Third Annual Report of the Distributed Generation Co-ordinating Group (2004/05)

A report to:

- The Department of Trade and Industry;
- The Department for Environment, Food and Rural Affairs;
- The Scottish Executive; and
- The Gas and Electricity Markets Authority.

March 2005

Foreword

When in 2000 an industry working group proposed the establishment of the Distributed Generation Co-ordinating Group (DGCG), it identified a considerable amount of work necessary to remove barriers to the further development of distributed generation and combined heat and power (CHP). Progress on those tasks is summarised in the high-level timetable at Appendix 2 to this annual report.

The DGCG recognised that it was taking on a challenging remit, but early project planning revealed a wide range of regulatory, commercial and technical issues that needed to be addressed. Much of the work, like Ofgem's review of the distribution price controls, has been carried out by existing organisations and agencies, with the DGCG assisting to define the issues and providing a cross-industry forum. In other areas, with the help of the electricity industry, leading consultancies, academic institutions and government departments, the DGCG and its Technical Steering Group (TSG) have made a direct contribution in bringing forward solutions. It is to the credit of all those involved that the high-level timetable now shows so much work as completed. As Appendix 3 reveals, most of the identified barriers to the development of distributed generation and CHP have been removed. The few that remain are mostly in the process of being dismantled.

The DGCG has now finished its work. It will hand over some long-term TSG projects to the new Electricity Networks Co-ordinating Group (ENCG), whose task it will be to focus on how electricity transmission and distribution networks need to continue developing, given the Government's environmental targets for carbon reduction. It is an exciting time. The work on which the DGCG and TSG have been engaged over the last three years suggests that the electricity networks are on the verge of some of the most far-reaching change for almost half a century. Distributed generation and CHP will be a major driver of that change, which is coincident with an expected rising trend in wider investment for age-related replacement. It is therefore particularly timely for increased attention to be given to the national electricity infrastructure.

DGCG and TSG members, together with the numerous people who contributed to the many individual TSG projects, have accomplished a great deal. It has been a privilege to work with them. We should like to record our considerable thanks for all the commitment, creativity and solid hard work shown by those who have contributed to this.

John Neilson
Joint Chairman

Neil Hirst
Joint Chairman

Summary

This is the final report of the Distributed Generation Co-ordinating Group (DGCG), covering the period 1 January 2004 to 26 January 2005 (the date of the DGCG's last meeting).

The DGCG was established to advise the DTI and Ofgem on the removal of a range of perceived, unjustifiable barriers to the connection and development of distributed generation and combined heat and power (CHP) as an integrated feature of Great Britain's power systems. Most of those barriers have now been removed. The recommendations of the former Embedded Generation Working Group (which reported in January 2001) have been implemented.

Work necessary for the longer term will be of a kind somewhat different from that on which the DGCG has been engaged for the last three years. It will focus on the longer-term co-ordinated development of electricity networks, under the influence of new power system technologies, within the context of a liberalised business framework. Now that many barriers to distributed generation and CHP have been removed, these generating technologies are free to constitute a significant driver for change. Regional and community energy schemes, perhaps incorporating significant amounts of domestic-scale microgeneration, may become increasingly important.

The design, operation and management of networks are expected to evolve, over time. Distribution networks may, in many locations, be more actively managed, increasingly demonstrating similarities to transmission networks, and perhaps contracting with distributed generators for network services to support security and quality of supply, and work with the transmission operators for frequency support services.

Much of the work of the Technical Steering Group (TSG), which the DGCG established to manage projects of a technical and technical/commercial nature, is now complete. Of 48 such projects, 23 are completed, and nine others are nearing completion. Plans have been made for bringing the remainder to satisfactory closure, under a new framework.

The DGCG has recommended that this outstanding work, of which the challenging areas of provision of ancillary services by distributed generation, islanded operation and active network management are examples, should be

taken forward by a new structure incorporating an Electricity Networks Co - ordinating Group overseeing a Distribution

Committee and a Transmission Committee. Such a structure would be able to take a holistic view of developing power system issues, ensuring co ntinued high-quality advice to the electricity industry, the energy regulator and the responsible Government departments.

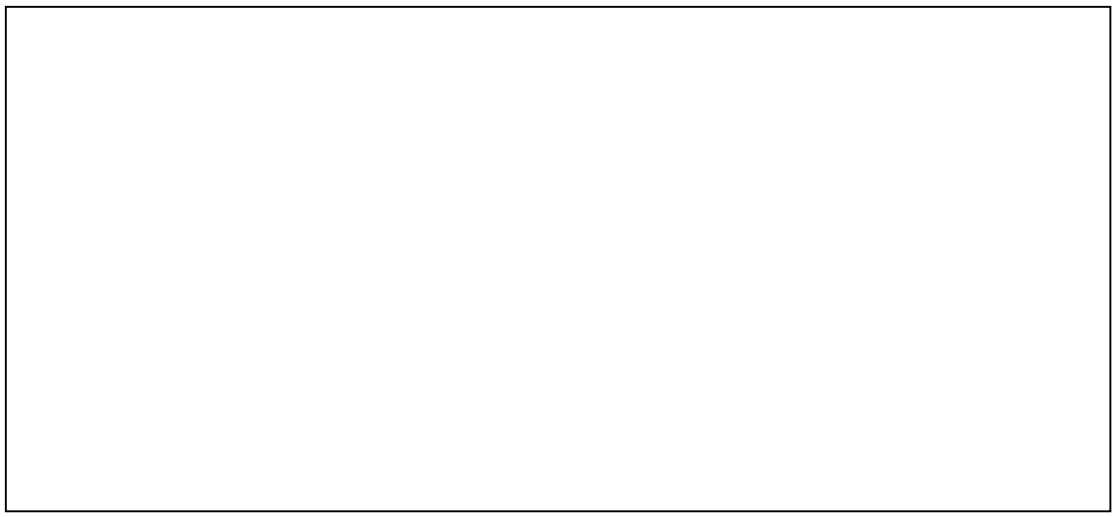


Table of contents

1. Background, terms of reference and membership

Background

1.1. Formed on the recommendation of the Embedded Generation Working Group (EGWG), which reported in January 2001, the DGCG provides advice to the DTI, Ofgem, Defra, and the Scottish Executive on issues associated with the development of generation connected to elec tricity distribution systems. The DGCG created the TSG to manage six workstreams consisting of a range of technical projects.

Structure of this report

1.2. This report covers the period fr om 1 January 2004 to 26 January 2005 (the date of the DGCG's last meeting). The full DGCG met quarterly.

1.3. Part 1 sets out introductory information about the DGCG and its work. Part 2 presents a resume of some of the key policy issues discussed at quarterly meetings. Part 3 gives a status report on the various projects that the TSG has set up and managed. Part 4 considers how, building on the work of the DGCG and TSG, issues to do with the future design, operation and management of electricity networks might usefully be taken forward. Appendix 1 contains a list of the DGCG's membe rs in this period. Appendix 2 is a high-level timetable, based on that originally suggested by EGWG, and updating the versions that appeared in our previous two annual reports. Appendix 3 gives an overview of the progress made to date on the removal of bar riers to the connection of distributed generation. Appendix 4 gives a detailed breakdown of what the DGCG and TSG see as future network issues for resolution, suggesting where responsibility for action might s ensibly lie. Appendix 5 is a diagrammatic repre sentation of a suggested framework to succeed the DGCG and TSG. Finally, Appendix 6 is a glossary intended for those unfamiliar with the technical terms used in this report.

Membership

1.4. The DGCG has 19 members, who are mostly directors or senior employees of businesses or trade associations having a significant interest in distributed generation. Members were also selected from particular sectors of the industry (e.g. smaller generators, DNOs, suppliers, consumers etc.). Members contribute to discussion in an individual capacity rather than as representatives of their employing organisations, but they are expected to explain the views or their sector or constituency and to disseminate information within that community.

1.5. A full membership list is at Appendix 1.

Terms of reference

1.6. The following terms of reference have been approved for the DGCG:

- To recommend priorities for action arising from the recommendations of the joint government industry working group on embedded generation.
- To monitor and comment on action taken in respect of the recommendations of the report and to advise on progress.
- To provide advice to DTI, Defra, the Scottish Executive and Ofgem on any additional action that may be required as a result of the progress made or events encountered which hinder such progress.
- To establish a technical steering group, to review reports from it and to direct its work programme.
- To consider and make recommendations as to any complementary (e.g. research and development) action that may be helpful to achieving the objectives set out in the EGWG report.
- To disseminate the results of its activities to the wider community.

Mission statement

1.7. The DGCG adopted the following mission statement:

1.8. *'The DGCG's primary objective is to facilitate the achievement of the Government's targets for renewable generation and CHP by addressing relevant technical, commercial and regulatory distribution network issues. It will do this in two ways. Firstly, it will identify and consider any network issues that are constraining the further development of distributed generation. Secondly, it will recommend to the DTI/Ofgem what actions it thinks might be necessary to remove unjustified constraints and if appropriate advise on priorities and incentives. The DGCG will operate openly in meeting these objectives, involving relevant sections of the industry and other interested parties.'*

The Technical Steering Group (TSG)

1.9. The DGCG has created the TSG, which draws on a wide range of expertise from the electricity industry and associated org anisations. Its terms of reference are to steer and report on work programmes necessary across the industry to support the objectives set by the DGCG. It has addressed a considerable number of technical and technical/commercial issues likely to arise from increased connection of distributed generation.

1.10. The TSG co-ordinates the work of six workstreams, each of which manages a number of projects. The workstreams and their overall tasks are summarised in the following table.

No.	Workstream	Area of work
1	Distributed Generation Status and projections	• Current status of connected and planned distributed generation. • Likely future distributed generation mix.

2	Standardisation of Information and Solutions	• Relevant and accessible standards for the industry, reflecting current developments. • Appropriate categorising, or banding, of distributed generation types. • EGWG recommendations on information and guidance documents.
3	Short-term Network Solutions	• Technical, regulatory and commercial issues relevant to the development of basic active management of distribution networks. • Identification of short-term measures to allow fuller recognition of the contribution of distributed generation to network security and performance.
4	Micro-generation Solutions	• Removal of barriers to micro-generation. • Simple, standard solutions for connection of micro-generation. • To advise on micro-generation in the context of the next distribution price control review.
5	Long-term Network Concepts and Options	• Technical issues pertaining to the longer-term transformation of distribution networks in order to facilitate distributed generation.
6	Industry Skills and Resources	• To help ensure that future skills and human resource requirements of DNOs and other organisations do not present barriers to the implementation of EGWG recommendations.

1.11. The TSG's work is discussed in greater detail in Part 3 of this report.

Communication

1.12. Without effective communication, the DGCG and TSG would have been unable to achieve what has been done to remove barriers to the connection of distributed generation. Discussion and consultation have been central to their work.

1.13. The DGCG has set up a website (www.distributed-generation.gov.uk), which is kept regularly updated. Intended to make information on the DGCG's work available to a wide audience, the website contains information sheets, papers and summaries of meetings. Details of TSG projects are also to be found there. 427 people have registered with the website.

1.14. Two TSG members have organised regular briefing sessions on the TSG's work. These have been held in various centres throughout Great Britain. It is indicative of the level of interest that audiences are frequently as many as 60 people.

1.15. The projects detailed in this report have required extensive liaison with, for example, organisations such as the Health and Safety Executive, the Energy Networks Association, Elexon, and Future Energy Solutions (Harwell), the last particularly on managing the setting up of DTI-sponsored consultancy work.

2. Key policy issues discussed

Technical architecture

2.1 In an attempt to look beyond the horizons of current regulatory concerns, the DGCG considered a paper on long-term network development. The issue had first arisen from a seminar ('Greener Generation – Delivering the Technology') organised by the Institution of Electrical Engineers (IEE), in November 2003. A main risk identified by delegates had been that significant inconsistencies might emerge in the approaches adopted by the various parties having responsibility for addressing the challenges presented by greener generation.

2.2 The paper outlined an approach that, while not constituting either a detailed technical agenda or a centrally-generated blueprint, acknowledged that all sectors can benefit from appropriate common standards and architecture. This seemed particularly to be the case where such fundamental commonality could encourage and facilitate independent action. Failure to achieve this might risk piecemeal lock-in to a diversity of protocols or technical specifications - with resulting lack of clarity, technical barriers and cost increases.

2.3 The paper suggested that there might be benefit in scoping the work required to provide a framework for guidance to the sector on best practice for technical architecture. Topics for consideration might include:

- procurement;
- network design;
- testing methodologies;
- safety considerations;
- network operation and management;
- performance indicators; and
- skill and support requirements.

2.4 Following that scoping exercise, a working group has been established to consider the technical architecture for future electricity networks. TSG members are working closely with the IEE in taking this work forward.

Power system technologies

2.5 The DGCG recognises that the political drivers for distributed generation, including the offshore wind programme and the Renewables Obligation, are likely to lead progressively toward the transformation of networks into less centralised and more actively-managed configurations. More numerous generators, using various technologies, will be likely to take advantage of the wider application of power electronics. The DGCG received a presentation from a major manufacturer of power interfaces for connection of generation.

2.6 Amongst existing distributed generating technologies, micro and mini turbines are now beginning to compete with reciprocating engines and wind turbines in the 10kW to 1MW band. Stirling engines are emerging as significant in the 1kW to 10kW band. Tidal and wave generation are at a stage of development roughly analogous to where wind generation was some twenty years ago. Solar thermal electricity generation will probably be less significant in the UK than it promises to become in Southern Europe. Biomass gasification, with its associated gas storage capability, is likely to become an interesting generating technology for stations over 1MW.

2.7 The key technical problems arising from increasing levels of distributed generation are fault level management, power flow management and voltage control. Reactors are available to limit impedance and contribute to the management of fault level. Research is currently being undertaken on the possibility of integrating new materials into this existing technology. Superconducting materials are still very expensive, but perhaps not far from commercial availability.

2.8 It is possible to envisage a 'road map' to power flow management, mapping the increasing, and progressively less expensive, incorporation

of intelligence into power systems. Existing SCADA[1] systems seem likely to become more sophisticated, and to be extended down to LV circuits. A further development might be upgraded SCADA with added real-time functionality. In time, networks might move to 'internet management' with sophisticated automation, 'plug and play' data processing, and resulting high levels of reliability and security. The emphasis, in developing these systems, is likely to be on information value per kWh.

2.9 Options for improving power flow management include bringing techniques for optimal asset management, wind forecasting, software and communications to distribution networks. Energy storage may also become important in addressing problems of intermittency and security of supply. Superconducting magnetic energy storage is still prohibitively expensive[2]. Redox flow cells remain an attractive option across a whole range of capacities, despite the recent abandonment of the Regenesys project. The DGCG understands that an integrated voltage regulator is being developed to replace SVCs[3].

2.10 Solutions to a number of technical problems have already been successfully implemented. Distributed generation can be combined with existing technologies. Bio-mass, bio-gas CHP, natural gas CHP, and coal-bed methane generation have all been successfully connected to networks.

2.11 New equipment can be tested in the laboratory, either by digital simulation or on scaled-down models. Such tests do not, however, give full assurance as to actual performance on the network. In the later stages of development, full-scale in-service tests are required. The Registered Power Zones proposed by Ofgem might be helpful here.

2.12 Superconductor materials are not currently available 'off the shelf'. Manufacturers currently produce bespoke products to individual

---

[1] System control and data acquisition

[2] A superconducting magnetic energy storage (SMES) system can store and discharge large quantities of power. It stores energy in the magnetic field created by the flow of DC current in a coil of superconducting material that has been cryogenically cooled. Some systems are in use to improve industrial power quality. Operating at relatively low voltages, SMES systems can be connected to the networks via a transformer and AC/DC converter.

[3] Static VAr Compensators.

specifications and requested ratings. This is expensive; it creates commercial risks. Moreover, practical issues about cooling have yet to be overcome. This is an instance of the way in which materials questions are at the heart of the development of new power system technologies. Ceramics, for example, are used in both superconductor and fuel cell applications.

2.13 In the context of the recent TSG project report on the safety case for fault current limiters, members discussed experience in other Member States of the EU. It is understood that the equipment generally in use is little different from a fuse. This is unlikely to be sufficient for future applications. There is a technology gap that might helpfully be filled by a device not requiring re-setting after operation. There remains significant uncertainty as to whether UK safety legislation permits the connection of fault limiters.

2.14 It is not clear how long it will be before a requirement for utility-scale electricity storage will result in a commercial product. The Japanese electricity industry has some experience of energy storage and there may be some interest in co-operating with initiatives in the UK. Institutional barriers might result in loss of some of the economic benefits of storage. In an integrated power system, network operators might be able to operate energy storage facilities. Separation of businesses means that the ownership of generation by DNOs is a difficult issue, and one with which energy storage will inevitably become associated. These questions will have to be addressed.

2.15 The DGCG believes that it would be helpful if manufacturers of power system equipment were to become involved in the dialogue about distributed generation and the future development of power systems. In particular, they could contribute views on changing market needs and technical challenges. If a framework could be established for sharing technical vision, manufacturers would be able to contribute from considerable experience with current solutions for distributed generation and related technical problems. This would be especially helpful in the longer term, in the context of work on technical architecture.

Research in the EU

2.16 The DGCG remains concern at the UK sector's lack of engagement with the intensively resourced (typically circa £50m) research projects in progress in the rest of Europe. It is likely that these projects will have sufficient impetus to result in new EU standards, which the UK would be obliged to implement. It might then prove too late to influence their content. An example might be standards relating to DCHP, which might have the effect of rendering non-compliant equipment on the verge of mass manufacture in the UK. While some liaison seemed to be in place, there is no machinery for managing the process of engagement.

Incentives on distribution network operators (DNOs)

2.17 Although not contributing directly to a regulatory review that was entirely Ofgem's responsibility, the DGCG has taken a close interest in the distribution price control review. This interest stems from EGWG's recommendations on the removal of barriers and disincentives to the connection of distributed generation and to concerns that existing mechanisms for capital investment to accommodate distributed generation appeared too restrictive.

2.18 The DGCG welcomed Ofgem's proposed 'hybrid incentive mechanism', combining a partial cost pass-through with a revenue driver incentive. Also particularly helpful was the proposal to allow, for the first time, investment before specific requests for generator connection. Together with its parallel mechanisms for the funding of innovation in network design and operation and the trialling of new equipment and working practices in Registered Power Zones (RPZs), the price control proposals for the period from 1 April 2005 constitute a major step forward in removing barriers to the further development of distributed generation and CHP.

Regional and community energy initiatives

2.19 An increasingly important manifestation of distributed generation is as part of community energy initiatives. During the reporting period, the DGCG received a presentation from 'Yorkshire Forward' about regional energy initiatives in the Yorkshire and Humberside area. Members also received a case study of a community energy project currently being taken forward on Westray in the Orkneys. Discussion of regional and community energy initiatives emphasised the importance of economic realism in the pursuit of goals. The chosen technologies would have to be financially viable. DGCG members recognise that Renewables Obligation Certificates (ROCs) can be a key consideration in this respect.

2.20 Regional development companies can identify possibilities and foster best practice in the region. They can help local companies to take advantage of business opportunities afforded by new energy solutions by:

- supporting markets and producers with funding and research;
- co-ordinating demonstration projects;
- linking new generation to local regeneration initiatives;
- raising awareness and promoting economic opportunities;
- fostering partnership, at both strategic and local level; and
- translating broad capacity targets into generation plans for individual communities.

2.21 Schemes such as that being developed on Westray, where the community plan to become a self-sufficient '100% renewable energy island' by 2012, highlight the importance of mechanisms by which communities might better be able to secure technical advice and to exchange information with other communities.

2.22 Although presently few in number, these small schemes provide useful early warning of the ways in which energy regulation might need to adapt, over the coming ten to twenty years. Evolving small-scale generation technologies seem likely to stimulate proliferation of these small schemes. Moreover, regional renewable energy initiatives will often sub-divide into community schemes not dissimilar to those being

developed on Westray.

2.23 There are parallels in Scandinavia and in Africa, which also demonstrate what can be achieved by enthusiasm in communities having a sense of ownership in electricity generation and local supply. Schemes of the sort planned for island communities might not always be economic if transferred to the mainland, but there are private wires schemes in operation by (or planned by) urban local authorities. Despite differences dictated by local circumstances, there are common elements in potentially successful community energy schemes.

2.24 The DTI had commissioned some work on network controls on 'mini-grids' and on small-scale energy storage suitable for use by island communities.

2.25 The DGCG considers there to be scope for future work on:

- tackling fuel poverty through local, low-cost energy supply;
- the development of energy storage technologies suitable for the size of development in which offshore island communities might be interested;
- the islanding of sections of network, supported by distributed generation;
- the practical application of licence conditions on exempt supply services and metering and data service requirements, in the context of community energy schemes;
- scope for extending access to ROCs, where the electricity is not directly consumed by the operator of the generating station; and on
- the possibilities for developing community energy initiatives through the medium of the Registered Power Zones envisaged in Ofgem's proposals for the next distribution price control.

2.26 There is growing interest in the possibility of creating independent 'power islands', connected to DNO networks for back-up supply but, for much of the time, substantially self-sufficient in terms of electricity

generation. The promotion of power islands might sensibly, and in appropriate circumstances, lead to the creation of one or more RPZs .

3 The work of the TSG: Removing the barriers to distributed generation

Introduction

3.1 Text The TSG meets every six weeks. It co-ordinates the six workstreams whose work is discussed in this section. The following chart sets out the current membership of the TSG.

Dr Phil Jones (Chairman)	System Investment Director, CE Electric UK
Mr Stephen Andrews	Director, ILEX Energy Consulting
Mr Phil Baker	Director, Electricity Technology, DTI
Mr Mike Barlow	System Manager, Scottish and Southern Energy
Mr Phil Bowley	Head of Electrical Engineering, Innogy
Dr Lewis Dale	Regulatory Strategy Manager, NGC
Prof. Nick Jenkins	Electrical Energy and Power Systems Group, UMIST
Mr Mike Kay	Head of Network Transformation, United Utilities
Mr Alan Laird	Director, Group Engineering and Technology, Scottish Power
Mr Guy Nicholson	Managing Director, Econnect
Mr John Scott	Technical Director, Ofgem
Mr Dave Sowden	Chief Executive, Micropower Council
Mr Henry Parkinson (DGCG Programme Manager)	Principal Consultant, Future Energy Solutions
Ms Ronke Adenuga (Secretary)	Electrical Engineer, Ofgem

3.2 The main focus of the various workstreams has been the removal of technical and technical/commercial barriers to the connection of distributed generation. Most of this work has been successfully completed, but a few long-term projects will continue to run into 2005. Further details of the TSG's projects are available in the DGCG's website (www.distributed-generation.gov.uk)

3.3 Each workstream has a Director (a TSG member) who is accountable to the TSG for projects within the workstream and particularly for:

- defining and directing projects;
- establishing objectives, deliverables and their timing;

- establishing, as appropriate, ad-hoc groups of interested parties to advise on and support the workstream; and
- co-ordination of activities with other workstreams.

3.4 Each workstream also has a Sponsor (a DGCG member) who is accountable to the DGCG for projects within the workstream, and also for:

- supporting the Workstream Director;
- ensuring that the timetable of work, as envisaged by the DGCG, is maintained;
- ensuring co-ordination of activities across the various workstreams; and
- providing a high level check on project content and priorities.

Workstream 1 (Distributed generation: status and projections)

Sponsor : Mr Mike Hughes	Director: Dr Lewis Dale

3.5 Workstream 1 undertook to create and develop a directory of the status and projections for distributed generation. This involved the definition of distributed generation, comparison of projection studies, and the identification and study of key scenarios of the impact of distributed generation on distribution networks. The project also undertook to contribute to work on the likely network cost of 20% penetration of renewables by 2020.

Project	Title	Status
1	Preliminary directory of existing status and projection sources	Completed
2	Directory of status and projections	The format for publication of this data is being finalised with the DNOs.
3	Definitions of distributed generation classes and their current status	Completed. Discussion in progress with DTI about future maintenance of the database.
4	Comparison of projection studies	Completed Watching brief
5	Identification of key scenario	Completed

	features required in client workstreams	
6	Issue and updating of projection scenarios	Completed
7	Research on international distributed generation practice	Completed
8	Estimation of cost of 20% renewables in 2020	Completed
9	Survey of perceived barriers to the development of distributed generation	Completed

Workstream 2 (Standardisation of information and solutions)

Sponsor: Mr Kevin Morton	Director: Mr Mike Kay

3.6 Workstream 2 has the task of planning and overseeing the translation of technical solutions into industry standards, codes and engineering recommendations. Its work has largely been driven by that of other workstreams.

Project	Title	Status
1	Banding of distributed generation	An initial proposal is complete. It will require review, in the light of developing technology and the findings of other TSG workstreams.
2	Project-specific information standards	Completed
3	Connection process guide	Completed
4	Review of management and governance of electrical standards	Completed
5	Revision of Table 2 in Engineering Recommendation P2/5	Awaiting outcome of consultation on a draft produced by Workstream 3, Project 1.
6	Review of Licence Condition 25	Deferred pending further evidence of user experience.
7	Standardisation of interactive connection offers	Completed

Workstream 3 (Short-term network solutions)

Sponsor: Professor Robin MacLaren	Director: Mr Mike Barlow

3.7 Workstream 3 has taken responsibility for projects delivering solutions to the immediate challenges that distributed generation presents to DNOs.

Project	Title	Status
1	Security contribution (ER P2/5)	Completed Passed to Workstream 2
2	Basic active network management	Completed
3	Impact of Small-Scale Embedded Generators (SSEGs) on LV networks	Completed
4	Is limiter safety case	Work in progress on developing an acceptable safety case, after which the work will be passed to Workstream 5.
5	Network splitting	Completed
6	Sequential switching safety case	On hold, pending Workstream 5's planned work on the Is limiter safety case.

3.8 Much useful work has been done in the specialised area of network security. Produced in 1978, Engineering Recommendation P2/5 recognised the contribution of generation to system security. The nature of connected generation has changed significantly since then. A review of ER P2/5 was due.

3.9 The deterministic standard in P2/5 was based on a probabilistic assessment of network security employing the concept of Expected Energy Not Supplied (EENS). Fortunately, the project team were able to utilise the expertise of one of the engineers most closely associated with the original work underpinning P2/5. The present review does not change the EENS concept. A consequence of this is that P2/6 will not relate directly to the separate measures of 'customer minutes lost' and 'customer interruptions' used in assessing quality of supply.

3.10 Work on P2/6 has been progressing steadily, given that many of those involved were also working on aspects of the distribution price control review. A draft P2/6 has been submitted to the Distribution Code Review

Panel (DCRP) for approval. As the proposed change would be licence-related, Ofgem's approval will also be required.

3.11 Some have argued that reliability is a difficult subject fully to capture in a single planning document. P2/5 sets a minimum standard, and DNOs take additional measures as the situation demanded. There might, in the longer term, be a case for setting an 'output' standard, allowing DNOs to choose their own network design methodology for system security. This would be a major piece of work to develop (P2/7 perhaps) and would have to be considered in the light of international experience and the availability of new modelling techniques. However, any such new methodology would have to be capable of explanation in relatively simple terms to planning inquiries and to other interested external parties.

3.12 Where a DNO takes account of a contribution from a generator for system security purposes, this would be dependent on the generator's availability at the time. The DGCG considers that further work is needed to ascertain how such assurance could be secured. It seems likely that some sort of contractual obligation might be appropriate.

Workstream 4 (Microgeneration solutions)

Sponsor: Mr Andrew Horsler	Director: Mr Dave Sowden

3.13 Workstream 4 is taking forward work on the connection of microgeneration (i.e. up to 16 amps per phase). This involves both technical and commercial considerations. By the end of 2004, Workstream 4's projects on microgeneration were either substantially complete or as far advanced as the existing project teams would be likely to progress them. New issues are likely to emerge during the next two years, as DCHP begins to become commercially available. This is a timely opportunity to review the allocation of resource to these microgeneration issues.

Project	Title	Status
1	Connection terms	Draft connection terms for microgeneration have been

		produced. Awaiting inclusion in new standard terms of connection.
2a	Basic metering and export reward criteria	Ofgem is considering the interim recommendations of these projects. It is planned to reconstitute these projects, aiming for completion by late 2005.
2b	Metering – legal, regulatory and commercial framework	
3	Lease financing through energy bills	Completed
4	Accrual of Renewables Obligation Certificates and Levy Exemption certificates	Work is in progress, in parallel with the DTI's review of the Renewables Obligation. The project is expected to conclude in 2005.
5	Engineering Recommendation G83	Completed
6	EN standard for microgeneration connection	Discussions with CENELEC[4] continue.
7	Wiring regulations	Completed
8	The Electricity, Safety, Quality and Continuity Regulations 2002	Completed
9	Microgeneration accreditation issues	Project taken over by the Society of British Gas Industries.
10	Mini-generation issues	Project abandoned following insufficient response to a preliminary questionnaire.
11	DC Injection and 'nuisance tripping'	Report on DC injection by the University of Strathclyde complete. Laboratory work will follow its approval. Work on nuisance tripping continues.

Workstream 5 (Long-term network concepts and options)

Sponsor: Dr Malcolm Kennedy	Director: Mr Alan Laird

3.14 Workstream 5 is working on the long-term impact of distributed generation, including the possibilities for new technologies and more active management to solve technical problems. An important aspect is the extent to which DNOs could use distributed generation to help

maintain the quality and reliability of supply (for example through contracting for network services or for reconfiguring part s of the network to have the capability of operating in island mode). Questions of system security beyond ER P2/5 also fall within the remit of this workstream. As it has been dependent on inputs from other workstreams, and as it deals with the longer term , a number of Workstream 5's projects have been obliged to wait for the completion of other tasks before going forward.

3.15 There is now considerable enthusiasm for making progress with projects under Workstream 5. The workstream has begun to forge links with the technical architecture project, with which it will work closely, in the long term.

Project	Title	Status
1	Fault level	In progress. Completion of existing work March 2005. Ongoing work on Is limiters taken over from Workstream 3 .
2	Voltage control	In progress. Completion expected early in 2005.
3	Active management	A project team and work proposal are in place.
4	Security	Deferred, pending outcomes from other activities.
5	Islanding	Completed
6	Supplementary (ancillary) services	Completed
7	Power quality	Work not undertaken, as EU project analysis indicated that no significant problem is anticipated before 2010.
8	Network design	Work in progress – being undertaken in conjunction with the Centre for Distributed Generation and Sustainable Electrical Energy.
9	Safety	Deferred, pending outcomes from other activities.
10	New technology	In progress. Draft report completed.
11	Network losses	In progress. Completion expected in April 2005.

· CENELEC: European Committee for Electrotechnical Standardisation

3.16 Project 6's report on the provision of ancillary by distribut ed generation is particularly helpful in identifying, and beginning to quantify the value of, those ancillary services most likely to offer scope for distributed generation. The report has begun to flesh out the relevant r egulatory and commercial issues, a lthough it concluded that significantly greater quantities of distributed generation will have to be connected before the provision of ancillary services will be a viable proposition. The report will form a useful basis for further work on allocating prior ities and responsibilities. Although the timescales envisaged in the report stretch forward to 2015, the DGCG believes there to be a case for undertaking some preliminary work over the coming months.

3.17 The DGCG recognises that the ancillary services report is very much about the future. As generation connections to distribution systems become more common, the prospects for distributed generation to provide ancillary services will probably increase. No commercial opportunity has, to date, been lost, but the r eport seems to point the way to maximising such opportunities as are likely to arise in five to ten years' time.

3.18 There will be important questions to address about how to put a distribution ancillary services market in place. Recent changes to the Grid Code would permit wind generators to co ntribute to ancillary services.

3.19 Some have suggested that there may be a possibility of developing a business framework of incentives for managing constraints and network services, achieving some harmonisation between t ransmission and distribution practice, and perha ps creating a role for a common independent system operator. Apparent inconsistencies between transmission and distribution charging might be addressed in this context, as might a review of embedded benefits.

Workstream 6 (Industry skills and resource)

Sponsor: Vacant	Director: Professor Nick Jenkins

3.20 Workstream 6 has assessed the skill requirements and human resource requirements for meeting the challenge that distributed generation presents to DNOs. It has related these to current initiatives in relevant education and training. This has improved understanding of the stimuli likely to deliver the necessary competencies. No work is currently being undertaken by this workstream, which has assumed the role of maintaining a watching brief.

Project	Title	Status
1	Current initiatives, assessment and summary	Completed Watching brief
2	Skills and human resource requirements	Completed Watching brief
3	Identification and stimulus of actions for education and training	Completed Watching brief

Use of resource

3.21 The TSG has initiated a total of 46 projects, of which 23 had been completed by the end of the period covered by this report. The bulk of this work has been carried out by representatives of the DNOs, NGT, generators, academics and consumers giving freely of their time and expertise. The best assessment is that, over the three years of the TSG's existence, to date, something in the region of 15 person/years have been devoted to this work.

3.22 It would not have been possible to take forward such a wide range of projects, nor to create and maintain the DGCG's website, without financial support from the DTI's Renewable Energy Programme. To date, funding provided or committed from this source has been in the region of £1.35 million.

3.23 The DGCG very much appreciates the resource that individuals and organisations have been prepared to devote to the TSG's various projects.

4 The way forward

Introduction

4.1 Established to advise on the removal of barrier s to the connection of distributed generation, the DGCG's work is now at an end. Appendix 3 to this report summarises progress with the removal of identified barriers. Most of the barriers have now fallen. Many of them have been removed by other organisations, but the DGCG and TSG have been able to make a valuable contribution to the work, and to maintain an overview of developments. Late 2004 was an appropriate time to review the existing structure.

4.2 With many of the barriers to the development of distributed generation and CHP remove d, it is likely that increasing numbers of such generators will be connected. In the coming years, we can expect such connections to be a significant, if not the main, driver of network development. The DGCG considers that the present need is for a new str ucture, having a wider remit to consider the whole range of electricity network issues.

4.3 Although transmission matters are outside the DGCG's remit, members have been aware of their interaction with issues that distributed generation raises for DNOs. During the reporting period, this aspect of the wider background to distributed generation has increasingly emerged in DGCG and TSG discussions. The desirability of bringing discussion of transmission and distribution issues together has become increasingly appa rent. To do so would make it easier to advise Government of the overall picture. A review of the DGCG's and TSG's structure and responsibilities was also an opportunity to consider options for taking forward the work of the Transmission Issues Working Group (TIWG).

An 'Electricity Networks Co-ordinating Group'

4.4 At the DGCG's request, the Joint Chairmen brought forward proposals for a framework to replace the DGCG, TSG and TIWG. DGCG members

discussed these proposals at their October 2005 meeting. It was agreed that, subject to the DTI's and Ofgem's approval, the DGCG's last meeting would be held in late January 2005, after which work would be handed over to an Electricity Networks Co-ordinating Group (ENCG), overseeing a Distribution Committee and a Transmission Committee. These might not be the names finally chosen for these committees. The suggested framework for the ENCG is shown diagrammatically at Appendix 5 to this report.

4.5 The ENCG should have a smaller number of members than the DGCG does currently, and would probably meet twice a year. The Distribution Committee should complete the work of the DGCG/TSG programme. The TIWG might gradually metamorphose into the Transmission Committee, its membership changing as appropriate. It is important to note that the new structure connotes no diminution of political and regulatory interest in measures appropriate to removing unjustified barriers to the achievement of the Government's targets and aspirations for renewable energy.

4.6 The DGCG considers the ENCG proposal to be a workable approach to managing both long-term distribution issues and the consequences for transmission networks of increasing offshore generation. While involvement of market participants will be essential to some discussions, it will be important to manage agendas so as not to inhibit dialogue between the regulated network companies, the DTI and Ofgem.

4.7 Careful thought will have to be given to the composition of the ENCG, and particularly to achieving an appropriate balance of expertise and interests. Moreover, it will be important to manage the transition to the new structure in such a way as not to jeopardise effective delivery of work in progress within the existing structure. To this end, a structure with two committees appears to be the most workable arrangement. Despite the existence of common issues, the necessary work remains diverse. It would be too much to ask of a single group of people.

4.8 The DGCG recognises the importance of monitoring developments in respect of distributed generation, both in the USA and in Europe. There has been a standing item on TSG agendas giving members the opportunity to share information about overseas initiatives. The DGCG recommends that the new Distribution Committee should do the same. CIGRE[5] now has a committee devoted to distributed generation. Ofgem is engaged with CEER[6] and will also continue to make a contribution in that forum.

Identifying future work

4.9 The former Embedded Generation Working Group (EGWG) left the DGCG with a range of recommended tasks and issues to consider. Appendix 2 to this report, which is an updated version of the high-level timetable included in the DGCG's Annual Report for 2003, summarises progress with these matters. As a result of the work of the DGCG and TSG over the past three years, it is possible to set out, with some degree of certainty, what topics now ought to be addressed. Some of them would not have been apparent three years ago.

4.10 Appendix 4 sets out the future work identified by the DGCG and TSG. The continuing activities of TSG Workstreams 4 and 5, in microgeneration and long-term network options, must be brought to fruition. Work has recently begun on the technical architecture initiative. Also included in the appendix are issues suggested by recent papers on ancillary service provision by distributed generation, islanded operation, dynamic system stability, the fault ride-through capabilities of wind turbines, and on community energy schemes.

4.11 It will be for the ENCG and its two committees to decide, in the light of their agreed terms of reference, whether, and in what way, to address the issues suggested in Appendix 4. There is no suggestion that headings in the appendix will necessarily translate into a new structure of workstreams.

[5] International Council on Large Electric Systems.
[6] Council of European Energy Regulators

Appendix 1 : DGCG Membership

Mr Neil Hirst (Joint Chairman)	Head, Energy Markets Unit, DTI
Mr John Neilson (Joint Chairman)	Managing Director, Corporate Affairs, Ofgem
Mr Mike Clancy	National Officer, Prospect
Mr Charles Davies	Former Commercial Director, NGT
Mr David Green	Director, Combined Heat And Power Association
Mr Andrew Horsler	Member, energywatch
Mr Mike Hughes	Formerly CEO of Midlands Electricity
Dr Malcolm Kennedy	Former Chairman, PB Power
Mr John Lanagan	Head of Business Development, Powergen Retail
Prof Robin MacLaren	Managing Director, Scottish Power Transmission and Distribution
Mr Stephen Mancey	Director of Electricity Supply, Centrica
Mr Alan Moore	Managing Director, National Wind Power
Mr Kevin Morton	Managing Director, EdF Energy Networks
Dr Tony White	Director of Research, Climate Change Capital
Mr David Williams	Director, ECO2
Mr John Scott	Technical Director, Ofgem
Dr Phil Jones (TSG Chairman)	System Investment Director, CE Electric UK
Mr Jeremy Eppel	Divisional Manager, Sustainable Energy Policy Division, Defra
Mr Robin Naysmith (to October 2004)	Head of Energy Division, Scottish Executive
Mr Henry Parkinson (Programme Manager)	Principal Consultant, Future Energy Solutions
Mr Phil Baker (Joint Secretary)	Director, Electricity Technologies, DTI
Mr Arthur Cooke (Joint Secretary)	Distributed Generation Co-ordinator, Ofgem

Appendix 2 : High-level timetable (as at 31 December 2004)

Recommendation[7]	Actions	Original EGWG timescale for completion	Current status
Facilitation of competition			
Review of incentives on DNOs *The DGCG reviewed progress on DNO incentives for distributed generation at its meetings in January and July 2004.*	Interim arrangements as in Ofgem's consultations on 'Distributed generation: price controls, incentives and connection charging' (March 2002)	Mid 2002	Achieved
	Ofgem's conclusions on the framework for monopoly network price controls	June 2003	Achieved
	Ofgem's initial consultation on the Distribution Price Control Review (DPCR)	July 2003	Achieved
	Outcome of Ofgem's preliminary DPCR consultation	October 2003	Achieved
	Ofgem's interim DPCR proposals	Summer 2004	Achieved
	Ofgem's final DPCR proposals	November 2004	Achieved

[7] See the report of the Embedded Generation Working Group (EGWG), published by DTI on 12 January 2001

	Ofgem's review of distribution charge structures – initial conclusions	June 2003	Achieved
	Ofgem's review of distribution charge structures – conclusions	October 2003 (as part of the DPCR document)	Achieved
	Ofgem's review of distribution losses – initial proposals	June 2003	Achieved
	Ofgem's review of distribution losses – conclusions	October 2003 (as part of the DPCR update document)	Achieved (although further development work will follow over the medium term)
Connection process guide	Action with TSG Workstream 2 (WS2)	Publication April 2003. Published, after some delay, in December 2003.	Achieved
Establish commercial forum	DGCG appointed	November 2001	Achieved
	TSG appointed	January 2002	Achieved
	Commercial forum on electrical standards for connection of distributed generation	First quarter of 2004	Achieved
Assessment of contribution from distributed generation			
Review of Engineering Recommendation P2/5	Revision of Table 2	Completion re-scheduled from September 2003 to July 2004	Achieved
	Short-term changes to P2/5	Date to be fixed	Achieved
	Decision on governance of P2/5	Completion re-scheduled for 2004	Achieved
Security services study	Longer-term review of	Date to be fixed	Project 4 has been deferred,

	security contributions from distributed generation. Action is with TSG Workstream 5, Project 4.		pending completion of other work.
Power quality, voltage and ancillary services study	Power quality work is with TSG WS5, Project 7. Voltage control is with Project 2. Ancillary services issues are with Project 6.	Date to be fixed	Project 6 has reported, but further work on ancillary service provision by distributed generation will be required. Work on voltage control is in progress. The power quality project has been deferred.
Islanded operation	Action with TSG WS5 (Project 5)	January 2005	Draft report completed.
Network design and practice analysis	Action with TSG WS5 (Project 8)	Date to be fixed	Work in progress – being undertaken in conjunction with the Centre for Distributed Generation and Sustainable Electrical Energy.
Basic active management assessment	Guidance on best practice in basic active management (TSG WS3 – Project 2)	'Solutions for the Connection and Operation of Distributed Generation' published July 2003	Achieved
	Longer term concepts and options (TSG WS5 – Project3)	Date to be fixed	A project steering group and an advisory panel have been appointed. A work programme is in draft.
Establish ancillary services market forum	DGCG to advise later on timing for this action. Possible issue for the Distribution Commercial Forum.	To be decided	On hold
Charging principles			

Identify short-term changes	Interim arrangements as in Ofgem's consultations on 'Distributed generation: price controls, incentives and connection charging' (March 2002)	Mid 2002	Achieved
Statement of intent by Ofgem	Ofgem's conclusions on the framework for monopoly network price controls	June 2003	Achieved
	Outcome of Ofgem's preliminary DPCR consultation	October 2003	Achieved
	Ofgem's interim DPCR proposals	Summer 2004	Achieved
Development of charging options	Ofgem's review of distribution charge structures – initial conclusions	June 2003	Achieved
	Ofgem's review of distribution charge structures – conclusions	October 2003 (as part of the DPCR update document)	Achieved
Regulatory arrangements for next DPCR	Ofgem's conclusions on the framework for monopoly network price controls	June 2003	Achieved
	Ofgem's initial consultation on the DPCR	July 2003	Achieved
	Outcome of Ofgem's preliminary DPCR consultation	October 2003	Achieved

	Ofgem's interim DPCR proposals	Summer 2004	Achieved
	Ofgem's final DPCR proposals	November 2004	Achieved
Provision of information			
Scoping for DNO network long-term development statements	Formal slc 25 direction	Issued Summer 2002	Achieved
	TSG WS2 (Project 6) to co-ordinate industry review	Re-scheduled from May 2003 to later in 2004 – to allow for collection of information on user experience	On hold.
Value balance assessment as part of scoping study	Integral to the scoping study for long-term development statements.	Summer 2002	Achieved
Information and connection process standard information	TSG WS2 (Project 2) to publish guidance on exchange of information between generators and DNOs.	'A Guide to Data Interchange for Distributed Generation Projects', published April 2003. Accepted by the DCRP for incorporation in the 'Connection Guide for Small Generators' (originally drafted by Econnect)	Achieved
	TSG WS2 (Project 7) to recommend guidance on interactive connection applications	Suggested text for slc 4 statements finalised and posted to the DGCG website. DNOs to implement at next revision of slc 4 statements	Achieved
Micro-generation issues			
Connection standards for micro-scale generation	Action by TSG WS4 (Project 5) on ER G83/1	Final publication by September 2003	Achieved

	Action by TSG WS4 (Project 6) on CEN Workshop Agreement on 'Electrical interface for domestic cogeneration'.	During 2005	The Electricity Networks Association is collating comments on a draft document.
Connection charging principles	Interim arrangements as in Ofgem's consultations on 'Distributed generation: price controls, incentives and connection charging' (March 2002)	Mid 2002	Achieved
	Ofgem's review of distribution charge structures – initial conclusions	June 2003	Achieved
	Ofgem's review of distribution charge structures – conclusions	October 2003 (as part of the DPCR update document)	Achieved
Metering and charging options analysis	Ofgem's policy set out in the distributed generation paper of March 2002.	March 2002	Achieved
	Action by TSG WS4 (Project 2a) metering requirements and export reward.	Re-scheduled from May to September 2003 to April 2004	Both TSG Workstream 4 projects have reported. Ofgem is considering their recommendations, and anticipates consulting on the supply implications of microgeneration in early 2005.
	Action by TSG WS4 (Project 2b) metering requirements: legal, regulatory and commercial framework	Recommendations by end 2002.	

Impact on the BSC	General impacts included in the TSG WS4 workstreams detailed above	See above	See above
	BSC Modification P81 to remove the half-hourly metering requirement for domestic-scale generation.	September 2003	Achieved
Future network issues			
Establish working group to consider future possibilities	TSG WS5 covers long-term network concepts and options	This is long-term work. No deadline has been set.	Work in progress across TSG Workstream 5's projects and in the Technical Architecture initiative.
Connection charging	Ofgem's review of distribution charge structures – initial conclusions	June 2003	Achieved
	Ofgem's review of distribution charge structures – conclusions	October 2003 (as part of the DPCR update document)	Achieved
Regulation and incentives on DNOs	Ofgem's conclusions on the framework for monopoly network price controls	June 2003	Achieved
	Ofgem's initial consultation on the DPCR	July 2003	Achieved
	Outcome of Ofgem's preliminary DPCR consultation	October 2003	Achieved
	Ofgem's interim DPCR proposals	Summer 2004	Achieved
	Ofgem's final DPCR proposals	November 2004	Achieved

	Ofgem's review of distribution charge structures – initial conclusions	June 2003	Achieved
	Ofgem's review of distribution charge structures – conclusions	October 2003 (as part of the DPCR update document)	Achieved
	Ofgem's review of distribution losses – initial proposals	June 2003	Achieved
	Ofgem's review of distribution losses – conclusions	October 2003 (as part of the DPCR update document)	Achieved
Ancillary services market	Action with TSG WS5 (Project 6), to consider technical aspects	Report due in late 2004.	Achieved
	Ofgem to consider wider commercial and regulatory implications.	No date fixed	Further work to be taken forward by the Electricity Networks Co-ordinating Group (ENCG)
Commercial mechanisms for active management	Action with TSG WS5 (Project 3), to consider technical aspects	Date to be fixed	A project steering group and an advisory panel have been appointed. A work programme is in draft.
	Ofgem to consider wider commercial and regulatory implications	No date fixed	Further work to be taken forward by the Electricity Networks Co-ordinating Group (ENCG)
Co-ordinated R&D	Ofgem to consider incentives for innovation.	Ofgem's consultation on Innovation Funding Initiative (IFI) and Registered Power Zones	Achieved

		(RPZs) published as part of the distribution price control review.	

Appendix 3 : Removal of barriers to distributed generation (overview as at 31 December 2004)

Ser.	Barrier	Status	Comment
1	Lack of information about the current status of distributed generation – and about its likely development.	Removed	See WS1 report in Section 3. Information on distributed generation connections is now available on the website of the Energy Networks Association, www.energynetworks.org.uk
2	Lack of incentive on DNOs to connect distributed generation.	Removed	The DGCG considers that appropriate incentives and mechanisms have been incorporated in the new distribution price control. Certain elements of this work are expected to roll over into the next distribution price control (from 2010?), when experience may suggest the desirability of some adjustment.
3	Insufficient scope for DNOs to pre-invest in networks actively managed to accommodate distributed generation.	Removed	
4	Lack of information on distribution network development (comparable to the NGT Seven Year Statement)	Removed	Long-Term Network Development Statements published under standard licence condition 25. Ofgem initiative completed during the 2002 reporting period. Will be subject to review by WS2 P06.
5	Lack of a transparent, common connection-charging methodology.	Removed	Connection charging methodology has been reformed as part of Ofgem's work on the new distribution price control and associated distribution charge structures.
6	Lack of non-DNO involvement in the management and governance of relevant electrical standards	Removed	TSG WS2 P04's work has resulted in changes to the constitution and rules of the Grid code Review panel for England & Wales, the Scottish Grid code Review Panel and the GB Distribution Code Review Panel. A Distribution Commercial Forum has been established, under Ofgem's chairmanship.
7	Difficulty of access to embedded benefits.	Removed	A modification to the Balancing and Settlement Code (BSC),

	Licence-exempt distributed generators formerly had to negotiate with suppliers to secure benefits of avoided TNUoS charges.		from 1 Apr 03, permitted licence-exempt distributed generators to receive embedded benefits directly.
8	Under the electricity trading arrangements, 'Gate Closure' at 3.5 hours before delivery tended to disadvantage wind-generation, which could not always forecast output over such a period.	Removed	The Gate Closure period is now reduced to one hour, allowing such generators to give more reliable forecasts to the System Operator responsible for balancing and settlement in the generation market.
9	Lack of standard approach by DNOs where more than one potential generator is seeking connection to the same section of the distribution network.	Removed	Standard approach now set out in DNO's charging statements under standard licence condition 4. (See WS2 P07)
10	Lack of standard technical guidance on the connection of distributed generation.	Removed	Publication (Jul 03) of 'Solutions for the Connection and Operation of Distributed Generation'. (See WS3 P02) and (in Dec 03) of the 'Technical Guide to the Connection of Generation to the Distribution Network' (revised by WS2)
11	Engineering Recommendation P2/5 does not cover more recent generation technologies.	Removed	Review of ER P2/5 completed.
12	Microgeneration was not covered by The Electricity Supply Regulations 1988.	Removed	The Electricity Safety, Quality and Continuity Regulations 2002 ('The ESQC Regulations') provide for microgeneration. (See WS4 P08)
13	Lack of appropriate connection guidance for microgeneration.	Removed	Promulgation of Engineering Recommendation G83/1 (See WS4 P05) and of Wiring Regulations Guidance Note 7.
14	Lack of guidance to electrical contractors on private electrical installations to which microgeneration is connected.	Removed	IEE Guidance Note 7 now provides guidance.
15	Concern about possible conflict between ER G83 and BS7671 (formerly the IEE Wiring Regulations) on microgeneration.	Removed	See WS4 P07.
16	Requirement for half-hourly metering was	Removed	BSC Modification P81 (effective Sep 03) removed the

	disproportionately expensive for micro-generation		requirement for half-hourly metering for equipment covered by ER G83.
17	No microgeneration equipment has accreditation for purposes of the Energy Efficiency Commitment.	Removed	Appropriate testing procedures and a Seasonal Performance Index have been produced. To date, only two 5kW products have been approved.
18	Standard terms of connection currently do not match the 'fit and inform' obligation envisaged in the ESQC Regulations and in ER G83/1	In process of removal.	Discussion of standard terms of connection continues between DNOs and suppliers. The TSG has suggested wording for inclusion in the new standard connection terms.
19	Lack of trading mechanisms for microgeneration output.	Barrier remains	Electricity trading arrangements were not designed with microgeneration in mind. Further work needs to be done on the valuation of output from these smallest generators.
20	Insufficient understanding of the likely impact of small-scale embedded generation on LV networks	Removed	Model developed by WS3 P03.
21	Lack of mechanism for investment in transmission networks to accommodate anticipated renewable and distributed generation.	Removed	The DGCG has welcomed work involving the two Scottish transmission operators, DTI and Ofgem to identify investment required for the export of increased renewable generation from Scotland. Approval for one upgrade has been given. Further approvals will follow, where it can be demonstrated that investment would be efficient.
22	Insufficient UK involvement in EU R&D projects associated with distributed generation.	Barrier remains	The DGCG has identified a mismatch between the aspirations of the Energy White Paper and UK involvement in relevant EU research initiatives. This is a matter that DTI might consider further.
23	Potential shortage of skills and qualified personnel in the power engineering profession.	Barrier remains	See WS6 report in Section 3.
24	Distributed generation cannot easily contract to	Work in	The TSG has published a major paper on the technical and

	provide ancillary services at distribution voltages.	progress	commercial aspects of the provision of ancillary services by distributed generation.

Appendix 4 : Future work

Ser.	Topic	T/C/M[1]	Responsibility	Timescale	Work to date
Ancillary services					
1a	Options (network infrastructure) to enable existing DG to provide ancillary services	T	Distribution Committee	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1b	Explore communication and other mechanisms needed to permit DG consolidation for participation in the standing reserve market.	T/M	Electricity Networks Co-ordinating Group to consider allocation of work between Transmission and Distribution Committees.	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1c	Consider extension of TSO's market-based mechanisms to permit DG to provide response and reserve services	M	Transmission Committee Ofgem	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1d	Consider bilateral contract framework to permit DG to contract for DNO security of supply services (including associated communication and control technologies)	C	Distribution Committee Distribution Commercial Forum	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"

[1] Technical, Commercial, or Market issue.

1e	Consider use of RPZs as an initial platform for development of ancillary service contracts.	T/C	Distribution Committee (Distribution Commercial Forum)	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1f	Consider ancillary service provision in the context of network constraints on actively managed systems and the consequent risk to DNOs of non-delivery.	C	Distribution Committee (Distribution Commercial Forum)	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1g	Consider mirroring of TSO's market-based mechanisms to permit DG to provide response and reserve services at distribution level.	M	Distribution Committee Ofgem	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
1h	Consider the future balance between capex and opex in funding network security, and its regulatory treatment.	C	Ofgem in the context of current (2005/10) and future distribution price controls.	By 2010	Preliminary consideration in TSG P06 report "Ancillary Service Provision from Distributed Generation"
Islanding issues					
2a	Consider update of ER G59/1 and G75 in the light of Technical Architecture issues and deliberate provision for DG-operated islands.	T	Distribution Committee Energy Networks Association		See TSG WS5, Project 5, Phase 2 Report "Islanded operation of Distribution Networks" (Sep 04)
2b	Consider amending ESQCR with more probabilistic approach to limits for voltage and frequency excursion.	T	Distribution Committee Energy Networks Association DTI (Engineering Inspectorate)		See TSG WS5, Project 5, Phase 2 Report "Islanded operation of Distribution Networks" (Sep 04)

2c	Consider common issues and timescales for provision of ancillary services and islanding support by DG.	T/C/M	Electricity Networks Co-ordinating Group to consider allocation of work between Transmission and Distribution Committees.		See TSG WS5, Project 5, Phase 2 Report "Islanded operation of Distribution Networks" (Sep 04)
2d	Consider interplay of RPZs and work on Technical Architecture in relation to the development and trial of successful islanding with DG support.	T	Distribution Committee Technical Architecture initiative Energy Networks Association DTI (Engineering inspectorate) Possible HSE interest		See TSG WS5, Project 5, Phase 2 Report "Islanded operation of Distribution Networks" (Sep 04)
2e	Technical Architecture initiative to include consideration of a route map for development of DG-operated islanding, suggesting DNO network requirements for 2024 and beyond.	T	Electricity Networks Co-ordinating Group Distribution Committee Technical Architecture initiative		See TSG WS5, Project 5, Phase 2 Report "Islanded operation of Distribution Networks" (Sep 04)
2f	Consider interrelation of market structures for islanding and for ancillary services respectively	M	Electricity Networks Co-ordinating Group Distribution Committee Technical Architecture initiative		Identified as an issue at the Technical Steering Group meeting on 7 Dec 04. Work not started.
2g	Methodologies for matching load to generation (demand-side management and storage)	T/C/M	Electricity Networks Co-ordinating Group Distribution Committee Technical Architecture initiative		Identified as an issue at the Technical Steering Group meeting on 7 Dec 04. Work not started.
2h	Consider retro-fitting of protective equipment and predetermination of its mode of operation	T	Electricity Networks Co-ordinating Group Distribution Committee		Identified as an issue at the Technical Steering Group meeting on 7 Dec 04. Work

			Technical Architecture initiative		not started.
2i	Method, and associated cost, of network zoning and the installation of synchronising relays	T/C	Electricity Networks Co-ordinating Group Distribution Committee Technical Architecture initiative		Identified as an issue at the Technical Steering Group meeting on 7 Dec 04. Work not started.
2j	Consider recommendations for immediate post-fault control of load shedding	T/C	Electricity Networks Co-ordinating Group Distribution Committee Technical Architecture initiative		Identified as an issue at the Technical Steering Group meeting on 7 Dec 04. Work not started.
2k	Further research on islanding protection, driven by a risk-based assessment of discrimination	T	Distribution Committee Technical Architecture initiative		Recommendation in Econnect report "Islanding Protection for Rotating Generation Plant Embedded in the Distribution System" (Nov 04)
Technical architecture and network management					
3a	Fault level and Is limiters	T	Distribution Committee		Ongoing work of TSG WS5, Project 1
3b	Voltage control	T	Distribution Committee		TSG WS5, Project 2 started work autumn 2004.
3c	Active network management, including technical aspects of utility-scale storage. (See also serial 6a)	T	Distribution Committee		TSG WS5, Project 3 work proposal in preparation.
3d	Network design work, utilising the UKGDS system model to generate system examples and to document current DNO design practice.	T	Distribution Committee Energy Networks Association. Linkages to Technical Architecture work		TSG WS5, Project 8 initiated (Oct 04)
3e	New technology	T	Distribution Committee		TSG WS5, Project 10 will report by end 2004. Its

					recommendations will require consideration.
3f	Network losses	T	Distribution Committee		TSG WS5, Project 11 initiated (Oct 04)
3g	Security	T	Distribution Committee		TSG WS5, Project 4 deferred (as at 2 Nov 04)
3h	Power quality	T	Distribution Committee	Unlikely to be an issue before 2010	TSG WS5, Project 7 deferred (as at 2 Nov 04)
3i	Safety	T	Distribution Committee Energy Networks Association DTI (engineering Inspectorate) HSE		TSG WS5, Project 9 deferred (as at 2 Nov 04)
3j	Input to Ofgem's price control monitoring and review process, to inform development of network charge structures.	T/C	Distribution Committee and Transmission Committee via Electricity Networks Co-ordinating Group Ofgem (Networks)	Ongoing	
3k	Dynamic stability of power systems to which wind generation is connected. Consider overall control strategies for power stations, to ensure dynamic compatibility, stability and system integrity.	T	Electricity Networks Co-ordinating Group to consider allocation of work between Transmission and Distribution Committees.		"A brief review of power system dynamic stability characteristics", Centre for Distributed Generation and Sustainable Electrical Energy, October 2004.
3l	Fault ride-through characteristics of wind generation, including consideration of the commercial implications (e.g. cost reflective pricing of frequency response) and further work on the inertial effect of DFIG wind turbines.	T/C/M	Electricity Networks Co-ordinating Group to consider allocation of work between Transmission and Distribution Committees.		"Value of fault ride-through capability of wind generation in the UK", Centre for Distributed Generation and Sustainable Electrical Energy, October 2004.

3m	Consider options for demand side management as a component of active network management	T/C/M	Electricity Networks Co-ordinating Group Distribution Committee.		
3n	Consider options for utility-scale energy storage as a component of active network management	T/C/M	Electricity Networks Co-ordinating Group Distribution Committee.		
3o	Technical Architecture. Define the regulatory and business context for the Technical Architecture initiative.	C/M	Electricity Networks Co-ordinating Group Technical Architecture initiative		Initial discussions in progress
3p	Technical Architecture. Identify stakeholders and enablers/barriers to adoption of future scenarios.	T/C/M	Electricity Networks Co-ordinating Group Technical Architecture initiative		Initial discussions in progress
3q	Technical Architecture. Review current standards and assess their influence on the development of future scenarios.	T	Electricity Networks Co-ordinating Group Technical Architecture initiative		A 'requirements specification' has been developed, in conjunction with PB Power. Initial consideration in progress.
3r	Technical Architecture. Review the role that procurement models could play in future scenarios, and assess how commercial drivers will affect the deployment of new technology and innovative solutions.	T/C	Electricity Networks Co-ordinating Group Technical Architecture initiative		Work not yet started
3s	Technical Architecture. Develop tools to evaluate technical scenarios, methodologies for low-risk implementation, and performance	T/C/M	Electricity Networks Co-ordinating Group Technical Architecture initiative		Work not yet started

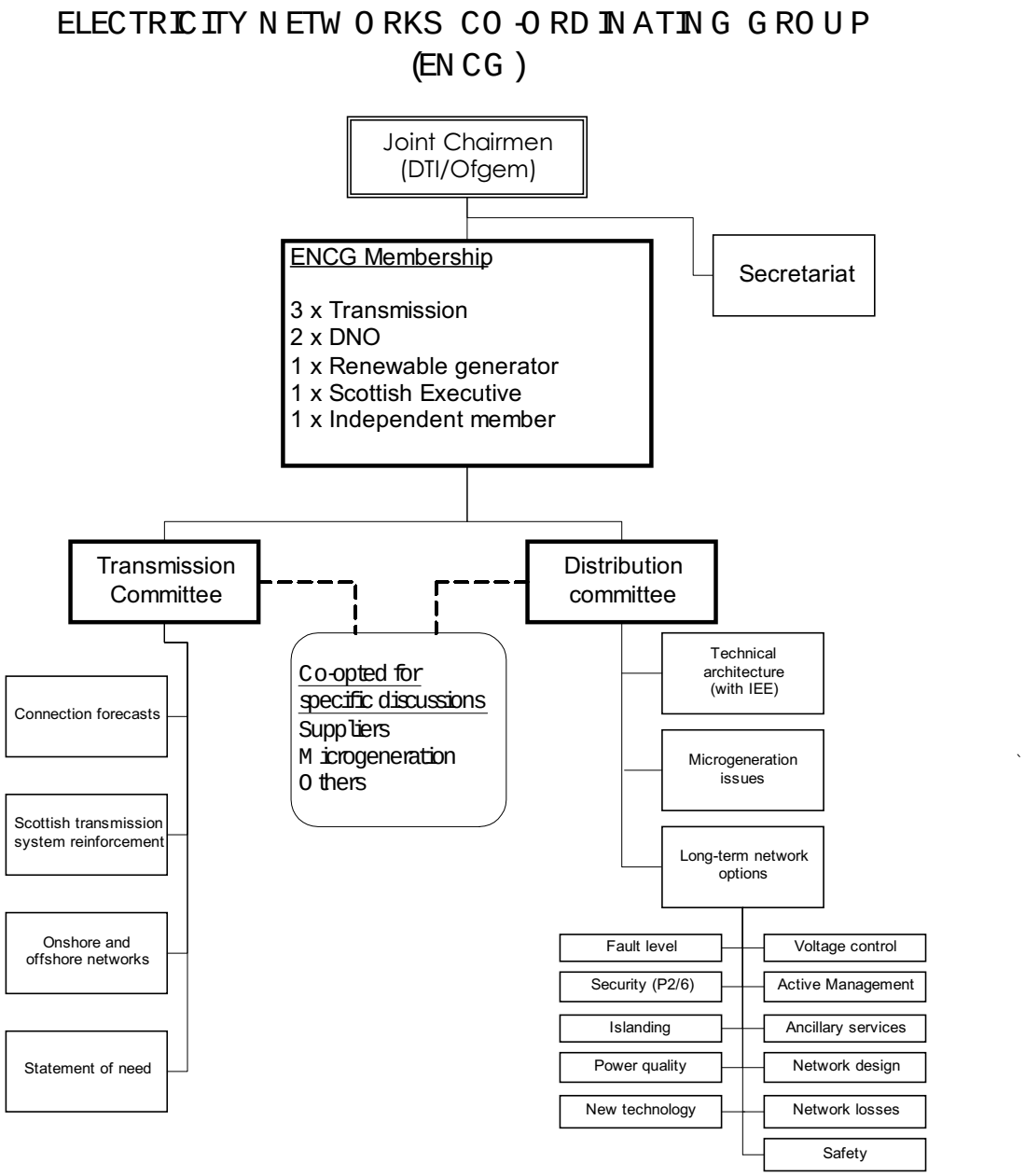
	indicators for the various scenarios.				
3t	Technical Architecture. Investigate the effect of new technology on the asset management cycle of planning, operation and maintenance. Identify associated skills requirements. Input to content of skills training.	T/C	Electricity Networks Co-ordinating Group Technical Architecture initiative		Work not yet started
3u	Technical Architecture. Identify the future scenarios most relevant to evolving network requirements.	T/C/M	Electricity Networks Co-ordinating Group Technical Architecture initiative		A small group, within the Technical Architecture initiative is developing a 'requirements specification'.
3v	Technical Architecture. Evaluate current network status as a basis for future development, including light current facilities for interoperability of legacy and new infrastructures.		Electricity Networks Co-ordinating Group Technical Architecture initiative		Draft initial paper completed.
Microgeneration issues					
4a	Supply implications of microgeneration (including metering and DNO obligations)	T/C/M	Ofgem	Mid 2005	Ofgem consultation paper in draft (as at 8 Dec 04)
4b	Input to, and work consequent upon, DTI's microgeneration strategy.	T/C/M	DTI (Energy Strategy Unit) Ofgem		

4c	Consider trading opportunities for microgeneration output	M	Distribution committee Ofgem	Ongoing	
4d	Renewable microgeneration access to ROCs	C/M	Distribution Committee		Current work by TSG, WS4, Project 4.
4e	Consider revised import profiles for premises with microgeneration	M	Distribution Committee Ofgem (Code Modifications) Elexon		Elexon has already produced export profiles for microgeneration.
4f	Measurement of reverse energy on one phase of a three-phase meter.	T	Ofgem (Metering) Distribution Committee		
4g	Consider DC tolerance levels and possible nuisance tripping	T	Distribution Committee		Current work by TSG, WS4, Project 11.
Community energy schemes					
5a	Interface of 'private wires' with utilisation of DNO networks. Consider structure of charges, treatment of standby capacity and related issues.	T/C	Distribution Committee Ofgem		Some practical experience (e.g. Woking Borough Council)
5b	Access to ROCs, including consideration of greater flexibility than presently allowed by way of 'sale and buy-back' agreements with licensed suppliers.	M	DTI Scottish Executive Ofgem		Options for amendment of Orders under consideration by DTI and Scottish Executive (as at 2 Nov 04)
5c	Switching systems for matching small-scale wind generation to domestic-scale storage radiator load, given the requirement for	T	Distribution Committee (monitoring only)	None	No evidence that any of these has a DNO connection. There is a case for keeping informed about

	faster response times than offered by radio-teleswitching.				developments, in case of possible impact on networks.
5d	To consider possible mechanisms for local trading of output from the smallest generators (if feasible, outside NETA/BETTA).	C/M	Ofgem		SCA meter splitting arrangements. Exempt supply obligations in the Electricity Supply Licence.
Miscellaneous issues					
6a	Monitor and assess emerging utility-scale storage technologies. (See serial 3c)	T/C/M	Electricity Networks Co-ordinating Group		DTI has funded some work on small-scale storage
6b	Availability and portability of 'embedded benefits'	M	Ofgem		

Appendix 5 Electricity Networks Co-ordinating Group: suggested framework

5.1 The following outline framework is discussed in Part 4 of this report.



5.2 The chart is intended to summarise possible work responsibilities for the ENCG and its two proposed committees. Organisation of workstreams and, indeed, the names of the committees themselves are matters for further discussion.

Appendix 6 : Glossary

Active Network Management – the provision of network control facilities to enable real-time management of voltage levels and real and reactive power flows.

Ancillary Services – voltage support, frequency response, reserve and black start.

Balancing and Settlement Code (BSC) – The code forming part of the electricity trading arrangements and governing the process of maintaining the balance of supply and demand and the mechanism for charging parties for the correction of imbalances caused by them.

CEER – Council of European Energy Regulators.

CENELEC – European Committee for Electrotechnical Standardisation.

CIGRE – International Council on Large Electric Systems.

DNO – Distribution Network Operator – as defined in the DNO's licence.

Domestic Combined Heat and Power (DCHP) – combined heat and power applied at domestic scale, to provide hot water and electricity to an individual, or to multiple, dwellings.

Double-fed induction generator – A wound rotor induction machine with two voltage source converters connected back-back in the rotor circuit. The 4 quadrant converters allow sub and super-synchronous operation of the induction machine at a power factor that can be selected.

Energy storage – A generic term for a range of technologies designed to provide storage facilities in an electricity grid system. They could avoid the need to design power systems with sufficient capacity to satisfy maximum demand. These technologies include pumped storage (that converts electrical energy into potential energy by pumping water from a lower to an upper reservoir), electro-chemical storage (in charged electrolytes), compressed air, super-conductors and flywheels.

Embedded benefits – Benefits accruing to distributed generators as a result of their not using the transmission network. Principally the avoidance of transmission use of system (TNUoS) charges.

Fault level – a measure of the potential energy infeeds at a specified point on a power system.

Islanding - A situation in which a portion of the network that becomes disconnected from the main grid system but continues to be supplied by generation connected to it. Faults on power networks are normally cleared by circuit breakers located close to the fault. The 'island' can be created when such circuit breakers open. 'Islanding' is conventionally regarded as problematic, but networks can be re-configured to use islanding as a means of maintaining supplies.

Is Limiter – a fault current limiting device capable of temporarily increasing network impedance, as required. Is limiters operate within 10ms, in response to the rapid rise in network current associated with a fault. Such devices can avoid the problems of security risk, losses and voltage control associated with permanently increased network impedance.

LV – Low voltage (415V three-phase or 230V single phase)

Microgeneration – small-scale generation (up to 16 amps per phase) connected to an electricity distribution network (Engineering Recommendation G83/1 refers).

Network splitting – reducing fault levels by reducing the number of parallel paths in networks comprising radial transformer feeding arrangements - by the opening of circuit breakers, rather than by physical network change.

Power quality – a coverall term referring to voltage stability, harmonic distortion and continuity of supply.

Registered Power Zone (RPZ) – The RPZ concept is currently under development in Ofgem's consultations associated with the distribution price control review. An RPZ would be a defined piece of distribution network in which a DNO would be able to manage and develop innovative solutions to the

connection of additional distributed generation – earning a higher return on well-managed projects, in recognition of the additional risk that they entail.

Static VAr Compensator (SVC) – An SVC provides continuous control of the reactive power balance in an electric line, as it changes in response to varying loading conditions (power factor correction). An SVC consists of a bank of binary configured capacitors which are switched in and out, as necessary, to give a range of values. Amongst other reasons, SVCs may be installed to stabilise voltage, reduce losses, and to increase available capacity.

Sequential switching – a method by which the multiple sources contributing to a fault are separated prior to the clearance of the faulted section of network. Sequential switching arrangements can permit generation connection without the need to uprate circuit breakers.

TNUoS – Transmission Use of System Charges. The charges levied for transporting electricity across the transmission system.