THE DEVELOPMENT OF SMART GRID SERVICES: GENERATORS

A PAPER TO SGF WORKSTREAM 6

Summary

As DNOs increasingly look to procure services from generators and manage their networks, there is scope for learning from the experience of the provision of these services to the Transmission System Operator. There is also the possibility of competition in the procurement of these services. Workstream 6 of the Smart Grids Forum could in particular usefully look at the following as an initial priority:

- the implications of widespread local (distribution) constraint management on national energy balancing and imbalance settlement
- the social, environmental, and economic implications of curtailing significant amounts of generation output
- predictability, sensitivity, and risk management of curtailment levels, including source of and liability for information provided
- arrangements for distributed generation and/or DNOs to participate in transmission constraint management services
- the provision of reactive power / voltage support from distributed generation to accommodate SO needs
- visibility of smaller generation both to DNO and to SO
- aggregation of services from smaller generators both to DNO and to SO
- the relationship between the service and the connection arrangement / cost

Introduction

Workstream 6 of the Smart Grids Forum exists to identify and resolve commercial and regulatory barriers to the deployment of smart grid solutions, notably by DNOs. The scope is "to introduce enablers for the development of smart grids, with a particular focus on the future roles and responsibilities of parties in the value chain and their relationships with each other and consumers."[1]

A sub-group of Workstream 6 has been looking at the potential services provided from demand, storage, and generation connectees. This paper covers the range of services that might be procured from the last of these – generation – and suggests areas for next steps for Workstream 6.

Potential Services to DNOs

The services DNOs may require will depend on how the role of the DNOs themselves evolves and how active they become in managing their own networks (on the way to

[1] Terms of Reference

becoming “DSOs”). In the medium-term of the RIIO-ED1 period to 2023, the following services may be required:[2]

- constraint management
- reactive power / voltage support[3]
- Intertrips and soft deloading
- Fault Ride-Through
- post-fault recovery
- fault level management

DNOs are already engaging with constraint management as an innovation, and as business as usual in some localised areas of the country, to avoid high connection costs and/or the need for wider network reinforcement.

Services Currently Offered by Generators

Even as DNOs begin to look at the procurement of the above services, some of these are already being offered elsewhere, notably to the Transmission System Operator.

- constraint management: Balancing Mechanism and bilateral contracts
- energy balancing: Balancing Mechanism and energy trading
- reactive power: mandatory services and commercially tendered services
- Intertrips and soft deloading: commercial services
- Fault Ride-Through: Grid Code requirement[4]
- post-fault recovery: Grid Code requirement[5]
- fault level management

These services have to date normally[6] been offered to the Transmission System Operator by transmission connected generation rather than by distributed generation, but this may change.

Competing for Services

It is clear from the above that DNOs may begin to compete with the Transmission System Operator for some of the services offered by generators. However there may well be a threshold in the size of generator. For instance, the Transmission System Operator tends to

[2] See Annex 1 for definitions of each service
[3] Both local voltage support to allow connection, and wider reactive input to maintain transmission stability.
[4] This is currently a Grid Code requirement rather than a service.
[5] This is currently a Grid Code requirement rather than a service.
[6] Some distribution connected generators sign bilateral arrangements with the System Operator.

procure most services from generators of 50MW and above.[7] DNOs are likely to call on generators of far smaller capacity. There will be a grey area either where smaller generators can aggregate their output, or where the Transmission System Operator need for services is highly localised and / or the market is restricted thereby necessitating participation by smaller players.

In addition, the Transmission System Operator procures services from generators that are unlikely to be needed by DNOs. They are listed here because the need to be available to provide these services may preclude or compete with other service offerings:

- energy balancing
- frequency response
- negative reserve (footroom)
- positive reserve (headroom)
- blackstart

From the perspective of the generator, they will need to consider not only the opportunity to offer services to competing clients; but also the competitive pressures on them from other sectors, i.e: demand and storage, also new providers such as Interconnection.

Lessons to Date

The Transmission System Operator in GB has decades of experience of procuring services from large thermal generation plant, and this is believed to be working well. Services are provided according to:

- mandatory Grid Code requirements
- mandatory Grid Code requirements with compensation for use
- commercial tender arrangements
- bilateral contracts

For newer technologies, such as windfarms which are a little smaller, with output varying according to the windspeed, the Transmission System Operator is developing its processes. This is an evolutionary and consultative exercise of developing understanding of technical and commercial capabilities and limitations of technologies not previously needed or used for this purpose. Lessons include the need for the following:

- building trust that services are requested because they really are needed
- need for a market development strategy that includes: accommodating upfront costs, first mover risk, engagement, and education

[7] There are some bilateral arrangements with distributed generators, and note also that STOR contracts may involve contribution from much smaller generation sets.

- clarity on the commercial proposition to incentivise participation, i.e: what's in it for the generator?
- payment arrangements that fully take into account lost revenue, notably renewables support
- clarity on long-term need, frequency of need, total use of service, and sensitivities around this to allow consideration in project financing and operation
- confidence that the market will be sustained for several years and is therefore worth investing in
- validation of services in a way that is appropriate to the technology, e.g: a requirement for independent testing at maximum windspeed will delay validation
- flexibility of contracts to accommodate specific technology characteristics
- consideration of the relative benefit of universal mandation vs location specific commercially procured services
- appropriate communications ("wind paid to do nothing" rather than "wind providing constraints management service")

As DNOs begin to procure further services, they will need to address a similar set of issues around market development as those set out above.

Next Steps – to Explore Further under Workstream 6

There is a wide range of interactions which could not possibly be mapped out in one go. We recommend that Workstream 6 concentrates on investigating the following areas:

- the implications of widespread local (distribution) constraint management on national energy balancing and imbalance settlement
- the social, environmental, and economic implications of curtailing significant amounts of generation output
- predictability, sensitivity, and risk management of curtailment levels, including source of and liability for information provided
- arrangements for distributed generation and/or DNOs to participate in transmission constraint management services
- the provision of reactive power / voltage support from distributed generation to accommodate SO needs
- visibility of smaller generation both to DNO and to SO
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ANNEX 1: SERVICES GLOSSARY

- constraint management
- energy balancing
- reactive power
- Intertrips and soft deloading
- Fault Ride-Through
- post-fault recovery
- fault level management
- frequency response
- negative reserve (footroom)
- positive reserve (headroom)
- blackstart

THE DEVELOPMENT OF SMART GRID SERVICES:

DEMAND SIDE RESPONSE

A PAPER TO THE SMART GRID FORUM WORK STREAM 6

Introduction

The goal of Work Stream 6 is to find – and to propose ways to mitigate – barriers to the uptake of Smart Grid services by and for Distribution Network Operators (DNOs). There is a large potential for Demand Side Response (DSR) services to be utilised by DNOs in the management of their networks, but the means by which this could happen are as yet undefined. For both DNOs and DSR Providers it is an area of potentially fruitful exploration. Neither party at the moment seems fully sure about the services the one would like or need from the other, although it is almost certainly the case that needs could be met with the right information and incentives.

Services currently offered by DSR

DSR services are provided in the main to National Grid as balancing services. A (non-exhaustive) list of the services which are currently provided to the TSO from the demand side includes:

- Frequency Response
- Short Term Operating Reserve (STOR)
- Frequency Response by Demand Management (FCDM)
- Triad Management
- Voltage Optimisation

The value of DSR providers to DNOs is the understanding they have of loads: which ones are suitable for DSR provision and; how those loads can be controlled to provide that service.

Competing for Service

When a DSR service is actively being provided for one purpose it cannot be used for another.

An example of this is the proposed form of participation of DSR in the Capacity Market during the Triad window. A company which regularly switches off its load to avoid a Triad

window will have those actions included in its power consumption baseline. It will not then be able to offer that load reduction action in the Capacity Market, even though:

- These actions effectively provide capacity
- The average company takes Triad avoidance actions up to 20-30 times a year (though there are only three Triad periods in a year).

As most DSR services are being sold to the TSO, and as all the existing markets for DSR are linked to TSO service requirements, DNOs will have to create opportunities for DSR providers and make the service proposition attractive in order to gain participation from the aggregators. Direct contact with known customers with large loads and standby generation assets is a possibility for DNOs, though finer control is possible from the aggregation of many smaller loads.

The Work Stream should look at methods of facing the potential Double Counting issue, and it should make decisions on services which can be offered to two or more parties at the same time. For instance, if a generator is participating in the capacity market and is called upon by National Grid to perform frequency response actions in an emergency then it will not be penalised in the CM for failure to deliver capacity. Similar latitude should be given to DSR services which can be provided to both the TSO and the DNOs. Perhaps a hierarchy of service merit could be drawn up.

Lessons to date

Several DNOs are already experimenting with DSR services to help manage the stability of their networks. It seems likely that with the Smart Meter roll out programme more services will become available to DNOs and the value of such services will be substantial.

DSR services are becoming more and more important to National Grid in order for it to maintain quality and security of supply (under NG's System Balancing obligation). A recent IEEE paper[8] suggests that DSR services are worth roughly £60k/MW/year today but under either heavily nuclear-or heavily renewable-based energy future scenarios these values are estimated to go up to £1.3m/MW/year to £3.3m/MW/year in the period 2030-2050.

It is understood that DSR services help to:

- Maintain system security
- Reduce operating costs
- Reduce carbon emissions from the generator fleet
- Avoid curtailment of wind assets

More work should be done to explore DSR's impact on:

- Reducing Transmission Network charges
- Reducing Distribution Network charges

[8] IEEE Transactions on Smart Grid, Vol 4, No 4, December 2013, pp 2036-2048

- Providing targeted stabilisation services to DNOs
- Reducing Suppliers' imbalance costs

Services to explore further

It would be extremely useful to both DSR providers and to DNOs to establish what services DNOs would like to have from DSR providers and to know which of these services are technically possible on the demand side.

- Geographically specific targeting is seen as a key requirement by DNOs.
- Peak shedding/shifting
- Constraint curtailment
- Avoidance of reinforcement actions

These are all services which can potentially be offered by DSR providers. More discussion between parties should take place. Understanding the needs of DNOs (especially on their journey to DSOs) will provide more fruitful results than waiting to see what services happen to emerge into the market.