimisation** Stakeholders, such as service providers, need to understand how the DNO and ESO have managed any service conflict. Whilst this can be helped by transparency of data, the rules governing how these decisions are made need to be accessible by stakeholders. We are looking to work with DNOs to develop common rules through the RDPs and ensure that learning is socialised through the ENA Open Networks project.
- **Investment Planning** Greater real time visibility of DG can also assist in longer term system design. Historic real time data, if stored, can facilitate improved system forecasting enabling more efficient development of both transmission and distribution networks.

4. *At what temporal resolution (instantaneous, seconds, minutes etc.) would real time data on DG be valuable to improve the resilience of the GB electricity system in the prevention of, live management, and recovery from loss of supply events?*

Of the data characteristics listed in our response to Q1 we believe there are only two types that would require temporal resolution; dynamic data and associated data on distribution networks.

Currently we receive data with one second resolution from generators joining the Balancing Mechanism. It would seem appropriate for real time DG data (MW and MVAr) to be standardised with this, which would also facilitate the provision of Balancing Services or BM access. Other dynamic data could be similarly standardised although a 10 second resolution would align with our existing transfer systems.

The resolution of all relevant data characteristics is ultimately governed by the infrastructure used in the transmission and reception of the data. This will include SCADA and control systems. Increasing data speeds may only be realised with replacement of the slowest element in the overall communication path.

5. *What investment would be required for monitoring, collecting, storing and disseminating real time operational data associated with DG? Which party should be responsible for these investments? How does this vary, based on the size of visible DG at 1MW or 50kW?*

For National Grid ESO there are a number of direct costs associated with monitoring, collecting, storing and disseminating real time operational data associated with DG. These areas are as follows;

- **Installation and maintenance of communication interfaces with DNOs.** Through our Regional Development Programmes we are already installing ICCP links with some DNOs. This work will continue into RIIO-2 to provide the ESO with the ability to have high quality data links with all DNO control rooms. This will enable the capability for bulk real time data transfer between DNOs and the ESO. We note that there will be ongoing costs associated with maintenance of this equipment. Responsibility for these links is joint work between the ESO and DNOs.
- **Installation of collection and dissemination IT infrastructure.** As greater volumes of data become available we need to ensure our control room IT infrastructure is sufficiently robust to facilitate both collection and dissemination of this data. Our proposed data and analytics platform will help the ESO in the collection and dissemination of this information.
- **Control room resource.** As the volume of DG grows, and distribution networks become more active, there will be an increasing need for additional control room monitoring and management. Some of this can be optimised through the use of Artificial Intelligence, but this will require additional investment in IT infrastructure.

The requirements for IT infrastructure and control room resource will change depending on the threshold for visible DG (1MW or 50kW). This is primarily due to the increased volume of data associated with a 50kW threshold.

In addition to ESO investments we are also aware of investments to other stakeholders in providing additional DG visibility. Our work through Regional Development Programmes is looking to minimise cost to the industry as a whole by making use of both existing and future DNO infrastructure and DG investments. This includes;

- **DG metering**. On site metering to a required standard as well as communications path installation and maintenance. Provision of balancing services may require additional metering requirements.
- **DNO communication and monitoring infrastructure**. Through RDPs DNOs are providing visibility and control links to required DG. In addition, DNOs are also installing monitoring equipment on their network that support more co-ordinated system operation.

6. *What are the credible technical, regulatory (industry codes, licences and governance) and legal barriers and costs associated with increasing the data collected, stored and shared regarding DG operations, and in obligating parties to do so?*

There are a number of credible barriers and costs associated with improving DG data. Below is a non-exhaustive list of credible barriers accompanied by specific examples.

a. **Lack of obligations to provide data.** Industry codes and frameworks were generally established in a regime where data was less widely available and the volume of DG was much smaller (and of less significance). Whilst we are working with DNOs to improve data availability, this is often challenging without the support of relevant industry obligations. For example, we have been working with DNOs to encourage DG to update their Loss of Mains protection settings. Establishing contact with many existing small DG is proving problematic with little available data on current contact details. Lack of underlying obligations could be through gaps in codes which require code modifications to update, or could be due to existing contractual arrangements (e.g. a DG's connection agreement does not require certain data to be made available). It should also be noted that changes to codes follow an open governance process which can add time delays in enabling sharing of the required data. We are therefore working with DNOs to facilitate additional data transfers ahead of code modifications, through mechanisms such as connection agreement changes for new DG and the RDPs.

b. **Need for appropriate funding.** Regulated entities such as DNOs and the ESO need to be appropriately funded to deliver any required IT changes to improve DG visibility where there is overall consumer benefit in doing so. It should also be recognised that procurement, installation and testing of communications infrastructure takes a significant period of time (12-24months typically). Funding can also prove a barrier to connected DG who may need to fit additional monitoring equipment. In the case of Loss of Mains we have supported smaller DG to fit new protection relays recognising that this creates an overall consumer benefit.

c. **Data confidentiality and security concerns.** Stakeholders may be concerned over the use of their personal data in association with DG visibility and it is important that only the required data is made available and only to those parties who need it for a specified purpose. Data security can similarly be a concern of stakeholders and it is important that data communication channels are appropriately secure and meet international standards.

d. **Cost of data.** We are aware that some DG data characteristics can be available to stakeholders, but there is a cost associated with their availability. For example, we currently receive, via Electralink, half hourly output data for all DG with half hourly metering (referred to as the 'Data Transfer Service'). This is not live data but is available within a few days. This data is helpful to the ESO in forecasting future generation patterns in all timescales however, we are required to pay an ongoing charge for this data. Whilst this may be appropriate as a funding route for the costs of data provision, such charges should not facilitate individual organisations making a profit from the provision of data.

e. **Need for interoperability**. It is important that data is provided in a format that is common and readily utilisable by third parties. Grid Code modification proposal GC0139 is currently looking at improvements to data exchange between ESO and DNOs in planning timescales. The workgroup has recognised that this will be a significant increase in the volume of data transferred and that current ways of working will not facilitate future requirements. They are therefore considering the adoption of a Common Information Model (CIM) to facilitate this transfer and a request for information will be sent to all DNOs shortly to understand the costs and timescales for implementation. Such an exchange mechanism may also be relevant for some of the more static data we have suggested in our response to Q1, and therefore there may be benefit in Ofgem considering responses to the GC0139 Request for Information as part of this Call for Evidence.