UNRESTRICTED REPORT

Operating the Electricity Transmission Networks in 2020

EA Technology's submission to National Grid's Consultation

Report No: 6460

August 2009

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2007

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1 Executive Summary

EA Technology is one of the UK's leading power asset management companies, based at Capenhurst, near Chester. The business has evolved and developed over the past 40 years to its present status as an independent limited company, working on behalf of clients in the electricity, energy, infra-structural and associated sectors. This document is our submission to National Grid's Consultation on Operating the Electricity Transmission Networks in 2020. In our response, we have limited our comments to those areas where we are qualified to contribute and have therefore not responded to those questions outside our expertise.

We generally agree with many of the assumptions made by National Grid about developments in relation to microGeneration and electricity demand. We do, however, believe that the potential for microCHP has been underestimated and we suggest that heat pumps need to be considered, alongside Electric Vehicles, as a significant demand that is likely to arise. We agree with National Grid that small consumers may offer the potential to contribute to balancing services and have highlighted some ongoing work in this area which National Grid is currently involved in.

We believe that competition may arise between Suppliers and National Grid for access to Demand Side Management (DSM) services but this is likely to be manageable through market processes, similar to those in place already for generation. (Presently, generation can be traded ahead of real-time or made available to National Grid, either through an agreement for the provision of Balancing Services or in the Balancing Mechanism). However, the drivers for Distribution Network Operators to procure DSM services are different, being intrinsically related to localised management of constraints on the distribution networks, and we propose a possible solution for how arising conflicts may be resolved.

Finally, we believe that System Operation in 2020 will be considerably more complex that it is today. We have therefore proposed a model of delegated authority and responsibility, which we believe will enable all parties to be better equipped to meet the changing role of the electricity networks. Under this model, responsibility is delegated to the most effective level within the electricity system, whilst accountability is retained by all relevant parties.

2 EA Technology

EA Technology is one of the UK's leading power asset management companies, based at Capenhurst, near Chester. Its origins date back to the mid-1960s, when it was established as the UK Electricity Industry's Research and Development facility. The business has since evolved and developed to its present status as an independent limited company, working on behalf of clients in the electricity, energy, infra-structural and associated sectors.

EA Technology provides a wide range of specialist services to the energy sector, particularly to the electricity Distribution Network Operators and energy Supply Companies in the UK and overseas. This response is largely based on our experiences in relation to:

- Demand Side Management – through our role as Operating Agent and National Representatives on a number of Tasks for the International Energy Agency's Implementing Agreement on DSM, particularly Task XIX (ongoing) looking at Micro Demand Response and Energy Saving;
- MicroGeneration;
- Heat Pumps; and
- SmartGrids and MicroGrids.

EA Technology welcomes National Grid's consultation on Operating the Electricity Transmission Networks in 2020 and is pleased to provide its response in the following pages.

3 Our Submission

EA Technology's response to National Grid's Consultation is provided in the following pages. Our response takes the form of a broad discussion of some of the topics raised by the Consultation document, rather than direct responses to the individual questions posed by National Grid. However, the relevant question numbers are indicated as appropriate to enable the reader to relate this response to the Consultation document.

We have targeted our response to those areas where we are qualified to contribute and have therefore not commented on areas outside our expertise.

3.1 Developments in Electricity Generation and Demand

3.1.1 MicroGeneration

Related Question: 13

We agree with some of the assumptions made by National Grid in relation to embedded and distributed generation. We note, for example, that the "Gone Green" scenario assumes around 3.5GW of solar micro-renewable energy. Solar units installed in the UK typically have a capacity factor of 5%. Assuming a typical installation size of 2kW, 3.5GW of solar translates to 1.75 million installations, which is close to the numbers assumed in the LENS Distribution System Operator Scenario (DSO). The DSO scenario assumes strong growth in Demand Side Management (DSM) and strong "green" awareness and a willingness by a significant number of informed consumers to participate in their electricity supply. This is consistent with the "Gone Green" scenario and therefore we consider the estimate of contribution from solar to be valid.

In contrast, we disagree with the conservative figure for MicroCHP. Whilst we agree with the thrust of the argument for the conservative view expressed in the consultation document, we believe that the argument is incomplete and therefore flawed. The consultation states that "*every unit of microchip electrical output will be at the expense of a unit of 'carbon sequestrated', nuclear or renewable electricity.*" This implies that the primary energy source for MicroCHP units will be fossil fuels and that the cost of each unit of electricity produced will be higher because of the carbon emission cost (essentially a carbon tax). This is not necessarily true. MicroCHP units (particularly external combustion units, such as the Stirling Cycle units) can be powered by a range of biofuels. The consultation recognizes that

MicroCHP promotes greater energy efficiency in the short term. Our view is that this is likely to result in a short term growth in installation of MicroCHP units, which subsequently are run using biofuels, to avoid the "carbon tax" on fossil fuels. We suggest that National Grid should revisit the model it has used to determine the impact of MicroCHP.

3.1.2 Developments in Electricity Demand

In addition to the potential impact that Electric Vehicles are likely to have on electricity demand, we believe that the focus on decarbonising heat at both a National and European level is likely to result in a greater uptake of heat pumps and similar technologies. This is likely to be particularly true for areas that are currently 'off grid' (i.e. do not have access to the natural gas system), as electricity for space heating is an economic alternative to oil, LPG or solid fossil fuels.

The adoption of such technologies raises two potential challenges for the electricity system. Firstly, at the distribution level, is the issue of whether there is sufficient network capacity to deliver the increased load requirement, especially if required at peak times. EA Technology is currently looking at this issue on behalf of the distribution network operators.

Secondly, and probably of more relevance to system operation, is the impact of such technologies on the demand shape. The majority of heat pump systems that are currently being retro-fitted for space heating do not include a thermal store. As such, they are likely to be run in both the morning ramp-up period and across the evening peak, with limited opportunities to encourage consumers to move their demands for heat away from these traditional 'peak' times.

The impact of heat pumps on the demand shape, both nationally and on an individual supplier basis, has received little attention. We believe that this is due to the number of units currently deployed remaining relatively low and the use of class profiles in the Balancing and Settlement arrangements smoothing suppliers' exposure to the increased consumption in peak half hours. (Presently, class profiles are not modified for properties where heat pumps have been installed.) We suggest that National Grid may wish to consider including the impact of heat pumps in its forecasts of how electricity is likely to be consumed in 2020.

3.1.3 DSM services and Small Consumers

Related Questions: 36 and 37

The potential for small consumers to engage and provide DSM services is, at present, a relative unknown. EA Technology is currently acting on behalf of the International Energy Agency's Implementing Agreement on Demand Side Management to consider the potential for small customers (with a maximum demand of less than 100kW) to engage in DSM schemes[1]. As part of this project, EA Technology is also coordinating a UK team, looking at the potential in the UK context, in which National Grid is currently participating.

This project brings together the experience gained from the participating countries to consider the potential for small consumers. In the UK-specific side of the project, the deliverables will include an assessment of the sub-loads within residential and small commercial properties, and the degree to which these are discretionary or deferrable. It will also evaluate the costs and benefits to a number of industry stakeholders, including National Grid, in developing such schemes. Finally, a number of recommendations will be produced as to the actions that can be taken in the UK that will promote or facilitate greater engagement by small consumers with DSM services[2].

An interim report will be available in October, which we believe will inform this consultation process. This will not be a publically available document, although it will be available to National Grid as a member of the UK team.

[1] A project overview is available at http://www.ieadsm.org/ViewTask.aspx?ID=16&Task=19&Sort=0
[2] Further information on the UK-specific work is available from Jen Carter (jen.carter@eatechnology.com or tel: 0151 347 2449) who is coordinating the UK team.

3.2 Competition in Procurement of Services from the Demand Side

Related Question: 10

EA Technology believes that distribution companies, suppliers and National Grid will value and may compete for demand side management (DSM) services. It is possible, but not certain, that aggregators will compete with suppliers and National Grid.

Clearly, reduction in demand is an alternative to increase in generation, although it should be noted that DSM also encompasses increasing and modulating demand to match the generation available at any particular time. Procuring DSM will be more attractive than procuring generation for both suppliers and National Grid, if DSM can be obtained at a lower unit cost than the cost of obtaining an increase or decrease in generation, whilst satisfying other parameters such as required notice period etc. There will therefore be a driver for competition between suppliers and National Grid, but this is no different in principle to the current potential competition in procuring generation, which is demonstrably well managed by current processes. In principle, these processes can be extended to demand[3].

Distribution Network Operator (DNO) companies, however, have different drivers for using DSM. The Electricity Distribution Price Control Review Initial Proposals, recently published by Ofgem[4], contain incentives to encourage DNOs to consider non-network solutions (including DSM) to solve capacity constraints, as an alternative to making capital investment in reinforcing the network.

There is a fundamental difference between the requirements of DNOs and those of suppliers and National Grid. A DNO requirement will be specifically localized to a particular network area, possibly restricted to an individual feeder, whereas the requirement of the suppliers and for the majority, if not all, of National Grid requirements is location agnostic within a BMU.

The competition between National Grid and suppliers is temporal and likely to be positively correlated. For example, National Grid may be unable to contract for services for maintaining operating margin because the provider has contracted with a supplier to provide

[3] As noted above, the possibilities for procuring of DSM services from small consumers in being considered as part of the work being undertaken as part of Task XIX of the International Energy Agency's Implementing Agreement on Demand Side Management. EA Technology is acting as Operating Agent for this Task and coordinating a Team looking at the specific opportunities within the UK. National Grid is represented within the UK team for this project.

[4] Available at http://www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/DPCR5/Pages/DPCR5.aspx

power during the required period. However, the requirements of both the supplier and National Grid are likely to be in the same direction. A possible problem for National Grid is that they may not have full visibility of forward contracts between suppliers and small generators or banks of load. National Grid will therefore lack visibility as to whether a reduced demand forecast is the consequence of the procurement of DSM services, for example, or a consequence of other factors.

The competition between a DNO and others is temporal and could be either positively or negatively correlated. For example, a DNO may be unable to contract for services to avoid a feeder overload because the provider has contracted with a supplier or National Grid to provide power during the required period. However, in this case, the DNO wishes to constrain generation or reduce load whereas National Grid or the Supplier wishes to dispatch generation or reduce load. The above examples serve to demonstrate that the potential competitive interactions, between a DNO and the other stakeholders, are likely to be more complex than those between the other stakeholders.

So who should take precedence in such a competitive situation? Logic would dictate that the DNO should take precedence, because the consequence of an overload is likely to be forced load (and generation) disconnection, which is not in the interest of any stakeholder. Market dynamics would dictate that the party who pays most gets the service, but firm forward contracts would prevent this. We believe that there are two possible solutions:

a) Forward contracts are not permitted and a “free-for-all” short time-scale market exists to trade services.
b) A framework of operating rules are developed which enable the DNO to take precedence when operational necessities require this to occur, with appropriate commercial settlement for the action, probably aggregated over a number of events and a reasonable period.

We suggest that the latter approach is more likely to deliver a reliable, workable solution.

We see aggregators as potential providers rather than competitors. In our view, the role of aggregators is to dispatch groups of small generators and / or loads, allowing smaller players to access the market. National Grid and Suppliers currently trade in larger units of power (or energy) than the size of the individual loads or generators which will increasingly be required to provide the services. Competition may occur if the units which are traded by suppliers and National Grid become sufficiently small for them to trade directly with those who are actually or potentially contracting with aggregators. It is unclear whether

aggregators would provide services for DNOs, as DNOs are likely to require control of a collection of small load and generation assets in specific locations. Perhaps a new role for a DNO is to act as an aggregator?

If continuity and quality of supply is given the same priority by customers in the future as it is now, then the first call on the components of the smart network must be to satisfy the need of the network operator to maintain continuity and quality of supply. The potential for other commercial and social forces to obstruct this first call will be very high if the assets DNOs are not given first call on those assets.

This raises further questions about how the potentially large number of relatively small demand and generation assets will be managed.

3.3 Operating the Networks

Related Question: 27

We agree with National Grid's view that there will be a requirement for increased balancing activity in the future. The estimates presented for forecast Net Imbalance Volume and its likely variability in the "Gone Green" Scenario are reasonable. However, this scenario has possibly underestimated the numbers of small generation units. Also, we note that the consultation identifies that, using the "Gone Green" scenario estimates, new providers are required for 56% of the increased balancing services requirement in 2020. We believe that it is unlikely that operators of large load or generation units will be able to satisfy this shortfall. Indeed, we assume that National Grid has already included a forecast of new units of this type in its analysis for 2020. Consequently, this shortfall must be satisfied by dispatch of a significantly larger number of smaller unit size assets.

We further believe that it is likely that balancing activities will be required over smaller regions of network than those represented by the fourteen grid supply points, which are currently taken as Balancing Mechanism Units.

Therefore, whilst we agree that the number of bid–offer pairs will increase, in reality the actual number of bid–offer pairs in 2020 is likely to be orders of magnitude higher than currently experienced, because the size of the trade represented by a typical bid–offer pair will need to be much smaller than now. This is the consequence of the two reasons described above:

- The typical unit size of physical assets will be much smaller than at present; and
- Balancing will be required within a larger number of smaller network units.

Both of these reasons can be further abstracted to the statement "*A typical Balancing System Unit in 2020 will be significantly smaller than it is today*."

Consequently, we believe that it is likely that there will be a step change in the level of complexity in managing the national system, due to a huge growth in the number and type of assets which will need to contribute to real-time energy balancing, together with a concomitant reduction in the typical size of those individual assets.

It is recognized that, whilst balancing to maintain system frequency within operational limits has a national (system wide) impact, balancing services that are procured have a local impact (most notably on voltage and thermal constraints). Therefore as the transmission

and distribution system evolves into one large active network, it will be important not to lose sight of local, as well as national, balancing issues. As the distribution system becomes more active, local network constraints must be taken into consideration when deploying Balancing Services. The complexity and size of the task ahead should not be underestimated.

3.3.1 Distribution System Operators – Delegation of responsibilities

Related Question: 29

We believe that there is a practical solution to this increased complexity. In our opinion, organizational theory and practical experience suggest that a structure of delegated authority and responsibility with strong and appropriate governance is the appropriate solution. We believe that the appropriate organizations to receive this delegated authority and responsibility are the DNOs and that the role of each of these organizations should evolve to become Distribution System Operators (DSOs).

In order for such delegated authority to function properly, it is essential that National Grid retains its role as National Electricity Transmission System Operator and the DSOs operate within a governance framework that is the responsibility of National Grid. In a manner similar to that deployed in many commercial organizations, we believe that responsibility should be delegated to the most effective level within the electricity system, whilst accountability is retained by all relevant parties (in this case, the Government, Ofgem, National Grid and the DSOs).

Our views can be summarized as follows:

- The current DNO role should be evolved into that of a Distribution *System* Operator (DSO).
- Some of the responsibilities of the NETSO should be cascaded to DSOs under revised licence conditions: based on the principle that responsibility within an organisation should be devolved to the most appropriate level to be effective, whilst all parties remain accountable for their contribution to the final outcome.
- Appropriate incentives are developed for the DSO that align the interests of the DNO/DSO and the National Electricity Transmission System Operator (NETSO). These could either be portions of the same incentive scheme or could be complementary incentives.

In practice, this would mean:

- The NETSO retains its licence obligation to maintain the UK system within statutory levels.
- The NETSO delegates responsibility for maintaining the networks on a regional level to the DSOs.
- DSOs are empowered to procure third party ancillary services (e.g. local generation and DSM) to balance their networks on a regional level. They interact with the NETSO within a defined governance framework to help balance the national system.
- DSOs are also empowered to adopt their own new technologies (e.g. energy storage) to balance the regional system.
- DSOs interests are aligned with those of the NETSO (and the country) through an appropriate incentive scheme.

4 Comments

We have endeavoured to ensure that our response to this consultation is a useful contribution to the process. We would welcome a discussion on any of the issues raised in further detail, if required. In the first instance, please contact Mike Lees (email: mike.lees@eatechnology.com or phone number: 0151 347 2309).