NETWORK INFORMATION PROVISION TO POTENTIAL GENERATORS

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EXECUTIVE SUMMARY

At the time of finalising this report, an Ofgem consultation is underway on the form of Distribution Licence Condition 25, which will state the requirements for Distribution Network Operators to provide and publish data. This report is also relevant to the DTI Ofgem Embedded Generation Working Group (EGWG), which has recently completed its report and recommendations. It is hoped that this document will provide an overview of the status, importance, role and benefits of network information, which can be utilised by Generators, Network Operators and other industry players in framing their responses to this and future consultations.

The report compares the information available to developers of embedded generators, who wish to connect to distribution networks, to the data available to developers of larger transmission connected generators. The Seven Year Statements (SYS) of Transmission Operators were undoubtedly important in the "dash for gas" following privatisation and, therefore, provide a model and basis for Distribution Network Statements (DNS). Distribution Network Statements will be required in the move towards distributed generation, especially the development of renewables, Combined Heat and Power (CHP) and micro generation in the future.

The report acknowledges that it would be an onerous task to provide a DNS, which covered all distribution assets, as the extent of this data would be several orders of magnitude greater than the data in SYS. However, a DNS which included 132, 66 and 33kV assets down to the 11kV busbars of primary substations would have on average two to three times the data in National Grid Company's (NGC's) SYS.

Network data and information is even more important for new embedded generators as they are subject to deep connection charges compared to transmission-connected generation, which only pays shallow or local connection charges.

Analysis suggests that the costs of producing such a statement might be in the order of £200,000 per DNO per year, probably much more for some in the first year but declining with time. The benefits would be considerable and are discussed. A number of possible alternative scenarios in which savings would equal the DNS costs are considered:

- Reducing connection costs for embedded generation by 3%;
- Saving DNO capital expenditure of 0.2% (but delivering the same level of service improvements);
- Bringing forward, by 12 months, 8MW of renewable generation in each DNO each year.

It should be noted that the DNS benefits fall primarily to generators and promote competition, while the costs are carried by the DNO. Other beneficiaries expected from a DNS include Ofgem, Government, Suppliers and Customers. DNOs are expected to benefit in relation to improved health and safety, management of confidential information, reduced DNO workloads, improved DNO customer relations, easier development of new demand connections, improved opportunities for load management, etc.

The risk reduction to DNOs by having good data should be considered. DNOs have a “fit and forget” policy with regard to a passive network. The EGWG has identified active management of networks as a key future option to accommodate increasing amounts of embedded generation and improve security of supply to customers. Active network solutions will, in many cases, require good network data and modelling to assess, optimise and implement.

The benchmarking exercise carried out for this study showed that most DNOs provided information to a high standard and free of charge. However in a few cases the charges were high, if not excessive. A few DNOs were still unwilling, unable or simply not geared to provide the most generic network data – an EHV network map.

The report makes a number of recommendations and provides:

- a draft DNS specification;
- a Pro-Forma with guidance notes for the provision, on a site specific basis, of HV (11kV) data which would not be included in the DNS; and
- a Code of Practice for the provision of maps and schematics.

The report contains a number of recommendations for Ofgem, DNOs and Generators.

Staff from each of the 15 network operator’s have co-operated substantially or fully with data requests and three DNOs have participated in discussions on the topics; their efforts are gratefully acknowledged.

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1 INTRODUCTION

Connection costs for embedded generation (meaning the generation is connected to the distribution network) vary considerably depending on the connection location, voltage of connection, and whether any network reinforcements are required. Identification of the optimal connection option for both a Distribution Network Operator (DNO) and a generator can be achieved by provision of appropriate network data by the DNO and open discussion with the generator on the connection options and associated issues.

Current practice for provision of such network data varies considerably between DNOs and even between DNO regional offices. Some DNOs provide information free of charge, and others at reasonable or nominal charges. This can enable generators to assess connection costs without the time and expense of making a formal connection application. Some DNOs have shown reluctance to provide information and/or levy what appear to be unjustifiable charges, giving potential generators no option but to make formal applications to discover whether a project connection is feasible or not.

There is often a failure to provide the 'best' connection since no codes of practice or firm regulatory guidelines exist to facilitate consistent and satisfactory practice with DNO data provision.

The Transmission Licensees (TLs) in the UK (ie NGC, Scottish Power and Scottish Hydro/SSE) currently provide an annual seven year statement (SYS) with regard to developments, constraints and opportunities on their transmission networks. Both existing and potential generators have argued that such a statement should also be provided for distribution systems. DNOs have, however, raised concerns particularly regarding the large volume of information to be provided. The feasibility and structure of Distribution Network Statements had not been pursued nor identified when this project was proposed, but could potentially provide extremely useful information for generators.

Some DNOs have acknowledged that generators can help improve network security and quality of supply, and avoid or defer reinforcements provided they are connected in the correct location. Some DNOs have been pro-active in identifying preferred locations for new generators to encourage mutual benefits, but this is not standard practice. No proper framework existed for DNOs to provide generators with such information, and hence, generators have generally been located such that opportunities for mutual benefits are missed.

1.1 Aims

The aim of this study is to promote the availability of network information to potential generators in order to facilitate and improve the connection of generators to DNO networks. Such information could potentially reduce connection costs to generators, increase speed of connection and development, reduce risks of interference with supplies to other customers, and assist in compliance with codes and standards, thus promoting health and safety.

1.2 Objectives

The original objectives of the study were to:

- Review current DNO practices regarding information provision;
- Review the potential for the provision of Distribution Network Statements by DNOs;
- Examine the feasibility of publication by DNOs of preferred locations for generation that would offer DNOs positive system benefits, thereby, helping to avoid or defer system reinforcement;
- Benchmark the cost, format, detail and timescale for information provision by DNOs.

1.3 Changes and Developments

During the time between the project proposal being put forward, the work being commissioned, and during the life of the project itself a number of changes took place in the industry. The key changes were:

- DTI Ofgem EGWG;
- Distribution Licence Condition 25;
- Ofgem Consultation on Condition 25.

1.3.1 DTI Ofgem EGWG

The Embedded Generation Working Group (EGWG) is a joint collaboration between the DTI and Ofgem. The EGWG has been considering relevant technical issues, publication of information, charging issues and other longer-term issues, which are relevant to the promotion of embedded generation. Increased embedded generation will help achieve the

Government's targets for 10% electricity sourced from renewable plant by 2010 and increased use of CHP.

There were four areas in the Terms of Reference relating to publication of information, as follows:

- *"The possible need for further requirements on distribution companies to publish sufficient technical and commercial information to allow prospective generators to make informed judgements concerning appropriate points of connection and opportunities to make proposals which would avoid the need for network reinforcement."*
- *"The adequacy of the present arrangements under which NGC and the distribution companies presently report publicly, at regular intervals, how they have facilitated competition in generation."*
- *The possible need for new rules on the publication of charges by distribution companies, so as to ensure transparency, and to provide a definitive basis for the financial appraisal of new embedded generation proposals."*
- *"The possible need for new rules on the publication of information by distribution companies on actual charges for connection to and use of systems."*

In January 2001, as a result of this investigation, the Group published a consultation document.[1] The document details a range of recommendations for improvements in the treatment of embedded generators in the energy market. Responses to the consultation were invited by 16th March 2001, and final recommendations relating to this issue are planned to be published before May 2001. The responses received as a result of the consultation were published on 7 June 2001.

Within the EGWG's report, Section 6 and Annex 6, in Volumes 1 and 2 respectively, deal with information provision to generation.

[1] 'Report into Network Access Issues', comprising two volumes. Volume 1 contains the 'Main Report and Appendices', and Volume 2 contains 'Annexes – The Rapporteurs' Papers'.

The subgroup of the EGWG working on Information Provision identified three areas of importance, the details of which are outlined below:

- *"High level network information needs to be available to meet the proposed licence requirement on DNOs to publish a network development statement:*

    - *inform the market-place generally;*
    - *enable developers to identify potential business opportunities;*
    - *provide transparency into the cost of network connections.*

  Work should commence to identify the distribution network information that should be contained in DNO's network development statements. Such statements would provide a link to accessing more detailed project specific information. [Target date: January 2002]"

- *"There needs to be an appropriate balance between the value of the information provided and the cost of providing it. Although it can be argued that in principle the level of a distribution network development statement should be similar to that of the National Grid SYS in depth and width, this may not be cost effective. Distribution systems are much more extensive in length and voltage levels, the loads and network are more dynamic. Consequently, the exercise outlined above should establish a pragmatic and economic balance between the information that is required to be generally available in the public domain and that which would be available on request. [Target date: January 2002]"*

- *"There should be a consistent approach across DNOs to the provision of information and to the connection application process. DNOs, together with other users, should work together to agree a standard format for the presentation of information including bringing forward general connection guidelines for Embedded Generation. The guidelines should clarify the roles of developers and DNOs and help to set standards both for the quality of information submitted by developers but also the quality of the response from DNOs. [Target date: January 2002]"*

1.3.2 Scottish Executive Ofgem EGWG

An equivalent EGWG has been set up under the auspices of the Scottish Executive and Ofgem in Scotland to deal with issues specific to Scotland. Network information is not considered to be a different issue, except that it is currently in a better situation compared to England and Wales. The transmission operators SYSs already cover 132kV assets in Scotland whereas this is not the case in England and Wales.

1.3.3 Ofgem's IIP

Ofgem's Information and Incentives Project (IIP) forms the start of a move from asset-based to performance-based regulation. It is aimed at further encouraging electricity distribution businesses to provide an appropriate standard of service to their customers. IIP represents a move away from asset-based regulation, whereby the returns allowed to regulated businesses are based on the value of the assets employed, towards returns based on performance regardless of the assets utilised. The document makes some limited reference to network information:

'In particular, the IIP looked to improve the quality of information collected from electricity distribution businesses. …These developments increase the importance of having access to good quality information'.[2]

'The first stage of the IIP has focused on improving the information produced by distribution businesses particularly in the areas of quality of supply and network performance'.[3]

Apart from these statements from the introduction, there are no other references within the document relating to information provision.

[2] Page 1 of IIP: incentive schemes. Initial thoughts, January 2001 (04/01)
[3] Page 2 of IIP: incentive schemes. Initial thoughts, January 2001 (04/01)

1.3.4 Distribution Licence

The Utilities Act is bringing in a Distribution Licence to compliment existing Supply, Generation and Transmission Licences. Draft Licence Condition 25 proposes requirements on Distribution Network Operators to provide information in a similar manner to the Transmission Licence. Consultation on Condition 25 has taken place during the course of this work and on 5th June 2001 Ofgem issued a full consultation on Condition 25.[4] Reponses are due by 2nd July 2001.

1.4 Deliverables

At the time of writing the proposal, the way forward was seen to be to include the requirements for information provision within the Distribution Codes and submissions of proposals to the Distribution Code Review Panels (DCRP).

Three documents were envisaged:

- A Pro-Forma (PF) for provision of standard data requests for generation connection;
- A Code of Practice (CoP) governing standards and methods for the provision of information under request;
- Recommendations for a DNO Distribution Network Statement (DNS) along the lines of the transmission system seven year statements.

As a result of cross industry support for better information provision (arising out of the work of the DTI Ofgem EGWG and the Distribution Licence Condition 25 consultation) it was agreed that formal submission to the DCRP was no longer appropriate and the report should, therefore, be used in the Condition 25 consultation.

4 "Proposed Electricity Distribution Licence Condition 25 – Form of Long Term Development Statements", Ofgem Consultation Paper June 2001

2 BACKGROUND

This section provides on outline of, and introduction to, relevant current industry background.

2.1 Industry Structure

2.1.1 Generation

In the UK, generation is considered as embedded generation if it is connected to the distribution network. Most large power stations connected to the transmission systems are above 100MW, are licensed, and participate in the balancing market under NETA (or were centrally despatched Pooled Generators before 27 March 2001 when NETA was introduced). Most embedded generators are less than 50MW and are not licensed, were not pooled, and contract in order to be exempted from participation in the balancing market under NETA.

Most generation from renewables and CHP is embedded. There is growing interest both internationally and in the UK in micro generation, micro CHP and distributed generation in general.

2.1.2 Supply, Generation, Transmission and Distribution

The Electricity Act, which privatised the industry in 1989 created the concepts of Supply, Distribution, Transmission and Generation. In England and Wales the Central Electricity Generating Board (CEGB) was split into Generation and Transmission; Second Tier Suppliers (new Suppliers without franchise areas or distribution assets) and Independent Generators were created; and the Regional Electricity Boards changed into Public Electricity Suppliers (PES), also known as Regional Electricity Companies (RECs). A fundamental flaw in the Act was in not creating and licensing a distinct Distribution function.

In Scotland, the privatised companies were vertically integrated, much along the lines of the previous structure, with Scottish Power and (then) Scottish Hydro-Electric having Generation, Transmission, Supply and Distribution functions within their respective territories.

Unbundling of supply and distribution functions in the PESs was enabled in the Utilities Act 2000, although the necessary parliamentary orders to complete the process have not yet been completed.

The Utilities Act has created a Distribution Licence and the licensees are known as Distribution Network Operators (DNOs). All 12 RECs in England and Wales and the two PESs in Scotland will be referred to as DNOs and operate under the same overall licences. The PES businesses have already split from an accounting and operation function into Supply and Distribution businesses and in some cases these are now in separate ownership.

2.1.3 Network assets in England and Wales

In England and Wales 400kV and 275kV assets are classified as transmission system and owned by the Transmission Licensee, the National Grid Company (NGC). The NGC does own some minor 132kV circuits and some Generators own 400 & 275kV assets local to their plant. The 132kV systems are owned by the DNOs and are largely radial, with a few notable exceptions, where they interconnect parts of NGC's system. DNOs also own assets at intermediate voltages down to low voltage including 33 & 11kV and in some cases 66kV, 20kV and 6.6kV.

In some areas, the DNO functions are already under different ownership to the Supply businesses and some regional merging has taken place. London and Eastern Electricity have merged their wires businesses as 24seven, as have SWEB and SWALEC as Western Power Distribution. Scottish Power (SP) and Scottish and Southern Energy (SSE) own Manweb and Southern Electric respectively.

2.1.4 Network Assets in Scotland

In Scotland the 132kV network is classed as transmission as it is operated largely as an interconnected rather than radial system and is crucial in securing much of the hydro generation in the north. The situation in Scotland is also different in that, within the SP and SHE areas, the Transmission and Distribution Systems are owned by the same companies. The Scottish Companies currently have a composite licence covering Transmission, Supply and Generation. The new Distribution Licences will apply to SP’s and SSE’s distribution networks.

2.1.5 Northern Ireland

Northern Ireland Electricity (NIE) transmit, distribute and supply electricity to both non-domestic and domestic customers throughout their operating area. NIE owns transmission assets at 275kV and 110kV and distribution assets at 33kV, 11kV and LV. NIE is governed by Ofreg (Office for the Regulation of

Electricity and Gas), a public body, which monitors the electricity industry in Northern Ireland.

2.1.6 Ofgem and Ofreg

Ofgem regulates the industry in Scotland, England and Wales, whilst Ofreg regulates the industry in Northern Ireland.

Ofgem publishes an annual report regarding the performance of both the distribution and transmission systems operating in GB.

2.2 Network Data Provision

There have been no requirements for the PESs to publish data on their distribution networks. This is likely to change with the requirements of Condition 25 of the Distribution Licence, which is due to be confirmed shortly following further consultation by Ofgem. The Transmission Licensees have, however, been required to produce information in the form of a Seven Year Statement.

2.2.1 Transmission data in England, Wales and Scotland

The three Transmission Licensees (Scottish Power, Scottish Hydro-Electric and the National Grid) operating in GB annually produce Seven-Year Statements (SYSs). Each document contains information relating to the appropriate transmission system, containing tables and figures giving key data, (eg circuit ratings and parameters), maps of the location of the transmission system, and commentary on opportunities, for demand and generation. The Seven Year Statement makes projections of system development seven years ahead, based on confirmed and planned changes.

Section 6 of the Electricity Act results in transmission licensing, and Condition 10 (5) of The NGC Transmission Licence places an obligation on the Transmission Licensee to annually prepare and publish a Seven Year Statement (SYS) as follows:

"The licensee shall, as soon as practicable, and in any event within 28 days after this licence has come into force, prepare a statement in a form approved by the Director showing in respect of each of the seven succeeding financial years, circuit capacity, forecast power flows and loading on each part of the licensee's transmission system and fault levels for each transmission node, together with:
such further information as shall be reasonably necessary to enable any person seeking use of the system to identify and

evaluate the opportunities available when connecting to and making use of such system; and

a commentary prepared by the licensee indicating the licensee's views as to those parts of the licensee's transmission system most suited to new connections and transport of further quantities of electricity."

SP, SHE and NGC produce their SYSs on an annual basis, and NGC also issues quarterly updates.

A principal purpose of a SYS is to facilitate competition by allowing existing and potential customers to assess the possible opportunities available to them with respect to generating or supplying electricity.

SP and SSE SYS's cover the 132kV system in Scotland and Generators. Renewable Generators (with both Transmission and Distribution connections) in particular, have found this data useful in planning and siting projects.

2.2.2 Transmission data in NIE

Northern Ireland Electricity plc (NIE) publishes a Seven Year Statement in compliance with the Transmission and Public Electricity Supply Licence Document issued under the Electricity (Northern Ireland) Order 1992. NIE transmission assets are 275 and 110kV. NIE's system is interconnected to the Electricity Supply Board Ireland (ESB) system in Eire and will soon be interconnected to the SP system via a new DC interconnector.

2.2.3 Evolution of NGC SYS

The NGC SYS is the most comprehensive and extensive of all the published SYS. It has developed and evolved over the years partly as a result of customer feedback. NGC believe that it is now in a state where adding more information would be counter-productive. If customers require specific information, which is not contained in the SYS, it is considered more effective to obtain this data through a specific request.

As the SYS can only discuss "confirmed" or "contracted" data future projections can often be of limited use. Most developments are instigated within a year or two of being confirmed. To help users assess the likely effects of developments, NGC publish general assessments based on the probabilities of, for example, certain new generation projects being completed. These "scenario" projections indicate the impacts of probable events that cannot be shown as they are not yet "confirmed".

2.2.4 Distribution data

DNOs have had no obligations to publish data. The Distribution Codes have allowed Users (eg prospective generators) to request a "statement of opportunity" relating to a specific part of the network, however, the scope of such a statement is not entirely clear.

Unlike transmission networks, which are interconnected, most DNO networks are radial and are generally operated on a "fit and forget" basis, with studies only being carried out for occasional or rare major developments or reinforcements. For passive radial networks with unidirectional power flows this is quite acceptable. Interconnected networks, however, require more careful operation and management and must be studied and monitored to ensure that they are not operated outside limits. DNOs with interconnected networks generally have much better access to data than those with radial networks.

DNOs appear to hold data in a wide variety of systems and formats and locations. Detailed data on physical assets may be held in a variety of formats and systems, including spreadsheets and paper records, and may vary across an individual DNO network. It is not unknown for DNOs to find data difficult to retrieve and for records to be lost, particularly for detailed information such as:

- Settings of off-line (commonly called off-load) tap changers on distribution, (eg 11kV/LV) transformers;
- Settings of AVC (automatic voltage control) schemes on primary (eg 33/11kVtransformers);
- Type of protection fitted;
- Protection settings.

DNOs do not all have equipment in place to monitor the operation and performance of their network on a consistent basis. For example, some primary substations may not be fitted with Voltage and Current Transformers, which are required to record demands, others are equipped to monitor demand in real time via on-line SCADA systems.

DNOs are obliged by law to provide data of asset locations for persons carrying out developments or street works. These may come from paper records or from a Geographical Information System (GIS) depending on the DNO involved. However, this detailed locational data is not necessarily tied to details of the specific assets involved.

2.2.5 Status of network information provision

The experience of generators with regard to information provision by DNOs is highly variable in the following respects:

- Some DNOs have provided excellent data whereas a few have seemed unwilling to provide data at all;
- In some DNOs it is difficult to find the right person to provide data, especially as many DNOs have undergone significant restructuring and rationalisation;
- The charges for the provision of data can vary;
- The quality of data provided can vary;
- The speed of response to supply the data can vary.

Some DNOs have in the recent past indicated that network information is "confidential" and not available for any reason. However, this attitude is changing, probably as a result of the introduction of Condition 25 of the Distribution Licence.

2.2.6 DNO obligations to provide information

DNOs in Great Britain are obliged by their respective Distribution Codes to provide information on request regarding specific parts of their distribution networks. The relevant sections of both the England & Wales Code and the Scottish Code are given below.

The Distribution Code of the Public Electricity Suppliers of Scotland:

"DPC5.2 Statement of System Capacity:

DPC5.2.1 – If so requested by any person The Company will, in accordance with its Public Electricity Supply Licence and subject to DPC5.2.2 and DPC5.2.3, give or send to the person making the request a statement showing its best estimate and forecast of present and future circuit capacity, power flows and loading on the part or parts of The Company Distribution System specified in the request, together with fault levels for each distribution node covered by the request. The statement will be prepared as soon as is practicable and in any event within 28 days (or where the Director so approves such longer period as The Company may reasonably request having regard to the complexity of the request) after the date referred in DPC5.2.2. The person making such requests must provide sufficient information to The Company to enable the statement to be made. The statement shall include:

Such further information as The Company consider necessary to the requester in the assessment of opportunities available for *connection to or use of the part or parts of The Company Distribution System specified in the request.*

(ii) When requested, a commentary prepared by The Company indicating its view as to the suitability of the part or parts of The Company Distribution System specified in the request for new connections and transport of further quantities of electricity.

DPC5.2.2 – Under the provisions of the Licence The Company may make a charge for any statement given, or sent, of an amount reflecting The Company's reasonable costs in providing such a statement which shall not exceed the amount specified in directions given by the Director. The Company will within 10 days after receipt of the request provide the requester with its reasonable costs of preparing any statement. The provision of the statement will be conditional upon the person requesting the statement agreeing to pay the charge (or such other amount as the Director may direct) and the statement shall be given or sent within 28 days of the date on which The Company receives agreement from the requester to pay the charge agreed. Where no charge is to be levied, the statement shall be given or sent within 28 days of the receipt of the request.

DPC5.2.3 – The Company may, with the prior consent of the Director, omit from any statement of system capacity any information, disclosure of which would, in the view of the Director, seriously and prejudicially affect the commercial interests of The Company or any other third party or which would place The Company in breach of the Confidentiality conditions of its Licence."

However, these statements of system capacity are aimed at load rather than generation connections and have not generally been used by developers for obtaining cost effective and timely information on the system in order to consider a number of options for generation locations.

2.3 Needs for data for Generators

The availability of distribution network data can have a significant impact on developers of new embedded generation projects. Compared to transmission networks the need for information is greater due to the different connection charging regimes which are detailed below. There are also two types of requirements to consider: data relating to a particular site that a generator may be considering; and data relating to the network in general in order to focus areas of search for new sites. The industry is also prone to changes in charging regimes and, therefore, an understanding of how a project impacts on the network may have a bearing on the risks of higher charges in future.

2.3.1 Generator connection and use of system charges

There is a considerable difference in charges between transmission-connected and embedded generation in England and Wales. Transmission connected generation pays "shallow" connection charges plus transmission use of system charges ie does not pay for "deep" reinforcements, which are modifications to and strengthening of existing network assets. The "shallow" connection charge indicates that new transmission connected generation will pay for new assets needed to join the generator to the most suitable point on the system. The transmission use of system charges paid by transmission-connected generators vary zonally with location in order to encourage generation to be sited close to demand. The charges in some zones are negative, ie generators are paid to locate there.

Embedded generators connected to distribution networks pay "deep" connection charges. This includes a charge for the local connection to a suitable point on the existing network and charges for any other works on the network needed to accommodate the generation, whether these are close to or remote from the connection.

Deep connection charges have been argued to deliver effective locational signals for generators to connect to parts of the networks which do not need expensive deep reinforcements. However, they often mean that a generator must fund a major network reinforcement which in some cases will accommodate more generation capacity than the generator requires. Often the charges are such that the project is no longer financially viable.

At present embedded generators do not (in general) pay distribution use of system charges for exports (energy or capacity delivered to the network). It has been mooted recently that embedded generators should only pay shallow connection charges but pay use of system charges, probably with a locational price signal included.

There are some differences in Scotland and Northern Ireland to these policies, but embedded generators also pay deep connection charges in these regions.

2.3.2 Typical assessments needed for generation connections

When carrying out connection studies and designs there are a number of technical aspects which need to be considered and the outcomes of these studies will determine how the connection is made to the local network. They will determine how close the connection can be made to a point on the existing network and what reinforcements will be required. The principle issues to be considered are:

- Fault level:

  As with all electrical systems, distribution networks have fault level limitations due the capabilities of existing equipment, which may be exceeded were a generator to be connected. Assessments are required to ensure that the additional fault current contribution from a new generator connection will not exceed the design limits or capabilities of the network. Generally remote (rural) areas of the network, which are distant from generator and transmission system infeeds and interconnections, are less likely to reach fault level limitations.

- Steady State Voltage Rise:

  The 11kV feeders (circuits/lines) of distribution networks were designed for unidirectional power flows from the primary substations, where the voltage is regulated. Many DNOs regulate this voltage at a high (or at the highest possible) level, according to statutory limits, as voltage will always drop from this point out. When generators wish to connect to these circuits, they may reverse the power flows and the voltage will rise in respect of the primary substation. This may take customers' supplies outside statutory limits of supply. Steady state voltage rise can limit generation to a few hundred kW on a network with a thermal capacity of several MW.

- Step Voltage change:

  Step voltage changes are caused by sudden changes in currents, and those due to generators include: Inrush currents when starting an induction generator and Energising transformers; and sudden disconnection of a faulted generator from the network. Such changes must comply with the Electricity Association's Engineering Recommendation P28 with regard to the level and frequency of step voltage changes.

- Thermal capabilities:

  Thermal capability refers to the loading that a network component (such as a transformer or cable) can tolerate without overheating, which would lead to permanent damage, or loading of an overhead line outside its design limits, causing a hazardous sagging of the conductors. Higher voltage systems have higher thermal capabilities so a developer of a 10-20MW project will be looking to connect at a voltage of 33kV or above.

- Other technical assessments:

  Other technical assessments may be required, though these are generally less common than those above. They are particularly likely to be required for larger generators connected at 33kV and above where, for example, protection stability automatic voltage control, harmonics, constraints and non normal operating scenarios may need to be considered.

2.3.3 Current methods for obtaining network information

As there is no formal source of network data to make the above assessments, generators use other means to gather information and make assessments including:

- Locating distribution assets by local knowledge and trial and error, eg identifying line voltages by their construction and following overhead line routes to create their own network map data and locate primary substations. This method can be useful in dealing with thermal issues and steady state voltage rise in rural areas. However, this method is more difficult in urban areas as most circuits are underground cables. Therefore, fault level data cannot even be estimated from visual inspection.

- Undertaking preliminary informal discussions with DNO staff can help developers to understand opportunities and limitations. However, the danger is that the staff themselves are not fully appraised of all relevant network factors and an initial positive indication regarding a connection can prove misguided.

- Using miscellaneous published information such as network maps or indications of connection potential published under regional resource assessment studies.

- Using consultants who may have greater experience, hold some network data or are able to make informal approaches to DNOs.

- Making a formal request for network data and carrying out studies and assessments with that data.

- Contracting the DNO to undertake feasibility studies on the generators behalf.

- Making a formal application for connection to the DNO and reviewing the issues if they result in a significant connection charge.

2.3.4 Connection process for embedded generators

Following any preliminary assessment or enquiries, the developer will eventually submit a formal application to the DNO for a connection, for which there is usually a charge for the studies, analysis and costings involved. The DNO has three months to produce a connection offer, which the developer usually has one month to accept, before it lapses. Acceptance often involves a payment towards the connection charge.

If another generator is connecting to the same part of the network, and both applicants need to use the same network assets, the offers may become "interactive" and both parties will be notified. The first to accept will be on the basis of the offer, the other offer will be withdrawn and a new offer made (at greater cost).

More information on the process of making generation connections can be obtained from an ETSU report.[5]

2.3.5 Need for network data for generators

Developers of new embedded generation projects can, and do, expend considerable resources pursuing projects, some of which do not proceed to fruition. Although planning

[5] 'A Technical Guide to Connection of Embedded Generators to the Distribution Network' (ETSU K/EL/00183/REP) by Econnect Ltd and published in 1999

permission is the main reason, grid connection can also be the deciding factor for abandoning a project.

Having full information at an early stage in any project can help the developer to:

- Size the generation for the grid connection capacity available;
- Select appropriate generator types for the grid;
- Select the number and rating of individual generators;
- Design appropriate connection equipment;
- Estimate the costs of connection, deep reinforcement and customers electrical assets;
- Develop a larger project (or number of projects) to meet the grid connection cost;
- Work with other developers in the area to fund the necessary reinforcements;
- Abandon the project altogether if no other solution is available.

It may also be useful and valuable for developers to understand:

- What the impact of the generator would be with regard to losses on the network;
- Whether the generator would or could defer a planned reinforcement by a DNO and if so what the design and operational requirements might be;
- What the likely risk of outages are, especially for a single circuit connection;
- Whether a lower cost constrained connection could be available and what the level of constraints might be.

When the generator receives a connection offer with a proposed connection charge from a DNO, available network data can help build confidence that all the proposed works are required.

2.3.6 Network data for competition in generation

In future, as embedded generation becomes far more significant in relation to transmission connected generation, generators will need to become more sophisticated in their choice of project locations. Price signals, charges, costs and benefits are expected to evolve in order to achieve the desired mix, type, location capabilities and characteristics of generation plant. This would once have been achieved by central planning and application of standards to a very small number of generation types and technologies. Charges have already evolved on the NGC transmission system with locational entry and exit charges (including negative charges in some places). In order for such a market system to work in the case of distribution networks, more information will be required so that charges can be anticipated.

3 METHODS

To ensure that a fair benchmarking process was carried out, assessments were made of comparable examples of information requested from each DNO. The benchmarking process allowed comparisons of the quality, cost, speed and ease of obtaining information. In order to acquire information, telephone contact was initially made with each DNO with an outline of the request. When the appropriate DNO contact was identified, written requests were sent to each contact for the material relating to each category of information. With this communication established, follow-ups to information requests were made via telephone calls and emails.

3.1 Requests for price lists

Requests were made to each DNO for a standard price list for network information, and also network maps and schematic diagrams of their operating area.

3.2 Requests for EHV maps

Requests were made to each DNO for maps of their networks showing assets at 33kV, 132kV and in some cases 66kV (known in the UK as EHV - Extremely High Voltage).

3.3 Generation Connection Analyses

A hypothetical generation project was conceived for each DNO, so that the process and information exchange could be benchmarked. The process used was as follows:

- A primary substation was selected in each DNO area, which aimed to have a mix of urban and rural feeders (ie was in general, on the edge of conurbations);

- A request was made to the DNO for 11kV network map and schematic diagram for 3km radius around the specified primary substation;

- A suitable site was located for the hypothetical generator within 1-1.5km from the selected primary substation, in an open location (close to an industrial/Greenfield site, but not too close to houses), at a section of the network that included both line and cable, and in an area, where there was no normally open point;

- A request for detailed information to carry out a preliminary grid connect assessment was made to the DNO using a standard Pro-Forma, which was developed for this purpose.

The data was used to assess how much generation could be connected at that point on the system and to identify the limiting factor (fault level, voltage rise or thermal limit).

3.4 Drafting and review of DNS

3.4.1 Drafting of DNS

The starting point for drafting the proposed Distribution Network Statement (DNS) was a review of data in existing SYSs, as much of this was considered to be applicable also to DNSs. Because Generators are liable for deep connection charges, some data were considered relevant to the DNS, but not relevant to the SYS – for example, the age and life expectancy of major assets. On the other hand, forward projections for a DNS are of limited value, as they can be significantly and radically changed by a new single connection, especially of a generator. For example, fault level at a point on the network would be expected to remain fairly constant without connection of generation, which would change it significantly.

Consultation on the DNS took place with generators through the Association of Electricity Producers' Embedded Generation Group (AEP EGG) and the document was given to the CHPA in order to receive feedback.

Direct meetings were held with two DNOs and a draft was presented to a meeting of the Scottish Distribution Code Review Panel.

A few of the concerns and suggestions made by DNOs were considered during the drafting of the document's final versions. However, it must be emphasised that the proposals come from the generator's perspective rather than the DNOs. It is intended that this report will form the basis of a further debate and discussion with the DNOs. The final version of the Document was presented at a meeting of the Scottish Distribution Code Review Panel for discussion and feedback.

3.4.2 Submission to Ofgem

Response was made to the electricity market regulator, Ofgem, regarding their consultation on 'The Utilities Act Standard Licence Conditions Volume 3: Electricity Distribution Licence'.

This consultation was relevant, as the requirements under Condition 25 are for DNOs to make available current, historic and planned network data. A copy of the response sent to Ofgem can be reviewed in Appendix F.

4 COMPARISON OF DNO'S

4.1 Standard price list for Network Information

Only two DNOs out of the 15 assessed responded that they did have a standard price list for the provision of network information. A summary of the categories and prices included in these lists is outlined in Table 1 and Table 2, respectively.

Standard price list categories	**DNO ID Number**	
	9	**12**
Geographic maps & schematic diagrams	✓	✓
Network data	✓	✓
Plant data	✓	✓
Fault level studies	✗	✓
Full system studies	✓	✓
Review of system studies produced by others	✗	✓

Table 1. Summary of network information categories

Table 1 shows that similar categories of information were offered by the two DNOs although in regard to response times, DNO 9 offered a return of request within ten working days, whilst DNO 12 could only offer a request return within six to eight weeks.

Although the data offered by both DNOs is similar, Table 2 shows that prices for the same category of information vary, in some cases quite considerably, up to a factor of twenty.

Network data category	**Charge (£)**	
	DNO 9	**DNO 12**
Drawings & maps:		
EHV network map	30/OS sheet	45
EHV network diagram	50	45
HV network map	30/OS sheet	45
HV network diagram	30	45
Network data		
HV circuit complex impedance & rating	20/circuit	65/circuit
Feeder load data (Amps)	30/5 circuits	65/feeder
Group load data (MW and MVAr)	25	65/group
Equivalent short circuit impedance at a busbar	-	130/busbar
Protection settings	30/10 circuit breakers	-
Plant data		
Circuit breaker ratings	30/10 circuit breaker	130/switch board
Transformer impedance, rating & tap range	20/3 transformers	130 /transformer
Fault level studies		
HV fault level study (up to the local primary s/s)	-	1200

Table 2. Network data charges

4.2 Assessment of information provided

The three categories of data provided were:

- EHV maps;
- HV maps and schematics;
- HV data (via the Pro-Forma).

These are compared and assessed in the next three subsections.

4.2.1 EHV network maps

EHV network maps were requested as indicated in Section 3.2. Table 3 compares the provision of the EHV maps by DNOs, and Table 4 compares the quality of the maps. Three DNOs did not provide a map, only one DNO made a charge for provision.

Many DNOs did not immediately accept that they could or should provide such a map. The entire time period, from first requesting the map to receiving it, took on average 47 days, with times ranging from two to 202 days. Once DNOs had accepted that they would meet the request for an EHV map it took, on average, 16 days to receive a map. This average was based on a wide range of response times, with two days being the minimum and 63 days the maximum. Three DNOs did not provide a map.

The maps were, in general, provided in A0 sized format and showed a scale of 1:250,000. All maps indicated the boundary to the operating area of the relevant DNO and many were provided in colour. Maps varied on the provision of detail (eg double circuits), of a key and in their geographic and OS grid referencing.

DNO I.D. Number	Quality of DNO service				
	No. of calls to find appropriate contact	**No. of verbal requests**	**No. of written requests**	**Duration of the request period (days)**	**Delivery time for map once request accepted (days)**
1	1	1	0	5	5
2	1	5	1	59	Request refused
3	4	4	0	48	6
4	2	2	0	12	Request refused
5	1	3	0	14	Map already acquired
6	4	6	0	90	Request refused
7	1	1	0	2	2
8	1	2	0	6	6
9	1	1	1	7	7
10	3	7	0	76	63
11	1	2	2	41	22
12	1	4	1	202	11
13	1	1	0	11	11
14	1	2	1	41	41
15	1	1	1	92	4
Mean	**1.6**	**2.8**	**1.2**	**47.1**	**16.2**

Table 3. Summary of the quality of the service provided by the DNOs when requesting an EHV network map

PES ID No.	Quality of Network Map												
	Size	**Scale (1:x)**	**Network (kV)**	**Double circuits**	**Boundary**	**Key:**	**indicating**			**Colour/ B&W**	**Geographical reference**	**Grid reference**	**Cost (£)**
							s/s[6]	**kV**	**line/cable**				
1	A2x3	250,000	33,66,132	N	Y	Y	N	Y	N	C	Y	N	0.00
3	A0	-	33,66,132	Y	Y	Y	Y	Y	Y	C	N	N	0.00
5	A1	250,000	33,132	Y	Y	Y	Y	Y	Y	C	N	N	0.00
7	A3	200,000	33,132	N	Y	Y	N	Y	Y	B&W	N	N	0.00
8	A0	250,000	33	Y	Y	N	N	N	N	C	Y	N	0.00
	A0	250,000	132	Y	Y	Y	Y	Y	Y	C	Y	N	0.00
9	A0	250,000	33,132/275 & 500	N	Y	Y	Y	Y	Y	C	N	N	0.00
	A0	50,000	11,33,132	N	Y	Y	Y	Y	N	C	N	Y	0.00
10	A0	250,000	33,66,132	Y	Y	Y	Y	N	N	C	N	N	117.50
11	A0	200,000	33,132	N	Y	Y	N	Y	Y	C	N	N	0.00
12	>A0	-	33	Y	Y	N	N	N	N	B&W	N	N	0.00
13	A0	-	33	N	Y	N	N	N	N	B&W	N	N	0.00
14	A0	250,000	33	N	Y	N	N	N	N	B&W	N	N	0.00
15	A1	780,000	33, 132/275	N	Y	Y	N	Y	N	C	N	N	0.00

Table 4. Summary of the quality of the EHV network maps provided by the DNOs[7]

[6] s/s = substations
[7] DNOs 2, 4 and 6 refused to provide an EHV map of their network

4.2.2 HV network maps and schematic diagrams

Generation connection analyses were carried out as indicated in Section 3.3 and these analyses initially required the provision of HV maps and schematic diagrams. Figure 1 compares the charges made (if any), Table 5 compares the provision of the HV maps and schematics by DNOs, Tables 6 and 7 compare the quality of each map and schematic.

A variety of responses were received from the DNOs after the request for the HV maps and associated schematic diagrams, for a 3km area around a specific substation, was made. Whilst thirteen companies provided the appropriate network map, only eight of these also supplied the relevant schematic diagrams. Two sets of information were not received due to charges of £225 and £250 being quoted by the DNOs. Two other companies, who provided both maps and diagrams, also quoted a charge for this information, but these were both in the region of £50 and, therefore, paid for and received. The duration of the request period for this information was, on average, 32 days, ranging from ten to 111 days.

Rather than being presented on a single sheet, these maps and diagrams were printed onto multiple smaller sheets, ranging from A4 to A2 size, with a scale that was most commonly found to be 1:10,000. Both the maps and diagrams were generally produced in black and white.

As with the EHV maps, the HV examples varied in the degree of information that was indicated on them. Size and composition of lines and cables were indicated on a few of the maps, but only five examples had a key. Although most of the maps were geographically referenced, only one was referenced to the OS grid.

All of the schematic diagrams indicated the network components, place names and codes, and distinguished between lines and cables. Some went into further detail, indicating the size, length and composition of the lines and cables, but only one had a key identifying the symbols.

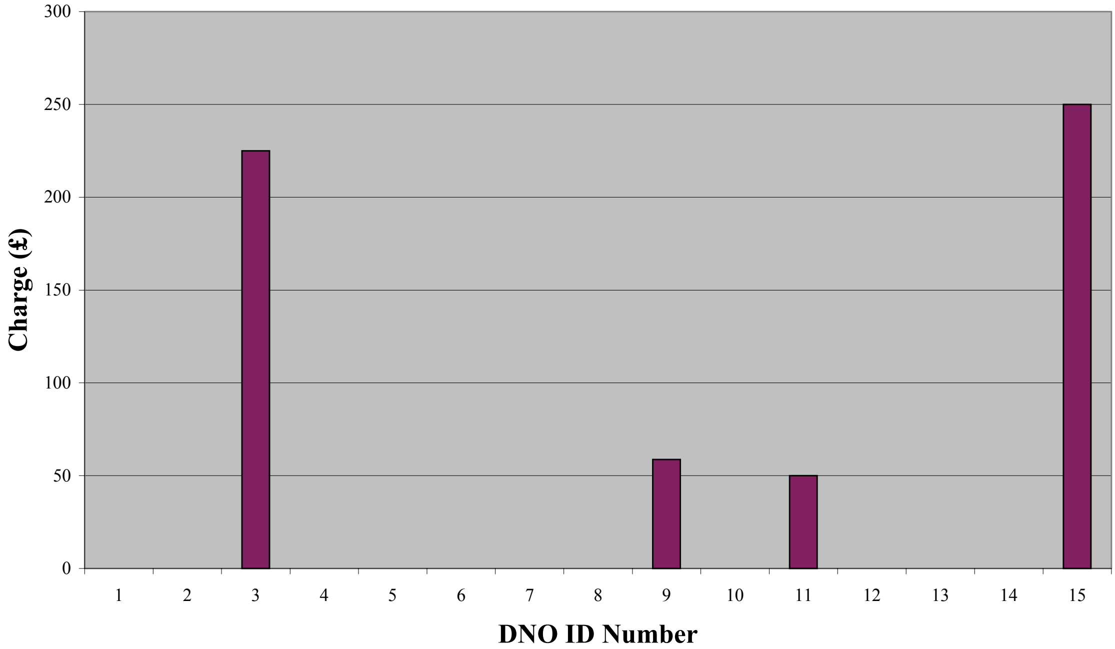

Figure 1. Charges proposed by DNOs for provision of HV schematics /maps

DNO ID Number	Quality of DNO Service			
	Number of written requests to DNO	**Number of correspondence from DNO[8]**	**Number of follow-up calls/emails to DNO**	**Duration of the request period (days)**
1	1	0	0	10
2	1	1	3	44
3	1	2	1	Request halted[9]
4	1	1	1	24
5	1	1	0	21
6	1	2	1	22
7	1	1	1	28
8	1	1	0	14
9	1	5	4	38
10	1	0	4	45
11	1	1	0	24
12	1	3	2	111
13	1	1	0	11
14	1	2	2	24
15	1	2	2	Request halted[10]
Mean	1	1.5	1.4	32

Table 5. Summary of the quality of the service provided by DNOs when requesting an HV network map

[8] Correspondence was in the form of letters, emails and telephone calls
[9] request halted due to charge of £225 for provision of relevant network information
[10] request halted due to charge of £250 for provision of relevant network information

HV map characteristics	DNO ID Number												
	1	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Size	c.A1	A3 x 4	A3 x 2	B2 x 4	A2 x 4	A2 x 4	c.A0	A2 x 9	A0	A0	A3 x 18	c.A1	A0
Scale (1:x)	-	-	10,000	10,560	10,000	10,000	10,000	10,560	2,500	7,500	-	24,500	3,504
Network (kV)	HV	HV	HV	HV/33	HV	HV	HV	HV/33	HV	HV/33	HV	HV/33	HV
Size of line/cable indicated		Y	N			Y		Y	Y		N		Y
Composition of line/cable indicated		Y	N			Y		Y	N		N		Y
Key:	N	N	N	Y	Y	Y	N	N	N	Y	N	Y	N
Substations	-	-	-	N	N	Y	-	-	-	N	-	N	-
Voltages	-	-	-	Y	Y	Y	-	-	-	N	-	Y	-
Lines/cables	-	-	-	N	Y	Y	-	-	-	Y	-		-
Line numbers	-	-	-	Y	Y	N	-	-	-	N	-	N	-
Line names/ destinations	-	-	-	Y	Y	N	-	-	-	N	-	N	-
Colour/B&W	C	B&W	B&W	B&W	B&W	B&W	B&W	B&W	B&W	B&W	B&W	C	B&W
Geographical reference	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Grid reference		N						Y	N		N		
Cost (£)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.75	0.00	50.00	0.00	0.00	0.00

Table 6. Summary of the quality of the HV network maps provided by the DNOs[11]

[11] The HV maps fro DNO's 3 and 15 were not acquired

Schematic diagram characteristics	DNO ID Number							
	2	4	5	6	7	9	10	12
Size	A2	A4 x 4	A4 x 4	A4 x 4	A0	A4 x 144	c. A2	A4 x 2
Scale	-	-	1:10,560	-	-	-	1:5,000	-
Network (kV)	HV	HV	HV	HV	HV	HV	HV	HV
Key:	N	N	N	N	Y	Y	N	N
O/H line	-	-	-	-	Y	-	-	-
U/G cable	-	-	-	-	Y	-	-	-
Mounted switchgear	-	-	-	-	Y	-	-	-
Ground	-	-	-	-	Y	-	-	-
Pole	-	-	-	-	Y	-	-	-
Primary s/s busbars	-	-	-	-	Y	-	-	-
Distribution transformers	-	-	-	-	Y	-	-	-
Normally open points	-	-	-	-	Y	-	-	-
Network components shown	Y	Y	Y	Y	Y	Y	Y	Y
Place name and code	Y	Y	Y	Y	Y	Y	N	Y
Line and cable distinguished	Y	Y	Y	Y	Y	Y	Y	Y
Size of line/cable indicated	Y	-	-	-	-	Y	Y	Y
Length of line/cable indicated		-	-	-	Y	-	N	N
Composition of line/cable indicated	Y	-	-	N	-	Y	Y	N
Colour or B&W	B&W	B&W	B&W	B&W	C	B&W	B&W	B&W
Geographical reference	N	N	N	N	N	N	N	N
Cost (£)	0.00	0.00	0.00	0.00	50.00	58.75	0.00	0.00

Table 7. Summary of the quality of the HV schematic diagrams provided by the DNOs

4.2.3 Pro-Forma

As described in Section 3.3, when a site had been selected from the HV network map (and schematic) provided, a Pro-Forma was submitted to the DNOs in order to obtain the necessary data to undertake preliminary connection studies. The final version of the Pro-Forma based on the ones used is included in Appendix B.

The majority of DNOs provided the data on the Pro-Forma free of charge. Only four out of 12 made requests for charges and these varied from £80 to £2500 as shown in Figure 2. Two of the requests were halted due to the high charges requested by those DNOs. One DNO did not complete and return the Pro-Forma. Pro-Formas were not sent to three DNOs as they had not provided the requested HV map.

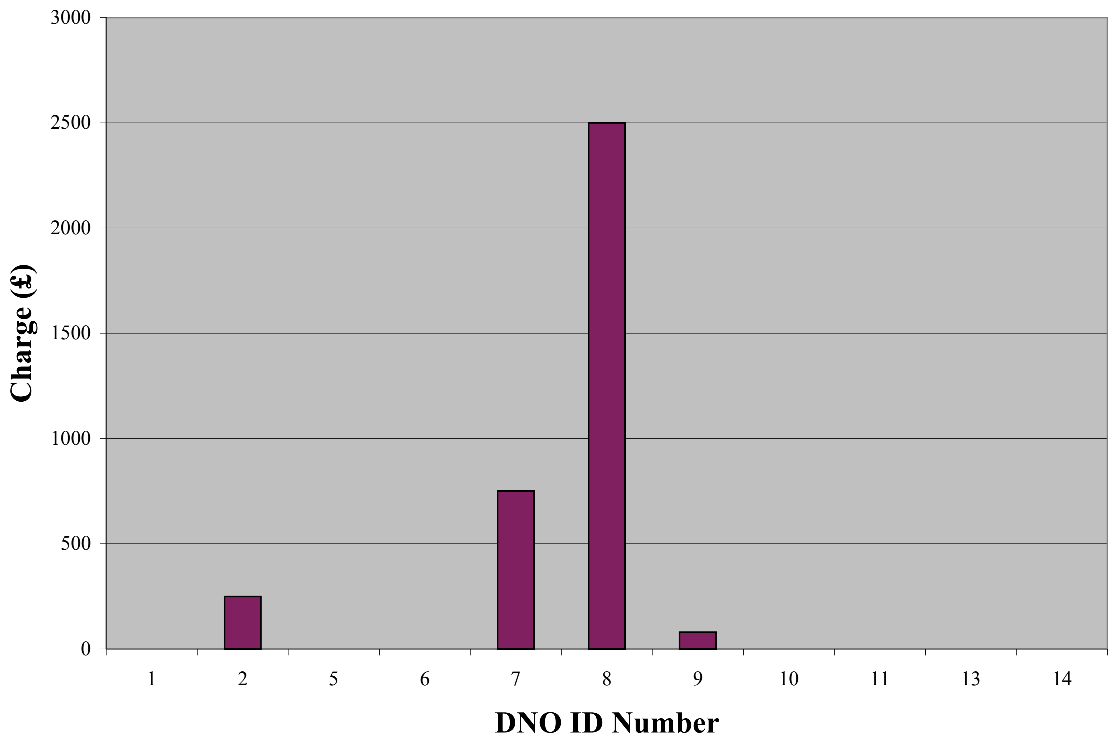

Figure 2. Charges proposed by DNOs for 11kV data on Pro-Forma[12]

Eight Pro-Formas were returned. Some DNOs indicated that particular categories of information were not applicable to the site in question, although other categories were left blank without an explanation and some data sets were occasionally incomplete.

The number of circuit impedance data entries relating to each of the chosen sites ranged from one to 21, and as only five spaces

[12] PFs not sent to DNOs 3, 12 and 15; PF not completed by DNO 4

were provided on the form it was necessary for some of the DNOs to attach additional sheets to the Pro-Forma in order to accommodate all of the information.

The data on each Pro-Forma was used to assess the maximum potential for generation export capacity at the chosen point of connection. The results for each site are presented in Appendix E. This exercise was undertaken in order to be able to make a thorough assessment and review of the Pro-Forma and data provided in it.

There was a formatting error in the original Pro-Formas sent out and no accompanying guide to aid completion. This lead to some errors and undoubtedly some of the data was not entered as intended. As a result the Pro-Forma was updated (Appendix B) and guidance notes provided (Appendix C).

5 PROPOSED CODE OF PRACTICE AND PRO-FORMA

5.1 Proposed Code of Practice

A Code of Practice was conceived to create consistent quality and standards of information provision amongst the DNOs. Sections 3.2 and 4.2.2 describe the acquisition and analysis of EHV maps. Sections 3.3 and 4.2.3 describe how HV maps and schematics were obtained and analysed. The quality of the provision, content and format of the EHV and HV network maps and schematic diagrams were evaluated to elicit best industry practice for inclusion in the Code of Practice.

The proposed Code of Practice is included in Appendix A.

5.2 Proposed Pro-Forma

The Pro-Forma was conceived and designed to provide a standard format for DNOs to submit technical data to Generators. This is particularly the case for 11kV network connections, as this data is not expected to be available in a DNS. The process of evaluating a potential generator connection in each of several DNO areas is described in Section 3.3 and the use of the Pro-Forma in Section 4.2.3. The final draft of the proposed Pro-Forma and Guidance Notes are in Appendices B & C. The summary of the analyses of potential for generator export capacities using the network information provided by the DNOs via the Pro-Forma can be reviewed in Appendix E.

To create the Pro-Forma the requirements of several previous connection studies were reviewed. It was decided that, to request all the information that might possibly be required, a very large volume of data would result and that most of it would not be used in any particular case. A balance had to be struck between the DNOs time required (and therefore costs) by a request for a large volume of information, and the usefulness of a minimal amount of information for a preliminary connection assessment.

The data on the Pro-Forma provides information for the assessment of fault level, voltage rise and thermal limits for the connection of generation, and these are the main issues for generators connected to 11kV feeders. The Pro-Forma was developed to provide the minimal data needed to make first order assessments of these issues.

Therefore the six main categories of required information listed on the Pro-Forma related to:

- Fault levels at primary substations;
- Automatic voltage control schemes at primary substations;

- Primary substation transformer ratings and substation demands;
- HV/LV Transformers off-line tap settings;
- Circuit minimum and maximum loads and presence of other generation;
- Cable and/or overhead line complex impedances and thermal ratings.

6 PROPOSED DISTRIBUTION NETWORK STATEMENT

6.1 Purpose of the DNS

The proposed DNS is designed to assist generators in locating and reviewing possible sites and identifying opportunities. These purposes are considered in more detail below.

6.1.1 Preferred search areas for generation

Where developers of new generation plant have at least some flexibility about the location or about their preferred areas of search, they may use the DNS (or a number of DNSs) to select a preferred DNO and/or to select locations with the DNO. At a high level this may involve reviewing the amount of existing generation in relation to network capacity, with developers likely to have more success on networks or parts of networks, where no or little other generation is present.

This information would be particularly useful for offshore developers looking to choose a UK coastal site, and weighing different issues such as environmental impacts, planning and public perception, fishing, Ministry of Defence and Civil Aviation issues, costs due to sea depth, access to port facilities and so on with grid connection costs and availability.

6.1.2 Reviewing a particular site

In reviewing the connection of a particular site, a developer would be able to carry out a preliminary assessment using data from the DNS. The DNS would enable an initial examination of the technical consequences of siting a generator at that site (technical and connection aspects are discussed in Section 2.3).

The DNS is not designed to replace any informal discussions between generator and DNO during preliminary assessments, but to enhance the initial assessment stage and to make such meetings and future studies more productive for both parties.

6.1.3 Estimating connection costs and charges

- Developers will be able to make initial estimates of the works that will be required to make a connection. This will include the local costs of constructing new assets to an appropriate point of connection on the existing network and reinforcement costs to upgrade existing assets;

- Where reinforcement requires the upgrading of existing assets and these are approaching the end of their life, it is appropriate that the cost is shared between the DNO and developer. Hence, the age and life expectancy of assets is required;

- Proposals to move to shallower connection charges have been put forward by the DTI Ofgem EGWG (see Section 2.3.1). However, developers will still need to understand what works are required to make assessment of the shallow connection charges and the timescales that might be involved to undertake the deep reinforcements.

6.1.4 Estimating connection timescales

The connection works required will impact on timescales for developing a project and these may determine a developer's approach to different sites. There are also trade-offs between the uncertainty of wayleaving (obtaining agreements with landowners to run cables or lines over their land) and planning of overhead lines, and the higher costs associated with the more rapid installation of underground cables. It is often important to understand a variety of possible cost/timescale trade-off options when developing a site.

6.1.5 Use of system charges

If "shallow" connection charges are introduced with entry use of system charges, developers will need to interpret the policy to be able to project potential use of system charges over the expected life of the project. This information may influence the search both between and within DNOs.

6.1.6 Strategic network development

If the DNOs are incentivised to connect generation they may consider speculative network reinforcements to accommodate more embedded generation where a large potential is severely limited by the network. The DNS may provide a platform for proposing such reinforcements and for receiving suggestions from generation developers.

6.2 Comparisons with other network data

6.2.1 Transco's Gas Network

Advantica Technologies Ltd, produces Map Viewer Compact Disks (CDs) detailing Transco's Mains and Plant data. A complete set of 32 disks cover Transco's UK gas mains and plant network. Single disks can be bought for specific regions. The CDs are produced from a Geographic Information System (GIS), which uses Ordnance Survey maps and draws the gas network onto them. Due to the Ordnance Survey copyright, users must be licensed, but licences are administered free of charge. The CDs were originally designed to be used by Transco workers, so that they could precisely locate gas mains whilst on-site, replacing microfiche, which in turn replaced maps. The disks are also issued to some Utilities, such as the Water Companies, free of charge due to safety obligations.

The CDs are 'stand-alone entities', in that no other software is necessary to view them. They can, therefore, be used on any computer system and there is also the option to print the information out. The disks are updated every three months, when any revised maps are extracted from the GIS. Users of the CDs are alerted at the end of each three month period as the disks may be showing out-of-date information and are, therefore, potentially unsafe. Usually, however, the disks may be used for one more month after this time, but after this they become inoperative.

Each disk costs approximately £3 to reproduce, with the biggest cost being the initial extraction of the information. The charges administered for the use of the data for commercial gain are shown in Table 8. Demonstrations of the capabilities of the CDs are available by Advantica personnel from their offices in Slough, Berkshire.

	Cost (£)
Administration	100
128 CDs (32 issued every 3 months)	512
VAT	107
Total	719

Table 8. Commercial charges for Transco's Mains Data CDs

6.2.2 Summary of SYS

The SYSs published by NGC, SP SHE and NIE contain various kinds of data. Clause 5 of Condition 10 of the NGC Licence provides an outline of the basic content of the document, ie for the subsequent seven years:

- Circuit capacities;
- Forecast power flows;
- Load on each part of the NGC system;
- Fault levels at each transmission node.

The NGC SYS goes well beyond these categories of information to provide technical and non-technical information for users and the industry. These can be considered as:

- Trading, regulatory and commercial information and background (eg Pool, NETA, 100kW market, market liberalisation, metering, settlement, Licensing, exemptions, etc);

- Demand forecasts and scenarios (embedded generation, self-generation, load management, profiles, maximum and minimum demands, demand by customer class);

- Generation forecasts and scenarios (fuel mix, merit order, max and min demands, decommissioning, new build, planning permissions/consents (Section 37), interconnections, geographic disposition, margin over demand;

- Transmission system (developments, performance, capability, tariff zones and boundaries, users group, constraints, GSP loadings, short circuit currents/fault levels, losses, zonal losses, switchgear fault ratings, thermal & voltage limitations, boundaries, security standards, transport and energy uplift);

- Opportunities and uncertainty (interconnections, base load plant, frequency responsive plant, new demand & generation, voltage support, reactive power, capacitor and static VAr compensators);

- Background information (on the power system, regulation, operation planning etc);

- Miscellaneous (FAQs, Addresses, glossary, index).

It is important to recognise that the NGC SYS covers more than mere technical information, also providing, for example, commercial information and industry background.

6.2.3 SYSs charges and availability

The charges made for SYSs do not reflect the cost of compiling and producing the statement, but are intended to cover the printing, administrative and distribution costs. However, for the small volumes of statements printed, it is unlikely that the charges cover the total costs of the operation.

A section within Scottish Power's web site contains information about their SYS. Much, but not all, of the text from the main published document is provided. NGC's SYS is viewable on the web and data is downloadable in spreadsheet format. A comparison of the cost for each SYS is outlined in Table 9.

Transmission Licensee	**Cost (£ - exclusive of VAT and p&p)**	
	Hard Copy	CD ROM
National Grid Company	50	10
Scottish Hydro-Electric	35	-
Scottish Power	46	-

Table 9. Comparison of charges for SYS

6.3 Estimation of data required for DNS

The volume of DNO assets is far higher that that of the Transmission Licensees. For example a DNO could have in the order of 50,000km of 11kV and LV lines and cables, whereas NGC has around 15,000km of circuits in total. In addition, the composition of the 11kV and LV assets will be much more varied than those at transmission voltages with additional other equipment such as transformers, switchgear, isolators etc. We estimate that the amount of data to describe all these distribution circuits could be two orders of magnitude greater than that needed for NGC's SYS.

To limit a DNS to a sensible volume of data, it has been proposed by this project that the DNS should cover assets down to, and including, the 33kV assets and 33/11kV transformers.

The amount of data that would be required for a DNS in comparison to the existing SYS of the transmission operators has been estimated by:

- Reviewing the length of circuits at each voltage for each operator;
- Reviewing average length of circuit per data entry[13] for each circuit at different transmission voltages;
- Estimating how the average length of circuit per data entry decreases with reducing voltage;
- Extrapolating this reduction to 66 and 33kV circuit voltages;
- Calculating the number of data entries that would be required for each DNO for 132, 66, & 33kV assets;
- In addition, a comparison of the number of substations has been made between transmission and distribution operators.

6.3.1 Circuit lengths

The circuit lengths for voltages of 33kV and above (EHV) for all of the transmission and distribution network operators are shown in Figure 3. Entries for Scottish Power (D) and Scottish Hydro-Electric (D) only include 33kV assets as the 66kV assets and 132kV assets are part of transmission. The data sources are the SYSs for transmission data, and Ofgem's 'Report on Distribution and Transmission System Performance', for distribution data. For Northern Ireland Electricity, data was obtained from their website. Unsurprisingly, NGC has the longest lengths of circuits, and London Electricity the shortest, at these voltages.

[13] Within the SYSs, each element of circuit has an associated set of data (eg resistance and reactance). A circuit with a uniform design and construction will have fewer elements and therefore fewer data entries. As the voltage declines, the length of each element tends to decrease and hence the amount of data (number of data entries) required to describe a given length of network increases.

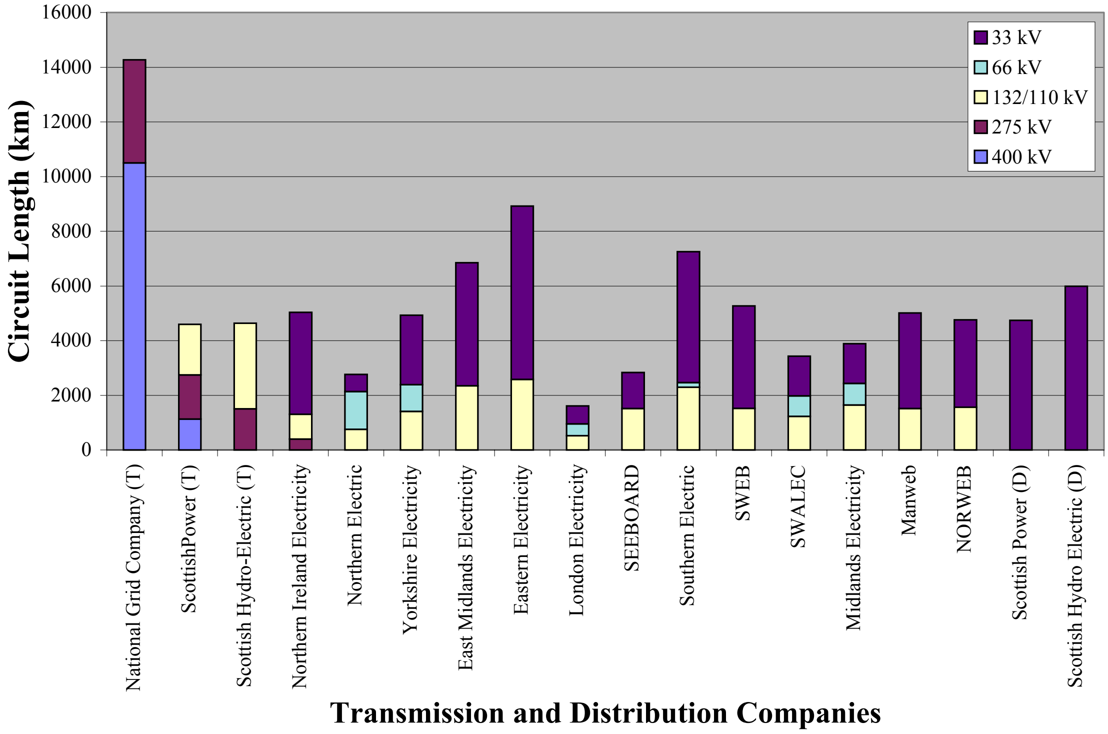

Figure 3. Circuit lengths by voltage for all operators at >=33kV.
(T = Transmission, D = Distribution)

6.3.2 Data entries

The average lengths of circuit per data entry were calculated for each transmission network operator (SP, SSE and NGC) at each voltage (Table 10). As is to be expected, and can be seen in the chart, the length per data entry falls with voltage.

Voltage (kV)	**Average number of km of circuit per data entry**
400	44
275	22
132	16

Table 10. Calculated number of data entries/km for 400, 275 &132kV

6.3.3 Circuit km per data entry divided by voltage

The lengths of circuit per data entry are divided by voltage as shown in Figure 4. By inspection the average length per entry per kV is of a similar order of magnitude. The average figure has been used to project an estimation of entries at lower voltages.

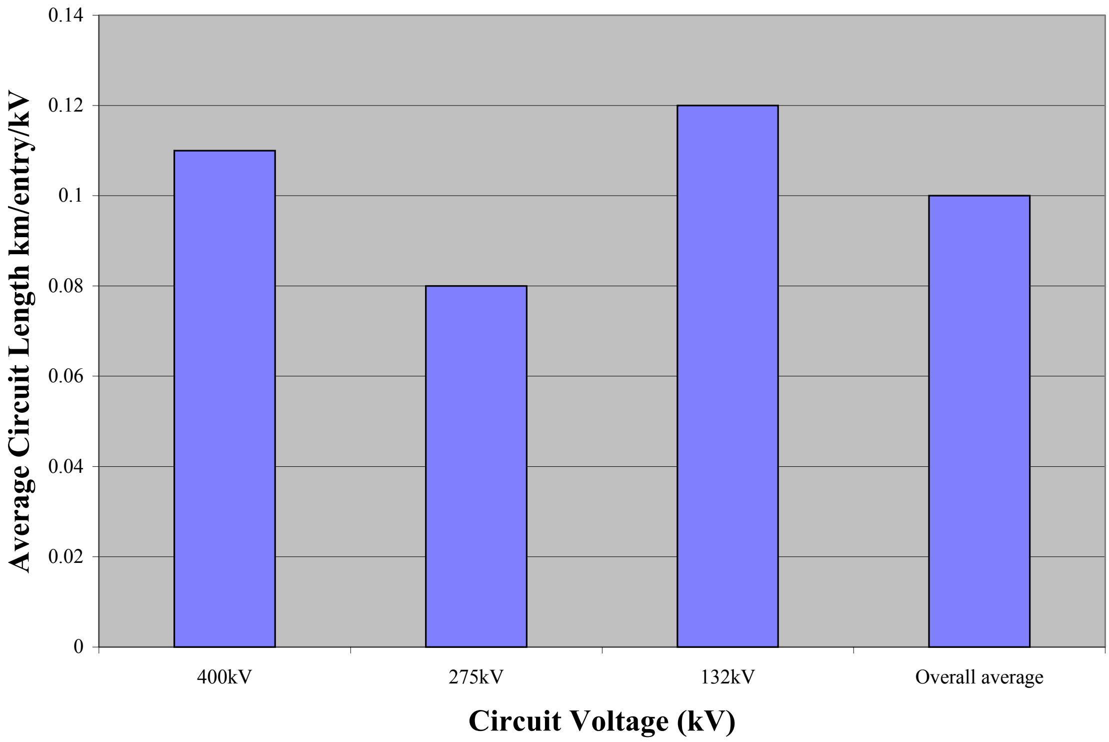

Figure 4. Average length of circuit (km) per data entry/circuit voltage.

Figure 4 gives an average figure of 0.1 km per entry per kV. To estimate the extrapolated entries for any other voltage this number is multiplied by the voltage as in Table 11.

Voltage (kV)	**Extrapolated number of km per data entry**
66	6.6
33	3.3

Table 11. Estimated number of data entries/km for 33 and 66kV.

6.3.4 Data entries per DNO for proposed DNS

An estimate of the number of data entries required for each DNO to compile a DNS at voltages of 33kV and above (EHV) is shown in Table 12 and Figure 5. The number of data entries for circuits (cable and line data) for each DNO has been calculated by dividing the number of km of circuit at each voltage by the average number of km per data entry per kV multiplied by the voltage in kV.

Operator	**Circuit km at:**			**Estimated data entries at:**			**Total data entries**
Distribution	**132kV**	**66kV**	**33kV**	**132kV**	**66kV**	**33kV**	
NE	759	1375	628	57.5	208	190	456
YE	1409	983	2532	107	149	767	1023
EME	2347	0	4503	178	0	1365	1543
EE	2585	0	6333	196	0	1919	2115
LE	519	442	649	39	67	197	303
SB	1511	0	1322	114	0	401	515
SE	2292	171	4786	174	26	1450	1650
WPD	1523	0	3746	115	0	1135	1250
Swalec	1234	751	1440	93	114	436	643
GPU	1649	786	1455	125	119	441	685
Manweb	1512	0	3497	115	0	1060	1175
NORWEB	1564	0	3193	118	0	968	1086
SP (D)	0	0	4739	0	0	1436	1436
SHE (D)	0	0	5988	0	0	1815	1815
NIE (D)	0	0	3724	0	0	1128	1128
				Actual data entries at:			**Total data entries**
Transmission	**400kV**	**275kV**	**132kV**	**400kV**	**275kV**	**132kV**	
NGC	10501	3769	0	244	210	0	454
SP	1129	1618	1848	22	86	146	254
SHE	0	1507	3129	0	23	172	195

Table 12. Estimated data entries per DNO and actual entries for SYS.

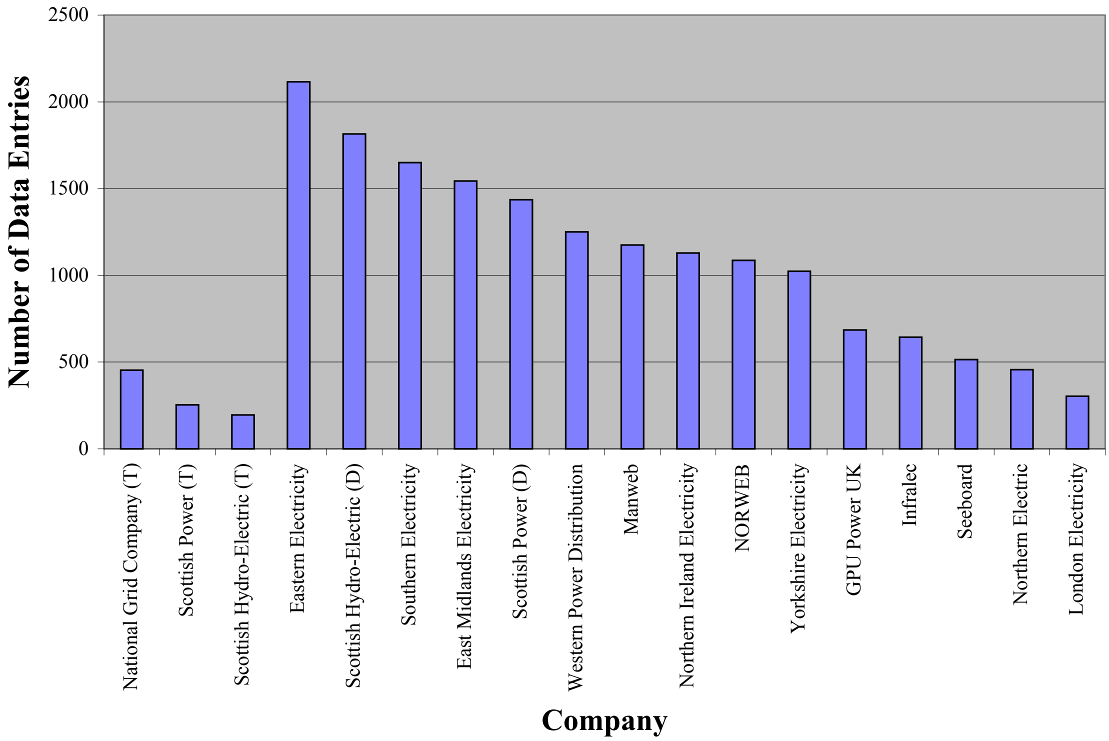

Figure 5. Total number of data entries for circuits: actual for transmission operators and estimated for DNOs.

6.3.5 Substations and transformers

As well as data on circuits (lines and cables), data are also required in the DNS for each primary substation (with a primary voltage at 33kV or above) and the transformer, switchgear, fault level and load data within that substation. The number of substations and transformers for the different network operators is shown in Figures 6 and 7.

These indicate that the average number of substations (at primary voltage and above) for DNOs is about one and a half times greater than NGC and that the average number of transformers (with windings of 33kV or above) for DNOs is nearly three times greater than NGC.

Substation numbers for most of the DNOs were physically counted from their operating area maps. Exceptions to this were for London Electricity, Yorkshire Electricity, Scottish Hydro-Electric Manweb and East Midlands Electricity. These companies had either not provided whole area maps or had not indicated substations on the maps that they had provided. The substation statistics for these five areas were, therefore, estimated by using the ratio between transformers and substations for other DNOs. In the case of Manweb which runs an interconnected system the numbers were estimated on the basis that most substations would have a single transformer. For NORWEB, 132kV substations numbers were not available. Substation statistics for TLs were found in their respective SYSs.

Transformer numbers for all DNOs (with the exception of NIE whose statistics were obtained from their website) were acquired from Ofgem's annually produced document 'Report on Distribution and Transmission Performance'. The transformer statistics for TLs were found in their SYSs.

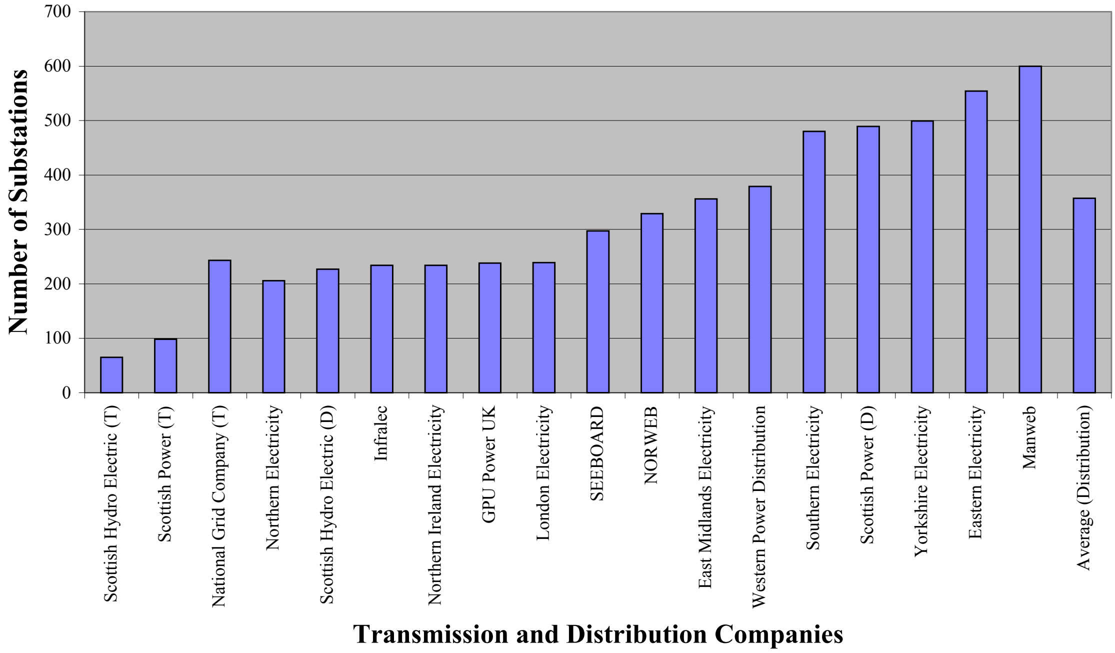

Figure 6. Number of (primary) substations by Operators

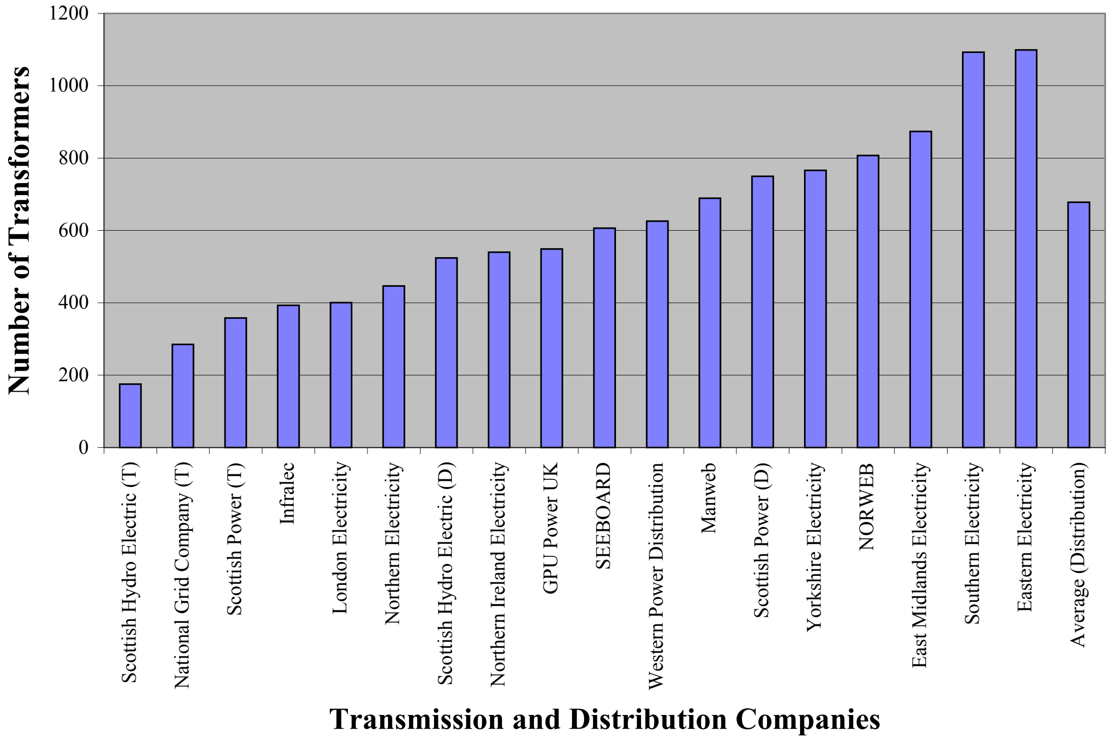

Figure 7. Number of (primary) transformers by Operators

6.3.6 Conclusions - DNS data

The volume of data for a DNS is primarily associated with circuits, particularly the makeup of each circuit in terms of numbers of cable and line sections and their specifications, and the number of transformers, substations and associated switchgear. There are, of course, significant variations between DNOs, and the above data are estimates as described. Some differences between DNOs may be less than estimated. Eastern Electricity, for example, would be expected to have long runs of 33kV circuits and, therefore, the number of data entries per km would be expected to be lower than London Electricity with much shorter runs.

However, the general overview from the analysis above is that by limiting the DNS to cover only EHV assets, the amount of data for a typical DNS would be around two to three times that in NGC's SYS.

6.4 Other beneficiaries of the DNS

This report has focussed on the benefits of the DNS to potential generators, however, during the course of the work the value of such a statement to other players has become apparent and they are listed below:

- All network users and potential connectees:

The DNS should provide an overview of the electricity industry and point to opportunities for new entrants and users. It will provide a point of reference for relevant documents, standards, codes and publications. This is similar to the role the transmission system Seven Year Statements play for larger generators and users;

- Suppliers:

Suppliers will benefit from increased understanding of the networks, locations of customers and options to purchase from embedded generators, impacts of load management and a background to, and description of, charges. A more open framework of information would help to ensure consistency of charging between customers of different suppliers, especially at EHV, where site-specific Use of System charges, are common;

- Consumers/Load Customers:

A few larger customers will benefit directly from enhanced information availability. Customers who wish to change their connection arrangements will have a better guide to the process, costs, options and implications. New customers will be better able to assess potential new connections to the system. The number of large distribution customers who may benefit from the data would probably considerably exceed the numbers of customers connecting directly to the transmission networks..

Also the information will enhance competition in generation and, therefore, help to reduce prices to all customers;

- Transmission Network Operators:

The DNS will provide a more consistent and detailed set of data for Transmission Network Operators (TNOs) connecting to the DNO's network. The TNOs can place more confidence on assessments and the impact of a growing embedded generation portfolio on security of supply, transmission power flows, etc. This will allow better and more cost effective planning of transmission networks.

- Ancillary service providers and market development:

Although markets for ancillary services, (eg frequency response, reactive power, black start) are in their infancy, and are generally not widespread on distribution networks, the DNS will provide a framework for information to develop such markets, thereby increasing competition and reducing costs.

As the amount of embedded generation grows, the role of the transmission network and auxiliary services market will evolve. Only by having good information for analysis can the costs be understood, managed and controlled;

- Regulator – Ofgem:

The DNS will provide the Regulator with higher quality and more consistent information to compare the performance of DNOs. The DNS specification would allow Ofgem to review compliance of DNOs with Condition 25 of the proposed Distribution Licence;

- Government:

The forecast data within the DNS will give the government feedback on the expected growth of embedded generation and renewable energy from the DNOs' viewpoint, which will be valuable in assessing whether targets for CO_2 emissions will be met;

- DNOs:

DNOs will benefit from:

- Complying with Condition 25 of the proposed Distribution Licence;

- Meeting their health and safety obligations by maintaining up to date and accurate data to mitigate and limit accidents, injury and damage;

- Having a reduced level of abortive enquiries for connections. It will improve their standing with customers through available information;

- The promotion of competition by helping users to understand the implications of decisions and options;

- Expected spin offs for DNOs in terms of improved monitoring, management and operation of their assets to reduce costs and losses, which become available through the improved access to, and quality of, data;

- The assistance in identification of optimum and cost effective actions to reduce customer minutes lost (CML) and customer interruptions (CI);

- A company reference manual to ensure consistency and quality of information in discussions and communications with customers, and in internal communications;

- A simpler and consistent approach to confidential information, as any data in the DNS is in the public domain and can be discussed and disclosed;

- A standard format to supply data to interconnected networks operators especially transmission network operators;

- Better data in order to implement more active management of distribution networks as envisaged by the DTI Ofgem EGWG.

7 COST-BENEFIT ANALYSIS ON PROPOSED DNS

The cost benefit analysis of the DNS has been undertaken in a comprehensive scope over the industry, as is the norm with environmental impact assessments, rather than as a financial appraisal limited to the DNOs. [14] It should be noted that the costs of producing the statements fall solely on the DNOs whereas the benefits lie principally with other market players, though not necessarily benefiting any one party, as the information will tend to promote more competition and reduce prices to consumers.

7.1 Costs of producing DNS

The costs of producing the statement are expected to vary from DNO to DNO according to the format and state of data availability. Those DNOs who have invested in effective IT systems will have the lowest costs.

From discussions with one DNO it was estimated that gathering the data and producing a statement broadly as proposed in this report would involve approximately 36 person months costing in the order of £200,000 per annum including overheads. It may be that in the first two years the effort would exceed this estimate and the effort may fall in later years as systems become established. Assuming this were the case for all DNOs, the total costs of DNSs would be £3 million per annum over the 15 DNOs. These costs would be expected to fall with experience of producing the DNS and as systems were put in place to automatically record and update data changes, and as manual data storage is replaced by IT systems.

7.2 Quantifying the benefits of the DNS

The benefits of network information to generators have been described in Section 2.3 and the benefits to other players in Section 6.4. It is not, however, easy to quantity all of the potential benefits of the DNS, although an attempt has been made in the following section:

- Reducing the costs of connections for new (embedded) generation projects;
- Reducing development costs on abortive generation projects;
- Increasing competition in generation and so reducing prices to consumers;
- Fulfilling the Renewables Obligation and so reducing the cost to consumers of the buyout price;
- Improving the efficiency of DNOs' capital expenditure.

[14] "Introduction to Environmental Impact Assessment" Glasson et al, UCL Press 2000.

Each area is discussed in more detail below and an estimate of the change, which would equal the annual cost estimate of producing DNSs.

It should be noted that the costs of producing the statements rest with the DNOs, whereas the benefits will generally fall to others in the industry.

7.2.1 New Generation cost savings

It has been estimated that 20GW of new embedded generation will be connected in the UK over the next ten years, a rate of 2GW per year. This represents an investment of around £1000 million per annum. Included in this is the cost of grid connection, which is typically in the order of £50k/MW or more for embedded generation. This represents £100million per annum in connection costs in the UK. As discussed in Section 6.1.3, DNSs would reduce connection costs through more effective design and matching of projects to the grid.

- A saving of 3% in the connection costs of new generators would equal the costs of the DNS.

7.2.2 Failed projects reduced

Developers spend money to assess projects and only a proportion of these will go forward for various reasons including planning permission, resource assessment and also grid connection costs and planning difficulties. Assuming that 5% of the total cost of new generation is spent on projects that will not progress, this represents an annual cost of £50 million per annum. As discussed in Sections 6.1.1 and 6.1.2, DNSs would focus developers on sites with effective connection and reduce the number of abandoned projects.

- A saving of 6% in development expenditure on failed projects would equal the costs of the DNS.

7.2.3 DNO capital expenditure more effective

In the UK, DNOs expect to expend approximately £1500 million per annum on capital expenditure. [15] This compares to annual capital expenditure of £200 to 300 million by NGC in 1996-1999. [16] The formal gathering of data that would be required to produce a DNS (see Appendix D for details of the proposed data) could result in more effective or reduced

[15] Ofgem "Reviews of PES 1998 to 2000 Distribution Price Control Review", May 1999
[16] Ofgem "The Transmission Price Control Review of NGC from 2001", December 1999

expenditure by DNOs to achieve the same goals, targets or service objectives.

- A saving of 0.2% in DNO capital expenditure would equal the costs of the DNS.

7.2.4 Lower prices through competition

Embedded generation is becoming particularly important in the competitive generation market. Domestic electricity sales, which make up one third of the market by volume, are valued at around £6000 million per annum in the UK. As identified in Section 2.3.6, DNSs would increase competition in generation.

- A reduction of 0.05% in domestic prices, due to increased competition, would equal the costs of the DNS.

7.2.5 Increase in renewables toward targets

The renewables obligation target will be increasing to 10% of electricity supplied, ie at least 30TWh/annum by 2010. Suppliers who do not meet their targets will have to "buy out" of their obligation. Assuming the buy out price for suppliers is 3p/kWh and renewable generators are offered 80% of this price, any shortfall in renewables capacity will cost consumers 0.6p/kWh. A shortfall in renewables capacity is expected under the proposed profile of the renewables obligation. If 0.5TWh of renewable electricity could be brought forward early every year to reduce this shortfall, this would save UK consumers £3million per annum. To achieve this, 114MW per annum of generation, at 50% load factor, equal to 8MW per annum in each DNO area would need to be advanced. The DNSs would make it easier for developers and existing customers to identify locations where project can be connected to the network.

- Advancing the construction of 8MW of renewables generation by one year each year for each DNO would bring savings to electricity consumers equal to the cost of the DNS.

7.2.6 Cost benefit summary

The costs of producing the DNS will fall to the DNOs. At present there are no known plans for Ofgem to allow the DNOs to recoup the extra costs incurred under the Distribution Price Control Review, which is in any case not due for review until

2005. The costs to DNOs will be lower for those DNOs who have invested in IT systems to store and process network data.

Most of the benefits identified will fall to other industry players rather than the DNOs. However, if a saving of 0.2% in DNOs capital expenditure were made as a result of having better and more up to date network information this would equal the cost of producing the statements. There are many other benefits to DNOs, listed in Section 6.4, whose costs have not been quantified.

We conclude that the benefits to the whole industry of full DNSs will exceed the costs to the DNOs of producing them. It would, therefore, seem reasonable that the DNOs should be allowed to increase their regulated income to cover the costs of a full DNS. The allowable costs should be based on the costs of the most efficient DNOs to reward those DNOs who have invested in good information and IT systems in the past. We would expect that the extra costs recovered from distribution network users through increased use of system charges would be offset by other savings, eg through increased competition and more renewable energy generation.

8 CONCLUSIONS

Most DNOs provided information to a high standard and free of charge. However, in a few cases the charges were high, if not excessive. A few DNOs were still unwilling, or simply unable to provide the most generic network data – an EHV network map.

In servicing customer demand for information most DNOs were co-operative, but in some cases their organisational structures did not appear to accommodate such a request and the responsibilities for dealing with it. This was shown in the speed of response, even after a request was agreed, timescales to provide data varied from two days to nine weeks. Two DNOs published standard price lists indicating that they had considered the provision and management of such data requests.

The standard of data provided was generally better for local HV data than for EHV data, demonstrating that DNOs are geared up to deal with local connection requests and less able to indicate more strategic issues in relation to siting of new generation.

It is more important for prospective embedded generators to have access to network information than centralised transmission connected generators because embedded generators pay deep connection charges and the economics are, therefore, much more sensitive to network interactions. Also, as distribution networks were not designed to accommodate generation there are as many if not more issues that are likely to effect a connection.

It would not be practical, and is probably not cost effective at present, for DNOs to produce a DNS covering all their assets. However, producing a DNS for EHV assets (132, 66 & 33kV) down to and including the HV busbars of primary substations is practicable and would involve two to three times the data involved in NGC's transmission system Seven Year Statement.

In terms of overall industry costs and benefits, it will probably be very cost effective for all DNOs to produce a DNS as above. However, we recognise that the associated production costs lie with the DNO whereas most of the benefits will fall to other industry players. Given that overall industry costs will fall, it seems reasonable to allow DNOs a modest recovery of costs, equivalent to the lowest cost DNO, in the Distribution Price Control Review.

The cost benefits of producing a comprehensive DNS look very attractive. The estimated annual UK cost of DNSs of £3million per annum (£200k per DNO) looks small when compared to the following benefits which might ensue:

- A saving of 3% in connection costs for embedded generators;
- A saving of 0.2% in DNO capital expenditure;

- A reduction in domestic prices of 0.05% due to increased competition;
- Advancing the construction of 8MW of renewable generation in each DNO each year.

A standard Pro-Forma with Guidance Notes could be used for DNOs to provide information to prospective generators on other assets (especially HV assets) not covered by the DNS in order that prospective generators could carry out a feasibility study.

A Code of Practice for DNO information should be used to specify best practice of provision of maps, schematics and data by DNOs.

9 RECOMMENDATIONS

9.1 A vision

We recommend that the industry, especially Generators and DNOs, establish a clear vision of how information will be made available and communicated. This vision could be along the lines of:

- A DNS provides overall information on assets and the use of assets including the 132kV, 66 and 33kV sub-transmission systems down to the 11 (20 or 6.6)kV busbars of primary substations;

- Detailed requests for initial data on 11kV systems are provided in a formal way according to an agreed code of practice and standard forms;

- More complex network data which may be required, particularly for larger and interacting projects, is dealt with on a case by case basis until it becomes common enough to be formalised.

In future, as more standard requests for data are received, more of these exchanges should be formalised in the Code of Practice and in standard forms.

9.2 Distribution Network Statement

We recommend that each DNO should produce an annual DNS according to the format reproduced in Appendix D.

9.3 Charges for DNS

As with SYS, the costs of developing and compiling the data for the DNS will far exceed the potential revenue from selling the document. SYS charges are designed to cover the costs of reproduction and administration.

Therefore, we recommend that the statements are published on the web, so that they are freely available without printing, publishing or administrative costs to the DNO or charges to users. This has the additional benefit that they can be easily updated and that users could download data for use in analysis.

Where DNOs do make charges for printed copies, these should be reasonable, designed to cover printing costs only and regulated by Ofgem.

9.4 Code of Practice

After consideration of this report and the Code of Practice draft in Appendix A, the DNOs should adopt a Code of Practice for information provision.

Generators should send the Code of Practice with requests for information to DNOs.

9.5 Pro-Forma

After consideration of this report and Pro-Forma, we recommend that the DNOs should adopt a standard Pro-Forma for information provision and include it in, or link it to, the Distribution Codes.

Generators and developers should start using the Pro-Forma and accompanying Guidance Notes (in Appendices B & C) to obtain information from DNOs.

9.6 Ofgem's IIP & regulatory incentives

We recommend that Ofgem should use their Incentives and Information Project to reward DNOs who provide a high standard of easily available, free or low cost network information, eg by means of web-based tools.

The Draft DNS Specification (Appendix D) is intended to ensure a high standard of information provision across all DNOs. However, there is still scope for the most pro-active DNOs to provide more comprehensive information and commentary, especially with regard to forecasts, opportunities, scenarios and future plans.

Ofgem is invited to consider the performance of DNOs in producing statements and whether they should be rewarded for excellence in this respect and whether penalties may be appropriate for poor performance, in respect of both the standard of information and the speed of provision. It may be pertinent to consider this information in relation to the IIP (Information and Incentives Project).

9.7 Ofgem annual distribution performance report

Ofgem produces an annual statement of distribution performance which contains statistics on the assets of each DNO. However, due to differences in the categorisation and formatting of the network data within the distribution performance report, it was often found difficult to compare the assets of the different DNOs.

We recommend that Ofgem specifies a standard format for all DNOs to provide data on their assets for the annual statement of distribution performance. When the DNSs are published, this data should also be provided in the DNS and be available to be compiled in a variety of different formats to promote competition.

9.8 Condition 8 statements

DNOs produce statements of charges for connection, use of system, provision of top-up and standby supplies or sales of electricity and for exempt supply services. In England and Wales, this stems from Condition 8 of the PES licence.

It is recommended that each DNO includes a new statement, annex or section on information provision. This document would include:

- A standard price list for information provision;
- A statement of how information will be provided with examples;
- Pro-Forma of data to be supplied for a generator request on the 11kV (or equivalent) network.

DNOs may wish to use the Pro-Forma and Code of Practice produced here for these statements.

9.9 Review of DNO data systems

In compiling the report is became apparent that the systems operated by DNOs for data storage and retrieval are highly variable and some data does not exist as is discussed in Section 2.2.4.

We recommended that Ofgem undertake a review of all DNO data systems to identify best practice and provide incentives and requirements of DNOs to improve these systems.

9.10 Future opportunities & possibilities

The industry considers using the new technologies to improve the assessment of generator connections. This could include:

- Provision of DNSs on the web;
- Provision of data and software to carry out the assessments;
- Running on line assessment and costing software for new connections;
- Automatic updating of records on a daily basis;
- Linking data related to street works, assets, customers, demands, faults etc into a linked data structure.

10 GLOSSARY OF TERMS AND ABBREVIATIONS

AEP EGG	Association of Electricity Producers Embedded Generation Group
CEGB	Central Electricity Generating Board (pre-privatisation)
CHP	Combined Heat and Power
CHPA	Combined Heat and Power Association
CI	Customer Interruptions (a measure of network performance)
CML	Customer Minutes Lost (a measure of network performance)
CoP	Code of Practice
DCRP	Distribution Code Review Panel
DNO	Distribution Network Operator
DNS	Distribution Network Statement
DTI	Department of Trade and Industry
EGWG	Embedded Generation Working Group (of DTI and Ofgem)
EHV	Extremely High Voltage (ie 33kV and above)
ESB	Electricity Supply Board (Ireland)
ETSU	Energy Technology Support Unit – part of AEA Technology plc
GB	Great Britain (Wales, Scotland and England)
GIS	Geographic Information System
HV	High Voltage (>1000V. Usually refers to 11kV, in some cases 20kV and 6.6kV and occasionally may include some 33kV circuits)
IIP	Ofgem's Information and Incentives Project
LV	Low voltage (<1000V. Usually refers to 400V or 230V the single-phase equivalent voltage).
Ofgem	Office of Gas and Electricity Markets (covering GB)
Ofreg	Office for the Regulation of Electricity and Gas (covering Northern Ireland)
PES	Public Electricity Supplier
PF	Pro-Forma
REC	Regional Electricity Company
SDCRP	Scottish Distribution Code Review Panel
SE/Ofgem WG	Scottish Executive/Ofgem Working Group
SHE	Scottish Hydro-Electric (part of SSE)
SSE	Scottish & Southern Energy
SP	Scottish Power
SYS	Seven Year Statement
TL	Transmission Licensee
TNO	Transmission Network Operator
UK	United Kingdom (Northern Ireland, Wales, Scotland & England).
UoS	Use of System

11 ACKNOWLEDGEMENTS

Econnect would like to acknowledge the assistance of many DNO staff in providing data, maps and information, often at no charge. Network operators and generators have provided input and feedback to the drafts and discussed some of the issues. The AEP have facilitated discussions on the subject.

12 USEFUL PUBLICATIONS

12.1 Transmission Licensee Seven Year Statements

- National Grid Company (available from the NGC)
- Scottish Hydro-Electric (available from SHE)
- Scottish Power (available from SP)

12.2 Ofgem Documents

Annual Report on Distribution and Transmission Performance

12.3 AEP Reports

- Electricity Production Connected to the Local Network – a guide
- Electricity Production Connected to the Local Network – a guide for Scotland

12.4 ETSU Documents

- Costs and Benefits of Embedded Generation (K/EL/00131/REP)
- Increasing Levels of Distributed Generation and its Effect on Electricity Networks (K/EL/00176/REP)
- Technical Requirements and Documentation for the Network Connection of Small-Scale Generation: As Applied to Embedded Generation in England & Wales – A Scoping Study (K/EL/00174/REP)
- A Distribution Network Review (K/EL/00188/REP)
- The Effect of Increasing Levels of Embedded Generation on the Distribution Network (K/EL/00184/REP)
- A Technical Guide to Connection of Embedded Generators to the Distribution Network (K/EL/00183/REP)
- Technical, Standards and Control Issues of embedded Generation (K/EL/00229/REP)
- Network Costs and Benefits of Embedded Generation (K/EL/00214/REP)

13 CONTACT DETAILS

13.1 DNOs

24Seven (for Eastern Electricity and London Electricity)

Customer Connections
8 Moores Walk
St. Neots
Huntingdon
Cambridgeshire
PE19 1AG

East Midlands Electricity

Herald Way
Pegasus Business Park
East Midlands Airport
Castle Donington
DE74 2TU

GPU Power Distribution

Network Information Management
Toll End Road
Tipton
DY4 0HH

Manweb

Network Design Section
Prenton Way
Birkenhead
CH43 3ET

Northern Electric Distribution Limited

Manor House
Station Road
New Penshaw
Houghton-le-Spring
DH4 7LA

Northern Ireland Electricity plc.

PO Box 2
120 Malone Road
Belfast
BT9 5HT

NORWEB

Hathersage Road
Manchester
M13 0EH

Scottish and Southern Energy plc.

- Southern Electric:

  Westacott Way
  Littlewick Green
  Maidenhead
  Berkshire
  SL6 3QB

- Scottish Hydro-Electric:

  Power Systems
  Inveralmond House
  200 Dunkeld Road
  Perth
  PH1 3AQ

Scottish Power

Power Systems
St. Vincent Crescent
Glasgow
G3 8LT

SEEBOARD

Transmission Projects
PO Box 15
East Grinstead
West Sussex
RH19 3WE

Western Power Distribution

- SWALEC area:

  Heol Pentwyn
  Nelson
  Treharris
  CF46 6LY

- SWEB area:

  Avonbank
  Feeder Road
  Bristol
  BS2 0TB

Yorkshire Electricity

Distribution
PO Box 161
161 Gelderd Road
Leeds
LS1 1QZ

13.2 Transmission Licensees

The National Grid Company plc

National Grid House
Kirby Corner Road
Coventry
CV4 8JY

Scottish Hydro-Electric

Power Systems
South Inch Business Centre
Shore Road
Perth
PH2 8BW

Scottish Power

Power Systems
Leven Street
Motherwell
ML1 2BF

13.3 Other Organisations

AEP

1st Floor
17 Waterloo Place
London
SW1Y 4AR

ETSU

Harwell
Didcot
Oxfordshire
OX11 0RA

Ofgem

9 Millbank
London
SW1P 3GE

14 APPENDICES – (AVAILABLE AS K/EL/00232/REP/A)

Appendix	Description & Company file reference	
A	Proposed Code of Practice for Information Provisions	
B	Proposed Pro-Forma	
C	Notes for Proposed Pro-Forma	
D	Proposed Distribution Network Statement	
E	Review of Pro-Forma Information	
F	Response to Ofgem’s Distribution Licence Consultation	