GC0042 Information on Embedded Small Power Stations and its Impact on Transmission System Demand Workgroup Report

What stage is this document at?

01	Workgroup Report
02	Industry Consultation
03	Report to the Authority

This proposal seeks to modify the Grid Code to include information on Embedded Small Power Stations of registered capacity of 1MW or more in Network Operators' Week 24 data to facilitate National Grid's development and operation of the Transmission System

This document contains the findings of the Workgroup which formed on 4th December 2012 and concluded on 19th June 2013.

Published on: **04 September 2013**

The Workgroup recommends:
That the technical requirements are taken forward for Industry Consultation as they better facilitate National Grid's development and operation of the Transmission System

High Impact:
None identified

Medium Impact:
Network Operators

Low Impact:
None identified

Contents

About this document

This Workgroup Report outlines the discussions and recommendations of the Information on Small Embedded Power Stations and Impact on Demand Workgroup.

Document Control

Version	Date	Author	Change Reference
0.1	17 July 2013	National Grid	Draft Workgroup Report
1.0	04 September 2013	National Grid	Final Workgroup Report

Any Questions?

Contact:

Djaved Rostom

Djaved. Rostom
@nationalgrid.com

01926 655384

Proposer:

Graham Stein

National Grid Electricity Transmission

1. Executive Summary

1.1. The Grid Code paper (pp12/02) on "Information on Embedded Small Power Stations and its Impact on Transmission System Demand" (Annex 1) was submitted to the Grid Code Review Panel (GCRP) on 18 January 2012.

1.2. This paper suggested a revision of the Grid Code obligations relating to PC.A.4.3.2 which currently requires any User to submit their active power demand forecast after deductions are made to account for the contribution from Embedded Small Power Stations, Embedded Medium Power Stations, Customer Generating Plant and imports. In addition to the demand, the Users are also required to provide details of the deductions made.

1.3. The increasing amount of embedded generation connected to the distribution networks is having a larger impact on the transmission network. To maintain the security of the system, National Grid believes it requires more visibility of Embedded Small Power Stations.

1.4. The GCRP recommended that a Grid Code Workgroup be established to consider the issues further and relevant Terms of Reference (ToR) (Annex 2) developed to this effect were agreed in May 2012.

1.5. The Workgroup have met on 4 occasions and debated the issues raised in the ToR.

Workgroup Recommendation

1.6. It was accepted at the meetings that further information than what is currently provided under PC.A.4.3.2 is required to enable National Grid to efficiently plan and securely operate the transmission system.

1.7. The following list of additional requirements was agreed upon for each Embedded Small Power Stations (ESPS) of 1 MW and above:

- A reference unique to each DNO licence area
- The fuel type or technology type, as per the definitions laid out in the Regulatory Instructions and Guidance Document (RIGs), Ref: 83/07, version 2 published in April 2007.
- The registered capacity in MW (as defined in the Distribution Code)
- The lowest voltage level node on the existing week 24 single line diagram to which it connects to
- The geographical location (either as latitude and longitude or as grid reference coordinates) of the primary (or higher voltage) substation to which it connects to (only for photo voltaic and wind based ESPS).
- The control mode (if it operates in voltage control or power factor control mode). Where it operates in voltage control mode the voltage set-point and reactive range must be provided. Where it operates in Power Factor mode the target power factor must be provided.
- The Loss of Mains protection type and relay settings for all ESPS connected during or after the Calendar Week 24 data submission beginning 2015. For ESPS connected prior to this date, the information should be provided on a reasonable endeavour basis.

1.8. Schedule 11 of the Data Registration Code would also need to be modified to capture the additional requirements listed above.

1.9. The Distribution code would need to be reviewed to enable the DNOs to capture any additional information that they are currently not entitled to receive from the ESPS (e.g. Loss of Mains protection type and relay settings)

1.10. The implementation date for the above information to be submitted was agreed to be the Calendar Week 24 data submission beginning 2015. It was noted that there may be a need to gather some of the proposed data items prior to the implementation date of 2015 to satisfy the European Transparency regulation. This could be enacted via a staged implementation in the Grid Code or a separate information request. The Workgroup favoured implementing a single process change for the 2015 target date rather than the staged approach.

1.11. It was agreed that ESPS below 1MW would not be considered at this stage due to the limitation in the amount of information available for these units.

2. Purpose & Scope of Workgroup

2.1. At the January 2012 GCRP, Graham Stein presented the pp12/02 paper which proposed that a Workgroup comprising National Grid, Network Operators and any other interested parties be developed to discuss a set of changes to the existing Planning Code (PC) and Data Registration Code (DRC). The GCRP agreed that this issue required further investigation and approved the Terms of Reference

2.2. The scope of the Workgroup was to review the information currently provided by Network Operators to National Grid concerning Embedded Small Power Stations and Demand. At the inaugural meeting it was observed that the information presented in pp12/02 needed to be refined and clarified, as additional information was required on top of the requirements listed in the document.

2.3. The detailed scope of the Workgroup was to:

- Review the information currently provided by Network Operators to National Grid concerning Embedded Small Power Stations;
- Review how this information is used to develop, plan and operate the Transmission System;
- Identify any inconsistencies between how Small Power Stations connected to Users' networks can be accounted for in the development, planning and operation of the Transmission System compared to Medium and Large Power Stations;
- Identify any information which is necessary and not provided;
- Identify any information which is provided but is no longer necessary;
- Develop recommendations to eliminate inconsistencies, omissions or unnecessary information provision where there is a material benefit in doing so.
- Take account of relevant international practice and the approach taken in European Code development.

Terms of Reference

2.4. A copy of the Terms of Reference can be found in (Annex 2) and was presented at the May 2012 GCRP (pp12/26).

Timescales

2.5. It was agreed that this Workgroup would report back to the May 2013 GCRP, but in agreement at the May 2013 GCRP this was amended to July 2013. Following the discussions of the Workgroup, the date was moved to the September GCRP to allow enough time to consider all the comments received from the DNOs.

Timeline

Workgroup Meeting Dates

M1 - 04 December 2012

M2 - 31 January 2013

M3 - 16 April 2013

M4 - 19 June 2013

3. Why Change?

3.1. The GCRP paper (pp12/02) estimated a growth in the capacity of Embedded Generation from 7.6 GW installed in 2006 to 11.3 GW in 2015.

3.2. In the past, the relatively low volume of embedded generation did not have any substantial impact on the National Electricity Transmission System (NETS). However due to the growth of embedded generation, the impact is becoming more noticeable especially in the planning and operation of the transmission network.

- In the planning domain, embedded generation is taken into account in order to evaluate the correct boundary flows. Depending on the location of the embedded generators and the nature of the boundary (i.e. whether it is exporting or importing), boundary flows can either increase or decrease in the presence of embedded generation. Having an accurate boundary flow is therefore essential for network planners to determine the right level of network reinforcements required as well as the timing of these reinforcements.

- Due to the additional flows from Scotland to England, over £1bn is being invested in the western HVDC link to reinforce boundary B6 by 2.2GW. The contribution of embedded generation to the B6 boundary transfer is nearly 600MW (see Figure 1 below), which is almost 30% of the link's capacity. This illustrates the material impact that embedded generation has on the need case for additional reinforcements

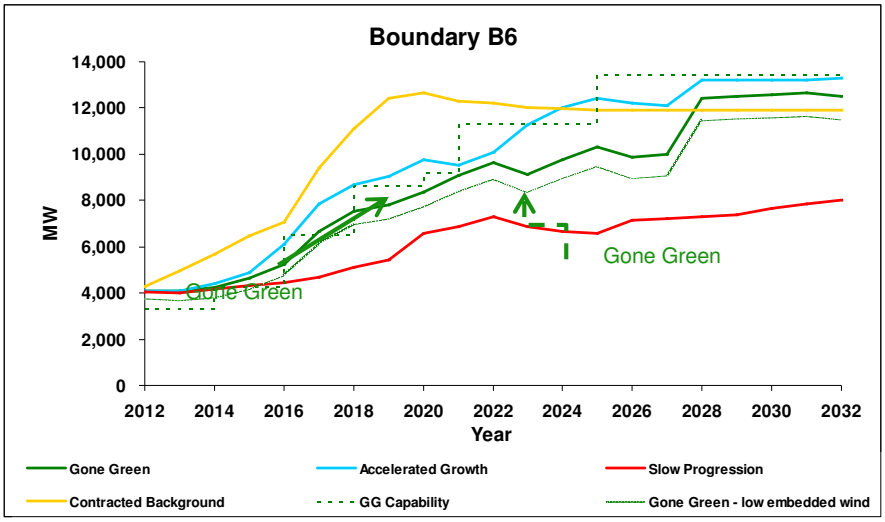

Figure 1 - Impact of Embedded Generation on Required Transfers for Boundary B6

- It is also believed that embedded generation can potentially have an impact on the reactive demand as shown in figure 2 below. Although there is a reduction in both active and reactive demands, the decrease in reactive demand is more pronounced thereby causing the Q/P ratio to decrease year on year.

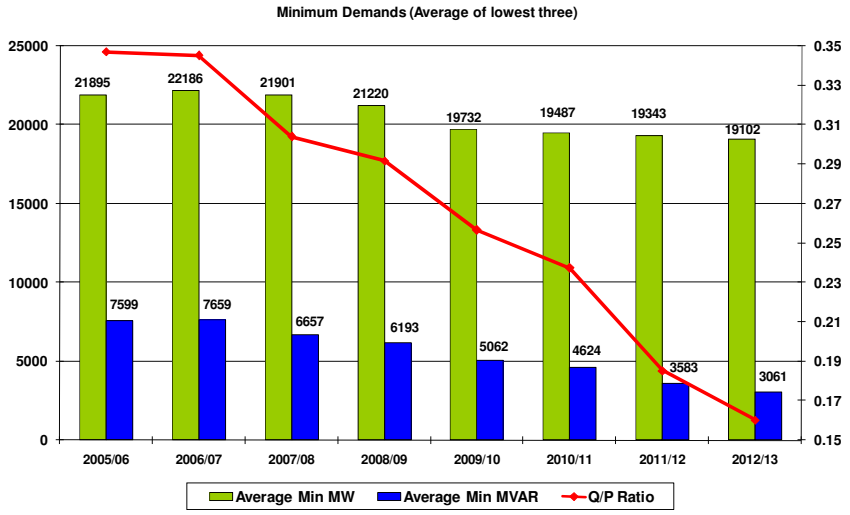

Figure 2 – Reactive demand trend 2005 - 2012

- The day-to-day operation of the transmission network relies on accurate demand forecasts to ensure that the right amount of generation is contracted. Demand forecasting errors have gradually become more pronounced and it has been found that the errors can be partly attributed to the growing contribution of embedded generation.

- The graph below shows the mean demand forecast error evaluated at 12:30 during summer from 2007 to 2012. The positive bias depicted in the graph implies that there is a tendency for National Grid to over-forecast demand and this may be due to the effect of demand suppression caused by embedded generators which cannot be forecast effectively with the information available currently.

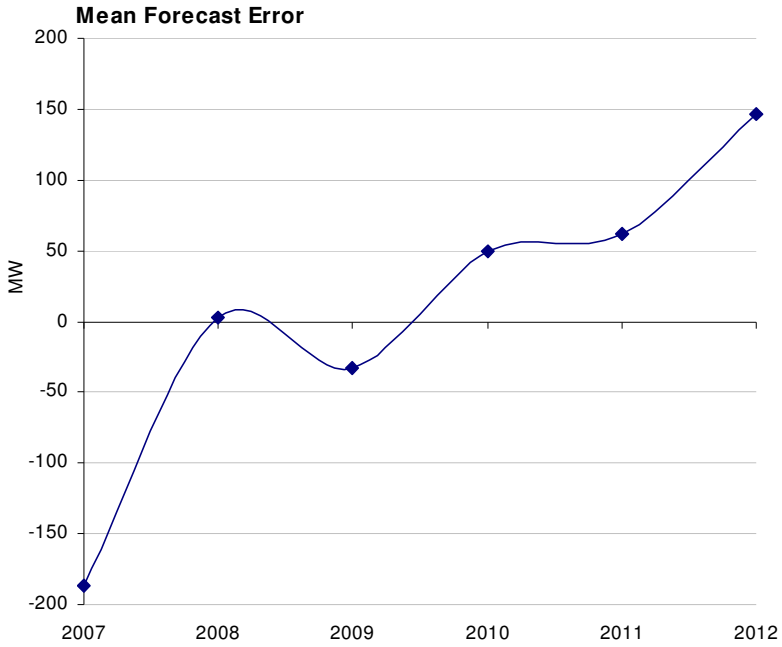

Figure 3 – Mean Transmission System Demand Forecast Error from 2007 – 2012 for Summer Peak Demand

3.3. With the limited amount of information that National Grid presently receives with respect to the Embedded Small Power Stations, it is becoming increasingly difficult to accurately determine the behaviour of the embedded generators. This uncertainty can only be reduced if further information is provided to National Grid.

3.4. The current obligations on DNOs to provide information about Embedded Small Power Stations are stated in PC.A.3.2.1 (b), PC.A.3.1.4 (a) & PC.A.4.3.2 (a) of the Grid code.

Under PC.A.3.2.1 (b), the following information is required:

- The registered capacity of each Embedded Small Power Station in MW

Under PC.A.3.1.4 (a), the following information is required:

- Number of Small Power Stations
- Number of generating units or Power Park Modules within these power stations
- The summated capacity of all generating units

Under PC.A.4.3.2 (a), the following information is required:

- The total contribution of Embedded Small Power Stations used to evaluate the net demand at each connection point at four specific times.

3.5. Currently, as per PC.A.4.3.2, National Grid obtains information for the forecast contribution from embedded generators at specific times and connection points. These forecasts are only valid for certain conditions and without the right granularity of information, it is impossible for National Grid to evaluate the behaviour of these generators under different scenarios. For example, under different weather conditions, the output from renewable-based Embedded Small Power Stations (e.g. wind driven Power Park Modules) would vary. However if no information was available to ascertain the location, the type of plant and the registered capacity, it would not be possible to determine the contribution of these generators to the system demand under these changing scenarios.

3.6. In order to improve the planning and operation of the system in the future, National Grid is seeking to obtain more clarity on the Embedded Small Power Stations with registered capacity of 1MW and above.

3.7. It was agreed that the information currently provided by the DNOs would be reviewed and any additional information required could be determined in accordance with PC.A.3.1.4 (b) which states that additional information about Embedded Small Power Stations may be requested by National Grid where reasonable justifications can be given to show that the aggregation of embedded power stations is having a significant effect on the National Electricity Transmission System.

3.8. However, since National Grid would require additional information on an on-going basis from all the network operators, and in a different form to that which could be specified via PC.A.3.1.4 (b), a Grid Code change is preferred.

4. Workgroup Discussions

4.1. The inaugural meeting of the Information on Small Embedded Power Stations and Impact on Demand Workgroup (SEPSWG) was held on 04 December 2012. As Proposer, Graham Stein presented the proposal and explained the rationale behind the changes being suggested.

4.2. The Workgroup met 4 times over the period between 4th December 2012 and 19th June 2013 where the following topics were discussed.

Requirement for Information on Small Embedded Power Stations

4.3. Initial discussion began with National Grid explaining why more information about Embedded Small Power Stations is required. The impact of embedded generation on both the design and operations businesses within National Grid was explained.

4.4. For the design stages, demand security assessment and wider boundary flows were addressed.

4.4.1. For demand security purposes, it was highlighted that the contribution of embedded generation to demand needed to be assessed using reasonable planning assumptions such that super-grid transformers are adequately sized to meet the demand in the event that the contribution from embedded generation is substantially reduced.

4.4.2. For wider boundary flows, it was shown that for certain boundaries, embedded generation can lead to increased power flows. This can potentially have an impact on the amount and timing of network reinforcements. It is therefore essential for National Grid to have better information about the embedded generation connected to the network.

4.5. For the operations business, it was stated that demand forecasting was becoming increasingly difficult to manage due to the uncertainty of the contribution from embedded generators. The current information received by National Grid does not have enough granularity to enable appropriately accurate estimations to be made.

4.6. Examples of the types of information that would be useful to National Grid were shared with the DNO representatives. The general consensus amongst the DNOs was that most of the information requested could be obtained, but that any new obligations to provide it need to be subject to a clear demonstration that the benefits of receiving it outweighed the cost of providing it.

4.7. It was suggested that an open book policy be adopted i.e. that DNOs provided all the information currently held so that National Grid could filter for any useful data. However the DNO representatives preferred that National Grid provided a list of requirements which would then be assessed to determine whether the information can be reasonably provided or not.

4.8. The information that DNOs could hold on Embedded Small Power Stations according to the current Distribution Code (DC) was reviewed. DNOs reminded the Workgroup that the DC only entitles DNOs to request information from embedded generators and that there is no obligation on the DNOs to ask for all the information in the DC if it is

not efficient to do so (i.e. if the information is not necessary for planning networks or for other purposes).

4.9. The Workgroup also discussed the best practice for sharing the information and it was highlighted that a consistent approach needs to be adopted by all network companies

List of Requirements

4.10. This section presents the list of items that were discussed in the Workgroup. Justifications were provided to the DNOs to support the need for requesting additional information about the Embedded Small Power Stations (ESPS)

4.11. The following items were discussed;

For ESPS above 1MW:

- Unique reference for each ESPS
- Fuel type for each ESPS
- The registered capacity for each ESPS
- The existing node on the single line diagram to which each ESPS connects to
- The geographical location of each ESPS
- The Short Circuit Contribution for 3 phase faults (with a reasonable attenuation factor applied to account for the impedance between the ESPS and the node on the single line diagram)
- The mode of operation that each ESPS can operate in. (e.g. Voltage control, Power Factor control)
- Loss of main protection type and relay settings

For ESPS below 1MW:

- An equivalent power station per node on the single line diagram to represent an aggregation of all wind generation
- An equivalent power station per node on the single line diagram to represent an aggregation of all Photo Voltaic generation
- An equivalent power station per node on the single line diagram to represent an aggregation of all other SEPS
- The geographical location of each node on the single line diagram where weather related intermittent power station (below 1MW individual capacity) have been identified.
- Loss of Main Protection type and relay settings

Other Requirements:

- Pure demand which is the demand which the system would see if there was no contribution from embedded generation.

Unique reference for each ESPS

4.12. The requirement for a unique identifier for each ESPS above 1 MW was discussed with the DNOs, explaining that this information will enable National Grid to distinguish between each ESPS. It was added that having a unique identifier enables units to be easily recognised and directed to if there are queries relating to particular units in the future.

4.13. It was suggested that the Meter Point Administration Number (MPAN) can be provided along with the site name to provide a unique identifier for the ESPS but this proposition was declined on the grounds that that there could be commercial issues with publishing MPANs. The Workgroup agreed to go with a reference unique to each DNO licence area. This which would become further distinct when combined with the additional information provided (i.e. fuel type, registered capacity etc.)

Fuel type of each ESPS

4.14. The requirement for the fuel type of each ESPS was also discussed as this would enable National Grid to forecast the output of intermittent generation (e.g. wind and PV generators) which is dependent on location and weather conditions. It was highlighted that about 3.5 GW of weather related embedded generation (2GW of wind and 1.5GW of PV) is introducing errors in the demand forecasts, being currently not visible to National Grid. It was therefore explained that this information would enable network operators to forecast demand to a better accuracy thereby reducing the demand forecasting errors currently obtained.

4.15. National Grid mentioned that for planning studies specific scaling factors for different plants types are used, and as a result having information about the fuel types would be very useful.

4.16. The list of fuel type-definitions was discussed by the Workgroup and it was agreed that the types defined in the Regulatory Instructions and Guidance (RIGs) document (Ref: 83/07 version 2 published in April 2007) should be adopted as best practice. It was noted that the RIGs refers to the term 'technology types' instead of 'fuel types'. For the purposes of this Workgroup, both terms are interchangeable.

Registered Capacity of each ESPS (MW and MVar)

4.17. The requirement for the registered capacity (MW and Mvar) of each ESPS was discussed within the Workgroup on the basis that it would help National Grid to forecast the contribution of ESPS to active and reactive demand under different scenarios. The DNOs were reasonably happy to provide the MW capacity but not the Mvar capacity claiming that in general ESPS are assumed to operate at unity power factor although they typically have a capability of between 0.95 Power Factor lead and 0.95 Power Factor lag.

4.18. It was agreed within the Workgroup that only the MW capacity would be provided by the DNOs and that National Grid would assume that ESPS operate at unity power factor unless informed otherwise by the DNOs. It was agreed that DNOs would inform National Grid if certain plants were specifically instructed to contribute to reactive power and provide voltage support.

Connection Node on the single line diagram

4.19. The requirement for the connection node on the single line diagram where each ESPS connects to was articulated by National Grid as being an essential a piece of information that would allow locational demand to be evaluated more accurately.

4.20. For the distribution networks that are highly meshed in nature, obtaining the connection point information at the Bulk Supply Points (BSP) instead of the Grid Supply Points (GSPs) offers a clearer picture as to where the ESPS will export most of its power to.

4.21. It was agreed following the discussions that the connection point information would be provided at the lowest voltage level node on the existing single line diagram through which the ESPS would be expected to export the majority of its energy.

The geographical location of each ESPS

4.22. The requirement for the geographical location of each ESPS was discussed within the Workgroup where it was stated that the information is required to enable National Grid to accurately forecast the output of the ESPS based on a location specific weather condition. It was agreed this requirement would be only applicable to Wind and PV based ESPS as the outputs of other types of ESPS are independent of location.

4.23. National Grid also confirmed that only one geographical location would be required for each ESPS even if they comprised of a number of dispersed generators as this would be adequate for forecasting purposes.

4.24. Two options were considered for the geographical location:

1) The connection point of the ESPS or

2) The primary substation or higher voltage substation to which the ESPS is connected.

It was agreed that the latter would be provided as in each case; there could be a considerable distance between the actual location of the ESPS and the connection point or the primary substation. For convenience, National Grid agreed to receive the location of the primary substation or higher voltage substation (whichever applies) as the DNOs already have the information directly available.

4.25. It was agreed within the Workgroup that the location of the primary substation (or higher voltage substation) would be specified using either geographical coordinates consisting of latitudes and longitudes or grid reference coordinates, although workgroup members acknowledged that this may mean more work for DNOs (compared to using postcodes for example).

The Short Circuit Contribution of each ESPS

4.26. This topic was addressed within the Workgroup where National Grid requested that the fault in-feed for three phase faults were to be supplied at the relevant nodes on the single line diagram (or Bulk Supply Points –BSPs). DNOs were also requested to provide impedances between the nodes on the single line diagram for meshed networks so that the fault current contribution of some ESPS could be evaluated at different BSPs.

4.27. The DNOs explained that short circuit in-feed data is provided to National Grid for each node shown on the single line diagram via schedule 5 of the week 24 submissions. However, this assumes that all ESPS are connected and can therefore contribute to the fault current.

4.28. To strengthen the need for this information, National Grid stated that that the running arrangements of certain substations had to be changed (i.e. split) due to the fault in-feed from the distribution networks. In operational timescales, some ESPS would not be connected, thereby reducing the overall fault in-feed. The running arrangement initially implemented because of a high fault level condition might no longer be optimal in operational timescales.

4.29. The workgroup discussed how fault contributions from ESPS could be evaluated accurately in operational timescales by using the real time availability of the ESPS, the short circuit models of each individual unit and appropriate network models. Since the provision of all this information would be time consuming and out of the scope of the Workgroup, the request for the short circuit contributions was dropped by National Grid. It was agreed that if additional short circuit information relating to specific sites was required by National Grid under reasonable grounds, DNOs could then consider the request.

The voltage or power factor control of each ESPS

4.30. Reactive power contribution from ESPS was then discussed and National Grid explained that understanding the behaviour of ESPS with regards to reactive power could potentially help in better managing the voltage on the transmission system.

4.31. DNOs were concerned that the information was not readily available and requested that the benefits be quantified before any resources and time was spent in obtaining the additional information. The DNOs explained that the ESPS mostly operate at unity power factor and therefore do not provide any reactive power support to the network.

4.32. National Grid agreed that unity power factor operation would be assumed unless informed by the DNOs that particular ESPS are specifically requested to operate in voltage control mode or power factor control mode with a target power factor outside unity .

Loss of main protection types and settings

4.33. It was also highlighted that it would be highly beneficial to receive information about the loss of Main Protection types and relay settings as this would allow National Grid to estimate the amount of generation that could potentially trip following a large in-feed loss.

4.34. The group noted there was another Workgroup addressing the issue of RoCoF settings[1] and that there was a risk of duplicating work. National Grid explained that the Workgroup would only provide RoCoF (Rate of Change of Frequency) information on a one-off basis whilst the current Workgroup was seeking this information on an on-going basis.

4.35. It was concluded that DNOs should provide the Loss of Mains protection types and their relay settings for all ESPS connected during and after the Calendar Week 24 submission beginning 2015. For all ESPS connected prior to this date, the information should be provided on a reasonable endeavour basis. The group noted that there will be a need to review the Distribution Code to ensure that this information can be collected.

Requirements for ESPS below 1MW

4.36. A request was made by National Grid for DNOs to provide the following information about Embedded Small Power Stations with registered capacity below 1MW in order to increase the visibility of these small units. It was proposed that an accuracy level of 1MW on either side would be acceptable for each node.

- An equivalent power station per node on the single line diagram to represent an aggregation of all wind generation
- An equivalent power station per node on the single line diagram to represent an aggregation of all PhotoVoltaic (PV) generation
- An equivalent power station per node on the single line diagram to represent an aggregation of all other types of ESPS
- The geographical location of each node on the single line diagram where weather related intermittent power station (below 1MW individual capacity) have been identified.
- Loss of Mains protection types and relay settings

4.37. It was stated that DNOs would have the information for ESPS connected under the Engineering Recommendation (ER) G59/2 which covers generating units with a rating of above 16A per phase, equivalent to about 3.7 kW for single phase connections and 11.1 kW for 3 phase connections. However most PV-based ESPS, for which National Grid is seeking data, would be connected outside the scope of ER G59/2 and very often these generators do not inform DNOs about their connections. DNOs would therefore not have the required information for these units. It was also suggested that Feed-in-tariff registers could be used to obtain visibility of the ESPS below 1MW but the idea proved to be too complicated and was therefore dismissed.

[1] http://www.nationalgrid.com/uk/Electricity/Codes/gridcode/workinggroups/Frequency+Changes+during+Large+System+Disturbances/

4.38. It was recognised by National Grid that obtaining information about ESPS with registered capacities above 1MW was already a good step forward and that it might be too burdensome on the DNOs, if more information was to be requested at this stage. There was a general consensus amongst the DNOs that the process should be tacked in steps and that it would be better to address the ESPS below 1MW in the future.

4.39. The workgroup agreed not to progress proposals for information about ESPS below 1MW for the time being. It was recommended that National Grid should engage further with the DNOs in the future to ensure that high quality information can be obtained for the ESPS below 1MW.

Request for Pure Demand Data

4.40. A request for demand data to be submitted in its pure form i.e. irrespective of the contribution from embedded generators was articulated by National Grid on the grounds that it would facilitate net demand forecasting. It was stated that knowing the pure demand along with registered capacity and fuel types of ESPS, would make the estimation of the net demand easier and more accurate.

4.41. It was also added that at the time of the peak GB Transmission System Demand, pure demand data would be required for each node shown on the single line diagram (PC.A.4.3.4) and this data would need to be consistent with those provided for the same time at the GSP level (PC.A.4.3.1 (b)). The ratio of GSP demand to distribution demand data is used by National Grid to populate all operational security studies.

4.42. To justify the requirement for pure demand further it was explained that the meshed nature of some DNO networks implied that having knowledge of the exact location and magnitude of demand independently from knowledge of the exact location and magnitude of ESPS will enable significantly more accurate network models to be developed for security analysis purposes.

4.43. The common view expressed by the DNOs to this effect was that National Grid is already provided, as part of the Week 24 submissions, with the net demand and the summated contribution from embedded generation at the GSPs. Therefore to obtain the pure demand, the net demand and the sum of the output from ESPS would need to be added.

4.44. It was highlighted by National Grid that the generation data submitted through the Week 24 route did not take into account all the ESPS and therefore the above methodology for calculating the pure demand would not be adequate. It was confirmed by the DNOs that the generation data submitted contained all the half-hourly metered ESPS. However below a certain threshold (30kW mentioned), data is not available on a half-hourly basis.

4.45. Since the group had concluded it was not appropriate to require DNOs to submit any information relating to ESPS below 1MW, the group decided not to pursue the concept of pure demand further. In addition, it was mentioned that the issue of “pure demand” would likely be a more relevant subject for discussion at other working groups such as that for Engineering Recommendation P2/7, where the implications of understanding the security contribution from ESPS may be more pertinent.

Active Network Management

4.46. Active Network Management was also discussed and it was confirmed by the DNOs that National Grid would be informed, via the statement of works process, if any restriction was imposed on the power output from ESPS. This could happen for example if overloads occurred on National Grid's assets in the case of an exporting Grid Supply Point or where a limit in export impacts on the management of the wider transmission system.

Alignment to European Codes

4.47. It was briefly discussed in the meetings that the information requested from the DNOs about the ESPS should be aligned to European legislation and that any definitions of terms used within the Grid Code with respect to the information requested from ESPS be aligned with the definitions of terms used in the European Codes as well as the GB Distribution code.

4.48. The Workgroup discussed the implications of the European Commission's Regulation on transparency and provision of information in electricity markets. The group noted that the information that TSOs (which includes National Grid) and market participants were likely to be entitled to receive (and TSOs could be obliged to publish) under the Regulation with respect to ESPS was consistent with the dataset under discussion. The new regulation stipulated that static data for generation of 1MW and above (e.g. capacity) should be made available to all.

Data Submission and Implementation date

4.49. The proposed time scale of the data submission was confirmed to be together with the Week 24 Data submission. It was recognised that more information will need to be provided in the yearly submission but this would not substantially change from year to year given that the static data on each ESPS would rarely change. This would therefore reduce the on-going effort to maintain the data for subsequent years.

4.50. The implementation date for the changes to become effective was discussed. National Grid suggested the 2014 Week 24 data submission as a possible target date. However, considering the amount of data processing that DNOs would have to carry out as well as the time required to amend parts of the Distribution Code, the implementation date was postponed to the 2015 Week 24 data submission, which was considered more achievable.

4.51. The Workgroup noted there may be a need to gather some of the proposed data items prior to the implementation date of 2015 to satisfy the European Transparency regulation. This could be enacted via a staged implementation in the Grid Code or a separate information request. The Workgroup favoured implementing a single process change for 2015.

5. Impact & Assessment

Impact on the Grid Code

5.1. The Workgroup recommends amendments to the following parts of the Grid Code:

- PC.A.3.1.4
- PC.A.5.1.3
- DRC.6.1.11
- Schedule 11 of the Data Registration Code

5.2. The text required to give effect to the proposal is contained in Annex 3 of this document.

Impact on National Electricity Transmission System (NETS)

5.3. Embedded generation capacity has grown and is expected to continue to do so. Its contribution already has a material impact on the flows on, off and through the transmission system. The proposed changes will facilitate more efficient investment decisions in transmission system development and will facilitate more efficient transmission system operation by enabling transmission companies to account for embedded generation appropriately.

Impact on Grid Code Users

5.4. The proposed changes to the Grid Code are for clarification and will impact on the information processing activities within DNOs which allow information to be supplied to National Grid.

Impact on Other Users

5.5. There will also be an impact on generators, who may be contacted by DNOs should the latter currently not have the information requested by National Grid (e.g. loss of main protection types and relay settings)

Impact on Greenhouse Gas Emissions

5.6. The Workgroup recommendation will facilitate a reduction in demand forecasting errors and therefore a reduction in the emissions associated with operating reserve.

Assessment against Grid Code Objectives

5.7. The Workgroup considers that the proposed amendments would better facilitate the Grid Code objective:

to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

This proposal better facilitates this objective by providing the information required to better forecast the demand presented to the transmission system for the purposes of operating and developing the transmission system

to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);

The proposal has a neutral impact on this objective

subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and

The proposal better facilitates this objective by providing the information required to forecast the demand presented to the transmission system

to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

The proposal is consistent with the European Commission's transparency proposals.

Impact on other industry documents

5.8. The proposed modification will have an impact on the Distribution Code with regards to the request for the loss of mains protection types and settings which is currently not part of the Distribution Code.

Implementation

5.9. The Workgroup proposes that, should the proposals be taken forward, the proposed changes be implemented 10 business days after an Authority decision. The proposed Grid Code changes would require new information to be provided in 2015 along with the Week 24 data submissions.

6. Workgroup Recommendations

6.1. The Workgroup recommended that the changes to the Grid Code identified in Annex 3 should be progressed to Industry Consultation. The objective of these changes is to improve clarity with regards to the contribution of Embedded Small Power Stations (ESPS) to demand.

6.2. The Workgroup recommended that the following additional information is requested for each ESPS with registered capacity of 1 MW and above:

- A reference unique to each DNO licence area
- The fuel type or technology type, as per the definitions laid out in the Regulatory Instructions and Guidance Document (RIGs), Ref: 83/07, version 2 published in April 2007.
- The registered capacity in MW (as defined in the Distribution Code)
- The lowest voltage level node on the existing week 24 single line diagram to which it connects or exports most of its power
- The geographical location specified using latitude and longitude or grid reference coordinates of the primary or higher voltage substation, whichever is applicable. This is required only for wind and photo voltaic-based ESPS.
- The control mode (if it operates in voltage control or power factor control mode). Where it operates in voltage control mode the voltage set-point and reactive range must be provided. Where it operates in power factor mode the target power factor must be provided unless it operates at unity power factor.
- Loss of main protection type and relay settings for all ESPS connected during or after the Calendar Week 24 data submission beginning 2015. For ESPS connected prior to this date, the information should be provided on a reasonable endeavour basis.

6.3. The following amendments will be made to reflect the new requirements for ESPS of 1MW and above

- Sections PC.A.3.1.4, PC.A.5.1.3 and PC.A.5.1.4 of the Planning Code,
- Section DRC.6.1.11 and Schedule 11 of the Data Registration Code

6.4. The Distribution code would need to be reviewed to enable the DNOs to capture any additional information that they are currently not entitled to receive from the ESPS (e.g. Loss of Mains protection type and relay settings)

Annex 1 – GCRP Paper pp 12/02

Grid Code Review Panel – Issue Assessment Proforma

Information on Embedded Small Power Stations and its Impact on Transmission System Demand

Date Raised: 18 January 2012

GCRP Ref: pp12/02[2]

A Panel Paper by Graham Stein

National Grid Electricity Transmission

Summary

The growth in the capacity of Embedded generation is having an increasing impact on the way the National Electricity Transmission System (NETS) is designed and operated. There was an estimated 7.6GW of embedded generation capacity installed in 2006 which is expected to grow to 11.3GW in 2015. This now offsets a significant proportion of the demand presented to the Transmission System.

High embedded generation output means that less Demand is seen on the Transmission System. When embedded generation output is low, observed Demand is higher. This is the case both for Active Power and Reactive Power Demand and can impact on local reinforcement and asset replacement requirements as well as wider boundary transfers.

A change to PC.A.4 has been developed for this document as an example for discussion. The change would add a requirement for the submission of additional data in regard of Embedded Small and Medium Power Stations and amendment of the related deductions made in the User's existing Demand submission would provide essential additional information. This paper recommends that interested parties should be brought together to review current arrangements in this area and develop proposals for appropriate changes

Users Impacted

High - None Identified

Medium - Network Operators

Low - None Identified

Description & Background

The information provided under the Grid Code has been specified to ensure that National Grid can meet its statutory obligations in planning and operating the National Electricity Transmission System. However, the information items exchanged do not fully capture the volume and variability that National Grid as the National Electricity Transmission System Operator is now seeing in Embedded generation, and expects to see in the future.

The existing data is appropriate for the evaluation of high Demand conditions in areas with low levels of Embedded generation. Where the capacity of Embedded generation is high, there is the risk that Transmission System capacity may be inadequate in situations where Embedded generation is running at high or low output levels.

[2] The Code Administrator will provide the paper reference following submission to National Grid.

One possible approach is to change PC.A.4 to add a requirement for the submission of additional data. The new data concerns Embedded Small and Medium Power Stations and the related deductions made in the User's existing Demand submission in respect of PC.A.4.3.1(b); Connection Point Demand at NETS Peak. This would allow the Demand seen by the transmission system to be represented more effectively by supplementing the information supplied under PC.4.3.2(d) (the User's opinion of the largest Demand that may reasonably be placed on the NETS) and would allow Embedded generation to be considered in a manner consistent with that applied to Transmission connected generation. The provision of this data would enable better Transmission System capacity planning and would promote the efficiency and security of the Transmission System.

Some Users already provide this information and thus such a change could standardise the requirement and enable National Grid to make better use of the data requested. The requested additional data items are predominantly available in the current Distribution Code (DPC7.3.2 and Schedule 5e). One additional refinement is the inclusion of generator 'fuel type' information in order that different generators may be set to varying availabilities.

Proposed Solution/Next Steps

It is proposed that a working group comprising National Grid, Network Operators and any other interested parties should develop a consensus on a set of changes to the existing PC and DRC that facilitate change.

The group could also usefully consider information relating to Reactive Power exchange at the boundary between the Transmission and Distribution networks. Additionally, the group could consider the most effective way to capture the necessary information. For example, does a 1MW threshold strike the right balance in providing enough detail (to capture solar PV for instance) without presenting an excessive burden on Users? There may be more effective ways to exchange the necessary data given current practice in Network Operators which a working group could develop.

Impact & Assessment

Impact on the National Electricity Transmission System (NETS)

National Grid has not identified any impacts that the proposed modification will have on the National Electricity Transmission System.

Impact on Greenhouse Gas Emissions[3]

National Grid has not identified any impacts that the proposed modification will have on Greenhouse Gas emissions.

Impact on core industry documents

The proposed modification does not impact on any core industry documents

Impact on other industry documents

The proposed modification may have some impact on the Distribution Code (DCode).

[3] The most recent guidance on the treatment of carbon costs under the current industry code objectives can be found on the Ofgem website at:
http://www.ofgem.gov.uk/Licensing/IndCodes/Governance/Pages/Governance.aspx

Assessment against Grid Code Objectives

Will the proposed changes to the Grid Code better facilitate any of the Grid Code Objectives:

(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

The proposal better facilitates this objective by providing the information required to forecast the demand presented to the transmission system

(ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);

The proposal is neutral on this objective.

(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and

The proposal better facilitates this objective by providing the information required to forecast the demand presented to the transmission system

(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

The proposal is neutral on this objective.

Supporting Documentation

Have you attached any supporting documentation	**YES**
If Yes, please provide the title of the attachment:	**Proposed Grid Code Drafting**

Recommendation

The Grid Code Review Panel is invited to **approve this issue for progression to a Working Group**.

GCRP Decision (to be completed by the Committee Secretary following the GCRP)

The Grid Code Review Panel determined that this issue should:

INSERT GCRP DECISION

Proposed Grid Code Drafting

The text below illustrates the changes required to the Grid Code to implement the change outlined above. New text is shown in red.

PC.A.4.3.2 All forecast **Demand** specified in PC.A.4.3.1 shall:

(a) be that remaining after any deductions reasonably considered appropriate by the **User** to take account of the output of all **Embedded Small Power Stations** and **Embedded Medium Power Stations** greater than 1MW and **Customer Generating Plant** and imports across **Embedded External Interconnections** and such deductions should be separately stated and include;

(i) Generator name
(ii) maximum Real Power output (MW)
(iii) output assumed under PC.A.4.3.2(c) for the date and time of annual peak National Electricity Transmission System Demand
(iv) name of Connection Point(s) to which the Embedded Power Station ultimately connects
(v) name and voltage of distribution substation nearest to the Embedded Power Station which is detailed in the Single Line Diagram submitted under PC.A.2.2.2
(vi) Generator fuel type
(vii) year of connection of Generator
(viii) where the sum of Embedded Small Power Stations of less than 1MW summate to 5MW or more, this total shall be stated

Annex 2 – Terms of Reference

pp12/26
May 2012 GCRP

GCRP Workgroup on Information on Embedded Small Power Stations and its Impact on Transmission System Demand

TERMS OF REFERENCE

Governance

1. This Workgroup, entitled "Information on Embedded Small Power Stations and its Impact on Transmission System Demand " is established by the Grid Code Review Panel.

2. The group shall formally report to the GCRP.

Membership

3. The Workgroup shall comprise a suitable and appropriate cross-section of experience and expertise from across the industry, which shall include:

Name	Role	Representing
Graham Stein	Chair	National Grid
Djaved Rostom	Technical Secretary	National Grid
Vandad Hamidi	National Grid Representative	National Grid
Brian Roberts	National Grid Representative	National Grid
Damien McCluskey	National Grid Representative	National Grid
Andrew Kensley	National Grid Representative	National Grid
Saeed Ahmed	DNO Representative	GTC
Andrew Akani	DNO Representative	Western Power
Peter Bolitho/ Paul Brennan	Generator Representative	Waters Wye
Ian Fletcher	DNO Representative	Northern Powergrid
Paul Graham	Generator Representative	UK Power Reserve
Mike Kay	DNO Representative	Electricity North West
Campbell McDonald	Generator Representative	SSE Generation
Kenny Stott/ Ammad Zulfikar	DNO Representative	SSE

Meeting Administration

4. The frequency of Workgroup meetings shall be defined as necessary by the Workgroup chair to meet the scope and objectives of the work being undertaken at that time.

5. National Grid will provide technical secretary resource to the Workgroup and handle administrative arrangements such as venue, agenda and minutes.

6. The Workgroup will have a dedicated section under the Grid Code part of National Grid's website. This will enable information such as minutes and presentations to be available to a wider audience.

Scope

7. The Workgroup will:

- Review the information currently provided by Network Operators to National Grid concerning Embedded Small Power Stations;
- Review how this information is used to develop, plan and operate the Transmission System;
- Identify any inconsistencies between how Small Power Stations connected to Users' networks can be accounted for in the development, planning and operation of the Transmission System compared to Medium and Large Power Stations;
- Identify any information which is necessary and not provided;
- Identify any information which is provided but is no longer necessary;
- Develop recommendations to eliminate inconsistencies, omissions or unnecessary information provision where there is a material benefit in doing so.
- Take account of relevant international practice and the approach taken in European Code development.

Deliverables

8. The Workgroup will provide updates and a Workgroup report to the Grid Code Review Panel which will:

- Detail the findings of the Workgroup;
- Draft, prioritise and recommend changes to the Grid Code, Distribution Code and associated documents in order to implement the findings of the Group; and
- Highlight any consequential changes which are or may be required.

Timescales

9. It is anticipated that this Workgroup will discuss the issue and determine appropriate timescales. Once these timescales have been determined, the Workgroup will confirm with the GCRP that they are suitable.

10. If for any reason the Workgroup is in existence for more than one year, there is a responsibility for the Workgroup to produce a yearly update report, including but not limited to; current progress, reasons for any delays, next steps and likely conclusion dates.

Annex 3 - Proposed Legal Text

This section contains the proposed legal text to give effect to changes identified by the Workgroup. The proposed new text is in red and is based on Grid Code Issue 5 Revision 3.

PC.A.3.1.4 (a) PC.A.4.2.4(b) and PC.A.4.3.2(a) explain that the forecast Demand submitted by each Network Operator must be net of the output of all Small Power Stations and Medium Power Stations and Customer Generating Plant and all installations of direct current converters which do not form a DC Converter Station, Embedded within that Network Operator's System. The Network Operator must inform NGET of:

i) the number of such Embedded Power Stations and such Embedded installations of direct current converters (including the number of Generating Units or Power Park Modules or DC Converters) together with their summated capacity; and

ii) in calendar week 24 each year, beginning from 2015, for each **Embedded Small Power Station** of registered capacity (as defined in the Distribution Code) of 1MW or more:

A reference which is unique to each **Network Operator**

The technology type(s) used, selected from the list set out at paragraph 2.23 in Version 2 of the Regulatory Instructions and Guidance relating to the distributed generation incentive, innovation funding incentive and registered power zones, reference 83/07, published by Ofgem in April 2007

The registered capacity (as defined in the Distribution Code) in MW

The lowest voltage level node that is specified on the existing calendar week 24 **Single Line Diagram** to which it connects or where it will export most of its power

Where it generates electricity from wind or PV, the geographical location using either latitude and longitude or grid reference coordinates of the primary or higher voltage substation to which it connects

The control mode, if it operates in voltage control or **Power Factor** mode. Where it operates in voltage control mode the **Network Operator** must provide **NGET** with the voltage set-point and reactive range. Where it operates in **Power Factor** mode the **Network Operator** must provide **NGET** with the target **Power Factor**, unless it operates at unity **Power Factor**

Details of the types of loss of mains **Protection** in place and their relay settings for each **Embedded Small Power Station** connected to the **National Electricity Transmission System** during or after the calendar week 24 beginning 2015

In calendar week 24 each year, beginning from 2015, the **Network Operator** must also use reasonable endeavours to inform **NGET** of the details of the types of loss of mains **Protection** in place and their relay settings for each **Embedded Small Power Station** of registered capacity of 1MW or more connected to the **National Electricity Transmission System** prior to the calendar week 24 beginning 2015.

PC.A.5.1.3 Each **Network Operator** need not submit **Planning Data** in respect of **Embedded Small Power Stations** unless required to do so under PC.A.1.2 (b), PC.A.3.1.4 or unless specifically requested under PC.A.5.1.4 below, in which case they will supply such data. The following items will be required for

PC.A.5.1.4 PC.A.4.2.4(b) and PC.A.4.3.2(a) explained that the forecast **Demand** submitted by each **Network Operator** must be net of the output of all **Medium Power Stations** and **Small Power Stations** and **Customer Generating Plant Embedded** within that **User's System**. In such cases (PC.A.3.1.4 also refers), the **Network Operator** must inform **NGET** of the number of such **Power Stations** (including the number of **Generating Units**) together with their summated capacity. In calendar week 24 each year, beginning from 2015, for each **Embedded Small Power Station** of registered capacity (as defined in the Distribution Code) of 1MW or more, the **Network Operator** must also inform **NGET** of:

A reference which is unique to each **Network Operator**

The technology type(s) used, selected from the list set out at paragraph 2.23 in Version 2 of the Regulatory Instructions and Guidance relating to the distributed generation incentive, innovation funding incentive and registered power zones, reference 83/07, published by Ofgem in April 2007

The registered capacity (as defined in the Distribution Code) in MW

The lowest voltage level node that is specified on the existing calendar week 24 **Single Line Diagram** to which it connects or where it will export most of its power

Where it generates electricity from wind or PV, the geographical location using either latitude and longitude or grid reference coordinates of the primary or higher voltage substation to which it connects

The control mode, if it operates in voltage control or **Power Factor** mode. Where it operates in voltage control mode the **Network Operator** must provide **NGET** with the voltage set-point and reactive range. Where it operates in **Power Factor** mode the **Network Operator** must provide **NGET** with the target **Power Factor**, unless it operates at unity **Power Factor**

Details of the types of loss of mains **Protection** in place and their relay settings for each **Embedded Small Power Station** connected to the **National Electricity Transmission System** during or after the calendar week 24 beginning 2015

In calendar week 24 each year, beginning from 2015, the **Network Operator** must also use reasonable endeavours to inform **NGET** of the details of the types of loss of mains **Protection** in place and their relay settings for each **Embedded Small Power Station** of registered capacity of 1MW or more connected to the **National Electricity Transmission System** prior to the calendar week 24 beginning 2015.

DRC.6.1.11 Schedule 11 - Connection Point Data

Comprising information relating to **Demand**, demand transfer capability and ~~a summary of~~ the **Small Power Station**, **Medium Power Station** and **Customer** generation connected to the **Connection Point**

The following amendments to schedule 11 of the Data Registration Code are also required

Small Power Station, **Medium Power Station** and **Customer** Generation Summary	For each **Connection Point** where there are **Embedded Small Power Stations**, **Medium Power Stations** or **Customer Generating Stations** the following information is required:										
No. of **Small Power Stations**, **Medium Power Stations** or **Customer Power Stations**											**PC.A.3.1.4 (a)**
Number of **Generating Units** within these stations											**PC.A.3.1.4 (a)**
Summated Capacity of all these **Generating Units**											**PC.A.3.1.4 (a)**
	For each **Embedded Small Power Station** of 1 MW and above, the following information is required, effective 2015 in line with the week 24 data submissions										
A reference unique to each **Network Operator**											**PC.A.3.1.4 (a)**
The technology type(s) used, as defined at paragraph 2.23 in Version 2 of the Regulatory Instructions and Guidance relating to the distributed generation incentive, innovation funding incentive and registered power zones, reference 83/07, published by Ofgem in April 2007											**PC.A.3.1.4 (a)**
Registered capacity in MW (as defined in the **Distribution Code**)											**PC.A.3.1.4 (a)**
Lowest voltage node on the existing calendar week 24 **Single Line Diagram** to which it connects or where it will export most of its power											**PC.A.3.1.4 (a)**
Where it generates electricity from wind or PV the geographical location (either latitude and longitude or grid reference coordinates) of the primary or higher voltage substation to which it connects											**PC.A.3.1.4 (a)**
Control mode of the **Embedded Small Power Station**. If operating in voltage control mode, the voltage target and reactive range should be stated. If operating in **Power Factor** mode, the target **Power Factor** should be specified, unless it operates at unity **Power Factor**											**PC.A.3.1.4 (a)**

Loss of main protection type and relay settings for each **Embedded Small Power Station** connected to the **National Electricity Transmission System** during or after the 2015 calendar week 24 data submission.											**PC.A.3.1.4 (a)**
On a reasonable endeavour basis, loss of main protection type and relay settings for each **Embedded Small Power Station** connected to the **National Electricity Transmission System** prior to the 2015 calendar week 24 data submission.											**PC.A.3.1.4 (a)**

Annex 4 – List of Items Required by National Grid

List of items required by National Grid for Embedded Small Power Stations (ESPS) with registered capacities of 1MW and above

	Requirements	Justifications	Comments
1	Unique reference for each ESPS	To enable National Grid to distinguish between each ESPS above 1 MW	The Site reference of the ESPS is required. With the additional information requested, each ESPS can be uniquely identified
2	Fuel type or technology type for each ESPS	To enable National Grid to evaluate load factors for different plant types. Knowing the different plant types would enable National Grid to establish the correct load factors for different weather conditions and this is essential for accurate demand forecasting.	The definition of fuel types (or technology type) contained in the Regulatory Instructions and Guidance (RIGs) will be adopted.
3	The registered capacity for each ESPS (MW)	To enable National Grid to evaluate the contribution of ESPS at different times by applying the respective scaling factors. This would also help in demand forecasting.	The term 'registered capacity' as defined in the Distribution Code will be used
4	The lowest voltage node on the existing single line diagram to which each ESPS connects or exports most of its power.	To enable National Grid to model the electrical location of power in-feed from the ESPS.	DNOs to provide National Grid with new nodes if the single line diagram is updated in the future.
5	The geographical location of each Wind and PV based ESPS, whose outputs are location dependent.	To enable National Grid to accurately forecast the output of generators (especially intermittent types) where the source of energy driving the prime mover varies with geographical location	This location corresponds to the location of the Primary or higher voltage substation which the ESPS connects to and should be specified either as geographical coordinates (i.e. latitude and longitude) or grid reference coordinates
6	The control mode of the ESPS i.e. whether it operates in voltage control or power factor control	To enable National Grid to evaluate the reactive power contribution from the ESPS at specific times.	Where the ESPS operates in voltage control mode, the voltage set point and reactive range is required. Where the ESPS operates in power factor mode, the target power factor is required unless it operates at unity power factor
7	Loss of Main Protection Types and relay settings of each ESPS	To enable National Grid to use such data combined with Frequency Management tools to estimate the system risk in case of loss of in-feed as a result of various rate of change of frequency levels.	DNOs are requested to provide the information for new ESPS connections made during or after the week 24 submission beginning 2015. For ESPS connections made prior to this date, DNOs must use reasonable endeavours to provide the information