Operating the Electricity Transmission Networks in 2020

Follow Up Report

February 2010

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1 Introduction

1.1 National Grid's consultation 'Operating the Electricity Transmission Networks in 2020' was published in June 2009, with responses requested by 14th August 2009. Responses were received from 47 parties, 4 of which were marked confidential. Non-confidential responses have been published on National Grid's website[1].

1.2 This document sets out the work that National Grid is taking forward in this area. It also presents a brief summary of respondents' comments and anticipated next steps.

1.3 Since June 2009 we have been carrying out the design and development work needed to implement the first phases of the Electricity Networks Strategy Group (ENSG) Vision of network reinforcements along with the transmission companies in Scotland. Ofgem consulted on continued funding arrangements for this work in November[2].

1.4 Our work includes an assessment of the tools and techniques needed to operate the new network features we expect to emerge from this exercise, against the generation and demand background set out in the 'Gone Green' scenario. We have also updated 'Gone Green', in line with recent data and re-forecasts[3].

1.5 There are three pieces of work started by the UK Government since summer 2009 which we believe will prove helpful in the context of the work we need to do at National Grid on network operation issues. These are:

- DECC's call for evidence on Delivering Secure Low Carbon Electricity;
- Ofgem's Project Discovery; and
- DECC and Ofgem's Smart Metering Implementation Programme.

1.6 Each of these initiatives warrants constructive contributions from interested parties and we are conscious that the consultation exercise we initiated created further work. Our thanks go to those who responded.

1.7 In setting out our next steps in this document we have been mindful of the need for National Grid to take a lead role in appropriate areas. For example, we intend to lead in the development of Balancing Services (the energy or network related services specifically required for the economic and efficient operation of the transmission networks). There are other issues which are critical to us as operator of the transmission networks for which a broader approach would seem appropriate. The assessment of the wholesale market rewards for generation capacity is one example of this, and we would expect an exercise such as Ofgem's Project Discovery to tackle this question. We would of course expect to make a significant contribution to this debate.

1.8 We look forward to engaging further with respondents to our consultation, whether through specific one-to-one discussions or via the initiatives we set out further in this document.

[1] Response are available at: http://www.nationalgrid.com/uk/Electricity/Operating+in+2020/
[2] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=178&refer=Networks/Trans/ElecTransPolicy/tar
[3] The 'Gone Green 2009' 2020 generation mix was outlined at Ofgem's Project Discovery seminar: http://www.ofgem.gov.uk/MARKETS/WHLMKTS/DISCOVERY/Documents1/Alison%20Kay%20Project%20Discovery%20Nov09.pdf

2 Summary of Responses

2.1 Respondents generally welcomed the consultation report, and found the information and analysis presented within it to be useful. A number recommended that future analysis should be made more useful by looking at a wider range of scenarios. We intend to adopt this approach for our future work where we expect to be able to focus on fewer topics than in our initial consultation.

2.2 Many respondents highlighted that the long term prospects for investment in flexible electricity generation are uncertain, which could have a detrimental impact on National Grid's ability to operate the transmission networks.

2.3 We understand that there will be an opportunity to examine this issue in the context of wholesale markets as Ofgem's work on energy markets (Project Discovery) progresses.

2.4 We also think it is important that National Grid plays its part by giving a clearer indication of future Balancing Services requirements than it has in the past, due to the pace and extent of the anticipated change in requirements. We have therefore published our statement of Future Requirements for Balancing Services and will look to develop this further in the coming months. Respondents agreed that such a statement would be useful, with some describing it as an essential development. We also intend to review some of our Balancing Service definitions, and would expect this process to continue into the future.

2.5 There was a consensus amongst respondents that energy markets will become more complex over the next decade and that operation of energy networks will become more complex in turn. National Grid believes that it and the other network companies will need to invest in the control and information systems required to manage this complexity. Respondents to the consultation generally agreed with this position, with some highlighting the need to make sure that a clear case needs to be made for investment in control and information systems, a point that we acknowledge.

2.6 We stated in the consultation that we believed that wind generation output forecasting could be improved, thus reducing the volume of operating reserve we would otherwise need to ensure is available. A number of respondents pointed out that network operators in other countries already had significant experience of dealing with large amounts of wind generation, and that a variety of forecasting techniques are available.

2.7 We have been sharing our experiences with and learning from other transmission companies and are in the process of further developing our systems for wind generation output forecasting. We summarise the functionality we are introducing and the wider experience we have gained later in this document. We will also continue to work closely with the industry, in particular wind turbine manufacturers and developers, to ensure that any technical issues associated with the connection of large scale wind farms to the transmission system are identified and resolved.

2.8 We also highlighted our view that network and energy market conditions in northern Europe will impact on the operating margins we see within Great Britain. We think that European developments and issues will have an increasing impact on the energy markets in Great Britain. We are engaged in European electricity transmission forums in an effort both to understand the impact of European developments and where appropriate, to influence the debate from a UK perspective. Our involvement is outlined in this document.

2.9 Respondents to the consultation saw a positive and growing role for electricity consumers in providing energy, balancing and other network services. However, no clear consensus emerged over the possible volumes of such services, at what time these services will emerge in significant quantity, or the way that such services would fit into the current energy market structure.

2.10 We expect to observe more demand side participation in wholesale energy markets as generators and suppliers make decisions based on an assessment of the costs and risks of investing in consumer led actions compared to new generation. However we note that there is currently no clear route-map for the development of demand side services across the full generation, transmission, distribution and supply chain. Ofgem and DECC's 'Delivering Smart Meters'[4] programme should go some way to developing the thinking required to deliver a 'Smart Grid'.

2.11 We at National Grid intend to continue to work with service providers and aggregators to expand demand side service participation in Balancing Services and expect to contribute fully to Ofgem and DECC's programme. We are also working with the Energy Networks Association to explore the inter-network issues around demand side services.

2.12 A wide range of issues were raised within the consultation responses. These are discussed further in the Appendix to this report.

[4] Information on 'Developing a UK Smart Grid' and 'Delivering Smart Meters' is available at:
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/network/smart_grid/smart_grid.aspx
http://www.ofgem.gov.uk/e-serve/sm/Pages/sm.aspx

3 National Grid's Work

3.1 This section sets out the key areas of work that National Grid is engaged in to address the challenges of 'Operating the Transmission Networks in 2020' as set out in our consultation document and the responses made to it.

3.2 Firstly, we describe our statement of Future Requirements for Balancing Services which we have produced recognising our role in identifying the need for new services and new providers. We also outline our intended approach to the development of relevant Balancing Services and how we propose to get interested parties involved.

3.3 We then describe our current work in the area of wind generation output forecasting which is critical to the secure and economic operation of the transmission networks as wind generation capacity grows.

3.4 Our involvement in European electricity transmission forums is also described in an effort to give some clarity to the wide and sometimes confusing range of European initiatives.

3.5 Finally, we outline how we intend to communicate our plans for the development of the control and information systems we use in our control centre in preparation for the operational challenges ahead.

Future Balancing Services Requirements

Statement of Requirements

3.6 The analysis presented in the consultation document illustrated the impact that changes in the electricity supply industry are likely to have on the requirements for Balancing Services within Great Britain. This showed a significant upward trend in the requirement for reserve services and we are therefore keen to explore the potential for new providers, and new technologies, to provide Balancing Services in the future.

3.7 We therefore thought it would be useful to present a regularly updated view of our forecast Balancing Services requirements as this could better inform future potential providers. Respondents to our consultation were in agreement with this and we published our first statements in January 2010[5]

3.8 Initially, we will focus on positive and negative reserve requirements as well as frequency response requirements. These reports will explain the characteristics and trends in these requirements over the coming years, including a discussion of how requirements under a 'gone green' scenario and 'business as usual' scenario differ.

3.9 We will also publish a set of spreadsheet models that will contain these forecasts of requirements on a per year basis to allow interested parties to perform their own analysis based on our forecasts.

3.10 We intend to report on the service volumes we have contracted for, and in due course, the average prices paid.

[5] The Future Requirements statements are available under 'Balancing Services', 'Services on the National Grid website : http://www.nationalgrid.com/uk/Electricity/Balancing/services/FutureRequirements/

Updates

3.11 We plan to update the requirements reports (and models) on an annual basis in November. During the first year we will update the reports in April, taking any industry feedback into account.

Balancing Services Development

3.12 Our current view is that reserve requirements will rise over the next decade as more wind generation is installed and larger generating units connect (subject to the Authority's decision on the Security and Quality of Supply Standard review request GSR006).

3.13 The forecast of an increasing reserve requirement also needs to be viewed against a rapidly evolving market for reserve products which National Grid currently believes will be characterised by:

- Older Power Stations closing as they reach the end of their operational lives (and use up their hours under the Large Combustion Plant Directive), which have historically contributed significantly through the provision of Open Cycle Gas Turbines (OCGTs) at those Power Stations; and
- A much greater dependence on sources of Reserve provided outside of the Balancing Mechanism – e.g. from smaller embedded generating units or by demand side management.

Ongoing Contract Development Work

3.14 National Grid continues to progress a number of areas of workt to stimulate the levels of reserve and response that may be available through new and innovative services and terms. These are described below.

Dynamic Demand Management

3.15 We have been working closely potential providers to develop an innovative service to provide response through the aggregation of multiple demand sites, despatched probabilistically. The service is based on the concept that a Grid Code equivalent response service can be delivered by using demand triggered uniformly across a number of sites where no single site is despatched more frequently than any other, thus minimising the impact on the processes underlying the demand.

Aggregation

3.16 We have been working with a number of new entrants into the aggregator market. This has culminated with these parties becoming active within the STOR tender process. With a larger pool of potential aggregators National Grid is stimulating competition within this market and hopes the services offered by an expanding pool of aggregators will maximise entry into the STOR market thus facilitating competition.

Analysis of new technologies

3.17 National Grid has been undertaking its own preliminary analysis into the economics of potential new sources of reserve and response from storage technologies such as batteries, flywheels and Compressed Air Energy Storage

(CAES). The aim is examine whether these sources might be able to offer a long-term cost-effective provision of services.

Electric Vehicles

3.18 We are currently investigating the ability of Electric Vehicles to offer Balancing Services and how the costs and technical capabilities of vehicle batteries would affect the costs of such services.

Raising Awareness

3.19 National Grid continues to raise awareness of the revenue opportunities available for new providers in the provision of Balancing Services. Such platforms include representation at the Demand Side Working Group, holding Balancing Services open days and exhibiting at the Energy Event.

Future Reserve Service Initiatives

3.20 We are developing our thoughts regarding the potential for the provision of future reserve services which we would like to discuss with interested parties.

3.21 We intend to discuss our thoughts with the industry in greater detail both through consultation and through industry workshops to examine the various potential future sources of reserve and response.

3.22 The topics we wish to address in the Future Reserve Review would broadly sit within 2 workstreams and are:

- **Workstream 1: Optimisation of Existing Reserve Services**
  - **STOR Contract Form and Service -** adapting the STOR contract form could enable greater participation in the STOR service from providers that cannot meet the existing contractual requirements (minimum of 3MW, delivery in timescales between 0 and 240 mins, and sustained delivery for a minimum of 2 hours). Two approaches that could help facilitate greater involvement in providing a STOR-type service are:
    - **Hybrid Service** - National Grid currently places most value on reserve that is able to be despatched quickly in response to an unexpected shortfall in energy. Reserve that is slower to respond is still of use. It needs to be instructed earlier, but then allows faster acting providers to be 'pulled back' to create reserve. Longer notice reserve might be useful when aggregated with other quicker sources of reserve that perhaps cannot be sustained for the STOR minimum requirement of 2 hours. It could be envisaged that a unit that can provide energy say within 10 minutes, but sustain it for no longer than 45 minutes could be combined with a similar sized unit that can output after 45 minutes and sustain itself for 75 minutes. Whether this aggregation is something that could be taken forward by aggregators, or by National Grid centrally is a point for debate. This concept is illustrated in the diagram below.

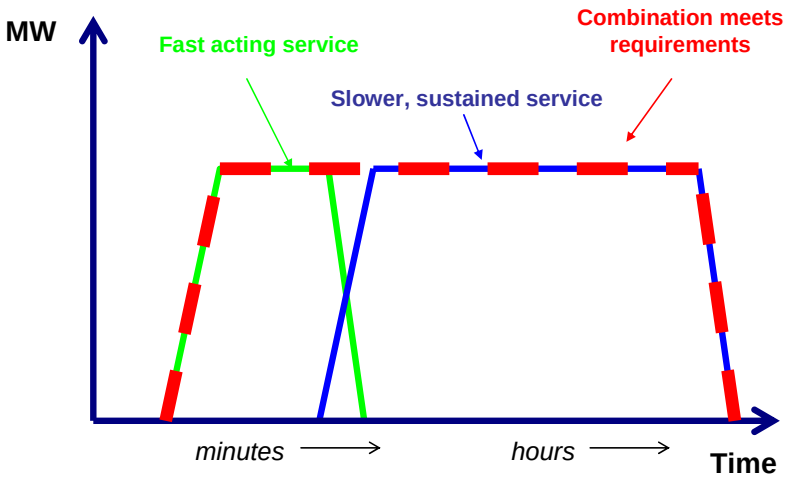

Figure 1: Example 'Hybrid' Reserve Service

- **Flexible Reserve Product -** greater volumes of reserve might be able to be made available over the core hours 8am – 6pm, Monday to Friday rather than the existing Working Day / Non-Working Day structure and availability windows. Similar areas of flexibility could be identified which may encourage a greater pool of reserve providers to participate in the reserve market. While the services that they are able to offer may not be as valuable as a 'full' STOR service, they may still be able to contribute to the overall while still able to secure sufficient revenue for the service they are offering.

The above concepts, along with others, are subject to more detailed consideration by National Grid and we intend to issue further more detailed proposals in this area in the second quarter of 2010.

- **BM Start-Up -** National Grid is currently undertaking an internal review of the BM Start-Up service and is looking at ways in which it might make the service more effective at delivering additional reserve into the Balancing Mechanism. Our current focus is upon examining whether greater transparency can be brought into the service through improving information provision and also whether there are aspects of the service that could usefully be clarified.

- **Workstream 2: Long-Term Reserve Development:**

  - **'Universal' Reserve Product Development -** a key question looking into the longer term is whether the existing approach to reserve procurement with individual products being tailored to certain plant types or operating characteristics will remain appropriate. It could be better to move to a consolidated reserve product that can be offered by a variety of different reserve providers, but where the product still offers the flexibility and service characteristics necessary for efficient, economic and secure operation of the National Electricity Transmission System.

- **Negative Reserve from Renewables -** one aspect of the Renewables Obligation Certificate (ROC) regime, that ROCs are issued for energy output, suggests that renewable generators will have a strong incentive to run at maximum possible output in all but extreme market conditions, unless a payment is made to compensate all affected parties for the loss of or risk of loss of the ROC. This is particularly relevant at times of low demand, when 'negative reserve' is required. Work could be done to further explore provision of reserve from renewable sources.

- **Smart Meters -** smart metering could offer an alternative to existing forms of reserve by providing access to consumer led services. The development of potential services that could be provided by smart metering is another area that needs to be explored especially when it comes to understanding who (wholesale markets, Balancing Services for transmission network operation, or distribution network services) will have access to the demand turndown. It is likely that the bulk of developments in the area of smart metering will be explored by workstreams outside of the National Grid initiated Reserve Review, however the consequences of smart metering developments on the procurement of Balancing Services will of course need to be considered.

Way Forward

3.23 National Grid intends to consider further the issues surrounding the procurement of reserve in the period up to 2020 and beyond over the coming months. Our current intention is to engage the industry in the second quarter of 2010, when we will issue our more detailed thoughts and initial proposals through consultation and associated workshops.

3.24 Should readers of this document wish to contact National Grid to discuss any of these elements in greater detail they should in the first instance contact Mark Duffield on 01926 654971.

Wind Generation Output Forecasting Development

3.25 In our consultation document, we made a direct linkage between our ability to foresee wind generation output and the amount of Short Term Operating Reserve we need to ensure is available. There are two elements to this, firstly National Grid's ability to predict the absolute level of wind generation output including, perhaps more importantly, the level of uncertainty around this, and the quality of the operational information submitted by wind generation operators.

3.26 Our work on Wind Power Forecasting is described below followed by a description of the work being undertaken by the Grid Code Working Group on ''BM Unit Data Provided by Intermittent Generation'.

Wind Power Forecasting

3.27 As the amount of wind generation capacity influencing the transmission system has grown, we have developed and adapted our operational procedures in two areas:

- To provide forecast wind generation output data to supplement operational information provided by generators; and
- To adapt our operating reserve such that we target any additional reserve required to cater for wind generation output uncertainty at the correct periods.

3.28 Work continues on developing our 'dynamic reserve for wind' processes, and we are considering ways of better reflecting varying wind forecast uncertainty into our reserve requirements. We have also embarked on a significant project which will improve the way that wind generation forecasts are integrated into our operational systems. The functionality we are working to build into the 'Wind Power Forecasting System (WPFS)' is described below.

The Wind Power Forecasting System (WPFS)

3.29 We currently use a combination of physical modelling (essentially a wind turbine power output curve matched to a wind speed forecast) and persistence methods to supplement the operational data we receive and produce a wind power output forecast over a range of timescales. The 'Wind Power Forecasting System' will improve this process by:

- Making use of multiple forecast methods such as:
  - An Artificial Neural Network[6], 'trained' using historical wind and generation output data;
  - A Linear Regression Model which can optimize established relationships between generation output and wind speed to produce forecasts;
  - A physical wind turbine model which makes use of a turbine type specific wind turbine power output curve and wind speed forecast to produce a generation output forecast; and
  - A time series model to extrapolate from recent behaviour.
- Allowing multiple ensemble wind forecasts (which can reflect the degree of weather forecast uncertainty) to be accessed;
- Performance Measurement by comparing metered outputs with forecasts to help select the most appropriate forecast method;
- Wind direction effect modelling using a probabilistic model.

3.30 The WPFS is expected to be commissioned in late 2010.

Output Forecasts from Generators and Suppliers – 'Physical Notification'

3.31 National Grid's management of the short term balance between supply and demand and power flows across critical system boundaries relies on forecasts of Generator output and the ability to vary that output through the acceptance of Bids and Offers in the Balancing Mechanism. The actions taken to achieve these objectives are determined using the data provided by Generators and Suppliers under BC1 and BC2 of the Grid Code. This data includes expected output, limits on output, and parameters defining the cost and ability to move from one output level to another. The accuracy of this data is critical in ensuring that the actions taken by National Grid deliver economic and efficient operation of the transmission system.

[6] This is model is based on ISET's Wind Power Management System (WPMS), developed for used on the German transmission network, and not to be confused with the term 'WPFS' which describes the overall tool

3.32 The existing data requirements were established when virtually all generating units were powered by fully controllable energy sources. Since then the capacity of generating units powered by less controllable sources, primarily wind, has increased significantly and will continue to do so. Some Generators have indicated that this is hindering their ability to submit data and actively participate in the Balancing Mechanism.

3.33 The 'Physical Notifications (PNs) from Intermittent Generation' working group is therefore considering:

- How the current arrangements could be amended to facilitate information provision by intermittent generation;
- If changes are required to reflect the uncontrollability of the primary source of power;
- The effect on system operation of 'inaccuracies in Supplier data' due to increasing levels of embedded intermittent generation; and
- National Grid and the Generators' understanding of Output Useable for intermittent generation and whether additional data is required.

3.34 The full terms of reference and working documents are available on National Grid's website under Grid Code Working Groups[7].

Working in Europe

3.35 In our consultation document, we expressed the view that wider European Issues need to be considered when assessing electricity operating margin issues for Great Britain. Respondents generally concurred with this view, with some also making the point that National Grid should be making the most of continental experience of intermittent generation.

3.36 National Grid is actively involved in a number of European forums which gives us access to continental knowledge and experience of renewable generation and also allows us to feed British network experience, alongside our network and regulatory counterparts, into the development of pan-European regulatory frameworks and technical rules.

3.37 Many of these forums are changing and developing under the terms of the European Union 3rd Energy Package. The package incorporates the ambition of introducing European wide network codes to facilitate wider market integration. For the electricity transmission sector, these codes will be developed by ENTSO-E (the European Network of Transmission System Operators for Electricity) under framework guidelines developed by ACER (Agency for the Co-operation of Energy Regulators). ENTSO-E's work is outlined below.

3.38 We have also contributed to EWIS (European Wind Integration Study), the European Commission sponsored study undertaken by the European transmission companies with the aim of developing common European solutions for integrating wind generation. We have continued our involvement in ERGEG (European Regulators Group for Electricity and Gas) regional initiatives as well, and have taken a one third stake in 'CORESO' which provides daily network assessments to the transmission companies in France and Belgium and interconnected parties. These are also described further below.

[7] Grid Code working group documents are available at: http://www.nationalgrid.com/uk/Electricity/Codes/gridcode/workinggroups/

European Wind Integration Study (EWIS)

3.39 The aim of the EWIS project is to look at how best to accommodate wind generation on a large scale and so meet European targets. Transmission companies (15 in total) from 13 countries have contributed.

3.40 The study is intended to take a Europe wide view of the immediate challenges of wind integration and those that will emerge by the middle of the next decade. This means going beyond the plans and analysis undertaken by individual transmission companies and examining the effect of, for example, windy conditions in Germany on flows observed in the Italian network.

3.41 In summary, the objectives of EWIS are:

- to address the network issues arising from wind power;
- to develop proposals for:
  - Minimising barriers to accommodating wind;
  - Optimising industry costs; while
  - Managing supply security and reliability;
- leading to recommendations for:
  - Technical compatibility;
  - Network Operation;
  - Network development; and
  - Market, regulation and commercial regime changes.

3.42 The project is nearing conclusion with a final report expected in the next few months. The interim report[8] is available on the EWIS web site in the downloads section.

The European Network of Transmission System Operators for Electricity (ENTSO-E)

Background

3.43 ENTSO-E was established under the EU 3rd Energy Package as approved by the European Parliament and the Council, in April and June 2009 respectively. In practice, ENTSO-E started work early, after its foundation in December 2008.

3.44 The objective of ENSTO-E is to strengthen Transmission System Operator (TSO) cooperation, in areas such as the development of technical and market-related network codes and the coordination of grid and market development and system operations, with the aims of:

- enhancing the integration of the European electricity market;
- contributing to a sustainable energy environment; and
- ensuring secure and reliable operation of the European power transmission system.

3.45 There are currently 42 TSOs from 34 countries represented within ENTSO-E.

3.46 ENTSO-E is organised in terms of a General Assembly, a Board, a Legal and Regulatory Group, Expert Groups and three committee:

- System Operation;

[8] http://www.wind-integration.eu/downloads/library/EWIS-Interim-Report.pdf

- System Development; and
- Markets.

3.47 This structure is illustrated on the ENTSO-E website[9].

Work Programme

3.48 ENTSO-E first released its work programme[10] for consultation in September 2009. Planned work falls under three headings:

- **Pilot code** – ENTSO-E have been asked to develop European rules harmonizing grid code requirements for wind generation as a priority (a recommendation emerging from the EWIS study). This recommendation has been adopted as a pilot exercise to trial and demonstrate ENTSO-E's processes in developing frameworks and codes for application across Europe. Three potential areas of benefit have been identified:
  - Common standards will facilitate adoption of best practice, thereby enabling achievement of policy goals;
  - Manufacturers and developers of wind turbine generators will benefit from a greater degree of standardisation of equipment requirements, connection design and commissioning procedures for example; and
  - Harmonisation of grid code structures and technical content will increase transparency.
- **Other Priority code areas** – the 2009/10 network code development priorities include Transparency, Design for Market Integration and System Operation Codes (including load flow managements, balancing tools and ancillary services and co-ordination procedures).
- **Further Key Areas of TSO Co-operation** - a number of activities fall under this category, with perhaps the most notable being the Ten-Year Network Development Plan (TYNDP), intended to identify capacity gaps and bottlenecks on a pan-European basis. The first release of the TYNDP is intended to be ready to go to public consultation in March 2010, with publication of the final report in June 2010.

ERGEG Regional Initiatives

3.49 The France-UK-Ireland Regional Initiative[11] has overseen a number of developments, most notably:

- the introduction of the new Capacity Managements System (CMS) under a joint project between NGIL (National Grid Interconnections Limited) and Réseau de Transport d'Electricité (RTE) for the interconnector between England and France (IFA); and
- the introduction of Cross Border Balancing (CBB), also across the IFA interconnection, the interim stage of which was introduced in March 2009.

[9] The ENTSO-E governance structure can be viewed at: http://www.entsoe.eu/index.php?id=16
[10] The work programme is available at: http://www.entsoe.eu/fileadmin/user_upload/_library/Key_Documents/091222_ENTSOE_overall_work_program_final.pdf
[11] More information on the ERGEG Regional Initiatives for France-UK-Ireland is available at: http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_INITIATIVES/ERI/France-UK-Ireland

CORESO

3.50 The first European regional technical co-ordination centre was incorporated by RTE and Elia, the French and Belgian TSOs, on December 19th 2008 with the formation of a new company, CORESO (Co-ordination of Electricity System Operators).

3.51 The first phase of operations started in Brussels on February 16th, with integrated grid security forecasts supplied to the national control centres. National Grid took a one third stake in CORESO on May 15th 2009.

Control System Development

3.52 The consultation document explored how National Grid's control processes and systems could be affected by:

- the impact of intermittent generation on energy balancing and network management processes; and
- the need to deliver value from the transmission networks, which are themselves growing to accommodate new generation connections.

3.53 Respondents to the consultation were generally in agreement that National Grid's processes would need to change, with many seeing a requirement for increased automation. A number of respondents cautioned against an over-reliance on automated control systems in situations where adequate manual back-up processes could not be put in place. A number of respondents also sought assurance that a specific need case would be identified for individual developments.

3.54 As previously discussed, a National Grid project is underway to replace our existing in house system which supports our Balancing Mechanism operations. This project is currently in the tender assessment stage. Our intention is to replace our present system with a package based solution which will provide a more reliable, higher availability system that is also more flexible such that it can be developed to manage the transmission system with a generation mix with similar features to 'Gone Green' by 2020. An update on the project was provided to the Operational Forum in August 2009[12].

3.55 Currently, we are also exploring developments that may be needed to our network control systems. These are required to support the ongoing efficient operation of the transmission network as two fundamental changes take place as the 'gone green' scenario unfolds. The first is the increased variability of power flows from day to day and within day as the relative output of renewable, and hence conventional, power stations varies as weather conditions change. This will significantly increase the number and complexity of the assessments made by planning and control staff to identify the most secure and efficient operating arrangements.

3.56 The second change relates to the transmission technology that will need to be deployed in order to deliver the increase in power flows that result from large amounts of renewable generation, and later nuclear generation, located remotely from the centres of demand. These technologies may include:

[12] http://www.nationalgrid.com/uk/Electricity/Balancing/operationalforum/2009/

- High Voltage Direct Current (HVDC) operating in parallel to the AC transmission system;
- Series Compensators (devices which reduce the apparent impedance of a circuit thus increasing transfer capability where this is limited by system stability); and
- fast acting co-ordinated Quadrature Boosters (devices that balance power flows across neighbouring circuits).

3.57 Many of these requirements stem from the developments envisaged by the Electricity Networks Strategy Group (ENSG) and therefore our work on control systems is closely linked to the preliminary design work associated with the ENSG's findings. We are also taking forward more general developments, such as improvements in real-time data visualisation, which have the potential to allow more complex situations to be managed effectively.

3.58 This exercise will include an evaluation of the risks and consequences of control system failures and how this could impact on the security and quality of supply to customers.

3.59 We expect to provide regular updates on further control systems developments through the Operational Forum, where we expect to receive some feedback on our plans. We also anticipate a process of review and consultation covering our control system developments as part of a wider business plan review in the next Transmission Price Control Review (TPCR5). Until this is complete, we will proceed under the funding arrangements set out in TCPR4 which run until the end of 2011/12, but are likely to extend to 2012/13 following Ofgem's decision to delay TPCR5[13].

[13] Decision on the Approach and timetable options for the next Transmission Price Control Review (TPCR5) http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=11&refer=Networks/Trans/PriceControls/TPCR5

4 Next Steps

4.1 The previous section sets out key work areas we are taking forward to address the challenges presented by Operating the Electricity Transmission Networks in 2020:

- Identifying long term Balancing Services requirements – the first statement was published in January 2010 we are keen to receive feedback on future form and content. We think it is important to encapsulate our view of future requirements within a regularly updated statement and favour this approach over ad hoc consultation where possible. We intend to use our first statement as a platform for future development.
- Developing our Balancing Services – we will initiate working groups to review and recommend changes where necessary in early 2010 and will be seeking working group members to contribute;
- Wind Generation Output Forecasting - we will provide updates on wind generation forecasting issues using our regular Operational Forum[14];
- Europe Frameworks– we will provide updates relevant to electricity transmission users as necessary using our regular Operational Forum and User Seminar[15] as well as to industry code panels as necessary; and
- Control System Development – we will continue to develop our plans and will provide updates as necessary at our regular Operational Forum.

4.2 These activities will complement the government's policy development for future energy issues under both DECC's Low Carbon Transition Plan and Ofgem's Project Discovery. The Smart Meter roll-out programme will also provide some clarity as to the extent that future consumers will interact with a 'Smart Grid'. New Transmission Access arrangements will also need to be factored into our considerations in due course.

4.3 We are also interested in meeting with individual respondents to our consultation. There is a wide range of topics which could usefully be discussed. However, we think there is value on focussing on three key areas in which we would welcome dialogue:

1) Future sources of flexible electricity generation and storage;
2) The potential for and impact of demand side services; and
3) Operational and control issues at the distribution and generation interface.

4.4 Following on from these discussions, and subject to government policy development in the areas mentioned above, we intend to take stock of developments in late spring, at which point we will publicise our communications and engagement plans in this area using our regular Operational Forum.

[14] Operational Forum dates, agendas and presentation material is available at: http://www.nationalgrid.com/uk/Electricity/Balancing/operationalforum/
[15] User Seminar dates, agendas and presentation material is available at: http://www.nationalgrid.com/uk/Electricity/GettingConnected/gb_agreements/seminars/

Appendix Questions and Responses

Section 5: Developments in Electricity Generation and Demand

Question 1: How do National Grid's observations align with your experience or modelling of wind generation?

The majority of the respondents who replied to this question stated that National Grid's observations aligned well with their own experience. A number of respondents pointed out that wind generation output could be forecast more accurately than was possible using the 'persistence' concepts uses to illustrate wind forecasting issues within the consultation document and that a wide range of wind forecasting experience was already present in Europe. Three respondents stated that National Grid's wind forecasting performance targets were optimistic.

One respondent commented that wind generation output forecast error could be more accurately represented using a Laplace distribution rather than the Normal distribution traditionally used in reserve calculations, a point that we agree with.

National Grid's wind generation output forecasting developments are described in greater detail earlier in this document. These make use of European operational experience and we will continue to liase with our counterparts in future developments.

Question 2: Are we correct in assuming that wind generation is controllable enough to assist in operating the networks?

Most respondents stated that wind generation was likely to be controllable but that they did not see clear economic drivers to encourage this. Some made the point that the ROCs mechanism actively discouraged flexibility. Others also highlighted the increased 'wear and tear' caused by flexible operation.

One respondent highlighted advances in wind turbine design that could also prove valuable, such as the provision of 'synthetic inertia' from power electronics systems.

Our recent experience has highlighted that wind farm operators view flexible operation as a low priority. This position is understandable at the present time given the relatively low level of installed wind generation capacity, the perceived infrequent need for flexibility from wind generation, and rewards they currently receive based on maximising generated output at all times.

However flexible operation will inevitably be required from some windfarm operators at some point in the future, increasingly so as installed capacity grows. Ultimately, wholesale and imbalance prices should encourage flexible operation particularly where high wind generation output coincides with low demand periods.

We will continue to monitor the prospects for flexible operation from wind generation and take action to encourage this where required. We also hope to

gain more experience of using frequency response services from wind generation as this the amount of wind generation grows.

In addition, we are assessing the need for 'synthetic inertia' (required to mitigate the possible reduction in system inertia, the property which slows down frequency changes, as power electronic systems become more prevalent) and plan to discuss any requirements with industry parties in the near future.

Question 3: Should National Grid assume that Supercritical Coal generators will provide some flexibility in operation which will assist in operating the networks?

Most respondents stated that limited flexibility in Supercritical Coal operation should be anticipated, subject to economics.

For now, it would seem reasonable to assume for energy and network modelling purposes, that any new Supercritical Coal generators would concentrate on base-load operation, with regimed running during lower demand periods (ie weekend shutdown or summer cold) rather than daily start-up and shutdown cycles. However, we would expect to see technical solutions brought forward which facilitate more flexible operation from Supercritical Coal generators if energy markets signalled a requirement for this.

Question 4: Should we assume that Nuclear generators will continue to concentrate on base-load operation?

Most respondents concurred with this assumption although some highlighted the more flexible operating regimes currently followed in other countries. One respondent stated that it was important that nuclear generation was not given priority over renewable generation because of its inflexibility.

We will continue to assume that Nuclear generators will concentrate on baseload operation for the foreseeable future but understand that more flexible operation is possible. We also expect future nuclear generators to be capable of providing Balancing Services in accordance with the technical requirements that apply to all generation technologies as set out in the Grid Code.

Question 5: Is it likely that Carbon Capture plant will impose material restrictions on the operation of electricity generating plant?

Respondents stated that it was difficult to comment on this question given the lack of practical experience in this area. However, most stated that some restriction should be assumed. One respondent highlighted that the need to make new CCGTs 'carbon capture ready' could mean less CCGT capacity would be constructed, meaning that essential flexibility was not present in the 2020 plant mix.

We are likely to assume similar operating regimes for Carbon Capture equipped plant as we assume for Supercritical Coal (indeed it may be the same generation). Again, we would expect to see more flexible operating regimes develop if the necessary economic signals were present.

Question 6: Are there other aspects of tidal or marine technologies that we should consider further at this stage?

One respondent stated that the impact of predictable but varying output warranted further consideration whilst one other pointed out that the diversity presented by multiple tidal installations could mitigate the impact.

Another stated that the combination of wind and tidal variations would result in extremely challenging operating regimes for fossil-fuelled plant and put pressure on prices. Therefore the development of 'must-run' generation should be considered alongside demand side measures.

We will continue to monitor the development of tidal and marine technologies in tandem with intermittent sources of generation to gauge at what point tidal or marine technologies will become operationally significant.

Question 7: Are there other restrictions we should consider in developing a view on gas fired generator flexibility?

A number of respondents commented that operating more flexibly will impact on the costs of operating gas fired generation and that gas supply issues need to be considered as well.

Respondents also commented that reducing load factors would fundamentally change the economics of gas fired generation. Another respondent stated that National Grid should consider how it needed CCGTs to perform as different designs have different characteristics and capabilities.

We note the points raised on the costs of operating gas fired generation and on the different characteristics of different gas fired generation. These will be considered when developing our assumptions for future analysis. We are continuing to assess the impact of increasing variation in gas off-take triggered by flexible operation of CCGTs on the gas network.

Question 8: What is your view of future electricity demand growth and how would you quantify any uncertainty around this?

Respondents expressed a range of opinions on our demand growth projections, evenly balanced between too high, too low and about right. Many suggested that the only reasonable way to view electricity demand growth was by using a number of scenarios. No respondents attempted to quantify the uncertainty around demand growth.

National Grid's forecasts of electricity (and gas) demand are now published in a number of forums (Winter and Summer Outlook Reports, Seven Year Statement, Transporting Britain's Energy) and include a number of different and scenarios and views as well as an opportunity for interested parties to comment.

Question 9: Are there other developments which will change the way that electricity will be consumed in 2020 that we should consider?

A number of respondents suggested that the adoption of heat pumps will have a more significant impact on demand growth than assumed. Others highlighted the potential impact of smart meters whilst cautioning on the degree of consumer engagement that should be assumed.

We will update our view of electricity consumption patterns as more information becomes available on the likely uptake of appliances such as heat pumps and the roll-out rate of smart meters.

Question 10: Do you share our view that distribution companies, suppliers, aggregators and ourselves will all value and compete for demand side services?

A number of respondents chose to emphasise that distribution network operators have a role in providing or an interest in demand side services. Many respondents however were unclear on the market mechanism to deliver demand side services. Two respondents saw suppliers and their customers offering demand side services within current wholesale market arrangements.

We recognise the need for distribution network operators to be involved in the development of demand side services for transmission network purposes and recognise that they may have a role in delivering these. Any assumptions made over demand side management need to take into account the competing markets for such services. We believe however that the strongest driver for demand side services could come from the wholesale energy markets as choices are made over investment in new generation, or demand side alternatives.

Whilst some uncertainty exists over wider demand side services, National Grid intends to continue in its efforts to expand demand side involvement in the provision of Balancing Services.

Question 11: Are our assumptions around the number of electric vehicles in 2020 reasonable?

A number of respondents stated these assumptions were reasonable whilst others stated the assumed number of vehicles was too high. No respondents stated the number of vehicles assumed was too low. One respondent also highlighted that distribution losses need to be factored into electric vehicle charging load models.

We see electrification of transport as a key development towards meeting carbon emission reduction targets and therefore see significant potential for growth in electric vehicle numbers. We acknowledge however that the rate and extent of electric vehicle uptake is still subject to great uncertainty.

Question 12: Is it valid to assume that electric vehicle charging will be co-ordinated via a smart grid or something similar and will react to price signals?

Respondents generally agreed with this assumption whilst cautioning that the development of co-ordinated charging should not be taken for granted. One respondent objected to the industry's ability to dictate vehicle charging times via a smart grid.

We continue to believe that co-ordination of electric vehicle charging, via a ‘smart grid’ or a similar concept is necessary. The full potential for reducing carbon dioxide emissions by switching to electric vehicles is unlikely to be delivered unless the bulk of vehicle charging can be matched with the periods where the rate of carbon emission from electricity generation is at its lowest.

Question 13: Do you foresee a greater or lesser role from embedded and distributed generation than we have assumed?

A mixture of responses were given to this question, again suggesting that a number of scenarios need to be examined in future analysis.

Section 6: Reserve and Operating Margin

Question 14: Is our anticipated improvement in wind forecasting performance at 4 hours ahead achievable?

Most respondents stated that improved wind generation forecasting was achievable. A minority suggested that forecasting performance would not improve.

One respondent suggested that a better solution was to integrate storage technologies with renewable generation whilst a further respondent questioned the basis of the 6% target.

We set out our planned developments in wind generation forecasting earlier in this document and intend to continue our dialogue over wind forecasting performance in the future.

Question 15: Do you have any views on our projected Short Term Operating Reserve requirement under 'Gone Green'?

Respondents were in general agreement over the upward trend of reserve requirements. One respondent commented that they seemed lower than expected.

A number of respondents commented that further analysis would be useful, including a view of zonal effects, incremental carbon emissions and more detail on costs. One party asked to see sensitivities around assumptions made.

The Short Term Operating Reserve Requirement is a key driver of activity for National Grid and of costs to the industry. We intend to publish our updated forecasts within our statement of Future Requirements for Balancing Services.

Question 16: Do you have any views on our projected volumes, prices and costs for STORR under 'Gone Green'?

A majority of the respondents who expressed a view suggested that prices would be higher than assumed. A number stated that prices needed to rise to attract more reserve providers. Another suggested that as the volume of reserve required grew, prices would inevitably rise as more marginal providers were used.

One party asked whether economies of scale could be achieved, as larger volumes of reserve were required. Another respondent also pointed out that there were many variables in this evaluation and significant uncertainty over how much reserve would be provided by market players, and how much would have to be procured by National Grid.

One party also questioned the basis of the reserve cost calculation, stating that the projected cost in 2020 of a reserve volume of 7.4TWh, based on an average

price of 99 £/MWh (derived from 2010/11 forecast costs), should be £732m rather than the £566m quoted.

We accept the majority view that prices in the future will be higher than presented. We did not attempt to predict the rate of reserve price growth for this analysis as we did not believe we could make a meaningful forecast of price. We think it is unlikely that economies of scale in reserve procurement will drive prices down but do believe that broadening the range of reserve providers can provide some price rise mitigation.

We note also the query raised over projected costs based on the extrapolation of averages. Our model derives two costs, one of which represents 'on the day' costs using different prices for different service provider types, the second of which represents up-front contracted services, for which a calculated average price would change depending on the volume used. We believe this method is potentially more accurate than extrapolating average costs, although the simpler method is easier to communicate and can give a valid view over the longer term.

We intend to capture our future requirements for short term operating reserve within our statement of Future Requirements for Balancing Services which will develop in consultation with interested parties.

Question 17: Is National Grid's current view that 'low wind' events across Great Britain need to be considered when evaluating electricity operating margins reasonable?

Respondents were in agreement with this statement. Some took the opportunity to emphasise that although 'low wind' events should be considered, this should not be confused with 'low wind' being the norm during peak demand periods.

Other respondents also highlighted that 'low wind' events would be forecast a number of days ahead, allowing time to prepare.

Care needs to be taken with the terminology used to describe events which have a low frequency of occurrence (and by definition a lower frequency of coincidence with times of peak demand) but are almost certain to occur at some point over the periods we need to consider (such as an entire year or number of winters). Our experience is that periods of high atmospheric pressure, meaning low temperatures (and hence high energy demands) and low winds, do occur between December and January in most if not all years.

National Grid in its System Operator role needs to be able to derive requirements for Balancing Services. To do this, we need statistical models of wind generation which in practical terms means choosing an appropriate distribution curve to represent forecast errors and applying parameters derived from measured data (eg mean, standard deviation).

A single 'capacity credit' figure for wind generation does not emerge as a by-product of this process therefore we do not intend to make a definitive statement on an appropriate generalised capacity credit figure for wind. We can however monitor the progress of this debate and produce views of future operating margins which illustrate outcomes for varying levels of wind 'capacity credit'.

Question 18: Are our generator availability assumptions reasonable for application to analysis of future operating margins?

A number of comments were provided which suggested some adjustments to the availability assumptions used could be considered. One respondent commented that these should include an element of uncertainty.

We will continue to keep our generator availability assumptions under review for future analysis.

Question 19: We would welcome comments from market participants on how they expect to manage periods of low wind generation output and whether this is an important consideration for them.

A number of respondents commented that they would expect to see price signals emerging from periods of low wind generation output which would drive behaviour, which could include the use of demand side management.

We expect wholesale markets (where over 95% of energy is traded) to respond to changes in wind generation output as they occur (ie within day). The extent to which the wholesale markets respond and signal this through changes to operating plans will have an impact on our Short Term Operating Reserve Requirement (STORR). The greater the market response, the lower the Balancing Service requirement is likely to be and vice versa. We therefore see a continued need for effective wholesale market activity within day and for an appropriate incentive to balance through imbalance prices.

Question 20: Are we correct to highlight the importance of wider European issues in electricity operating margin analysis?

A number of respondents highlighted the importance of both making use of European experience with wind generation and of being able to quantify the risk of continental scale events, which could impact on how operating reserve can be shared.

We continue to believe that wider European issues are important and have described our involvement in European forums earlier in this document.

Question 21: Are there further technical solutions for maintaining operating margins which we have not mentioned here?

One respondent suggested that interconnectors could play a bigger role, another suggested the development of storage was a key variable whilst another emphasised the role of demand side services. Another respondent also suggested that CCGT peaking capacity could be considered.

Question 22: Do you think National Grid's view of future operating margins is useful and do you have views on how this should be presented?

Respondents found National Grid's view of future operating margins useful. Again, comments suggested that more value could be gained by presenting alternative scenarios.

Question 23: Are our assumptions regarding the level of electricity demand during the minimum demand periods reasonable?

Respondents agreed that the assumptions used were reasonable. Again, presentation of a number of scenarios was requested.

Question 24: Are our generation availability assumptions for minimum demand periods reasonable?

Again most respondents commented that the assumptions used were reasonable. One commented that CCS plant cannot be assumed not to run at minimum demand periods. Another commented that gas fired generation should not be considered as 'must run' generation in favour of renewable sources.

We agree that there is no guarantee that CCS equipped generation plant will not run at minimum demand periods. However, we believe it is reasonable to say at this stage it is less likely to run than nuclear, wind and gas fired CHP plant at these times under the generation and demand patterns seen under 'Gone Green' and similar scenarios due to the likely efficiency and flexibility overhead of the CCS plant itself.

We should also clarify that our definition of 'must run' gas fired generation captures plant which in our experience has submitted operational data to this effect, rather than being granted a 'must run' status.

Question 25: Is our central assumption regarding wind generation bid prices related to ROCs reasonable?

Respondents concurred with this assumption (an average bid price of -£100/MWh for generators affected by lost ROCs) although one pointed out that other risk factors apply.

We note that there are two aspects to be considered here, the first being the direct loss of ROCs payments to a renewable generator and the second being the potential shortfall created within a corresponding energy supplier's renewable energy purchases. Whilst the value assigned to the this second aspect is less straightforward to evaluate than the direct loss of ROCs payment, we still think it is possible to assign a value to a change in generator output related to ROCs.

Question 26: Is it reasonable to assume that minimum demand periods will be managed using Interconnectors and Wind Generation in preference to the curtailment of Nuclear Generation?

Most respondents agreed that this assumption was reasonable but that, in the event, the most economic solution would prevail. One respondent expected higher demands, meaning less action would be required. Another respondent suggested that a greater volume of action would be required.

Section 7: Operating the Networks

Question 27: Do you agree with National Grid's view of increased balancing activity in the future due to variation in market length?

There was general agreement that activity levels were likely to increase. Some respondents queried the strength of the link between balancing activity and variation in market length.

One respondent pointed out that assumed level of imbalance was dependent on the assumed incentive to balance, which could change if imbalance pricing arrangements changed. The respondent suggested there was a case for these to be reviewed to reflect the ability of generators to manage imbalance.

Balancing activity is a key driver in the design and dimensions of National Grid's processes and systems. We remain of the belief that the level of balancing activity undertaken by National Grid is likely to rise, driven in part by increased variability in market length. We would expect changes in levels of balancing activity to be observable over time to be correlated with measurable variables and will present analysis as necessary to this effect.

Question 28: Do you agree with National Grid's view that ramping effects will impact on operation of the networks?

Respondents agreed that ramping effects will have an impact. One respondent saw this as an opportunity for fast acting service providers. Others saw automation as key, whilst one cautioned against over reliance on automation to address problems like this.

Question 29: Do you believe that a new approach is required in the development of System Operator to generation or demand control point interfaces for 2020?

Respondents saw a need for change here, but many saw a need for incremental development rather than an entirely new approach.

A number of respondents saw the role of Distribution Network Operators changing, potentially into 'Distribution System Operators' as their networks become more active.

One respondent suggest improvements to generation modelling in the Balancing Mechanism (with reference to CCGT dynamic parameters) and a review of gate-closure for intermittent generation. Another highlighted the need to demonstrate a cost benefit for any changes.

Question 30: Are there any specific factors which suggest that adequate flexibility will not be available to National Grid for use in operating the networks in 2020?

Most respondents did not identify a specific issue but did question whether the incentives to provide flexibility were strong enough, whether from generation or demand sources.

One respondent quantified the risk of not having enough flexibility as 'high' citing a number of factors:

- A large amount of the generation plant traditionally used for its flexibility will close under the LCPD;
- The more extensive use of gas fired plant required to replace this is unproven;
- The economics of flexible generation are uncertain; and
- The economics and prospects for flexibility from demand suggest demand has only limited ability to provide the flexibility required in the period concerned.

National Grid recognises the large number of factors which drive uncertainty in this area. However, we do expect to see a continued capability to provide flexibility within the generation fleet for the foreseeable future, for as long as an appropriate incentive to balance is in place. We believe that our statement of Future Requirements for Balancing Services will also help in giving a clearer indication to investors over the volume of Balancing Services required into the future.

We also see value in investigating the economics of generation flexibility in the future and believe this could usefully be assessed under Ofgem's project Discovery.

Question 31: The combined challenge of: a) ensuring the networks are operated safely and securely against a background of generation variability; whilst b) getting more from existing infrastructure; suggests to us that control, communication and information systems have a greater part to play in controlling flows across the transmission networks. Are there alternative approaches which should be considered?

Respondents agreed that control, communication and information systems will have a greater role to play in general terms. One respondent chose to highlight the potential value of demand side solutions but emphasised the work need to put these into practice. Another explored the network control issues relating to voltage control (requiring local sources of controllable voltage support) and the risks and limitations of inter-trips.

One respondent suggested that the task of network control could be subdivided into discrete operating areas.

One respondent stated that National Grid needed to articulate the complexity of these challenges and emphasise that ‘off-the-shelf’ solutions are not currently available.

Our approach to the development of new control systems for the transmission networks is described earlier in this document in Section 3.

Question 32: What criteria should National Grid use in developing any requirements for information regarding embedded generators? Are there other ways of obtaining this information?

Most respondents thought that this issue could be managed under the current commercial frameworks with information gathered by DNOs.

National Grid and the Distribution Network Operators are currently managing issues relating to embedded generators through existing Grid Code and Distribution Code processes. The latest information on the 'Small Embedded

Generators Frequency Obligations' working group as initiated at the request of E3C (the Energy Emergencies Executive Committee) is available in the Grid Code Working group area of National Grid's website[16].

Question 33: Are there additional options that National Grid should consider to maintain a Black Start capability?

Two respondents recommended investigating the potential for using local generation for Black Start. Others wanted to see support for energy storage applied to Black Start. One respondent highlighted that distributed generation could present a problem during system restoration. Another respondent asked whether the auxiliary units at generating station where the main units are expected to close, could continue to be used for Black Start. Another respondent recommended that the existing market based solution should be developed further.

Section 8: Balancing Services

Question 34: Are we correct in assuming that new interconnectors will be able to meet some of our Balancing Services requirement?

Respondents concurred with this assumption subject to the applicable commercial terms and the needs of the interconnected parties. One respondent also made the proviso that sterilising interconnector capacity inappropriately for Balancing Services would be inefficient.

Question 35: What is your view on the potential of electric vehicles to provide balancing and other energy services?

There was a consensus that electric vehicles were likely to be able provide services, but respondents point out that:

- Significant volumes before 2020 were unlikely;
- Metering and billing systems would need to be developed and installed;
- Services were most likely limited to charging control based services rather than battery discharge (as this had a perceived adverse effect on battery life); and
- It should not be presumed that electric vehicle owners will want to provide such services.

We continue to liase with manufacturers and electric vehicle experts over the future potential of 'Vehicle to Grid' services.

Question 36: How much of the electricity demand in Great Britain do you think could be regarded as discretionary or deferrable and hence available for use as a Balancing Service or other energy service?

A number of respondents estimated that around 5% of electricity demand in Great Britain could be regarded as discretionary or deferrable but emphasised that there was little evidence to back this up. Some also outlined their experiences but gave the general impression that demand side services were challenging to pursue at the moment, in part because of the perceived lack of benefit to potential providers.

[16] http://www.nationalgrid.com/uk/Electricity/Codes/gridcode/workinggroups/

Some respondents also commented that the figure of 11GW quoted within the consultation document was optimistic. One respondent highlighted work that is currently underway to assess demand side potential.

In National Grid's view, responses to this question highlight that significant further work is required to quantify the volume of demand side services available for use as a balancing or other network service and the timescales over which these will be realisable.

Question 37: What specific actions should National Grid take to facilitate Balancing Services from demand-side providers while maintaining the required quality and volume of service?

Some respondents asked for a review of the technical criteria for some Balancing Services to match demand side capabilities more closely. Others asked for clearer market signals and stronger incentives whilst another respondent suggested that capability would not be delivered though market signals alone.

We intend to develop our services with interested parties as outlined in Section 3 of this document.

Question 38: Are there further aspects of storage or other storage technologies we should consider when looking forward to 2020?

Respondents highlighted a range of technologies which they felt should be considered as storage including heat based storage, stored hot water and dynamic demand. Another argued strongly that storage could be integrated into intermittent generation installations thus eliminating a range of issues raised within the consultation document. One respondent commented that investment would be stimulated if National grid identified a requirement for storage.

We will continue to discuss future provision of Balancing Services from different storage technologies with parties interested in developing storage facilities.

Question 39: What are the prospects for the provision of Balancing Services from new OCGTs or other 'Back-Up' generation?

Respondents suggested that the prospects were low in the absence of a change to market arrangements or longer term contracts with National Grid. One respondent highlighted that emission standards take a step change if over 500 hours running per year is anticipated.

These responses are consistent with the feedback we have received from potential OCGT developers to date. Again, as outlined in Section 3, we intend to keep our Balancing Service definitions and contract forms under review as well as publishing our long term requirements which should give potential storage developers better information to use in assessing investment decisions. We will also monitor generator investment activity for signs of activity in OCGT development.

Question 40: Is our mapping of technology to Balancing Services reasonable?

Respondents generally concurred with the mapping presented with some suggesting that demand side services could have a wider role than presented.

Question 41: Is a statement of National Grid's view of its long term Balancing Services requirement useful to industry stakeholders?

Respondents agreed that that such a statement was useful, with one describing it as essential. Some respondents commented that the statement needed to be followed up with a commitment to procure services.

One respondent added that the statement should be produced under formal governance.

We intend to develop our statement of Future Requirements for Balancing Services as outlined in Section 3 in line with the feedback received from interested parties.

Question 42: What period should a long term Balancing Services Requirement statement cover?

The majority of respondents suggested a period of 10 years or more was required.

Question 43: What changes to the current reserve products would better encourage the provision of reserve services?

Some respondents suggested that longer term contracts were needed. One suggested up-front payments were required to attract new technologies. Another respondent expected to see a continuous process of service development. One respondent stated that National Grid needed to change the way it evaluated services, and not assume that contracted service providers should attract less income under a Balancing Service contract than they could in wholesale markets.

Our plans for the development of reserve services and engagement with interested parties are outlined in Section 3 of this document.

Question 44: What actions would ensure that procurement of reserve services does not impact adversely on the efficient operation of the wholesale energy markets?

Two respondents urged care in the development of reserve services to avoid removing capacity from wholesale markets. Another suggested there was some scope to procure more services. Others asked for more open markets whilst one respondent suggested alignment with international definitions would be helpful. One respondent suggested that the arrangements for reflecting the costs of certain contracted services within imbalance prices need to be revisited.