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Date: 16th September 2011

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Dear Sir/Madam,

RenewableUK consultation response

RenewableUK is the trade and professional body for the UK wind and marine renewables industries. Formed in 1978, and with over 660 corporate members, RenewableUK is the leading renewable energy trade association in the UK, representing the large majority of the UK's wind, wave, and tidal energy companies.

Specifics:

(1) Market and Supplier side balancing activities;

We note market participants are currently incentivised to balance their portfolio of contracted generation and demand within each half hour (HH) market via the balancing mechanism, imbalance settlement processes, and related traded arrangements. Although the contribution of wind generators to such generation portfolios has been historically low relative to other forms of generation, this position is changing. As variable renewables increasingly impact the balancing position of market participants, the party in question will become increasingly incentivised to manage such impacts.

In the procurement of reserve and response services we note that NETSO currently takes "no account of how market participants might arrange any uncertainty around generation and demand". Furthermore, there appears to be no account taken by NETSO as to how market participants will contribute to balancing requirements in future, in the context of higher levels of output from variable renewables. With over 5.7GW of wind now installed in the UK, and an increasing proportion of this connecting into the GB transmission network, it is now the right time to assess in detail the extent to which market participants account for wind output when balancing HH market positions.

From discussions between National Grid and RenewableUK, we note the NETSO has internally examined market data at instances of high wind output and assessed the extent to which the balancing market has gone "long", i.e. the extent to which Suppliers are taking no action to accommodate higher wind output within their respective generation portfolios. The results of this analysis are not publicly available for peer review, but could prove very useful in uncovering the contribution the balancing mechanism has to make towards GB system operation.

RenewableUK is concerned that the failure of the System Operator take full account of market balancing activities in a future of higher contributions from variable renewables will encourage the excessive procurement of reserve and response services. As such we request that NETSO instigate detailed assessments of the role of the market and balancing mechanism in managing output from variable renewables.

(2) <u>Long term Reserve requirements;</u>

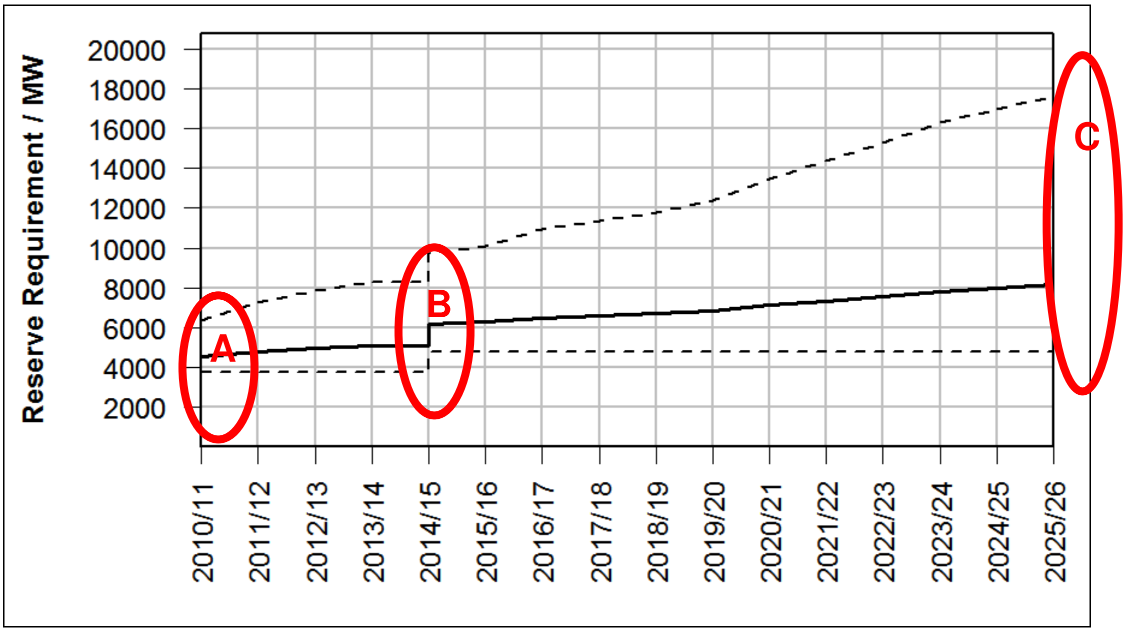

Figure 1: Reserve requirements for the Gone Green scenario

We have concern over the reserve requirements forecast within Figure 1, (which is in line with the Gone Green deployment scenario). We have separated the concerns with regard to three separate dates (A) 2010/11, (B) 2014/15, and (C) 2025/26:

(A) 2011/12 –

National Grid provided the following data:

Wind capacity = 5.795 GW

Wind forecast error = 47.79 %

Therefore:

Wind capacity multiplied by forecast error = 5.795 x 46.79% = 2.7 GW

Wind capacity multiplied by forecast error,

minus 500MW ("Reserve for wind") = 2.7-0.5= 2.2GW

From inspect of figure 1

Wind@100%Output = 6.5GW

Wind@0%Output = 3.8 GW

Therefore

Reserve required for wind, Wind@100%Output - Wind@0%Output = 6.5-3.8=2.7 GW

Error Figure 1 = 2.7-2.2 = 0.5GW

There is a discrepancy between the reserve requirements on the chart and the methodology used by NGET

(B) 2014/15 –

National Grid provided the following data:

Wind forecast error = 41.14 %

Wind capacity multiplied by forecast error = 10.681 x 41.14% = 4.4 GW

Therefore:

Wind capacity multiplied by forecast error = 10.681x 41.14% = 4.4GW

Wind capacity multiplied by forecast error,

minus 500MW ("Reserve for wind") = 4.4-0.5= 3.9GW

From inspection of figure 1

Wind@100%Output = 9.9GW

Wind@0%Output = 4.8 GW

Therefore

Reserve required for wind, Wind@100%Output -Wind@0%Output = 9.9–4.8= **5.1GW**

Error in Figure 1 = 5.1-3.9 = 1.2GW

There is a discrepancy between the reserve requirements on the chart and the methodology used by NGET

(C) 2025/26 –

National Grid provided the following data:

Wind capacity = 30.605 GW

Wind forecast error = 32.0 %

Therefore:

Wind capacity multiplied by forecast error = 30.605 x 32.0% = 9.8 GW

Wind capacity multiplied by forecast error,

minus 500MW ("Reserve for wind") = 9.8-0.5= 9.3GW

From inspection of figure 1

Wind@100%Output = 17.5 GW

Wind@0%Output = 4.8 GW

Therefore

Reserve required for wind, Wind@100%Output-Wind@0%Output=17.5–4.8= 12.7GW

Error in Figure 1 = 12.7-9.3= 3.4GW

There is a discrepancy between the reserve requirements on the chart and the methodology used by NGET

Summary of errors.

In all three cases, according to the NGET methodologies, the additional reserve required as a result of increasing wind output from 0 to 100% should be far lower than illustrated in Figure 1

(3) <u>Impact of increase infeed loss limits on addition reserve holding for wind;</u>

Additionally Figure 1 appears to imply the new infeed loss limits introduced in 2014 act to increase the amount of additional reserve holding for wind by up to 1300MW (1800-500).

Form inspection of Figure 1

The reserve increases at this time due to the change in maximum allowable infeed loss.

Reserve increase at 0% wind output = **500MW**

Reserve increase at 100% wind output = **1800MW**

The reserve increase of 500MW during no wind can be attributed to increasing the infeed loss from 1320MW to 1800MW (ie.~500MW). However the increasing reserve carried for infeed loss should result in a decrease in reserve for the high wind scenario as there must be some sharing of the reserve for infeed loss and for wind**.** **There is no logical explanation for the chart which shows a step *increase* in reserve for the high wind event due to a change in infeed loss.**

(4) <u>Wind generation forecasting;</u>

We note NETSO apply a maximum wind forecast error which ranges from 47.79% in 2011/12 down to 30% in 2020/21. In our view this error is unacceptably high, and whilst we recognise NETSO have recently invested resources in the improvement of forecasting techniques, much more attention should be given to the economic merit of improving such techniques further. Given the significant impact poor forecasting techniques have on reserve holdings, and therefore consumer bills, we would welcome further assessment as to the Cost Benefit Analysis (CBA) on investing in improved forecasting techniques going forward.

Secondly, it is not clear how the maximum error changes with the extent to which the forecast is carried out before real time. We request that the NETSO place such information in the public domain. This data should inform a CBA on the merits of moving reserve procurement closer to real time, e.g. from 4 hours out to 2 or 1 hour out.

Thirdly, the NETSO applies a single maximum error value to all levels of wind output. We note other European System Operators have analysed the extent to which the maximum error changes with level of wind output, and particular identifiable weather conditions. E.g. In percentage terms the maximum error will decrease as the level of wind generation increases. We would request NETSO place in the public domain information clarifying how this maximum forecast error changes with (a) Wind output levels, (b) Weather categories, (c) categories of market specific events. Our concern is that NETSO are being overly conservative in applying excessive error values in the procurement of wind reserve. In the first instance, we recognise the worst forecast need not be applied at all times.

(5) <u>Generation and Demand forecasting;</u>

It would be useful to understand how the forecasting accuracy compares across the following:

(a) Demand (on the basis of time ahead, size, and categories of market specific events);
(b) Conventional generation (on the basis of time ahead, size, and categories of market specific events);
(c) Wind generation (on the basis of time ahead, size, and categories of market specific events);

(6) <u>High wind cut-out;</u>

NETSO have requested information and data relating to high wind shut down scenarios, with particular reference to Round 3 offshore wind sites.

We would like to bring to NETSO's attention the event of 8 January 2005 in Denmark. Figure 2 shows how a collection of onshore and offshore wind farms responded to the arrival of an extreme weather front. Whilst the weather front was predictable, the impact on wind farm outputs delivered a reduction of over 2000 MW over a period of 9 hours. This broadly equates to an average rate of change of 0.07MW per second. We note previous publications have listed standard morning pick ups in demand to deliver a rate of change of demand approximately equal to 2MW per second. Even if one scales Danish wind generation to GB 2020 scenarios, the rate of change (although challenging) is not overly severe. Furthermore GB 2020 offshore generation would be more dispersed that the Danish wind fleet. Specifically we note the 3 hour time lapse between the high wind shut down at Horns Rev and the impact of the same event onshore.

The event of Denmark 8 Jan 2005 is most extreme large scale high wind shut down event on our records. However we would recommend SOs in Spain and Germany may be able to provide additional contextual data, albeit from lower wind regime where the frequency of high wind shut down events will likely be far lower than that of the UK.

We recommend that NETSO carry out some comparative analysis on the potential for high wind shut down events, taking account of output change rates from existing onshore and offshore wind farms. Whilst current GB onshore wind farms may generally be far smaller than those expected offshore as part of Round 3 developments, larger onshore wind farms such as Whitelee will aid the understanding of behaviours to be expected offshore.

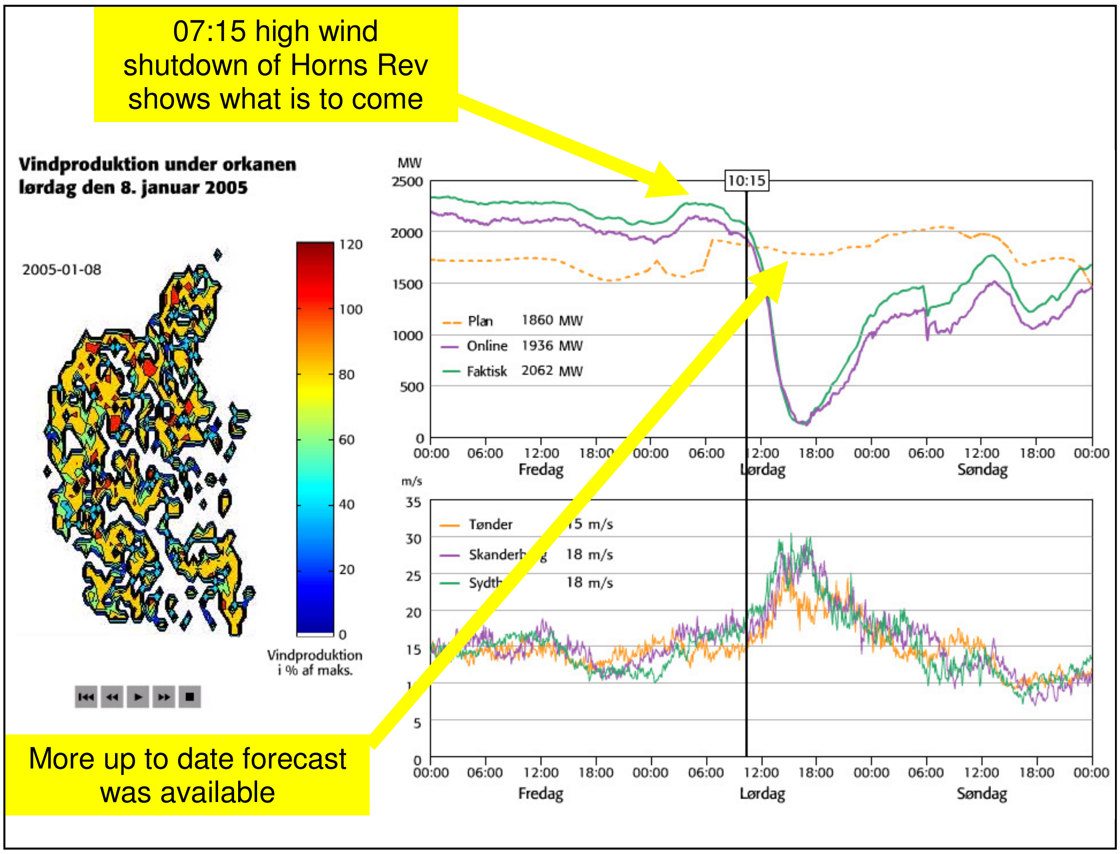

Figure 2: Danish high wind event – 8 January 2005.

	Capacity (MW)	Area (km2)	Capacity density (MW/km2)
Dogger bank R3 wind farm	13,000	8,660	1.5
Denmark (2005)	3,100	43,000	0.072
Whitelee wind farm	322	55	5.8

Figure 3: Comparative statistics

Overall, we recognise instances of high wind shut down will need to be properly understood and managed by the SO. Accurately forecasting such events will enable the SO to build a better understanding as to the economic merit of controlled reduction of specific wind farm output prior to any predicted event. However, we do not believe instances of high wind shut down will deliver the SO any greater operational challenges than are already encountered. Indeed the extent and speed of output change promoted by high wind shut down events will likely be far smaller than balancing challenges posed by instantaneous circuit/plant loss, or even the daily morning pick up. As such we would recommend that the NETSO does not jump to any conclusions over the severity of the challenges posed, and does not adopt an overly conservative approach to the management of such event in the short or long term.

(7) <u>Data loss;</u>

RenewableUK understands from members that NETSO has incurred problems maintaining visibility of output data from transmission connected wind farms. Indeed at times when wind farm outputs have been at high levels, NETSO have reported relevant outputs as zero. Quite apart from data loss promoting complication in the operational control, we are concerned that data loss may be contributing to a view on the extent and frequency of wind farm output changes. We request that NETSO clarify how the frequency and extent of data loss events with regard to wind farm output. We also request NETSO provide assurances that data loss events are taken full account of when assessing the pattern and operational characteristics of wind generation output.

(8) <u>NETSO Data visibility;</u>

We recognise not all wind farms are required to provide the NETSO with data through operational metering, and that for many embedded wind farms the NETSO has no visibility of real time output data. Whilst we acknowledge the NETSO has explored the installation of SCADA systems for those wind farms current not visible to NETSO, we also recognise the cost of deploying this technology is significant.

We also recognise the value of visibility of such date to the NETSO, as well as to the wider wind industry through the provision of comfort and additional confidence within NETSO in accessing the “full picture” regarding real time wind output. In this regard we intend to continue to work with NETSO and industry in order to examine solutions and means by which to deliver progress in future. However we would encourage the NETSO to provide incentives for generators to provide operational data e.g. through low cost internet based channels.

We are concerned that recent NETSO trends to constrain embedded windfarms without compensation and to demand that wind generators limit their outputs to their submitted PN (physical notifications) creates a culture of suspicion which is unhelpful in engendering cooperation between the NETSO and the wind industry in order to reduce system operation costs.

(9) <u>Reserve procurement process;</u>

We recognise that reserve procurement is formalised at 4 hours ahead of real time. The timescale for this procurement holds significant implications for the amount of reserve contracted, the type of reserve that can be contracted, the accuracy with which variable renewable output can be forecast, and the overall cost of providing reserve services.

In future, with large volumes of variable renewable generation connecting to the transmission network, the forecast error of such plant will start to become the primary driver of how reserve is procured, and how much reserve is needed. Given the maximum forecast error will become the single largest contributor to the amount of reserve holding that is required, any effort to improve the extent of this error will become increasingly economic to pursue. One straight forward way in which the error can be reduced is to move the procurement lock down time closer to the real time, perhaps to 1 or 2 hours before real time.

We note the historical 4 hours head start on procuring reserve has been driven by technology need, and by warm up times. However we note new OCGT plants could potentially make available to NETSO plant possessing rapid warm up times of approximately 1 hour. If sufficient volumes of such plants are made available to NETSO for reserve service, there must be strong economic argument to reform the process via which reserve is contracted, such that improved wind forecasting can be taken advantage of. We request that the NETSO carry out a CBA to outline when such reform becomes economically attractive, both in terms of how much wind will need to be on the system, but also in terms of what technology provisions will need to be available to NETSO.

(10) <u>Low demand scenarios and downward reserve;</u>

We recognise that in future there may be instances where NETSO may identify a requirement to curtail wind output, primarily in order to facilitate reserve requirements. In such instances it important that NETSO consider the development of arrangements via which wind plant may provide "footroom" services, (downward reserve services), and therefore prevent high value low carbon energy from being wasted. The economics of such arrangements do require closer consideration and should take account of the lost revenue potential, but also the cost of curtailment.

(11) Reserve for wind – why 500MW discount?

RenewableUK notes that as part of the "reserve for wind" policy, a 500MW subtraction is made to wind output prior to allocating/calculating reserve requirements. We would request that NETSO provide further evidence/reasoning as to why this figure is applied, as opposed to any other figure.

(12) System inertia.

We note reference to the issue of system inertia, and would like to draw the attention of NETSO to the recent publication of a RenewableUK Position Paper on the matter[1].

(13) Role of "spinning" reserve;

We note that EirGrid have achieved ~annual 10% wind energy penetration and ~50% wind power penetration without the need to provide extra reserve. If the spinning reserve is deployed due to a large infeed loss, it must be replaced in ~30minutes. The same process and speed can be used in the case of wind forecast error. We request that the NETSO provide a clear explanation of the relationship between spinning reserve and reserve for wind.

(14) Maximum output figures for GB wind;

Figures 8-10 within the consultation illustrate diurnal operating reserve requirements. We question why a 100% load factor figure is applied in this instance, especially in summer months where maximum output of all wind farms geographically dispersed across GB is highly unlikely to be 100% at any time.

(15) Sum of Squares:

We note that international academic and industry best practice is based on a sum of squares for combining uncorrelated uncertainties. i.e.

(total uncertainty) squared = (demand uncertainty) squared + (wind uncertainty) squared.

There are various reference to this technique including:

> Farmer at Al [all CEGB] – "Economic and operational implications of a complex of wind-driven generators on a power system" – IEE proceedings, A, volume 127 number 5 (June 1980).

[1] http://www.bwea.com/pdf/publications/RenewableUK_Inertia_Position_Paper.pdf

Hudson, Kirby and Wan – "The impact of wind generation on system regulation requirements", Oak Ridge National laboratory report 110830, 2001.

Enernex Corporation for Xcel Energy and the Minnesota Department of commerce – "wind integration study – final report". September 2004.

Please could national grid confirm that they are using this technique and demonstrate this in the methodology.

Yours sincerely,

Guy Nicholson, Head of Grid for RenewableUK