Preliminary report into the recent electricity transmission faults affecting South London and East Birmingham

30 September 2003

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1. Summary

1.1. This paper presents Ofgem's preliminary findings into the transmission failures that resulted in short term power cuts in areas of South London and Kent on 28 August 2003, and in the Birmingham area on 5 September 2003.

1.2. Ofgem has a duty to protect the interests of consumers which includes the delivery of secure supplies. Investigating these incidents is therefore a matter of very high priority.

1.3. The main objective of Ofgem's investigations is to examine whether there has been a breach, or breaches, of the statutory or licence obligations which apply to National Grid Company (NGC) and the relevant distribution network operators (DNOs) involved in the power cuts.[1]

1.4. However, the investigations will also inform the development of the regulatory framework, price controls and incentives on the companies involved, and will identify any lessons for communications between companies and with the public during major incidents. Ofgem will also carefully consider if there are any lessons for Ofgem, particularly in terms of communications with the relevant companies in the event of a power supply failure.

1.5. Further, Ofgem has commissioned a report from independent technical consultants to assist it in forming a view as to whether there has been a breach of statutory or licence obligations on the part of NGC or the relevant DNOs. For this reason it is important to note that nothing in this report is in any way intended to fetter Ofgem's ability to arrive at any conclusions or take any action that it might consider appropriate upon considering the findings in that consultants' report and any other information made available to Ofgem.

[1] The DNOs involved in the power cuts were Electricité de France (EDF) in London, and Aquila and East Midlands Electricity (EME) in Birmingham.

Summary of events

1.6. In the early evening of 28 August 2003, electricity supplies to 476,000 consumers in South London were involuntarily interrupted. Just over a week later, electricity supplies to 220,000 consumers to the East of Birmingham were also involuntarily interrupted. A more detailed summary of these events is provided in Appendix 1.

1.7. In both of these events power supplies were restored to all customers within an hour. However, there were significant disruptions to normal activities, particularly transport systems. Such unplanned involuntary events directly impact customers and also have wider impacts on the operation of local infrastructure and services. Some consumers' standby arrangements (hospitals, airports etc.) minimised the impacts whereas for others (e.g. London Underground) the short interruption of supply led to extended disruption of services.

1.8. It is noteworthy that disruption to infrastructure in Birmingham was less than that experienced in London and reflects, in part, the measures adopted by customers, such as Birmingham Airport, to mitigate the (small) risk of supply interruption.

Overview of Ofgem's investigations

1.9. In light of the recent power interruptions, Ofgem has a duty to form a judgement as to whether any of the companies involved have breached any of their statutory or licence obligations and, if so, whether any remedial action (such as a financial penalty) is appropriate.

1.10. The companies involved have important obligations with respect to security of supply. In particular, Ofgem will be assessing whether the companies have fulfilled their obligations to develop and maintain efficient, co-ordinated and economical systems of electricity transmission and distribution. More detailed explanations of their obligations are contained in chapter 2. To date our investigation has focused on two broad areas: develop and maintain; and coordination. Without prejudice to the generality of the statutory and licence obligations, these are discussed below:

Develop and maintain

1.11. In this context, the obligations to develop and maintain the electricity networks relates *inter alia* to the distribution and transmission companies' decisions to expand, maintain and replace assets, as necessary, on the relevant networks and to manage this process appropriately to meet the relevant security standards.

Coordination

1.12. Again, in this context, the obligations to act in a coordinated manner relates *inter alia* to the need to effectively communicate with any parties likely to be materially affected by decisions taken by the licensee and to adjust plans to reflect their requirements, if it is economic and efficient to do so.

Preliminary findings

1.13. Based on the evidence submitted to Ofgem by the companies involved in the power failures, it is apparent that there were certain similarities between both events. In each case, interruption occurred while planned work was underway to accommodate upgrades to the national grid transmission system, and in both cases the actual loss of supply arose from the incorrect operation of protection equipment. Protection equipment is installed to ensure that the assets on the transmission system are preserved in the event that a very high current occurs on that part of the transmission system. Such currents would typically follow a fault on a related part of the network.

London

Develop and maintain

1.14. Our preliminary findings are that the transmission failure that affected London was the result of incorrectly installed protection equipment. This protection equipment incorrectly disconnected electricity supplies, when that part of the network was in fact capable of safely bearing the load it was under. Ofgem is further investigating the circumstances surrounding the installation of this equipment.

Coordination

1.15. It appears that during the outage there was close liaison and cooperation between the operational staff of EDF and NGC. This facilitated the efficient restoration of supplies. It may have been possible for EDF to restore supplies to the Lots Road substation at an earlier stage. This substation is one of the points which connect London Underground to the part of the distribution network affected by the transmission failure. It therefore may have been possible to have reduced the duration of the disruption of supplies to London Underground. However, in line with the licence obligations of EDF, priority was given to restoring larger groups of customers.

1.16. Ofgem will be considering whether these events have any implications for the way in which the obligations to not discriminate are discharged in future, and whether these obligations could be improved in a manner that would better protect the interests of customers. In particular, Ofgem will be working with the government to consider whether these events have any implications for the way in which customers are reconnected following a major supply incident.

1.17. Transmission networks require both maintenance, including the replacement of existing assets, and upgrading through investment in additional equipment. At the time of the transmission failure NGC were completing a number of overlapping maintenance projects, which contributed to a higher level of risk of failure than would otherwise be the case. Ofgem is further investigating whether these risks were understood, managed and communicated to relevant parties including end customers such as London Underground in an appropriate manner. As part of this investigation it will be important to understand whether there was sufficient coordination between NGC and EDF in their maintenance planning.

1.18. Ofgem will also be investigating further whether, once the transmission fault occurred, there was sufficient coordination, including communication to all affected customers.

Birmingham

Develop and maintain

1.19. The incident that affected Birmingham also raises concerns surrounding the adequacy of the protection equipment. However, in Birmingham we have particular concerns surrounding the commissioning procedures adopted by NGC.

1.20. The initial problem was caused by a fault on an incorrectly installed transformer.[2] Under normal circumstances the electricity transmitted by this transformer would be safely borne by other circuits/transformers, which should have been capable of transmitting the additional load. However, this did not occur due to a fault with the protection equipment. This fault incorrectly disconnected another transformer, causing the remaining circuits to overload and to correctly disconnect from the high-voltage network.

1.21. Ofgem will be seeking to fully understand the reasons as to why NGC's commissioning procedures failed to detect that the protection equipment was incorrectly installed. This will include examining the processes adopted by NGC that should minimise the risk of the incorrect installation of equipment.

Coordination

1.22. Unlike London, the transmission failure that occurred in Birmingham does not appear to have any significant relation to outage planning and coordination. However, as for the London incident, Ofgem considers it important to establish whether there was sufficient coordination and communication between NGC, the DNOs and relevant customers after the incident had occurred.

[2] Transformers change voltage levels on or between networks.

Preliminary conclusions

1.23. Ofgem notes that neither transmission failure was caused by any shortage of generating capacity (there was sufficient electricity available — the problem was the inability to transmit this power to customers).

1.24. Nor does it appear that either failure was due to underinvestment. None of the equipment involved with the transmission failures was old or due for replacement. Rather, in both cases the equipment that caused the faults was less than two years old and had either been incorrectly installed or malfunctioned.

1.25. NGC has an obligation to invest in the network to meet its statutory and licence obligations, in particular with respect to the need to deliver a reliable service. Ofgem has a duty to ensure that NGC has sufficient funding to meet this level of efficiently incurred expenditure. Ofgem also relies upon a number of incentive schemes to ensure that NGC invests as efficiently as possible.

1.26. It is clear that NGC has been able to make substantial investment in reinforcing the transmission system. Since privatisation (in 1990) there have been high levels of investment in the national grid with over £3 billion invested. This investment is running at a much higher rate than occurred in the previous nationalised industry.

1.27. In compiling preliminary findings into the London and Birmingham power cuts, Ofgem has sourced information primarily from incident reports from NGC, and additional reports on the power cuts received in confidence from each of the DNOs involved.

1.28. However, in order to make a fully informed assessment as to whether any of the companies involved with the power failures have breached their statutory or licence obligations, Ofgem has engaged independent technical consultants to examine more closely a number of specific issues (discussed later in this report) arising from the supply interruptions and to prepare a report on these issues. These consultants will focus on a number of specific and specialised issues for which they have the relevant expertise, independence and objectivity. Hence this report is not intended in any way to fetter Ofgem's ability to arrive at

conclusions or take any action that it might consider appropriate in the light of the findings of the consultants' report and any other information made available to Ofgem.

Next steps

1.29. The consultants' report will help inform Ofgem's assessment as to whether any of the companies involved in the power supply failures have breached the conditions of their respective licences and what penalty, if any, should be applied to the relevant companies involved if such a breach has occurred.

1.30. The consultants are scheduled to report to Ofgem in late November this year on a number of key issues related to the transmission failures. Subsequently, Ofgem expects to complete its full investigation by the end of the year, including an assessment of whether or not any of the companies concerned were in breach of their statutory or licence obligations.[3]

1.31. Any views on the issues raised in this document should be emailed to Tracey.Hunt@ofgem.gov.uk, or sent to:

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1.32. Respondents are free to mark their reply as confidential, although we would prefer, as far as possible, responses that can be placed in the Ofgem library (with any confidential comments in appendices). Ofgem would also prefer that non-confidential responses are sent electronically so that they can be placed on the Ofgem website.

1.33. If you wish to discuss any aspect of this paper please contact: Steve Argent (020 7901 7418) for technical issues; Richard Clay (020 7901 7264) for distribution issues; and Joe Sunderland (020 7901 7374) for transmission issues.

[3] Due to the processes involved, the resolution of any enforcement action would be unlikely to be completed by the end of the year.

Structure of this document

1.34. The remainder of this document describes:

- the legislative and regulatory context for Ofgem's ongoing investigations into the power failures, including the relevant licence obligations which apply to NGC and the DNOs with respect to their development, maintenance and operation of the electricity transmission and distribution networks respectively;
- the events that led to the power supply failures in both London and Birmingham, and how each incident was managed by the relevant parties involved. This includes Ofgem's conclusions and preliminary findings arising from the investigations undertaken thus far; and
- Ofgem's overall findings to date and future actions regarding the ongoing investigations.

2. Statutory framework

2.1. The principal objective of both the Secretary of State and the Authority[4] is to protect the interests of consumers in relation to electricity conveyed by distribution systems, wherever appropriate by promoting effective competition between persons engaged in commercial activities connected with the generation, transmission, distribution or supply of electricity[5].

2.2. Both the Secretary of State and the Authority are additionally required to carry out particular functions under the Electricity Act and have further general duties which include having regard to "the need to secure that all reasonable demands for electricity are met" and that licence holders are able to finance their licence obligations.

2.3. Given these statutory duties, the Authority places the highest importance on all issues associated with security of supply. Ofgem works to ensure security of supply by:

- ensuring there is sufficient investment in the regulated networks through price controls;
- monitoring the gas and electricity markets for signs of anticompetitive behaviour; and
- ensuring companies meet their licence conditions. For example, companies like NGC have conditions which require them to operate the electricity system in an economic, efficient and coordinated manner. These are explained further below.

2.4. Ofgem is required by law to form a judgement as to whether any of the companies involved with the recent power failures have breached any of their statutory or licence obligations. Further, we wish to understand if there are any lessons to be learnt in terms of best practice or the regulatory framework.

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[4] Ofgem operates under the direction and governance of the Gas and Electricity Markets Authority (the "Authority"), which makes all major decisions and sets policy priorities for Ofgem.
[5] These obligations are set out in the Electricity Act.

Financial penalties

2.5. The Electricity Act provides the Authority with the power to investigate whether a licence holder has breached the conditions of their licence and, if so, whether remedial action (such as a financial penalty) is appropriate.[6] Further details of the Authority's powers in relation to this matter can be found in Appendix 2.

2.6. If the power cuts are determined to be the result of a contravention by the licensee of its statutory or licence obligations, the Authority has considerable powers at its disposal to require compliance with these conditions and penalise the licensee for contravention, if it considers it appropriate to do so.

2.7. For example, the Authority has the ability to impose a financial penalty equivalent of up to 10 per cent of the relevant company's turnover within the United Kingdom.

Key obligations of licence holders: NGC

Statutory obligations

2.8. Section 9(2)(b) of the Electricity Act requires NGC to "develop and maintain an efficient, co-ordinated and economical system of electricity transmission".

Licence obligations

2.9. Standard Licence Condition 7 states that "the licensee shall not unduly discriminate against or unduly prefer any person or class or classes of person in favour of or as against any person or class or classes of persons".[7]

2.10. Similarly, Standard Licence Condition C7C states that "in the provision of use of system or in the carrying out of works for the purpose of connection to the licensee's transmission system, the licensee shall not discriminate as between any persons or class or classes of persons."

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[6] For more information on the processes adopted by the Authority in considering financial penalties, see: 'Financial Penalties – The Process', Ofgem, February 2003.
[7] SLC 7.9.

2.11. Special Licence Condition AA4 of NGC's transmission licence reinforces this statutory obligation by requiring NGC to "operate [its] transmission system in an efficient, economic and co-ordinated manner."

2.12. Special Licence Condition AA2 requires NGC to "at all times plan, develop and operate [its] transmission system in accordance with "NGC Transmission System Security and Quality of Supply Standard", Issue 2… together with [its] Grid Code and such other standard of planning and operation as the Authority may approve from time to time".

2.13. This System Security and Quality of Supply Standard determines, among other things, the degree of additional resilience that must be built in to the transmission system so that the system is robust against credible equipment failures and the need to maintain the assets. Typically, the main system must be able to withstand the unplanned loss of a double circuit (two overhead lines hanging on the same transmission towers), although smaller demand groups are permitted to be dependent on a single circuit when circuit outages are required.

Key obligations of licence holders: DNOs

Statutory obligations

2.14. Section 9(1) of the Electricity Act requires that DNOs "develop and maintain an efficient, co-ordinated and economical system of electricity distribution".

Licence obligations

2.15. Standard Licence Condition 4A states that "in the carrying out of works for the purpose of connection to the licensee's distribution system, or in providing for the modification to or retention of an existing connection to its distribution system, the licensee shall not discriminate between any persons or class or classes of persons. In the provision of use of system the licensee shall not discriminate between any persons or class or classes of persons."

2.16. Under Standard Licence Condition 5 of their licenses, DNOs are required to "plan and develop the licensee's distribution system in accordance with a

standard not less than that set out in Engineering Recommendation P2/5…or such other standard of planning" following consultation with NGC and other DNOs that may be materially affected and with the approval of the Authority.

Other obligations

2.17. Under Section 29 of the Electricity Act the Secretary of State has the power to make regulations relating to supply and safety. The regulations currently in force under this section are the Electricity Safety, Quality and Continuity Regulations 2002 (SI 2002 No. 2665).

2.18. These regulations apply to both NGC and DNOs. The regulations concern inter alia standards of equipment, safety and the control of network frequency. These requirements are enforced by the Department of Trade and Industry's (DTI's) Engineering Inspectorate.

3. London — preliminary investigation

Causes of the transmission failure

3.1. The national grid delivers electricity to the distribution network supplying South London through a series of connected substations at Wimbledon, New Cross, Hurst and Littlebrook. These substations are connected to their neighbouring substations by two separate circuits, which are designed to ensure that the network is robust to the failure of any one circuit or substation.

3.2. The sequence of events that led to the incident commenced at 18:11 on 28 August 2003 with an alarm indicating that part of a transformer at the Hurst substation was malfunctioning which, left unattended, could lead to a major fire or explosion. NGC reconfigured the network at 18.20 to ensure safety. This reconfiguration left all supplies to Hurst and New Cross dependent on a single circuit from Wimbledon.

3.3. The loss of supply was caused by the incorrect operation of protection equipment on the back up (Wimbledon-New Cross 2) circuit. This protection equipment is designed to ensure that the network is not exposed to currents well in excess of their physical capabilities. Such high currents would typically be experienced following a fault on other equipment on the network.

3.4. The faulty operation of the protection was due to the installation of an incorrect item of equipment when the Wimbledon-New Cross protection was upgraded in June 2001. NGC installation procedures did not identify this error.

3.5. A contributory factor was the extent of the scheduled outages on the networks in South London. However, it appears that these planned outages met the required minimum security standards, whereby the relevant part of the transmission network should be planned to be robust to a fault on any one piece of equipment.

Preliminary findings

3.6. Ofgem is not yet able to conclude whether or not the companies involved — both NGC as system operator, and EDF as the relevant DNO — have fulfilled their obligations to develop and maintain efficient, coordinated and economical systems of electricity transmission and distribution. However, Ofgem's preliminary findings and areas for further work are discussed below.

Develop and maintain

3.7. Ofgem believes further investigation is required to determine whether NGC's processes for planning and carrying out the installation of new protection equipment are satisfactory. This concern is reinforced by similarities evident in the cause of the Birmingham transmission failure. Ofgem notes that NGC has subsequently tested similar protection equipment and not found other instances of incorrect installation/commissioning.

3.8. Ofgem's preliminary view is that NGC and EDF met the required minimum standards in planning the outages on their networks. Nevertheless, we believe that lessons can be learnt in the areas of risk management and mitigation and communication with key stakeholders.

3.9. The circuit outages were planned and agreed by NGC and EDF.[8] In particular the 3 month outage at Wimbledon caused the supply to London Underground, via Lots Road, to be at a slightly increased risk due to lower levels of potential back-up. It is not clear whether this enhanced risk was adequately understood and managed by London Underground.

3.10. Ofgem's role is limited by statute to establishing whether NGC and EDF minimised and communicated such risks. It is left to customers (including

[8] According to NGC, scheduled maintenance was underway on one circuit from Wimbledon to New Cross and one from Littlebrook to Hurst on 28 August 2003. This level of maintenance is usual during the summer months, when demand for electricity is generally lower. In line with normal practice, the arrangement of the transmission system to accommodate the maintenance had been agreed with the operator of the distribution system for the London region, EDF Energy, well in advance, during July 2002. Routine weekly communication between EDF Energy and National Grid resulted in the planned outage at Wimbledon proceeding on 1 July 2003. EDF Energy confirmed that it could arrange its distribution system to accommodate this outage securely for the maintenance period.

London Underground) to choose how to manage any such risk. Ofgem considers that this provides the best protection to customers as they alone are able to assess their needs. A parallel DTI investigation will examine this issue in more detail.

Coordination

3.11. Ofgem's preliminary view is that the close liaison and cooperation between EDF and NGC operational staff ensured that supplies were restored in an efficient manner. It may have been possible for EDF to restore supplies to Lots Road (and therefore London Underground) at an earlier stage, but priority was given to restoring larger groups of customers. EDF has told us that it believes that this was unavoidable due to the non-discrimination obligations within its distribution licence. Therefore, a relevant factor in this decision-making process is the company's non-discrimination obligations.

3.12. Ofgem will be considering whether these events have any implications for the way in which the obligations not to discriminate are discharged in future, and whether these obligations could be improved in a manner that would better protect the interests of customers. In particular, Ofgem will be working with the government to consider whether these events have any implications for the way in which customers are reconnected following a major supply incident.

3.13. The main priority of the various control centre staff was to reconnect supplies to customers. To this end, EDF called in additional staff to assist with the complex switching required to restore supplies to such a wide area. It appears to Ofgem that NGC executed a complex set of switching operations in a short period of time, which acted to reduce the length of the disruption to high voltage supplies to EDF.

3.14. The company that operates and manages London Underground's electricity network (SEEBOARD Powerlink Control) telephoned EDF Control at 18.25 and were advised of the situation. It is understood that because there was uncertainty as to when supplies would be restored to Lots Road — one of the four main points in London where London Underground derive power — London Underground then decided to switch its network to an alternative source

of electricity supply. At approximately 19.01 hours, EDF contacted London Underground to inform it that supplies to Lots Road had been restored. However, by this time the London Underground network was sourcing power from alternative supply points and was no longer dependent on supplies from Lots Road. Therefore restoration of Lots Road at that time provided little benefit to London Underground.

3.15. With regard to wider coordination and communication during and after the event (with government, customers and the media), NGC and EDF alerted senior managers and public relations staff in order to brief the media, the DTI, Ofgem, energywatch and others. There was an inevitable concern that terrorism might be involved, and approximately 30 minutes after the power cut occurred, New Scotland Yard called NGC and were informed that this was a system incident with no third party involvement.

4. Birmingham — preliminary investigation

Causes of the failure

4.1. The national grid supplies both the East Midlands Energy (EME) and Aquila distribution networks from the Hams Hall substation, located near Coleshill. The Hams Hall site contains three substations operating at 400kV, 275kV and 132kV. The substations are close to each other and are owned by NGC. Major upgrades were underway at the Hams Hall site.

4.2. The sequence of events commenced with the discovery of a problem with a recently re-commissioned transformer, whereby part of the transformer equipment was emitting sparks and smoke, requiring the removal of the transformer from service for safety reasons. The cause of this initial fault appears to have been incorrect installation, resulting from an incorrect wiring configuration.

4.3. The loss of supply was then caused by the subsequent incorrect operation of newly commissioned protection equipment, as the load on alternative circuits increased. It appears that this protection equipment was incorrectly installed, as was the case with the London power cut.

Preliminary findings

4.4. Ofgem is not yet able to decide whether the companies involved have fulfilled their obligations to develop and maintain efficient, co-ordinated and economical systems. However, Ofgem's preliminary findings are detailed below.

Develop and maintain

4.5. Ofgem believes further investigation is required to determine whether all of NGC's processes for planning and carrying out the installation of these types of new equipment are satisfactory. This relates both to the initial incident and the subsequent incorrect operation of protection equipment.

4.6. Prior investment by one of the DNO's (EME) allowed supplies to be more rapidly restored to Tamworth than would have been the case had EME not made the additional investment. This was achieved by reconfiguring EME's network and rerouting supplies to use alternative NGC substations.[9]

Coordination

4.7. Outage planning and coordination does not seem to have been a significant contributory factor. The sequence of circuit outages planned and agreed by NGC and the DNOs in order to carry out the upgrade works at Hams Hall appear satisfactory and met the required minimum standards.

4.8. Ofgem's preliminary view is that there was close liaison and cooperation between DNO and NGC operational staff, which ensured that supplies were restored in an efficient manner.

4.9. It is noteworthy that disruption to infrastructure was less than that experienced in London and reflects the measures adopted by customers, such as Birmingham Airport, to mitigate the (small) risk of supply interruption. These sites had back-up generation to ensure that they were not completely reliant on the transmission system.

4.10. Whilst some major customers are able to re-arrange their supply arrangements to limit the impact of any interruption (e.g. Network Rail at Tamworth) it was apparent that the loss of relatively small supplies (e.g. to local signalling), impeded the success of such contingency plans. However, as noted earlier, Ofgem considers that it should be left to customers to choose how to manage the risk of supply loss as they alone are able to assess their needs.

[9] EME commissioned a 132kV inter-connector in 2001 between Tamworth and Drakelow. Due to this, EME submits that it was able to restore all its customers via remote operation directly from its Network Management Centre within 11 minutes via its own 132kV network, and not await the restoration of the NGC supplies.

4.11. With regard to wider coordination and communication during and after the event (with government, customers and the media), NGC and the DNOs alerted senior managers and public relations staff in order to brief the media, the DTI, Ofgem, energywatch, key customers and others.

5. Way forward and future actions

5.1. In this document Ofgem has identified the areas that it needs to investigate further to understand whether NGC or any of the DNOs involved have breached any of their statutory or licence requirements. A crucial part of this investigation will be the report from the independent technical consultants, which is due towards the end of November. The consultants' scope is described in Appendix 3. Ofgem will endeavour to publish the conclusions of this investigation by the end of this year. It is important to note, therefore, that nothing in this report is in any way intended to fetter Ofgem's ability to arrive at any conclusions or to take any action that it might consider appropriate after reviewing the findings in the consultant's report and any other information made available to Ofgem.

5.2. In addition to investigating the companies involved Ofgem will additionally be taking forward work to understand the lessons that can be learnt from these transmission failures. Any proposals to change the existing regulatory framework as a result of these transmission failures will be fully consulted upon.

5.3. Ofgem also notes the investigations being undertaken by the DTI, the Trade and Industry Select Committee, and the Greater London Authority. Ofgem will be fully cooperating with all of these investigations.

Appendix 1 Technical description of the events

London

Transmission system in South London

1.1 The 275kV transmission system in south London consists of three 'mesh' substations at Hurst, New Cross and Wimbledon[10]. EDF then provide the distribution connection between these substations and consumers in the area, including large users such as NetworkRail and London Underground. Following the incident supplies were lost from Hurst, New Cross and part of Wimbledon.

1.2 Prior to the event three of the nine circuits were out of service for scheduled maintenance. This had been coordinated and agreed with the distribution network operator (DNO) EDF. This is shown very simply in Figure 1.1 below:

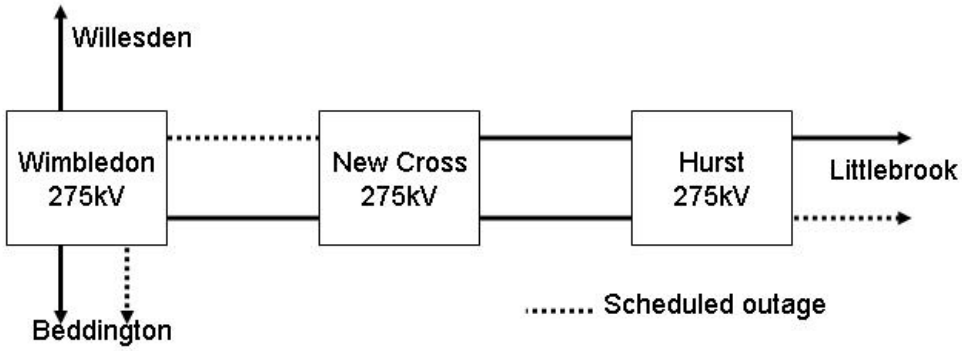

FIGURE 1.1

1.3 Two of the scheduled circuit outages were part of a major upgrade to mesh corner [1] at Wimbledon, which is illustrated in slightly more detail by Figure 1.2 below:

[10] These south London 275kV substations adopt what is termed a 'mesh' arrangement. This arrangement has only four circuit breakers and leads to some lack of operational flexibility, but reflects the historical cost balance at the time of their construction (late 1960's), when circuit breakers were relatively more expensive.

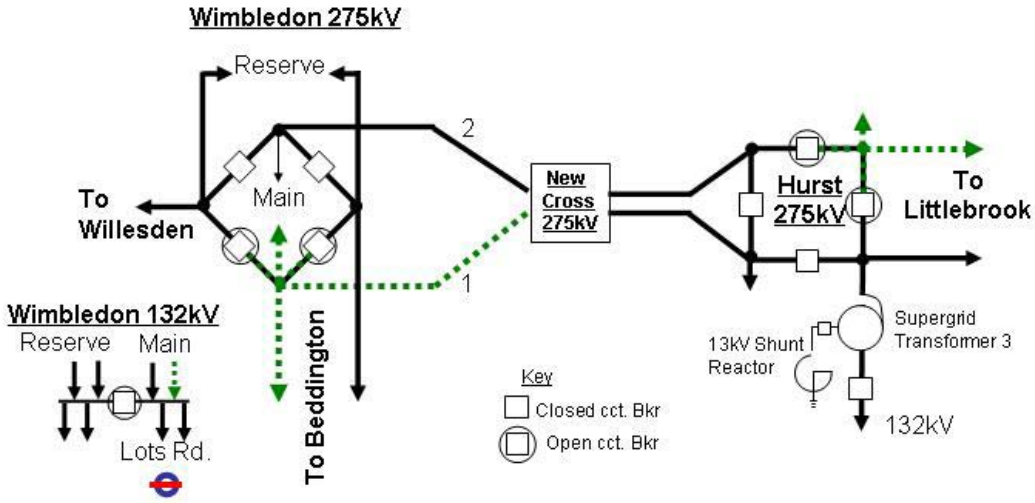

FIGURE 1.2

1.4 This diagram also indicates that for the initially planned 3 month outage duration of the Wimbledon mesh corner, the supplies to the Main section of the Wimbledon 132kV busbars were supported solely from diagonally opposed mesh corner 3. This section of busbar supplies Lots Road, one of the four main points in London where London Underground derives power. In the event of a fault affecting this mesh corner, supplies would be lost, although they could be rapidly restored by post fault switching - closing the open Bus Coupler circuit breakers between the Wimbledon 132kV main and reserve busbars. (Busbar sections 3 and 4). Note ideally this would operate normally closed, but safety considerations prevent this because it would increase potential fault currents above equipment ratings.

1.5 EDF is part way through an upgrade to the Wimbledon 132kV network initially intended to remove this ratings constraint. Three 132kV circuit breakers were replaced in 2002, including those feeding Lots Road. The replacement of the remaining three awaits the commissioning of a fourth grid transformer at Wandsworth. This is programmed for completion during 2004. At this time auto close will be fitted to the buscouplers, because increase in demand and especially fault level will still require periods of split operation.

1.6 Ofgem has been assured that the extent and duration of the scheduled outages met the required minimum operational standards. In accordance with the requirements of the Grid Code, the process includes consultation between NGC,

EDF Networks and key customers regarding the yearly outage plan. As the plan changes during the year, consultation takes place to achieve agreement to a revised programme. An updated 8-week plan is circulated to NGC, EDF and key customers, on a weekly basis.

1.7 The original plan was such that the Wimbledon mesh corner outage and the Hurst-Littlebrook outage would not overlap, but the planned Wimbledon mesh corner outage was delayed by a series of outages on EDF's network, including the Beddington – Sydenham circuits. In carrying out the work before demands increased as winter approached, an overlap was accepted for 3 days. This consequently marginally increased the system operating risk but, it appears, continued to enable NGC to meet its operating standards.

1.8 It is understood that NGC had adopted some mitigation measures including 12 hours per day, 7 days per week working on the Wimbledon outage in order to reduce the duration of the overlap.

The event

1.9 The sequence of events started at 18:11. Engineers at the Electricity National Control Centre (National Control) received an alarm indicating that a transformer, or its associated shunt reactor, at Hurst substation was in distress. This "Buchholz alarm" detects potential breakdown of the equipment insulation, which, left unattended, could proceed to a major fire or explosion.

1.10 National Control therefore agreed with EDF to temporarily disconnect mesh corner 4 at Hurst, in order to isolate the transformer and shunt reactor and then return the mesh corner to service. This would leave all supplies to Hurst and New Cross dependent on the single remaining transmission circuit from Wimbledon during the switching sequence (up to 10 minutes). This sequence commenced at 18.20. The interim and resultant system arrangement was to be as shown in Figure 1.3 below.

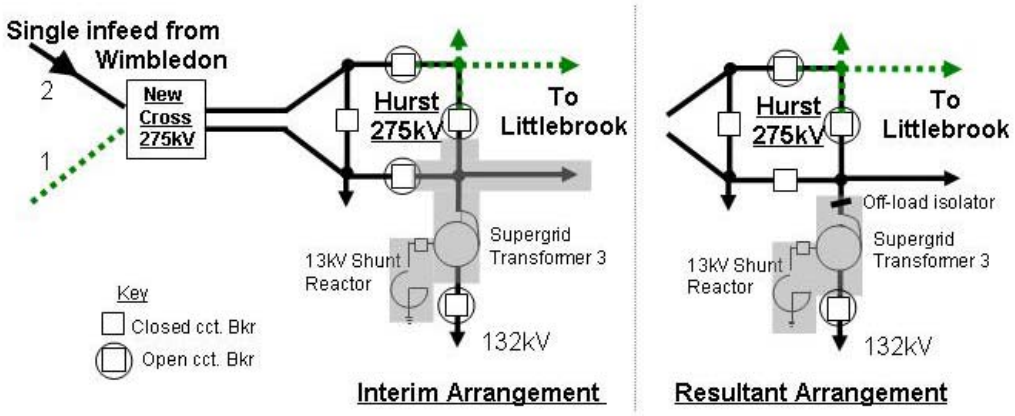

FIGURE 1.3

1.11 However, within a few seconds of the Hurst-Littlebrook circuit being taken out of service, the protection equipment on the single infeed circuit (Wimbledon to New Cross No. 2) operated incorrectly. This disconnected supplies to New Cross, Hurst and part of Wimbledon. This left the system as shown in Figure 1.4.

1.12 As a result, 724MW of supplies were lost, amounting to around 20 per cent of total London supplies at that time. This affected almost half a million EDF customers, with supplies being lost to parts of London Underground and NetworkRail.

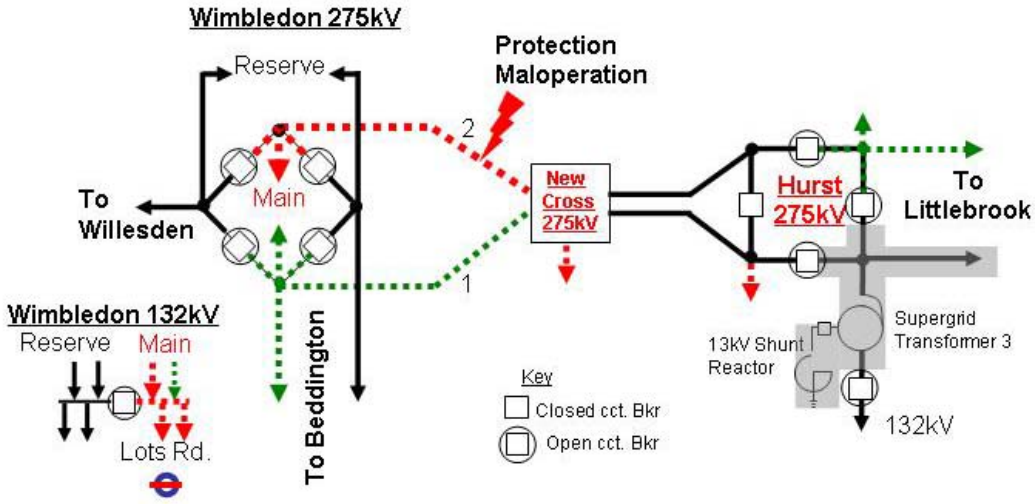

FIGURE 1.4

1.13 Although National Control suspected that the protection had operated incorrectly (based on the limited information available to them) this required confirmation by an engineer on site. A standby engineer was requested to visit

the site. In the meantime, restoration of supplies from Littlebrook via Hurst was commenced. This began at 18:26 (T+6), re-energising the Hurst substation from Littlebrook (ref. the 'Resultant' arrangement in Figure 1.3). Following sequences of switching by both EDF Networks and National Control, supplies were restored to approx 145,000 customers at 18:32 (Hurst), with final supplies being restored to New Cross at 19.01 (T+41).

1.14 The Wimbledon -New Cross No. 2 circuit was isolated to allow the Wimbledon mesh corner 3 that had been taken out of service by the protection maloperation to be restored at 18.38 (T+18). This permitted EDF to reconnect a further 143,500 customers at 18:51 (Wimbledon)

1.15 SEEBOARD Powerlink Control telephoned EDF Control at 18.25 (T+5) and was advised of the situation. It is understood that because there was uncertainty as to when supplies would be restored to Lots Road, London Underground then decided to switch its network to an alternative supply point (near Aldgate). At approximately 19.01 hours, EDF contacted London Underground to inform it that Lots Road had been restored. By this time all London Underground load had been transferred and remained so for at least a week. Therefore restoration of Lots Road was no longer significant to the restoration of supplies to London Underground.

1.16 Hurst and New Cross remained connected to the rest of the transmission system via a single circuit until 23:00, when Wimbledon - New Cross No.2 circuit was returned to service after the faulty protection equipment had been disabled.

Birmingham

Transmission system to the east of Birmingham

1.17 Supplies to the East of Birmingham, including Solihull and Tamworth are normally derived from NGC's Hams Hall Substation, near Coleshill, which comprise both 275kV and 400kV substations. NGC are part way through a 5 year investment programme which will upgrade the Hams Hall 400kV substation and eventually decommission the 275kV substation.

1.18 Part of this program is to replace three 120MVA 275/132kV super grid transformers, which are close to the end of their lives, with two 240MVA 400/132kV transformers along with the complete rebuilding, in sections, of the 132kV substation. The anticipated completion of the project is 2005.

1.19 On the evening prior to the event (4 September) the existing supergrid transformer SGT6 circuit had been re-commissioned after the transfer of primary connections and changes to its control circuitry. SGT8 was a new transformer that had been in service for approximately 3 weeks, while SGT7 and SGT9 were still undergoing construction works.

1.20 By the morning of 5th September, SGT6 was in service and two of the 275/132kV transformers had been switched out and were being prepared for decommissioning. This is shown in Figure 1.5 below.

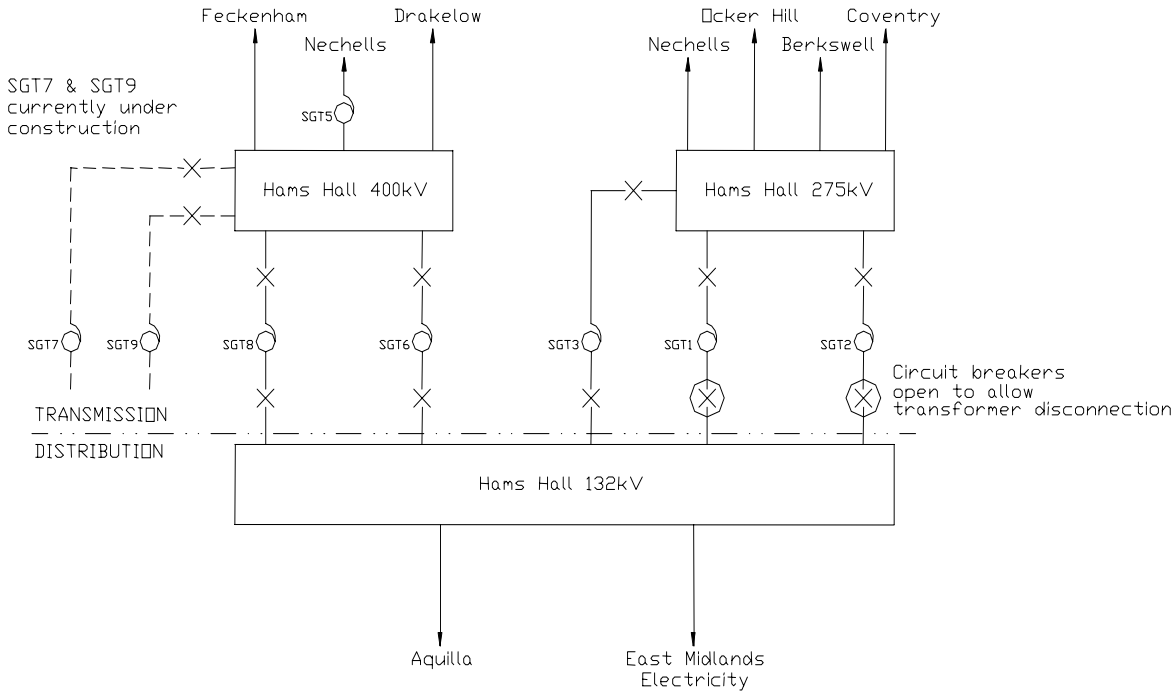

FIGURE 1.5

1.21 Note - two distribution network operators (DNOs), Aquila and East Midlands Electricity are supplied from the 132kV substation at Hams Hall. In this instance, NGC own the 132kV substation and the DNOs own their respective circuits. Both EME and Aquila were aware of the major construction work being undertaken by NGC at the Hams Hall.

The event

1.22 On the morning of 5 September, during a site check of the recently re-commissioned SGT6 circuit, a burning smell was being investigated. Subsequently, smoke and sparks were observed in a relay panel in the SGT6 relay room. National Control assessed that the available transformer capacity at Hams Hall was enough to meet the current demand without SGT6, plus there was the possibility of returning SGT1 and SGT2 to service. The SGT6 low voltage circuit breaker was opened at 10:09, taking the transformer off load.

1.23 Less than half a minute later, the protection equipment on the other 400/132kV transformer (SGT8) then operated incorrectly. The demand of 253MW at Hams Hall 132kV substation was then supplied only via SGT3, the one remaining 120MVA transformer. The automatic protection on this remaining transformer operated correctly, to prevent the transformer from being overloaded.

1.24 This disconnected all load at Hams Hall 132kV substation. Approximately 250MW of supplies were lost, affecting over 200,000 of Aquila's and East Midlands Electricity's customers, as well as larger users, including Birmingham International Airport and the National Exhibition Centre (who were able to minimise the impact due to their back up supplies). Also affected were industry (e.g. Landrover), hospitals, major shopping centres and the west coast main rail line.

1.25 EME was able to restore all its customers within 11 minutes via load transfer using its own 132kV network, and not await the restoration of the NGC supplies11. Tamworth load was eventually transferred back to Hams Hall from 12.59.

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[11] EME commissioned a 132kV inter-connector in 2001 between Tamworth and Drakelow, which exceeded the minimum requirements of Engineering Recommendation P2/5. The project involved the re-commissioning of a line which had been out of service. This demonstrated prudent asset risk management as EME could have met its P2/5 standards by limiting its investment to reinforcement of the 33kV network, but this would not have provided any transfer capacity.

1.26 At 10:11 NGC requested Aquila to split its demand at Hams Hall into smaller blocks. The Hams Hall 132 kV substation was then re-energised via SGT 3 and the first block of demand restored at 10:21.

1.27 The SGT6 circuit was restored to load at 10:36, followed by the recall of SGT2 to service at 10:48. By 10:52 all supplies from the 132kV substation had been restored. A minor delay of occurred in the restoration of one small section of Aquila's network due to failure of a SCADA link (computer equipment that permits remote control).

Appendix 2 Ofgem's statutory framework

Section 25 of the Electricity Act 1989

2.1 Under this section, if the Gas and Electricity Markets Authority (the 'Authority') is satisfied that a licence holder is "contravening, or is likely to contravene, any relevant condition or requirement, he shall by final order make such provision as is requisite for the purpose of securing compliance with that condition or requirement."

2.2 This section covers contravention — or likely contravention — of both licence obligations and statutory obligations. Hence, if NGC were to be contravening its section 9(2) Electricity Act obligation (as discussed below), section 25 could be used to enforce against it in the same way as if it was contravening a licence condition.

2.3 The Authority need not make such an order if it is satisfied that its statutory duties preclude it from doing so[12], or if the licence holder is taking all such steps that the Authority considers appropriate to secure compliance with the relevant condition.[13]

2.4 Section 26 sets out the procedural requirements that the Authority must follow before making a section 25 order.

Section 27A of the Electricity Act 1989

2.5 Provided the Authority is satisfied that the Competition Act 1998 is not the most appropriate method of proceeding, it may impose a penalty upon a licence holder when it is satisfied that a licence holder is contravening or has contravened any relevant condition or requirement. No penalty imposed may exceed 10 per cent of the turnover of the licence holder.[14]

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[12] Section 25(5) EA.
[13] Section 25(5A) EA.
[14] Section 27A(8) EA.

2.6 There are procedures to be followed before imposing a penalty and these are set down in sections 27A-C.

2.7 It should be noted that the ability to impose a penalty for contravention of a relevant condition or requirement is discretionary, and if a penalty is imposed it must be reasonable in all of the circumstances.[15] Again, this is a power conferred only upon the Authority.

Section 28 of the Electricity Act 1989

2.8 Where it appears to the Authority that a licence holder may be contravening or have contravened any relevant condition or requirement it may, for the purposes of performing its functions under section 25 or 27A-F, require the provision of information to it.

2.9 Should a party, without reasonable excuse, fail to provide information to the Authority when required to do so under this section, he shall be liable on summary conviction (Magistrates' Court) to a fine not exceeding Level 5 on the standard scale (£5,000).

Section 47 of the Electricity Act 1989

2.10 Clearly, for section 25 and related sections to be operative a threshold must be passed by the Authority in that it must be satisfied that a contravention of a relevant condition or requirement is occurring or is likely to occur. Should the Authority not have sufficient information upon which to decide that it is so satisfied it may still request information from the licence holder, although the licence holder would not be under an obligation to supply it.

2.11 Section 47 places a duty upon the Authority to keep activities connected with the generation, transmission and supply of electricity under review and to collect information from parties involved in these activities with a view to facilitating the performance of its functions under Part I of the Act. Further, the Authority is quite at liberty to request information of a party at any time and seek to rely

[15] Section 27A(1) EA.

upon the party's desire to co-operate in the absence of any formal information gathering powers. This is a course of action open to the DTI/Secretary of State also.

The Utilities Act 2000

2.12 The Utilities Act 2000 (the Utilities Act) amended the Electricity Act 1989 (the Electricity Act) and provided the necessary legislation to introduce the New Electricity Trading Arrangements in March 2001, it also enabled a number of other reforms to the electricity and gas markets, including:

- the introduction of standard licence conditions for each type of electricity licence granted under the Electricity Act and provisions for making modifications to standard licence conditions; and
- the creation of an additional power to enable the Authority to impose financial penalties on companies found to be in breach of their relevant licences under the Electricity Act.

2.13 In addition, the Utilities Act introduced new powers on the Authority to impose financial penalties on licensed companies up to 10 per cent of their turnover in the previous year. Ofgem has indicated that in considering the quantum of financial penalties for breaches of licence obligations, it will have regard to:

- the seriousness of the contravention or failure;
- the harm that has been caused to customers or other market participants;
- the length of the contravention or failure; and
- any gains, financial or otherwise, that have been made from a contravention or failure.[16]

[16] Ofgem 2002, *The Office of Gas and Electricity Markets News — Policy On Financial Penalties Set Out By Ofgem*, No. R/10, Tuesday 23 January.

Appendix 3 Summary of consultants' scope of investigations

3.1 The consultants will support Ofgem (and DTI) in assessing specific aspects of the power cuts experienced in South London on 28 August 2003 and areas to the east of Birmingham on 5 September 2003.

3.2 Specifically, the consultants will:

- review and critical evaluation of the approach, systems, processes, and management techniques adopted by NGC for selecting and commissioning protection equipment and deriving and implementing the associated protection settings;
- review and critical evaluation of the approach, systems, processes, and communication strategies adopted by NGC and the relevant DNO for programming and management of transmission outages; and
- review and critical evaluation of the communications with consumers and other stakeholders during and immediately following the incident.