Doosan Babcock Energy

Doosan Babcock Energy Limited
Porterfield Road
Renfrew, PA4 8DJ
United Kingdom
Tel: +44 (0) 141 885 3942
Fax: +44 (0) 141 885 3378
MFarley@doosanbabcock.com

13 August 2009

To National Grid:

Doosan Babcock response to National Grid Initial Consultation on Operating of the Electricity Transmission Networks in 2020

Please find attached our company response for consultation.

We would be happy to explain further our response and to provide supplementary information if you wish.

To maintain grid balance and stability, it is vital, in our view to limit the amount of intermittent renewables attached to the grid. They need to balance demand using just hydro, pumped storage, back-up/peaking plant, interconnectors and discretionary/deferrable. Otherwise you will end up with a scenario where high efficiency, lower cost, low carbon baseload plant such as nuclear or coal+CCS would have to load cycle or be switched off entirely to maintain grid stability - not a viable option

Yours faithfully,

Dr J M Farley
Director of Technology Policy Liaison

Michael Doig
Graduate Engineer

Doosan Babcock response to National Grid Initial Consultation on Operating of the Electricity Transmission Networks in 2020

Introduction

Doosan Babcock is a multi-specialist energy services company operating in the thermal power, nuclear, petrochemical, oil & gas and pharmaceutical industries.

Doosan Babcock designs, supplies and constructs advanced steam generation technology for the power industry and are developing some of the cleanest, most efficient and lowest emissions coal powered plant in the world. Doosan Babcock are investing heavily in R+D on higher efficiency coal powered plant and CO_2 capture technologies at our R&D Centre in Renfrew. It is our ambition to develop and demonstrate these technologies and see them deployed widely as soon as possible, at home and overseas.

Doosan Babcock has conducted research into the roll-out of carbon capture technologies and examined scenarios for the future of UK generation, their associated costs and the infrastructure required.

Question 1: How do National Grid's observations align with your experience or modelling of wind generation?
National Grid’s observations broadly agree with our observations – particularly regarding that incidences of low wind output are plausible throughout the whole year. Analysis of electricity generated from wind has shown it can be essentially zero at times, including those of peak demand. We have also noted occasions of prolonged lack of wind generation
We would question whether a wind farm that has many turbines would result in the smoothing of effects of the wind farm output. As a wind farm is in a relatively small localised location, we would have expected that wind speeds that the turbines experience will be fairly constant at any given time. However, the wind speeds can change very quickly which could mean very significant changes in electricity generated over a short space of time, especially if the windspeed is close to the cut-off point for safe operation.

Question 2: Are we correct in assuming that wind generation is controllable enough to assist in operating the networks?
Our opinion is it would be vital for wind to be controllable - Scenarios show that as wind penetration increases, and at times of high wind generation, that typical baseload plants such as coal, CCS coal and even nuclear would have to be load cycle a significant amount in order to maintain grid stability if wind were a “must-run” resource. This is not a viable option. It would be detrimental to both the efficiency of thermal plants, and the increased mechanical risk of numerous hot and cold restarts. With the construction of a significant number of wind turbines approaching 2020 and beyond, it is vital that mechanisms such as throttling are in place for wind generation to be controllable, to ensure it does not detrimentally affect the operation of typical baseload plant.

Question 3: Should National Grid assume that Supercritical Coal generators will provide some flexibility in operation which will assist in operating the networks?
Supercritical coal generators will provide some flexibility of operation which will assist in operating the grid networks.
In order to comply with the existing UK Grid Code and thereby be allowed to connect and export electricity to the Grid, supercritical coal fired plant will need to incorporate features that to date have not been widely deployed in UK power plants. For example, it is anticipated that all new supercritical coal plant will be equipped with 100% HP bypass stations and suitably sized LP bypass stations. These are recognised as aiding plant flexibility by (1) shortening start-up times, and (2) assisting during planned shut downs, turbine trips and load rejections.
Additionally, features such as modulation of the main condensate stop valve (at condensate pump outlet) and possibly fast closing bled steam control valves for the LP feedwater heaters will enhance primary frequency response ability. This method of responding to primary frequency response does not incur the plant efficiency penalty associated with other commonly used methods (e.g. turbine throttling). While a full 10% primary response requirement could not be achieved by this method alone, it does represent a useful 'first line of defence'."

Question 4: Should we assume that Nuclear generators will continue to concentrate on base-load operation?
It is an acceptable assumption that Nuclear generators should and will continue to provide baseload operation. It is the only way that they can operate effectively. However, future simulations from Pöyry have shown that if wind continues to operate as a ‘must-run’ resource, that from 2030, in order to maintain stability of supply, other

generators, including coal, CCS coal, CCGT and even Nuclear would have to load cycle, or switch off entirely at times of peak wind generation but low electricity demand, which is an unviable solution to this problem.

Question 5: Is it likely that Carbon Capture plant will impose material restrictions on the operation of electricity generating plant?
It is difficulty to say at this stage. Ideally CCS plant should act as part of the baseload. It is designed to operate under optimal conditions – if it is not operating under optimal design conditions it may cause a decrease in operational efficiency. Whilst a small degree of load cycling will be acceptable, if it were to load cycle to follow the highly variable wind generation, the stations would become increasingly inefficient, and the cost of capturing the carbon dioxide produced could increase significantly.

Question 7: Are there other restrictions we should consider in developing a view on gas fired generator flexibility?
Gas already operates very flexibly currently. They load cycle a lot to meet the varying demand throughout the day, and can come online very quickly. However, if a significant proportion of gas is considered "low merit" and "low load factor", then this could affect investment in new gas plants by utility companies, as they will be unsure whether the plant will be economical and how long it would take to make a return on their investment. This is an important issue as with increasing wind penetration, it is vital to have sufficient back-up plant available to handle any sharp drop in wind generation.

Question 8: What is your view of future electricity demand growth and how would you quantify any uncertainty around this?
We should plan on growth of demand to power electric cars and to power heat pumps for industrial and domestic heating.

Question 14: Is our anticipated improvement in wind forecasting performance at 4 hours ahead achievable?
We are unsure why this will improve – currently we have a relatively small amount of wind installed – mainly in Scotland. If the current forecasting error of 10% (rms) is achieved in what is a fairly small number of geographic locations we are unsure why the forecasting error percentage will decrease when there are a greater number of wind turbines installed over a greater number of geographic locations. We would expect there would be an error associated with forecasting for each site, which as the number of sites grows, the total forecasting error would grow. However, it may be the case that errors in forecasting would average out over a larger number of geographic locations.

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?
Definitely. It is vital that "low wind" events across Great Britain are considered. The figures clearly show that wind resources cannot be depended upon at times of peak demand. Your data shows that between 1986 and 2008, the annual highest peak demands, consistently occur mainly at times of very low wind speeds, hence low wind generation. As wind penetration increases, it has to be assumed this trend could continue, which would mean that no matter how much wind capacity is installed, it cannot be relied upon to provide electricity at times of annual peak demand based on previous trends. This is backed up by scenarios from Pöyry who simulated potential wind generation in 2030 which also found long periods of "low

wind” and hence low wind generation were likely at some point during peak winter demand. This is vital when evaluating electricity operating margins.

Question 18: Are our generator availability assumptions reasonable for application to analysis of future operating margins?
Yes, generally, but we would query whether the availability of hydro would be so low

Question 20: Are we correct to highlight the importance of wider European issues in electricity operating margin analysis?
It is important to consider the importance of Europe in electricity margin analysis. It is wrong, as suggested in some questions to suggest that wind variability can be compensated in full by more interconnectors. Around 25GW would be needed and this would be uneconomic, and the supplies from Europe may not be available when needed. There have been instances of very low wind generation across a large amount of Europe simultaneously, which has occurred at times of peak demand. Some European grid networks heavily reliant on wind generation use interconnections with neighbouring countries to balancing their grid. As wind penetration increases significantly towards 2020, it is vital that sufficient operating margins are maintained throughout Europe, by ensuring that there is significant back-up generation capacity.
However, Britain is an island nation, and has a largely isolated grid network. With 2GW of interconnection capacity currently installed, it only represents a small part of the total operating “capacity” of the UK.
Your models shows that there will be issues with the “Gone Green” scenario, in the event of low wind, and that action must be taken.

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?
It is vital that minimum demand periods are managed by interconnectors and curtailment of wind energy. Nuclear energy should always be considered as baseload generation. There is practically zero flexibility in its generation, and would therefore be both uneconomical and impractical to stop nuclear generation in precedence of wind. The best way to control large and rapid variability of wind generation is the throttling of wind generation at times of minimum demand.

Question 34: Are we correct in assuming that new interconnectors will be able to meet some of our Balancing Services requirement?
Whilst interconnectors will usually be able to meet some of the balancing services requirement, there will be situations when a weather system can affect a large area of Europe. In this instance you could have very high, or very low wind generation across the number of countries simultaneously. In this instance it would not be possible to balance the system using interconnectors to import or export excess power, as other countries may be attempting to do the same thing.

Question 35: What is your view on the potential of electric vehicles to provide balancing and other energy services?
At first sight, electric vehicles are a potential route to store off-peak power, charging at night and used in the day-time. However, in the context of a system with large amounts of wind capacity, sometimes not generating for several days at a time, these cars add to the demand that MUST be satisfied and thereby add to the need for reliable back-up.
A solution could be for each car to have more than one battery but this would add to the cost of electric cars.

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?
We are not able to quantify this but suspect the amount of demand which is discretionary or deferrable for several days is very limited. Also deferring demand from devices which are ‘on’ at random will lead to sharp peaks when they are allowed back on.

Question 44: What actions would ensure that procurement of reserve services does not impact adversely on the efficient operation of the wholesale energy markets?
The total amount of intermittent generation on the system should be limited to the sum of

(i) Hydro capacity
(ii) Pumped storage
(iii) Back-up/peaking plant
(iv) Estimate of reliable supply via interconnectors
(v) Estimate of discretionary/deferrable demand