The Voice of the Networks

Energy Networks Association

Open Networks Project
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Flexible Resources Connections Guide

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Related Documents

Reference 1	Upgrading Our Energy System – Smart Systems and Flexibility Plan
Reference 2	Open letter Call for Evidence on the Incentive on Connections Engagement: Looking Back Reports 2016-17 and Looking Forward Reports 2017-18

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Table of Contents

1 Introduction

1.1 The ENA and Open Networks Project

Energy Networks Association (ENA) represents the "wires and pipes" transmission and distribution network operators for gas and electricity in the UK and Ireland. Our members control and maintain the critical national infrastructure that delivers these vital services into customers' homes and businesses.

The Open Networks Project is a key initiative to deliver Government policy set out in the Ofgem and BEIS Smart Systems and Flexibility Plan, the Government's Industrial Strategy and the Clean Growth Plan. The Open Networks Project is working in collaboration with Ofgem, BEIS, 10 of UK and Ireland's electricity network operators and other key stakeholders.

1.2 Purpose

This document presents a Flexible Resources Connections Guide to clarify the processes and products available today, covering topics raised through the associated call for evidence. The document has been developed in alignment with Issue 1.6 of the Smart Systems and Flexibility Plan. Although the issue focuses specifically on energy storage, Open Networks has widened to include all flexible resources in order to be technology agnostic. This enables the options presented to be applied to energy storage and any other technology which could provide the same flexibility in a DSO world. While we are not in a full smart grid world, licensees have made notable steps towards facilitating this individually and collaboratively through targeted working groups. This document is aimed at stakeholder led flexibility rather than network led flexibility requirements and those actively seeking connection of flexible resources in the shorter term on the GB electricity network at any distribution voltage level. It complements the ENA DG Connection Guides[1], providing detail relevant to many customers exploring connection options for some form of flexible resource. Support in finding the correct ENA DG Connection Guide is given in Section 3.

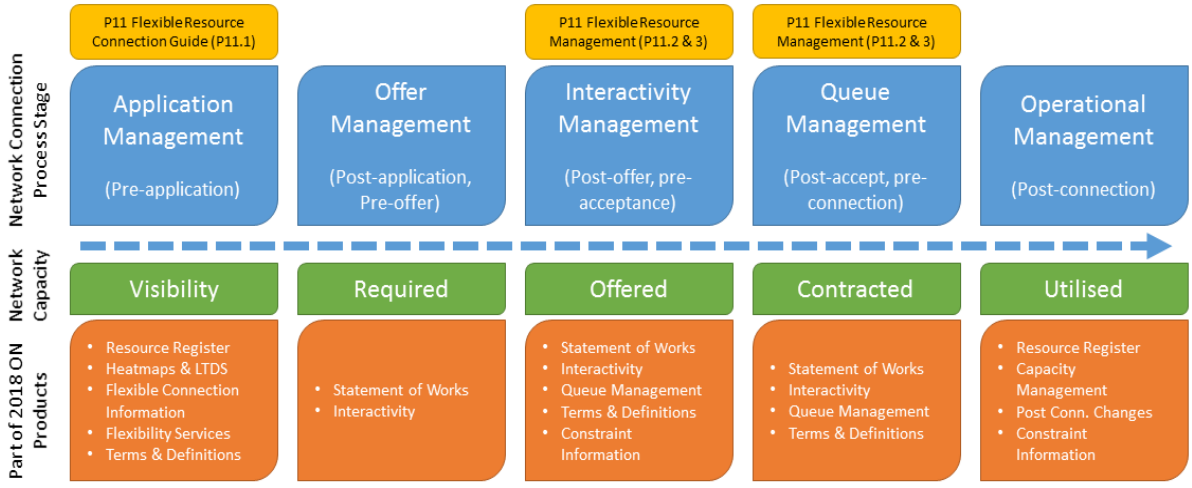

Figure 1: Customer connection timeline

Importantly this document concentrated on today and the near term and does not propose any changes to existing processes. Issues relating to the underlying queue are being addressed by the Interactivity and Queue Management product (WS2 P5) and approaches designed to optimise the path through these for flexible resources are being developed under this product

[1] http://www.energynetworks.org/electricity/engineering/distributed-generation/dg-connection-guides.html

(WS1 P11) with the concepts included in the Interactivity and Queue Management Consultation and future associated reports in 2018 and 2019.

2 What are Flexible Resources?

2.1 Flexible Resource definition

During such a dynamic period in the energy industry, it is important to clearly define new and traditional terms to limit misinterpretation and variations across licensees. The Open Networks Project published a "Terms and Definitions"[2] document developed within Product 3 of the Customer Experience Workstream.

Term	Area	D or T	Plain English Definition
Flexibility	Ancillary Services	D/T	This refers to modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system.
Flexible Connections	Connection Capacity	D	**Flexible Connections** are connection arrangements whereby a customer's export or import is managed (often through real-time control) based upon contracted and agreed principles of availability of capacity. **Timed Connections** and connections utilising **Active Network Management** arrangements are examples of **Flexible Connections**. Occasionally, **Flexible Connections** are also referred to as **Managed Connections**. The need for network access to be managed, may arise through capacity limitations which are local or remote from the Connection Point. For example, a **Flexible Connection** might comprise a **Firm** local connection, but with a constraint being present deeper in the network. **Flexible Connections** are offered to customers so that **Reinforcement** can be avoided or deferred.
Flexibility Market	Industry Term – DSO Models	D/T	The arena of commercial dealings between buyers and sellers of **Flexibility Services**.
Flexible Resources		D/T	**Flexible Resources**, typically distributed generation, storage or demand response, are connected to the electricity network, and are flexible in how they operate and impact the network.
Flexibility Service	Industry Term – DSO Models	D/T	The offer of modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system.

Table 1: Defined 'flexibility' definitions

The five terms outlined in the document including the words "flexible" or "flexibility" are presented in Table 1. This guide utilises all these terms, but importantly it has been designed for "Flexible Resources".

[2] http://www.energynetworks.org/assets/files/180723%20ON-PRJ-WS2%20-%20P3%20Terms%20and%20Definitions%20V1.1%20(published).pdf

2.2 Examples of Flexible Resources

As the definition states, Flexible Resources are typically distributed generation, storage or demand response which are to some extent flexible in how and when they operate. They do not have to be connected through a Flexible Connection agreement and include most generation and storage technologies. Demand flexibility predominantly lies with industrial and commercial customers (e.g. datacentres, factories and food stores) at present, but as Smart Meters (SMETS2), low carbon technologies and electric vehicles become more commonplace, the opportunities for domestic customers will increase.

2.3 Smart Grid Facilitation

Flexible Resources and Flexible Connections are key to the smart grid transition, giving more power to the consumer while minimising the cost of energy in the longer term and supporting the drive to a low carbon economy. Open Networks and supporting innovation projects are looking at several potential uses of Flexible Resources, including enabling new connections, peer to peer trading of energy and network management.

2.3.1 New Connections

To move us towards a low carbon economy, decentralising generation and moving to more local sustainable forms, the electricity distribution networks will have to accept a high number of new connections across all voltage levels. Using traditional methods, this transition would quickly meet barriers due to network limitations. However, these worst-case scenarios creating the constraint are often for relatively short periods across the year or under certain conditions, thus could be managed with a Flexible Connection. This arrangement can give customers the demand and generation capacity they need without triggering significant spend on other solutions such as network reinforcement. It is recognised that needs vary across the broad range of different applicants and that one solution will not fit all. As the network becomes more dynamic, connection arrangements need to reflect this and offer customers choice through a suite of differing Flexible Connection offerings.

2.3.2 Peer to Peer Trading

One requirement of the DSO and ESO is that they are Neutral Market Facilitators (NMF). A smart grid world should give consumers the opportunity to trade energy locally and have peer to peer contracts to optimise their generation, storage and consumption. Such arrangements give the customer more control, leading to economic and sustainable energy industry in the longer term. Flexible Resources are key here as these arrangements are likely to be dynamic and require generation, storage or demand response connected to the electricity network to be flexible in how they operate.

2.3.3 Network Management

While some of the terms in Table 1 are relatively new within the electricity distribution industry, flexibility itself has long been used to ensure secure delivery of electricity to meet real-time demand. It can be defined as the ability to adjust energy usage (generation or consumption) up or down to meet a system need such as managing network constraints to maintain the stability of the electricity system. Thus, as well as facilitating connection of distributed low carbon technologies and more customer choice, flexible resources can be used to provide network services.

National Grid as the transmission system operator (TSO or ESO) has been procuring balancing services for some time and therefore the processes and service requirements are mature. Balancing services can take many forms but typically fall into just a few headline categories as shown below.

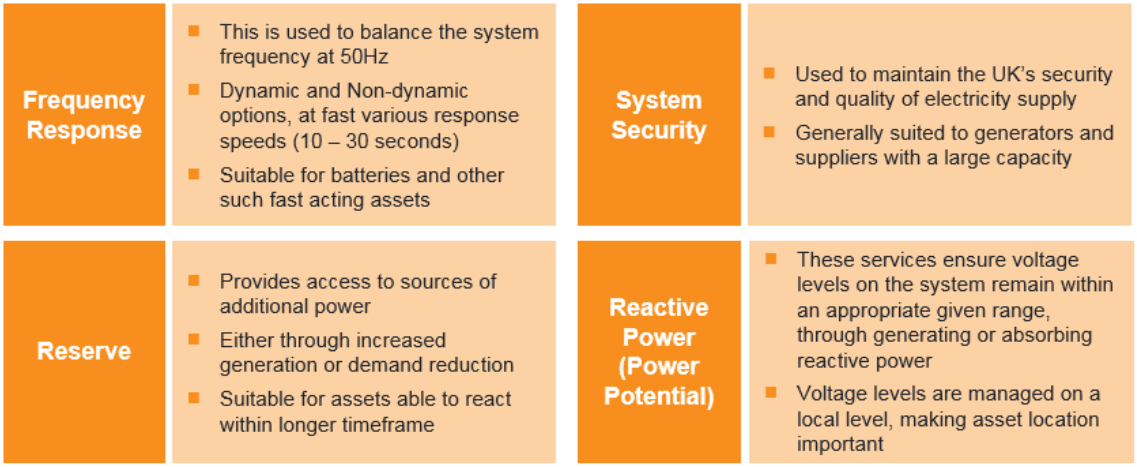

Figure 2: Typical ESO balancing service categories

At distribution, the market for flexibility is nascent but DNOs are increasingly looking to use flexibility services from DER to support the planning and operation of the network. As the market for flexibility matures over the coming years, with increasing penetration of electric vehicles and low carbon technologies onto the lower voltage networks, service requirements on the distribution networks would likely increase, resulting in a suite of requirements similar to that shown in Figure 3.

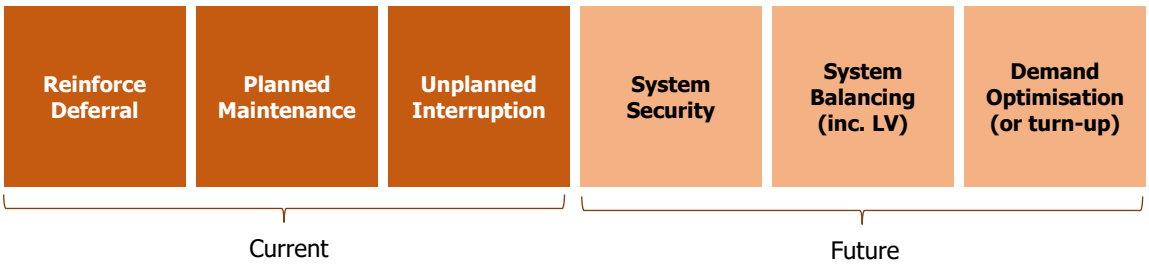

Figure 3: Potential DNO/DSO service requirements

The categories shown are each made up of a number of specific services which can be applied GB wide by all licensees or more specific to individual network requirements. As the transition to a DSO World progresses, the specific services and their specifications will become more developed.

3 Flexible Connection Options

Flexible Connections are connection arrangements whereby a customer's export or import is managed (often through real-time control) based upon contracted and agreed principles of availability of capacity. Importantly, these arrangements can be applied to either Firm or Un-firm connection and do not replace them. For example, a Flexible Connection might comprise a Firm local connection, but with a constraint being present deeper in the network.

The term Firm is used to describe a connection that remains available in a first fault scenario. A clear example of a Firm connection is a connection of two or more circuits to maintain availability in the event of one circuit not being available. A Firm arrangement is one which, in

the event of a fault on, or the taking out of commission for maintenance or other purposes, any one circuit forming part of the connection arrangement, ensures continued availability of the agreed Maximum Import Capacity or Maximum Export Capacity (assuming that the wider network assets that the connection is connected to are intact and operating normally).

Un-firm (or Non-firm) connections on the other hand are typically single circuit whereby the connection becomes unavailable in the event of a fault or necessary maintenance. The connection then remains unavailable for the duration of the necessary works. Un-firm connections have become commonplace for generator connections on distribution networks to reduce connection charges (due to fewer assets being required than for two circuit connections).

Flexible Connections are currently offered to customers so that reinforcement (or other suitable alternatives incurring costs) can be avoided or deferred. The existing offerings are summarised in Table 2.

Flexible Connection	UKPN	WPD	SPEN	ENWL	NPG	SSEN
Timed Connections	Yes	Yes	Yes	No	No	Yes
Active Network Management	Yes	Yes	Yes	No	Yes	Yes
Operational Tripping Schemes	Yes	Yes	Yes	Yes	Yes	Yes
Export Limiting Devices (G100)	Yes	Yes	Yes	No	Yes	Yes

Table 2: Flexible connections presently available on distribution networks

While Electricity North West do not officially offer a number of the options, this is predominately due to lack of requirement and or request. However, there are plans in place to develop these and applicants are asked to speak with their Customer Relationship Manager if they wish to explore a Flexible Connection.

The table currently only summarises the options which have become most widely available across DNOs in recent years. Additional options are being offered in certain areas or through trials, so any applicant is advised to check what alternatives are available.

Flexible Connections listed in Table 2 are explained in more detail within the following sections.

3.1 Timed Connections

The timed import and or export connection offers the customer the possibility of connecting to the network and exporting during certain periods of the day or week. In some network areas there is the potential to make use of generation or demand diversity. Timed connections are determined when a customer sets out their planned usage and we design an appropriate connection and provide a price based on their profile. Customers need to provide their anticipated usage pattern which would be reflected in the connection offer and later agreement.

The examples generally supported are where the majority of generation in an area is PV then during non-daylight hours other types of generation can export freely, such as wind. Another alternative is where demand is high during the week but low over the weekend, for example in an industrial area, in this case a generator can export Monday – Friday but constrained over the weekend.

3.2 ANM (Active Network Management)

In areas where there are multiple complex thermal constraints affecting a number of customers over a long-time period, full active network management systems can be implemented, where it is technically viable. Distributed control systems continually monitor all the limits on the network and then allocate the maximum amount of capacity to customers in that area, based on the date their connection was accepted. This Last In, First Out (LIFO) hierarchy prioritises the oldest connections when issuing capacity but is scalable so that new entrants will get access to the capacity when it becomes available (based on the date their connection was accepted).

Many DNOs also offer Single Generator ANM (SGANM) which is similar to a full ANM scheme, except instead of managing multiple constraints and multiple generators it manages only one generator and up to two constraints. The SGANM will monitor constraints and issue the generator a safe level of export capacity in real time. The SGANM will be offered to the first generator in the constrained area, should second generator request a connection in the same zone then a full ANM will be installed.

3.3 Operational Tripping Schemes

Some networks are constrained due to a single upstream asset requiring reinforcement, or a single limit being infringed under certain conditions. Through monitoring these conditions, further capacity can be released when these limits or assets are within normal operating parameters. When there is no further capacity available, the connection will be curtailed to a predefined limit, which may be zero.

For example, DNOs must ensure that if there are two circuits running in parallel and one of the circuit's fails then the other circuit can pick up the load. A new connecting generator may incur additional reinforcement charges due to the remaining circuit not having a sufficient excess capacity under these conditions. Thus, an intertrip connection may be offered to allow a customer to connect onto the network under the condition that the generator will be disconnected from the network if one of the circuit fails.

In addition to this N-1 constraint example, where appropriate the system can be used to monitor:

- Transformer Reverse Power
- Voltage Constraints
- Thermal Constraints

The levels of curtailment corresponding to the operation will be defined at the planning stage. Note that due to the coarse method of curtailment, there will be a maximum number of participants per area.

3.4 Export Limitation Devices (G100)

Customers who are seeking to increase the amount of generation or energy storage installed but have been advised an increase in export capacity will require costly or time bound upstream reinforcement, may choose to restrict the net export of their connection rather than wait for or contribute to the reinforcement. DNOs generally will consider applications for export-limiting

schemes which comply with the relevant power quality standards and with ER G100 on a case by case basis.

An export limitation scheme measures the Apparent Power (kilowatts) at the exit point of the installation and then uses this information to either restrict generation/energy storage output or increase the customer demand in order to prevent the Agreed Export Capacity from being exceeded.

These schemes allow network operators to continue to maintain the supply security of existing customers whilst also enabling new generation/energy storage onto the network.

The customer will ensure the export limit given by us is not exceeded, but DNOs will also install a failsafe system so that in the event of the generators export limiting scheme failing, the generator will be disconnected.

4 Glossary

Term	Definition
Workstream 1, Product 11	Facilitating Connections: Develop connection guide and action plan for flexible resource connection queue optimisation options (including storage as per action 1.6 from the Smart Systems and Flexibility Plan) and publish to stakeholders.
Workstream 2, Product 1	Good Practice ahead of Connection Applications: Review network operator approaches for handling prospective connection applications and publish good practice for supporting customers pre-application.
Workstream 2, Product 5	Good Practice Following Connection Applications: Review approaches for handling customer connections in the post-application phase and agree good practice.
ER P2/6	Engineering Recommendation P2/6 (ER P2/6) is the current distribution network planning standard.
Customer	A person who is the owner or occupier of premises that are connected to the Distribution System.
Distribution Code	A code required to be prepared by a DNO pursuant to condition 9 (Distribution Code) of a Distribution Licence and approved by the Authority as revised from time to time with the approval of, or by the direction of, the Authority.
Distribution Network Operator (DNO)	The person or legal entity named in Part 1 of the Distribution Licence and any permitted legal assigns or successors in title of the named party.
Grid Code	The code which National Grid Electricity Transmission plc. is required to prepare under its Transmission Licence and have approved by the Authority as from time to time revised with the approval of, or by the direction of, the Authority.
Long Term	An implementation period of more than eight years
Market	The non-geographical area or arena in which commercial dealings are conducted.
Medium Term	An implementation period of longer than three but less than eight years.
National Electricity Transmission System Operator (NETSO / ESO)	National Grid Electricity Transmission (NGET) in its capacity as operator of the National Transmission System.
Short Term	An implementation period of less than a year.
Statement of Works (SoW)	Statement of Works is submitted to National Grid for the purposed of assessing the impact of embedded generation upon the National Electricity Transmission System.
System Operator (SO)	The System Operator is responsible for ensuring the stable and secure operation of the whole transmission system.
Transmission System	A system of lines and plant owned by the holder of a Transmission Licence and operated by the NETSO, which interconnects Power Stations and substations.
Transmission Owner (TO)	Transmission Operators (TOs) are licensed to develop, operate and maintain the high voltage system within their own distinct onshore transmission areas.
User	A term used in various sections of the Distribution Code to refer to the persons using the DNO's Distribution System.
Whole System	The integrated system of connected generating plant, Transmission System, Distribution Systems and associated electrical demand.