



**REPORT ON  
DISTRIBUTION AND  
TRANSMISSION SYSTEM  
PERFORMANCE  
1997/98**

## Introduction

All licensees who operate transmission or distribution systems are required to report annually on their performance in maintaining system security, availability and quality of service. This information provides a picture of the continuity and quality of supply experienced by final customers. Information is now available for each of the years since Vesting. This year's report continues to incorporate year-by-year comparisons to help identify trends in companies' performance.

The figures submitted by the companies for 1997/98 show that, in general, the standard of supply for customers has been maintained. There are nonetheless differences between companies.

There are also differences within companies. From 1995/96 companies have supplied disaggregated performance data as part of their new Quality of Supply Reports. This enables customers to get a better picture of how different parts of company networks perform. As in last year's report, instead of single average performance figures for companies, this report contains performance data for each separate operating area within each company. Companies are also required to set targets for performance achievement during the price control period which ends in March 2000 - a summary table is included showing the targets.

As part of the review of distribution price controls which is now in progress, consideration will be given to quality of supply including the way in which standards are set and data is reported.

Each company's Quality of Supply report for 1997/98 is publicly available. The reports give more detailed information about company targets and spending plans.

## Security and Availability of Supply

This report begins with information on the overall security and availability of supply, measured in terms of the number of interruptions and supply minutes lost experienced by customers connected to the distribution systems of the 14 distribution companies. Information is also given on the quality of service, in terms of restoration times achieved, provided by these companies.

The quality of supply experienced by customers is influenced by the performance of all stages of electricity supply: generation, transmission and distribution. However, the number of supply failures caused by failure or lack of generation has usually been extremely small, and the contribution from transmission system failures has also been minor. Distribution systems are by far the most significant determinant of the quality of supply experienced by final customers.

### DISTRIBUTION SYSTEMS

The numbers of interruptions on each company's distribution system in 1997/98 are examined and compared. The performance of the High Voltage (HV) network is particularly significant. Further analysis shows how this performance varies for the overhead and underground HV networks for each company.

### TRANSMISSION SYSTEMS

There are three transmission licensees in Great Britain - The National Grid Company (NGC) in England and Wales and the two Scottish companies, ScottishPower and Hydro-Electric. Transmission systems transport large amounts of energy and are normally designed to continue to provide supply in the event of single or even multiple circuit failures. The number of incidents that result in a loss of supply to final customers is extremely small. Information is given for 1997/98 and this is compared with previous performance for NGC and the two Scottish companies. The average energy that would have been supplied without such outages is also given.

One measure of the performance of a transmission system is the percentage of the time during which the system is not available for use. System unavailability is shown for the three transmission systems and for the three interconnectors.

Transmission companies have been asked to provide a classification of the causes of transmission system unavailability. These causes are system maintenance, system construction, connection of users and system faults.

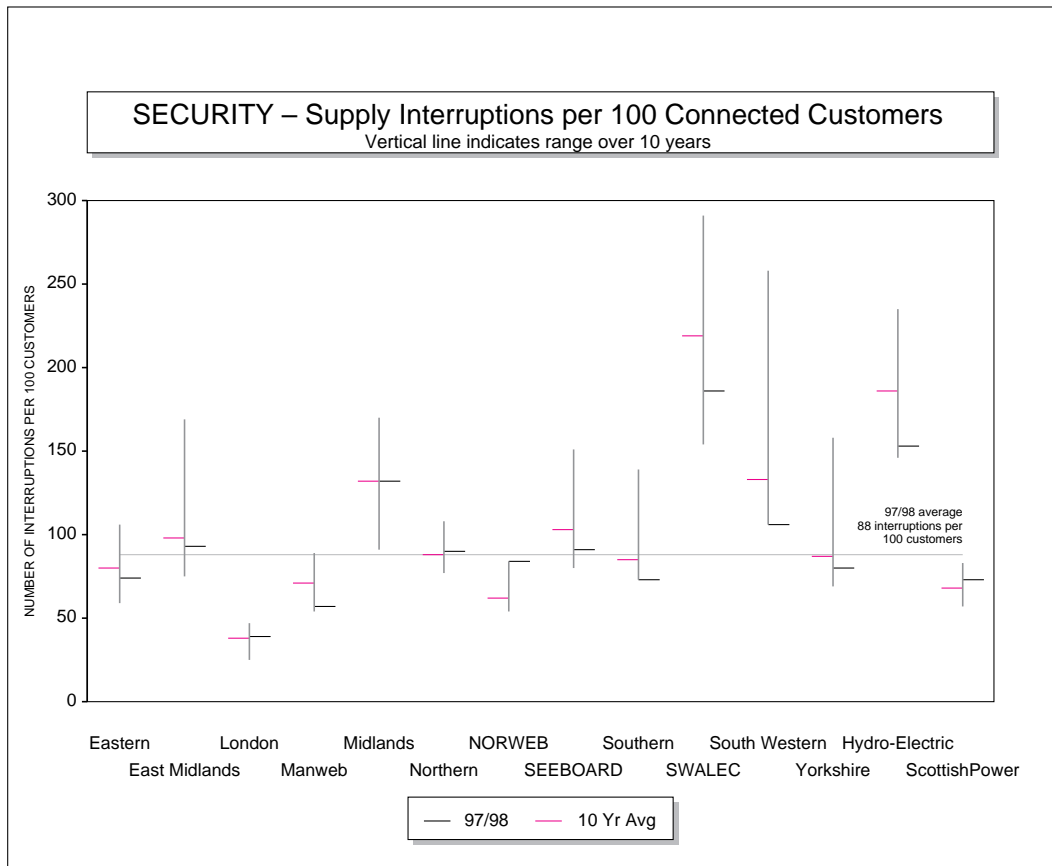
## Standards of Supply Quality

It is a statutory requirement on the transmission and distribution companies to keep voltage and frequency within prescribed limits, in all but exceptional circumstances. Transmission system operators reported on incidents which caused excursions outside the prescribed limits for both frequency and voltage. Distribution system operators provided details of complaints by customers who were receiving voltage outside statutory limits. In these instances, companies need to consider whether local reinforcement of the distribution system or other measures may be needed.

## Analysis

The figures supplied give an overview of system performance in 1997/98. Statistics extracted from companies' figures have been used to provide diagrammatic comparisons of performance. Figures 1 to 15, and 25, relate to security and availability experienced by customers, and the factors affecting these aspects of performance. Figures 16 to 24 show transmission system performance.

The format chosen for many of the graphs is similar to that used previously. The 10 year average and 1997/98 results for each company are shown as horizontal bars. Vertical bars indicate ranges, either highs and lows of performance in the last 10 years, or the different performances of different operational units within each company.



**FIGURE 1 SECURITY** presents data on interruptions of supply. For each company, the figure shows the number of supply interruptions per 100 customers in 1997/98, the average for the last 10 years and the range of annual figures over the last 10 years. The data covers all interruptions, including those caused by bad weather, faults and pre-arranged shutdowns for maintenance and construction.

For nine companies, the number of interruptions in 1997/98 was lower than their 10 year average. SWALEC, Midlands and Hydro-Electric continue to have the highest proportion of supply interruptions. London, Manweb, Southern and ScottishPower have the lowest. Southern and SWEB reported figures which are equal to or better than those of the last nine years. As in previous years, some companies (Manweb, South Western and ScottishPower) submitted additional data which excluded the effects of particular periods of bad weather. These are not significantly different from the figures shown in Figure 1.

The broad horizontal band shows the average for all companies for 1997/98 (88 interruptions per 100 customers). This is slightly better than the average of 89 interruptions per 100 customers in 1996/97 and better than the ten year average of 93 interruptions per 100 customers.

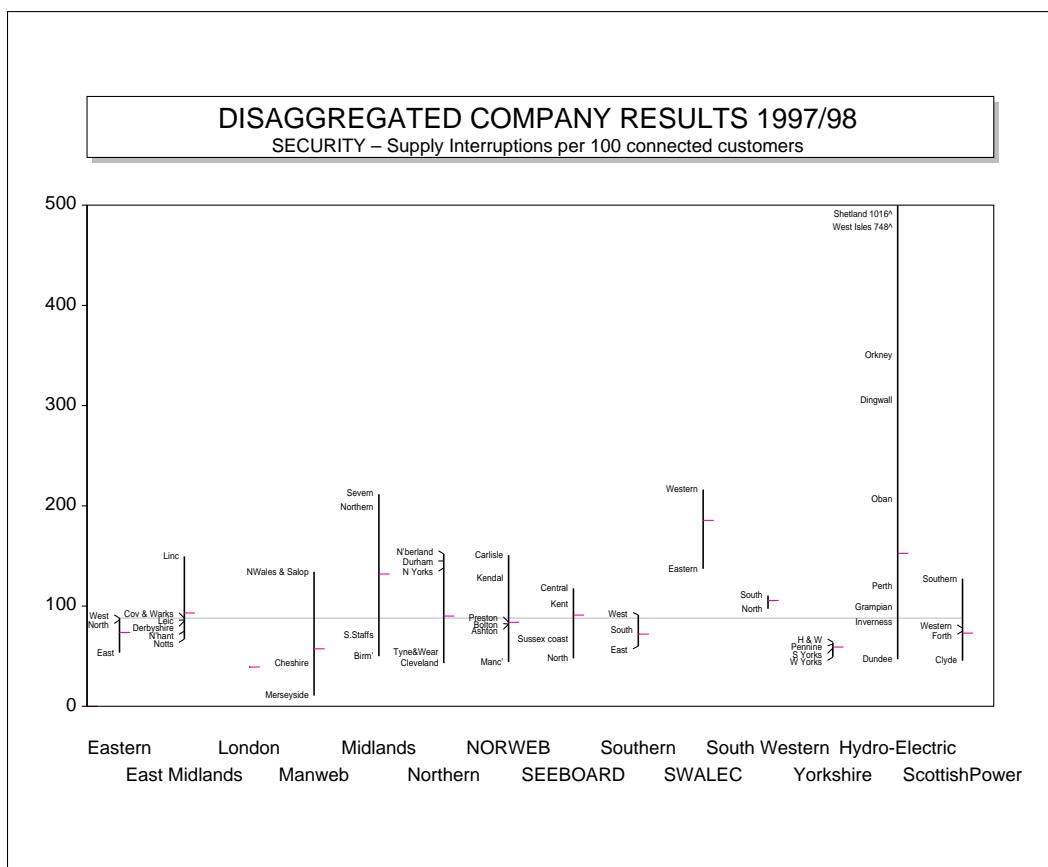


FIGURE 2 SECURITY DISAGGREGATED BY COMPANY ORGANISATION UNIT

Companies provided security data broken down by company operating units. All companies except London have more than one operating unit, varying between two for SWALEC and SWEB, and nine for Hydro-Electric.

Customers can experience varying performance depending on where they are in a company's area. The management units which exhibit the best performance tend to be those which include a larger proportion of urban territory. As in last year's report, Merseyside region (MANWEB) shows the lowest number of interruptions (11 per 100 customers) for 1997/98. Various regions of Midlands, SWALEC and Hydro-Electric show the highest numbers.

The horizontal band shows the average for all companies (88 interruptions per 100 customers).

## SECURITY TRENDS – Supply Interruptions per 100 Customers

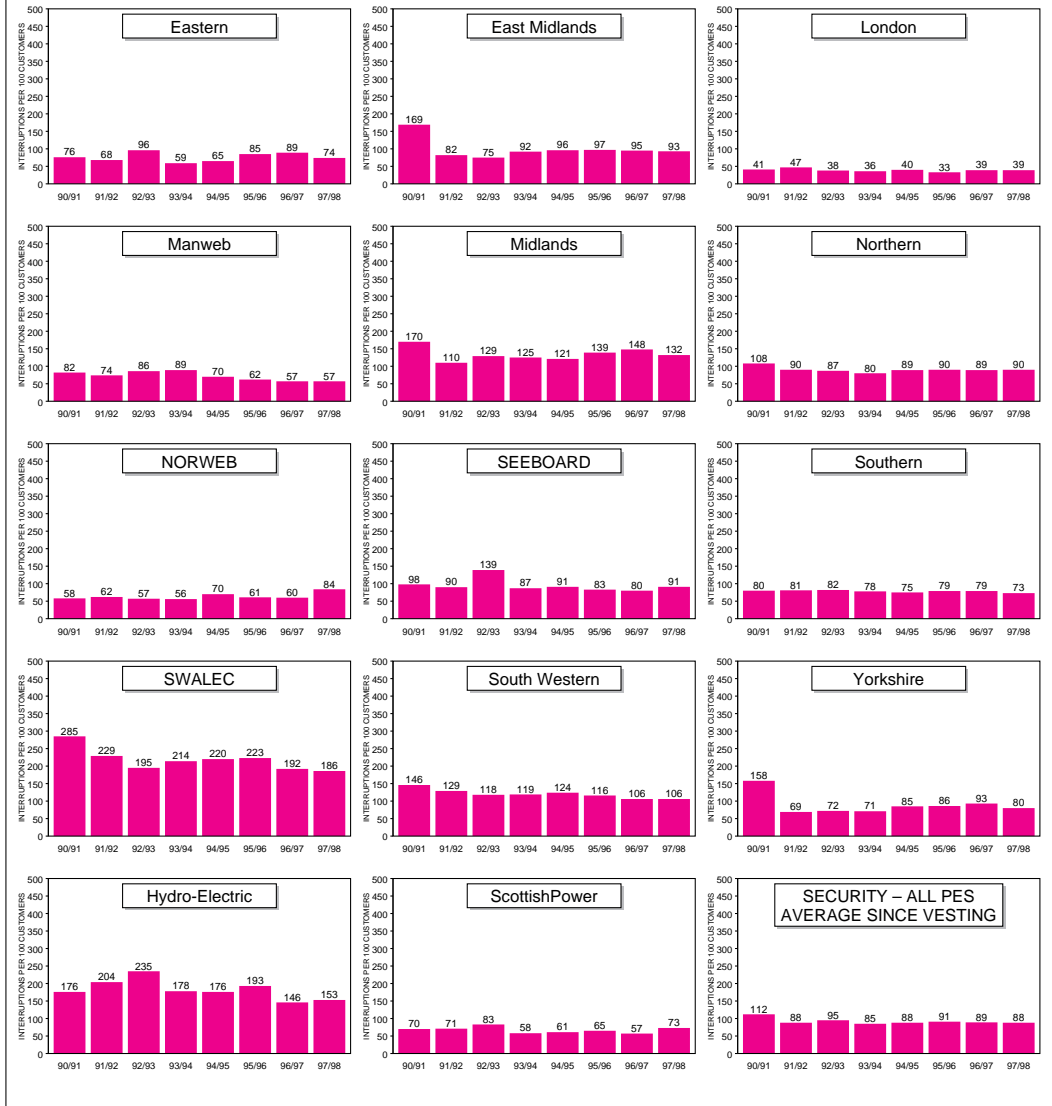
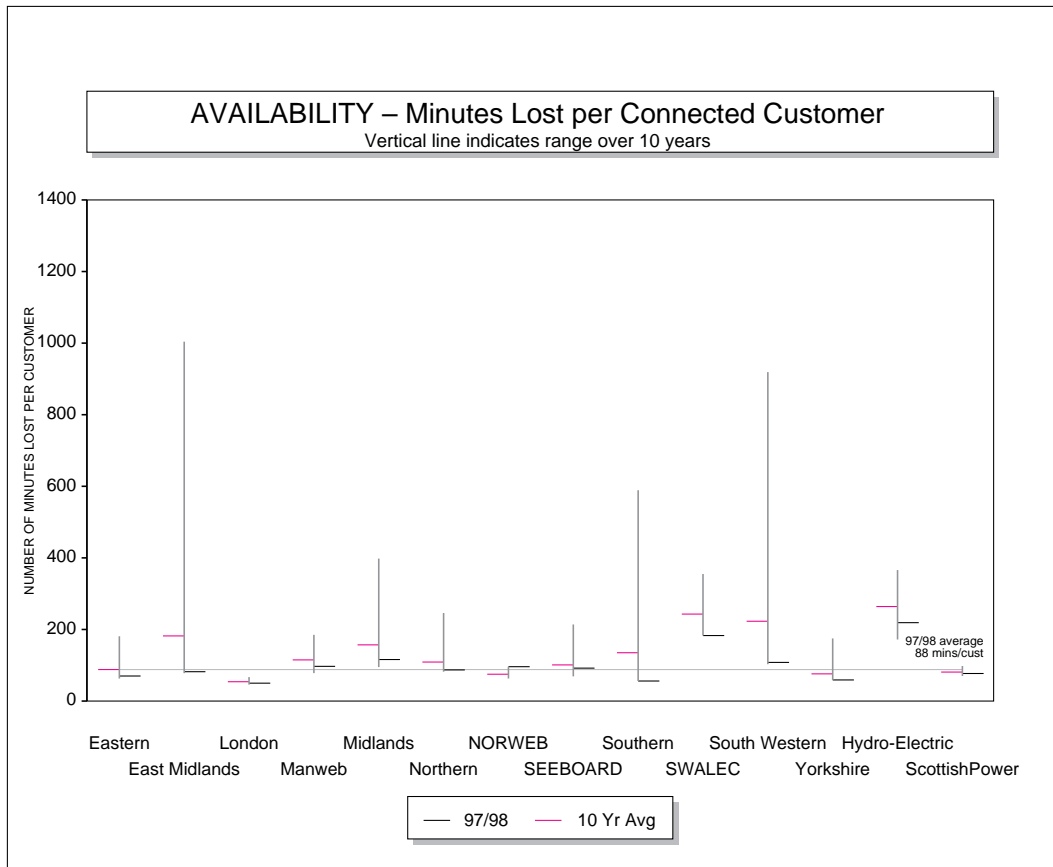


FIGURE 3 SECURITY TRENDS shows the security of supply as measured by the number of interruptions per 100 customers served by each distribution company in the eight years since Vesting. There have not been major changes in the security of supply for any company since Vesting.

In 1997/98 five companies had a better performance than in 1996/97, five performed at a very similar level over the two years and four were worse in 1997/98.

## Availability



**FIGURE 4 AVAILABILITY** displays for each company the average number of minutes off-supply experienced by its customers. The figures for 1997/98 range between 50 (London) and 219 minutes (Hydro-Electric). All companies, except NORWEB, reported figures which were better than their 10 year average result. Southern, SWALEC, and Yorkshire recorded their best results for 10 years.

The broad horizontal band shows the 1997/98 average for all companies, this was 88 minutes per customer, compared with 87 minutes per customer in 1996/97.



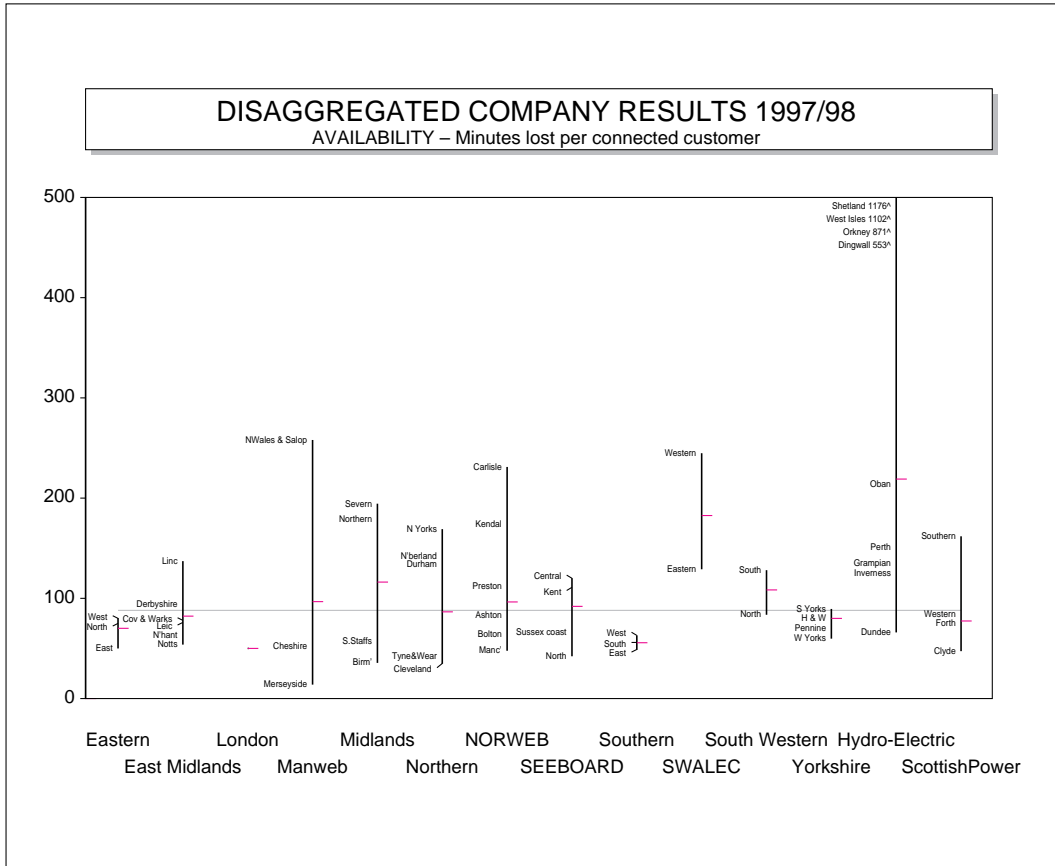


FIGURE 5 AVAILABILITY DISAGGREGATED BY COMPANY ORGANISATION UNIT.

As for security, companies provided availability data for each of their operating units expressed in minutes lost per connected customer. Restoration of supplies in remote areas and those with low population density can sometimes be delayed by difficult terrain and longer distances between company depots and customers. Some companies say they are targeting this by investing in network automation and remote control; details can be found in their Quality of Supply Reports.

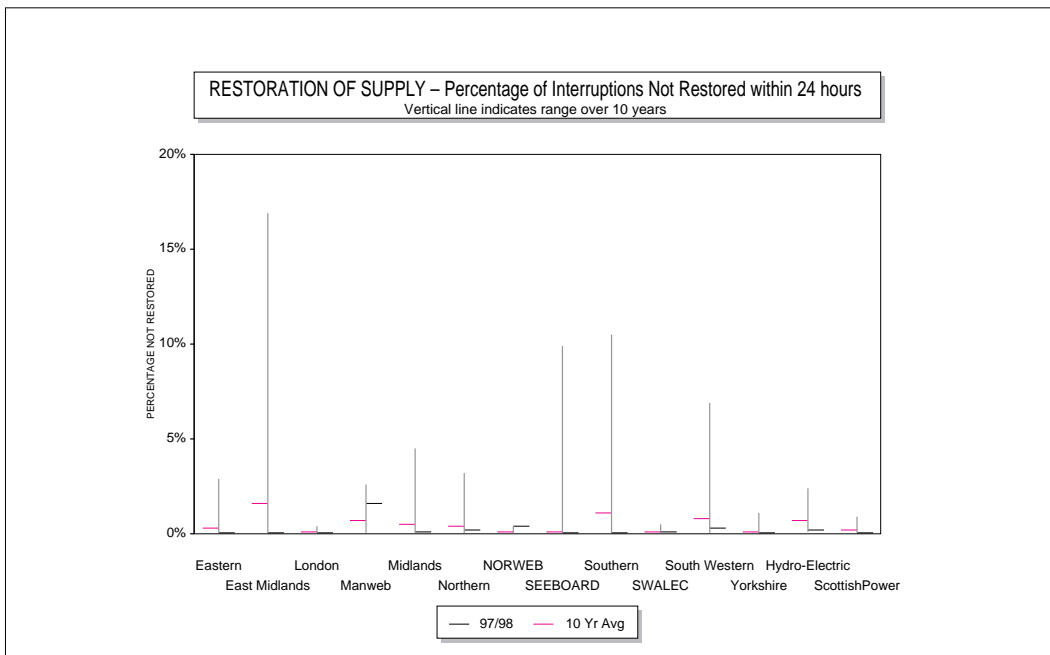
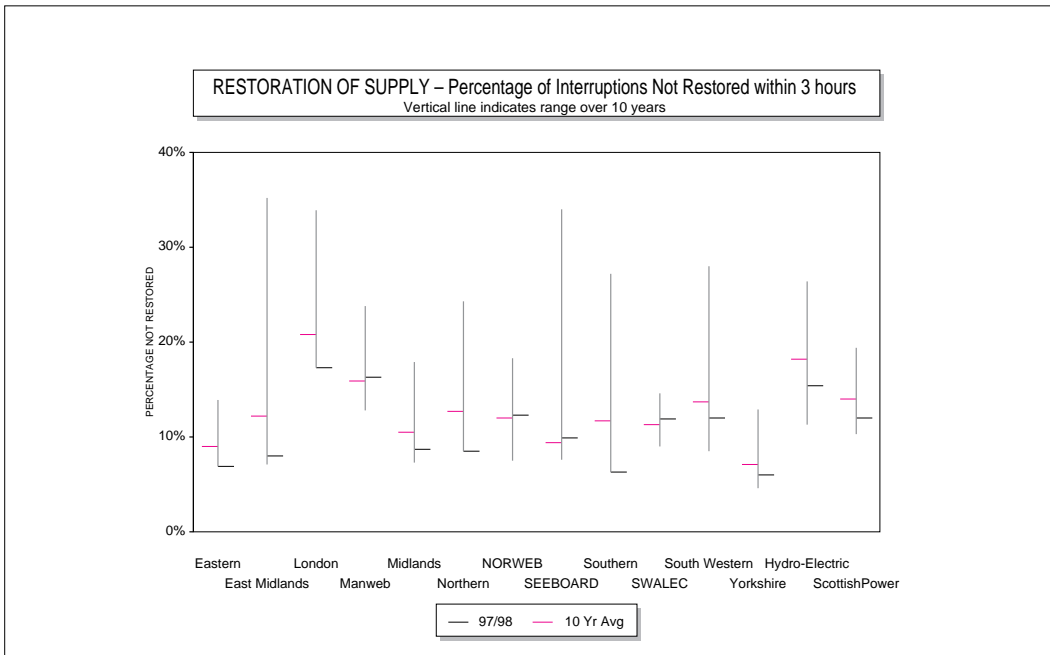
The horizontal band shows the 1997/98 average for all companies (88 minutes per customer).

## AVAILABILITY TRENDS – Minutes Lost per Connected Customer



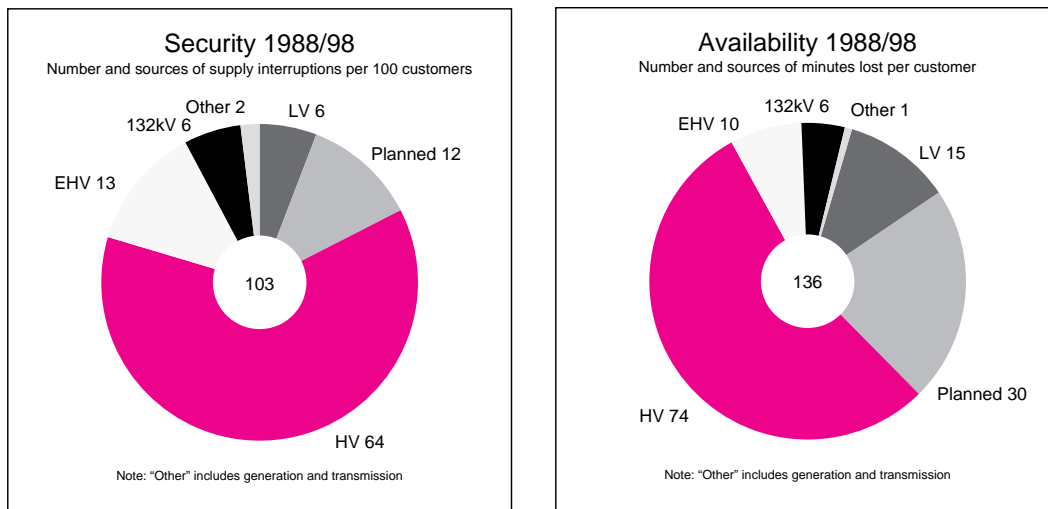
FIGURE 6 AVAILABILITY TRENDS shows the average number of minutes off-supply per customer served by each distribution company in the eight years since Vesting. London, Southern and Yorkshire have the lowest minutes lost per customers, SWALEC and Hydro-Electric the highest. No company exhibits a significantly worsening performance though seven companies performed worse in 1997/98 than in 1996/97.

# Restoration of Supply



**FIGURES 7 AND 8 RESTORATION OF SUPPLY** show the companies' performance in restoring interruptions to supply within three hours and 24 hours. 10 companies performed better than their 10 year average figure for three hour restorations. Four companies achieved or approached their best performance figures in the last 10 years. Overall, 89 per cent of interruptions were restored within three hours. Virtually all interruptions (over 99 per cent) were restored within 24 hours, as shown in Figure 8. For 12 companies, performance in 1997/98 was better than their average performance in the past 10 years.

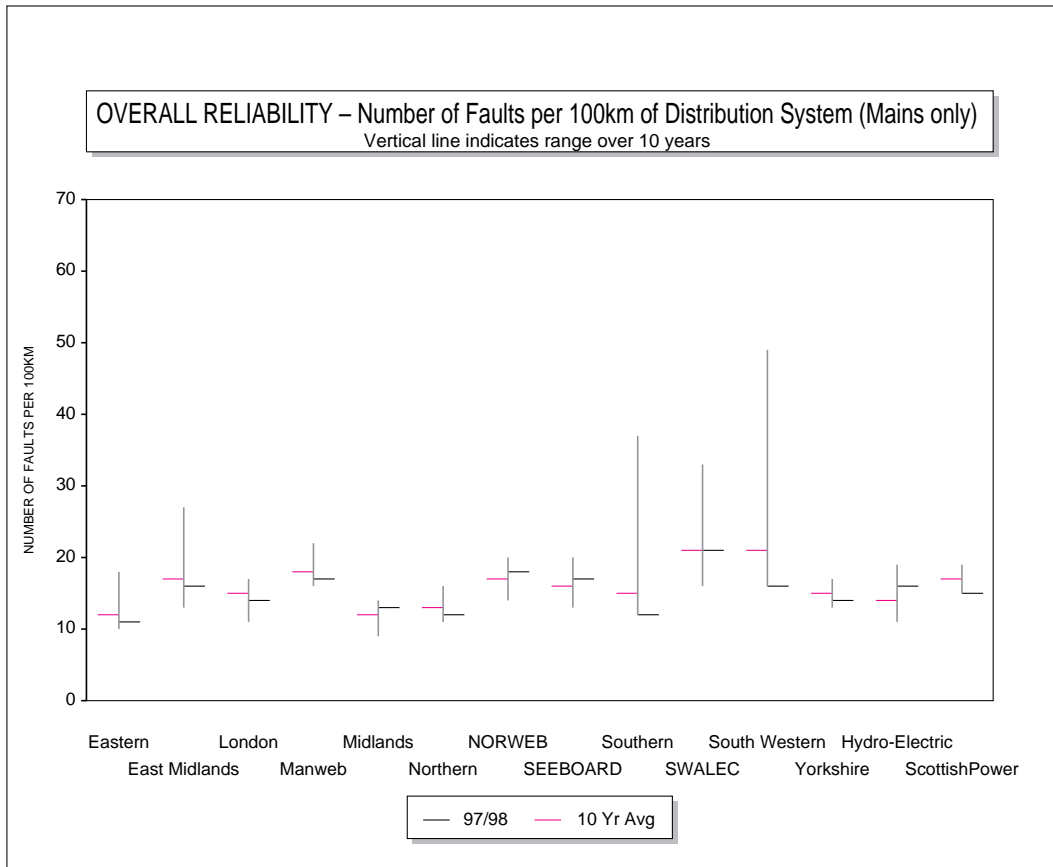
## Factors Affecting Security and Availability of Supply



FIGURES 9 AND 10 NUMBER AND SOURCES OF INTERRUPTIONS AND MINUTES LOST show the contribution to the average number of supply interruptions and overall minutes lost per customer of lack of availability of different parts of the supply system. Generation shortfalls and transmission system failures are included in these figures – together they account for only about one per cent of the shortfalls experienced by customers. These charts are based on the 10 year figures for all companies. They demonstrate the crucial role of the distribution system, particularly the HV (generally 11kV) distribution system, in the security and availability of supply experienced by customers. Almost all planned interruptions to supplies occur due to work on the LV and HV networks. These results are not significantly different from previous years.

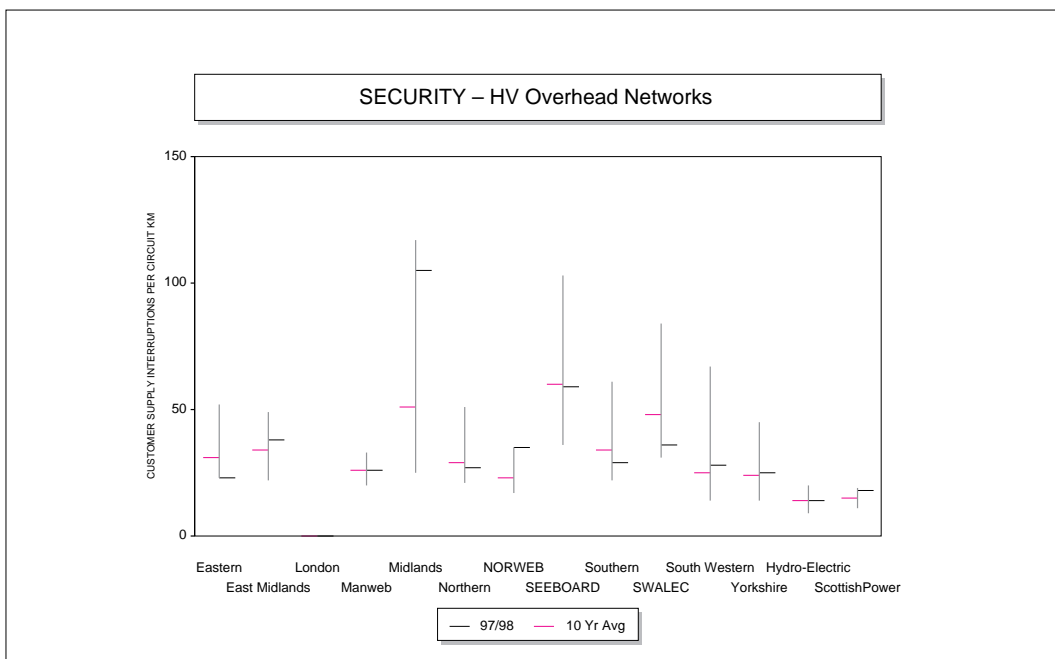
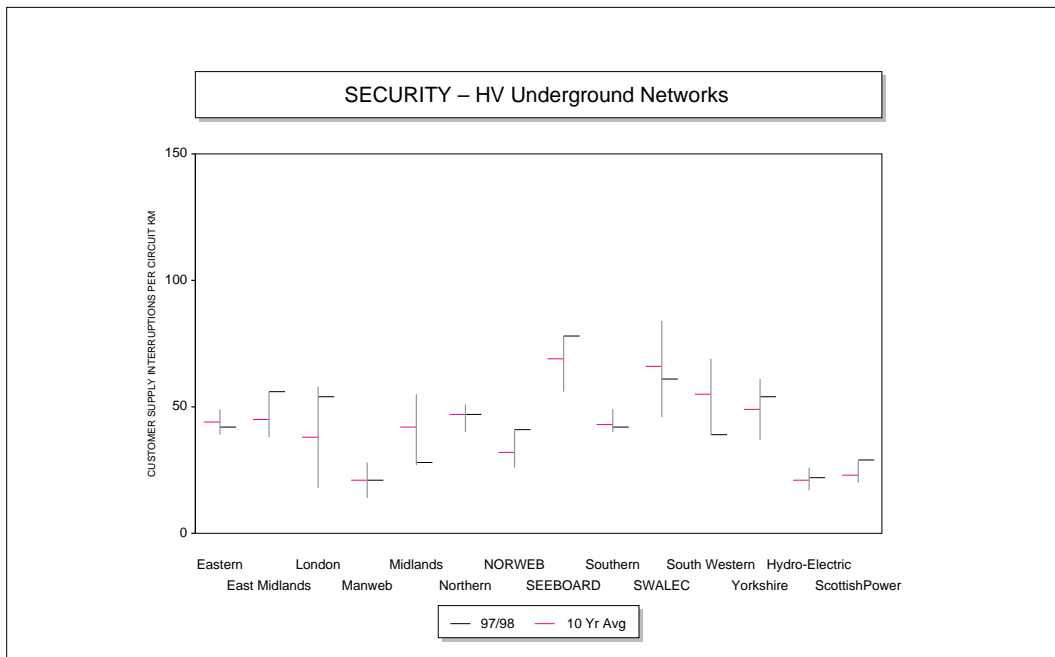
The HV system has a large impact on overall system performance because much of it does not have duplicate or alternative supplies and each fault can affect a large number of customers. In general, the higher voltage systems (EHV, 132kV and transmission systems) do have duplicate supplies so that most faults at these voltages do not result in an interruption of supply to customers. Each LV fault does not affect as many customers as those at HV. Improvements in the control and operation of HV systems, to reduce the number and duration of circuit outages due to planned work and faults, could bring significant improvements in overall levels of performance. Some companies have reported initiatives in these areas in their Quality of Supply Reports.

## Overall Distribution System Performance



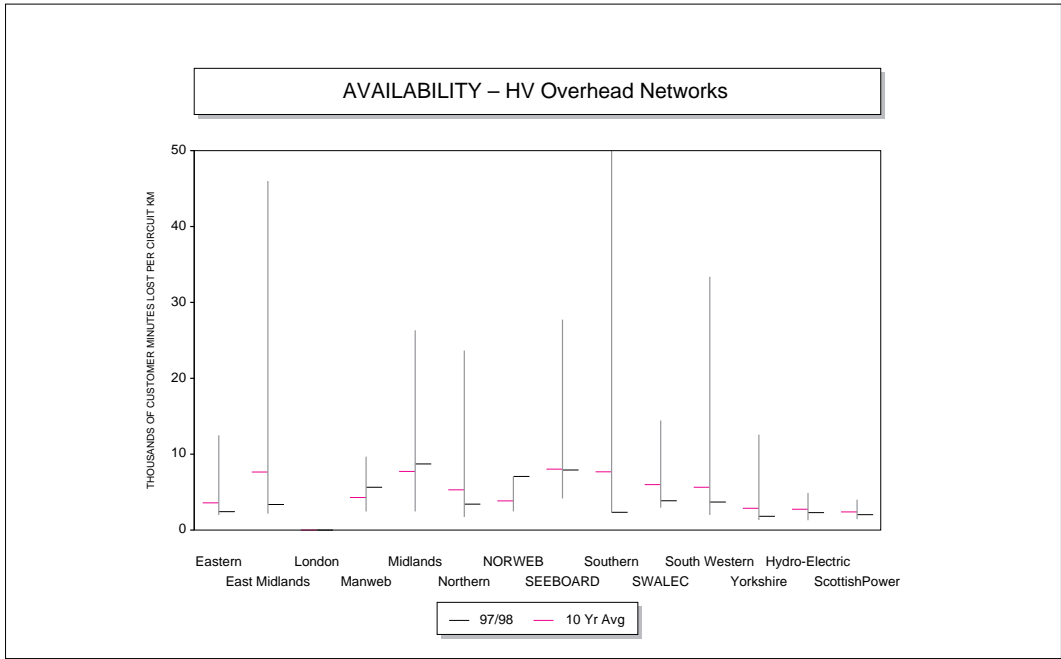
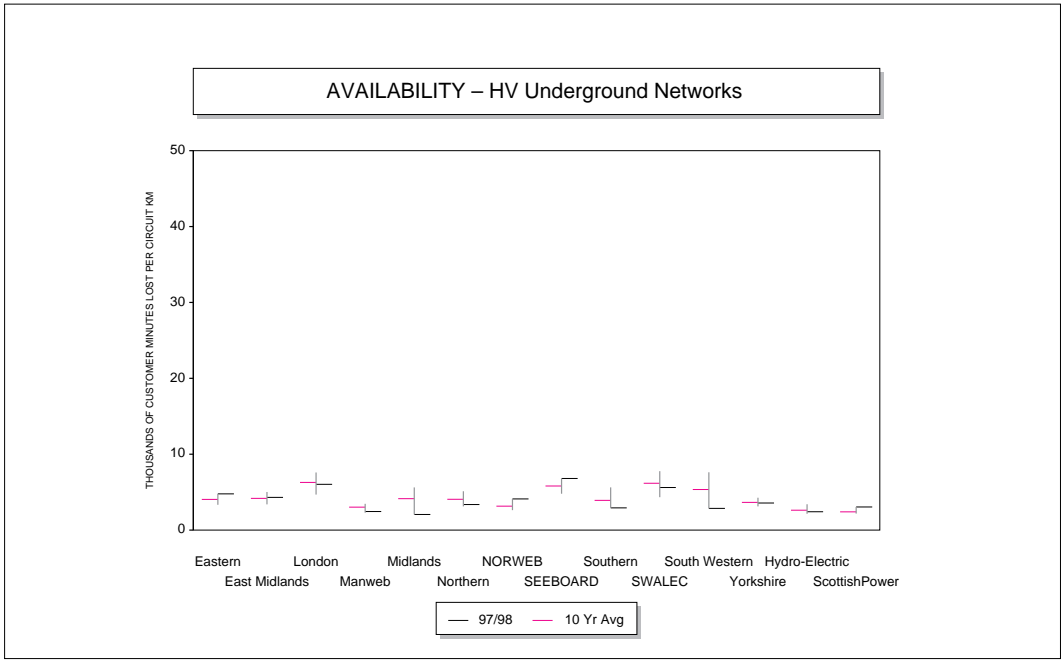
**FIGURE 11 OVERALL RELIABILITY** of distribution system performance is defined as the number of faults per unit length of network. This length of the network is taken as being the length of the mains only, excluding service cables which connect each customer to the mains. This is because reliable data on the length of service cables is not always available. The information on the mains, which is generally the network that supplies more than one customer, is more accurate. In making comparisons between companies it should be noted that the Scottish companies' 132kV circuits are classified as part of their transmission networks and are therefore not included in this analysis, whereas for regional electricity companies these circuits are part of their distribution networks.

Nine companies performed better than their 10 year average figure and ScottishPower and South Western reported their best results for the 10 year period.



FIGURES 12 AND 13 SECURITY OF HV UNDERGROUND AND OVERHEAD NETWORKS show the number of customer interruptions per circuit kilometre arising from faults on the HV underground and overhead distribution systems.

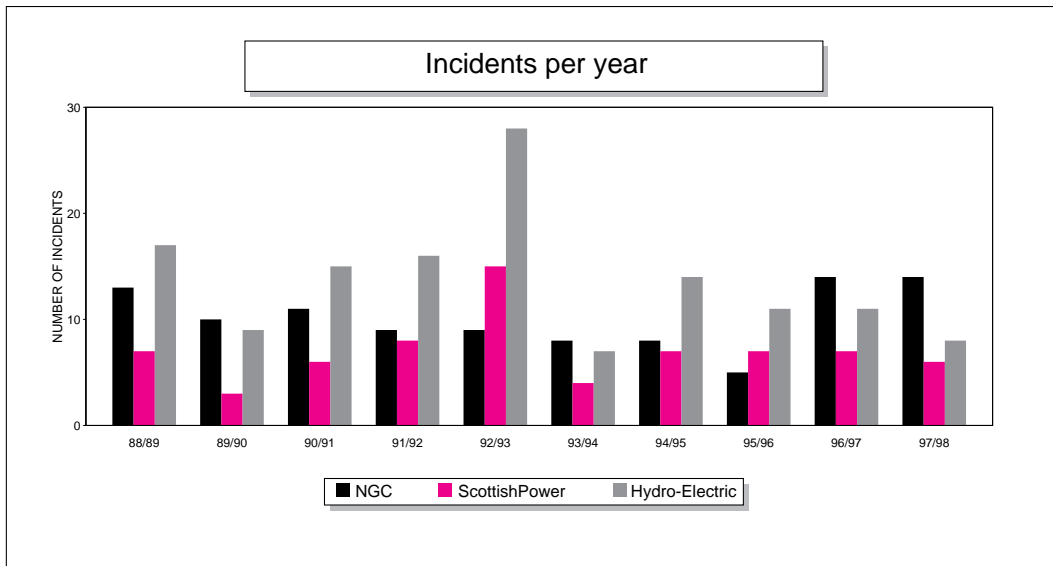
On underground systems about half the companies reported better results than their 10 year average, the other half reported worse. East Midlands and Seeboard reported their highest number of HV underground interruptions per circuit kilometre in the last 10 years. On the overhead networks, about half of the companies reported better results than their 10 year average. Eastern reported its lowest number of HV overhead interruptions per circuit km in the last 10 years while Norweb reported its highest numbers for both HV overhead and HV underground networks.



**FIGURES 14 AND 15 AVAILABILITY OF UNDERGROUND AND OVERHEAD NETWORKS.** Underground circuit availability performance in 1997/98 was better for most companies than their 10 year average performance. Southern, Midlands and South Western reported their best performance in 10 years while Norweb, SEEBOARD and ScottishPower reported their worst.

Over the past 10 years overhead circuit availability performance has been far more variable than underground circuit availability, reflecting the effects of weather conditions. Ten companies reported better results than their 10 year average. Southern reported its best in 10 years while Norweb reported its worst.

## Transmission System Performance

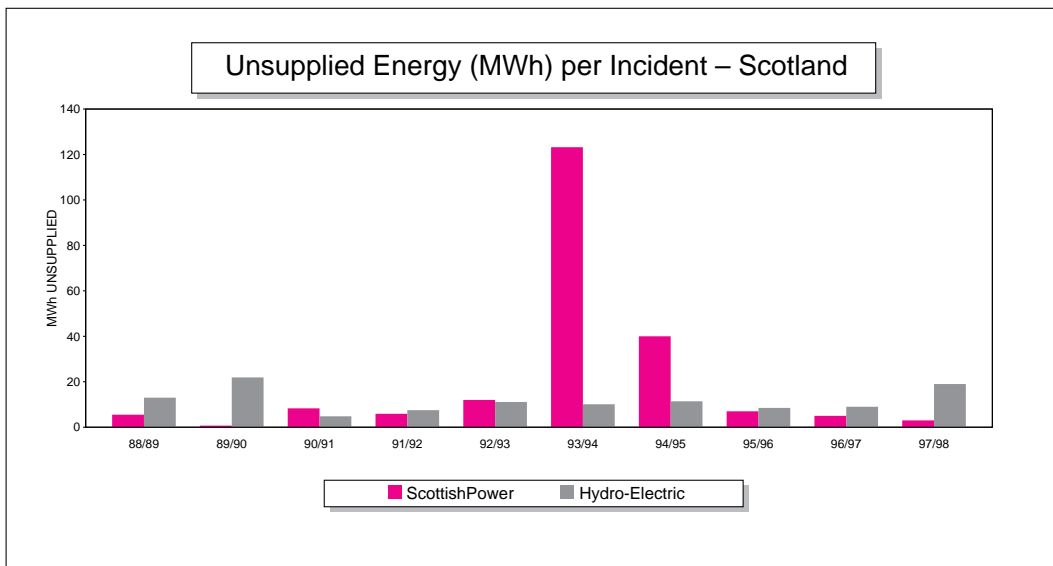
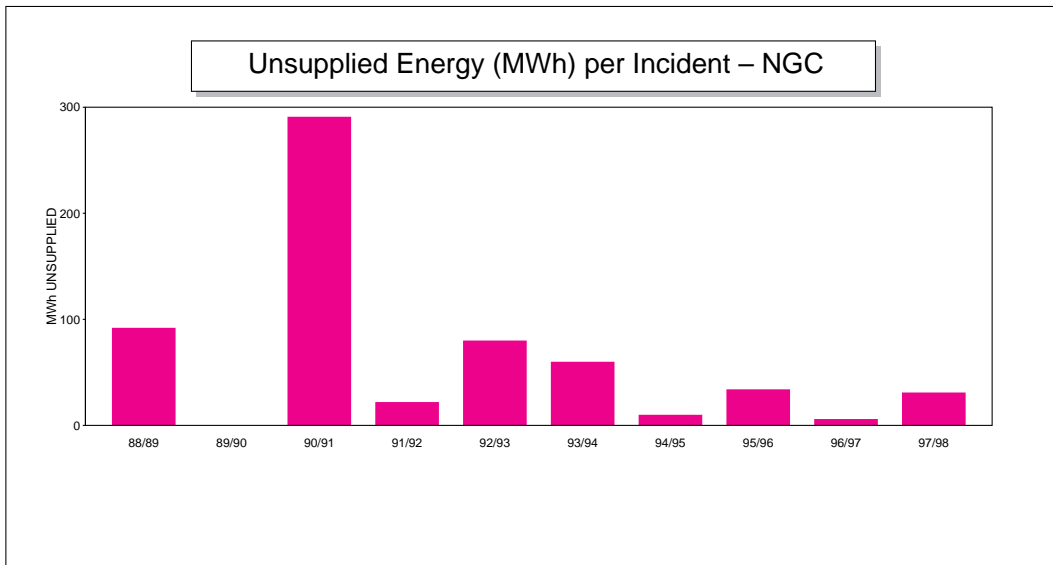


**FIGURE 16 INCIDENTS PER YEAR** shows the number of incidents when there was a loss of supply to one or more customers because of faults on the transmission system.

NGC reported the equal highest number of such incidents (14) in the last 10 years. NGC said that, of the 14 incidents reported, eight of the incidents were due to lightning and five incidents were due to connection arrangements chosen by customers at single customer sites, customer system configuration or faults on other adjacent systems.

ScottishPower and Hydro-Electric reported fewer incidents (six and eight, respectively) than in recent years.





FIGURES 17 & 18 UNSUPPLIED ENERGY PER INCIDENT display the average amount of energy that is not supplied for the incidents recorded in Figure 16. The unsupplied energy per incident is generally higher in England and Wales than in Scotland, primarily reflecting the differences in load density.

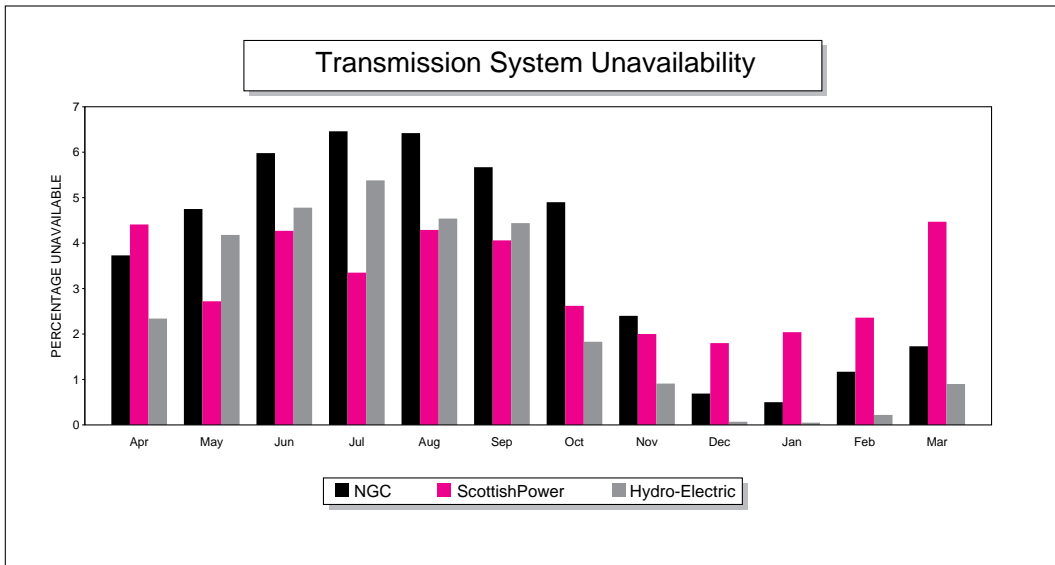
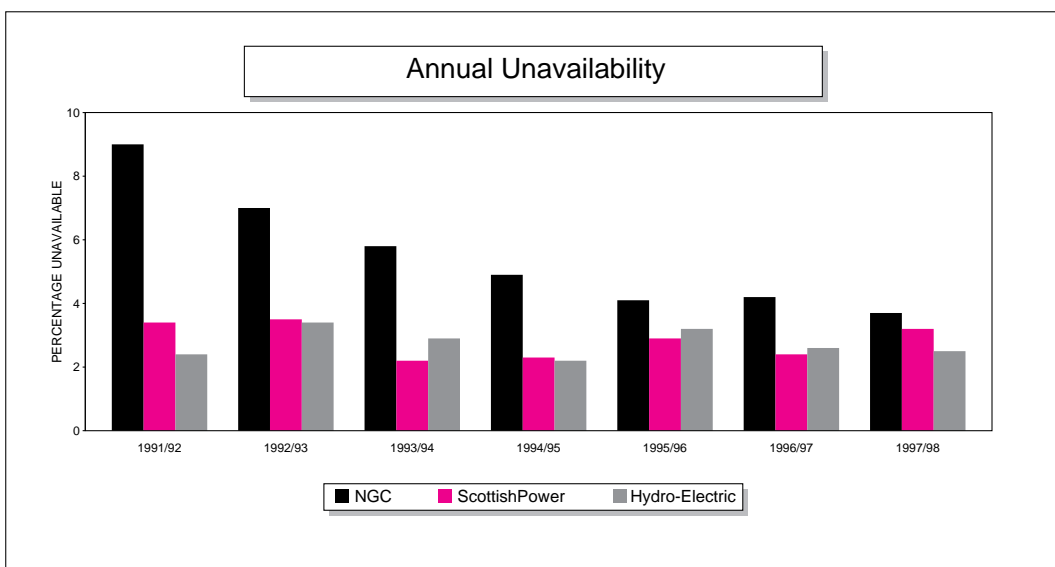
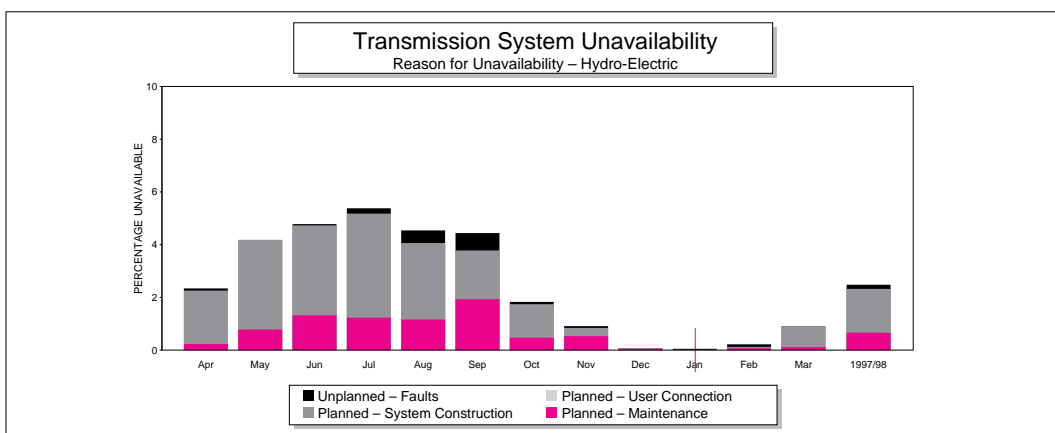
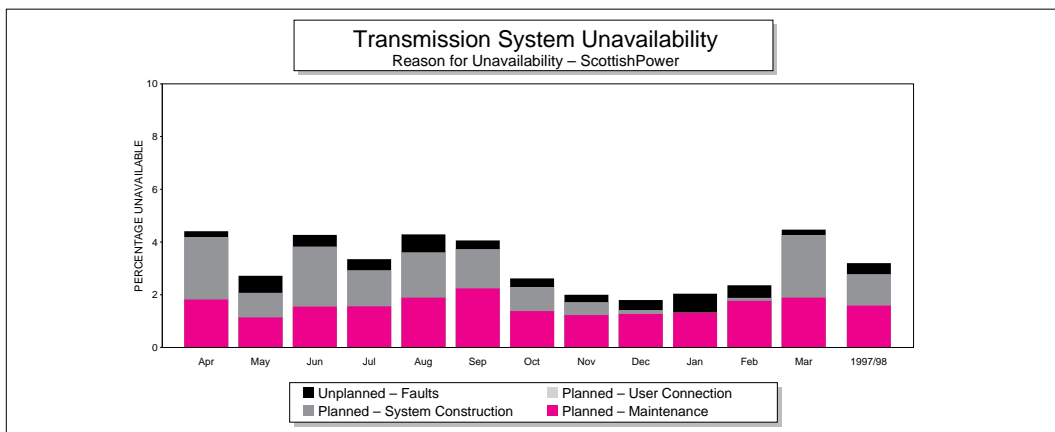
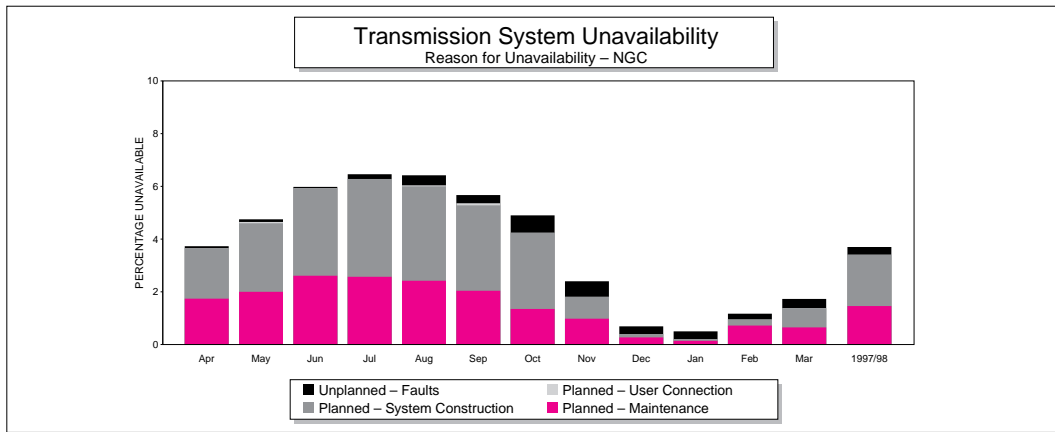


FIGURE 19 TRANSMISSION SYSTEM UNAVAILABILITY shows the monthly pattern of the time for which transmission circuits are out of service. The highest unavailabilities occur during maintenance work, which is generally scheduled for the summer when overall electricity demand is at its lowest.

Trends of annual unavailability are shown in Figure 20 below. NGC's unavailability has fallen in recent years, but remains higher than that of the two Scottish companies. NGC has said that its initiative to reduce transmission uplift is reducing annual unavailability through the better planning of system outages.





FIGURES 21 TO 23 REASONS FOR TRANSMISSION UNAVAILABILITY show the monthly unavailability for the transmission companies. These are categorised as follows:

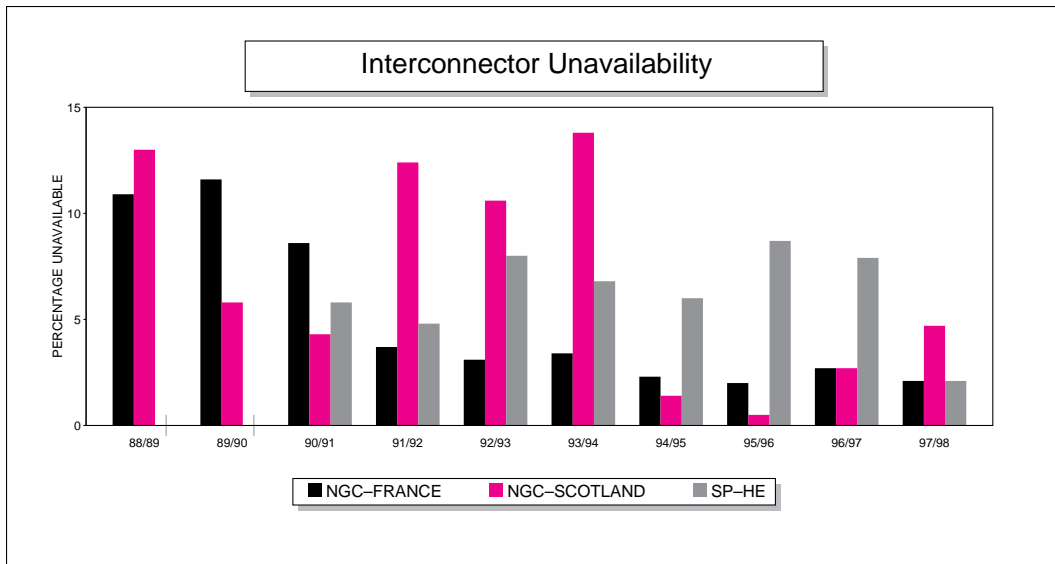
Transmission system **Maintenance**

Transmission **System Construction**

**User connection** to the transmission system (i.e. work on assets dedicated to one user)

Transmission system **Faults**

Most of the unavailability results from factors which are planned and are within companies' control, and these causes of unavailability are reduced during the winter months.



**FIGURE 24 INTERCONNECTOR UNAVAILABILITIES** presents the levels of unavailability of the transmission system interconnectors at the geographic boundaries of the three transmission systems. The unavailability of the interconnector between England and Scotland was higher in 1997/98 than in the previous three years. The unavailability of the links between the two Scottish companies was at its lowest since recording began in 1990/91.

## Standards of Supply Quality

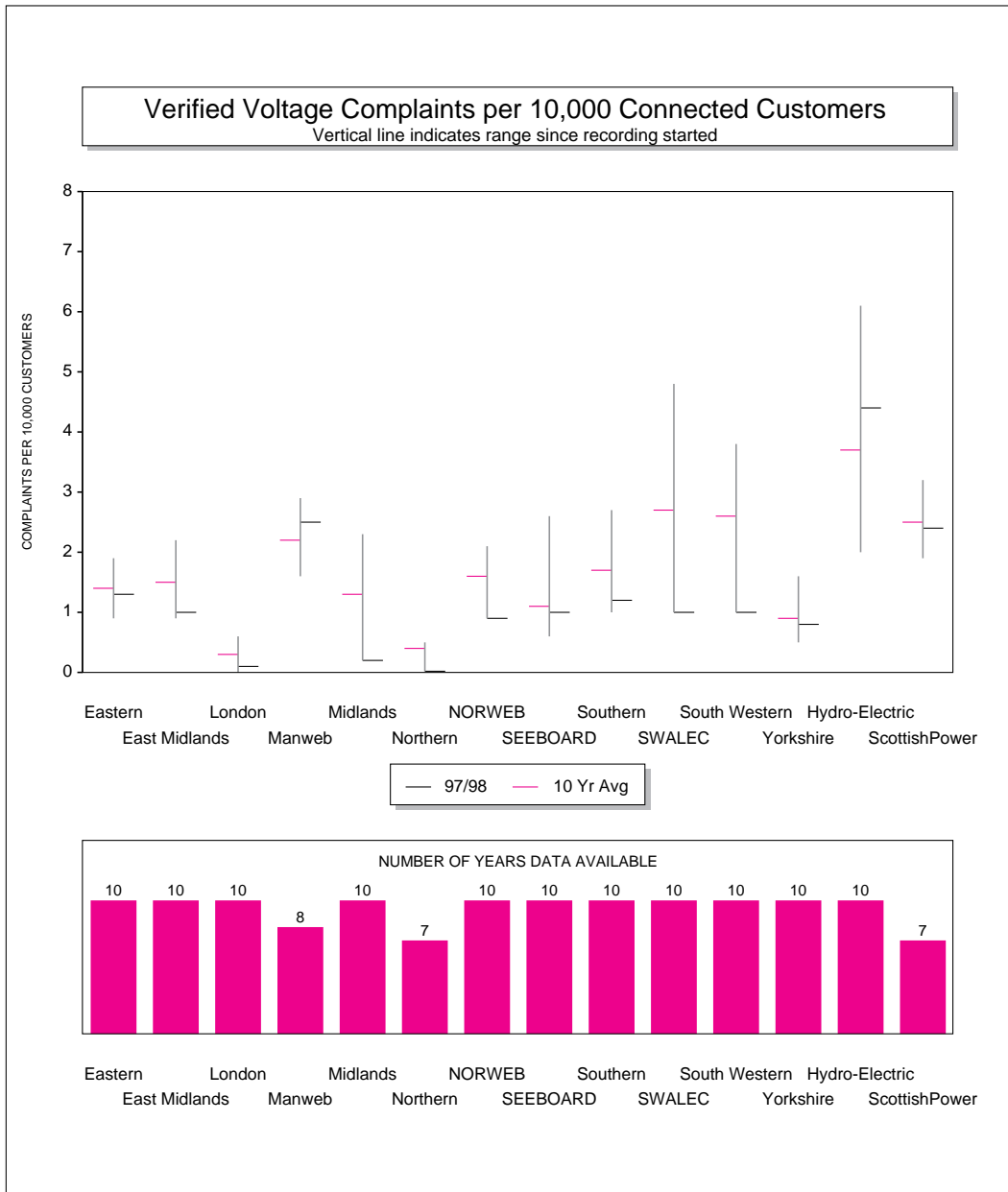
### FREQUENCY

The electricity system in Britain is interconnected and all customers experience a common frequency. NGC is responsible for keeping system frequency within the statutory limits of  $\pm 1$  per cent. NGC reported that there were no frequency excursions outside statutory limits during 1997/98.

### TRANSMISSION SYSTEM VOLTAGE

Transmission system voltages must comply with limits of variation set out in the Electricity Supply Regulations and Grid Codes. NGC reported two occasions when voltages went outside prescribed limits in 1997/98. Hydro-Electric reported one such voltage excursion.

## Distribution System Voltages



**FIGURE 25 - VERIFIED VOLTAGE COMPLAINTS** Companies reported the number of voltage complaints which they received during the year and which resulted from supply voltages being outside the statutory limits. Not all companies have statistics going back for the previous 10 years. MIDLANDS, Northern, Norweb, SWALEC and South Western each reported their best year.

From 1 January 1995, the nominal supply voltage in Britain changed from 240V +/- 6 per cent to 230V, +10 per cent, -6 per cent, that is, the permitted voltage range changes from 225.6V-254.4V to 216.2V-253V.

## DISTRIBUTION SYSTEMS QUALITY OF SUPPLY

As mentioned earlier, the Companies produce annual Quality of Supply reports which include their own targets for improved performance and details of actual capital expenditure compared with OFFER's assumptions made at the price control review.

## DISTRIBUTION SYSTEMS QUALITY OF SUPPLY TARGETS

The tables below show summaries of company targets for improvements in numbers of supply interruptions and numbers of customer minutes lost. Individual companies' Quality of Supply reports contain fuller details of company objectives and also describe how companies intend to improve quality of supply for their worst-served customers.

## Security Targets

### Number of interruptions per 100 Customers

	94/95 number of interruptions per 100 customers	Company year 2000 targets	
		Percentage reduction from 94/95 level	1999/2000 number of interruptions per 100 customers
Eastern	65	15%	55
East Midlands	96	10%	86
London	40	25%	30
Manweb	70	29%	50
Midlands	121	10%	109
Northern	89	At least 5%	At most 85
NORWEB	70	10%	63
SEEBOARD	91	10%	82
Southern	75	20%	60
SWALEC	220	14%	189
South Western	124	30%	87
Yorkshire	85	10%	77
Hydro-Electric	176	8%	162
ScottishPower	61	26%	45

## Availability Targets

### Customer Minutes Lost per Connected Customer

	94/95 number of customer minutes lost per connected customer	Company year 2000 targets	
		Percentage reduction from 94/95 level	1999/2000 number of customer minutes lost per connected customer
Eastern	94	30%	66
East Midlands	105	20%	84
London	58	30%	41
Manweb	102	30%	71
Midlands	128	33%	86
Northern	95	Up to 5%	Between 90 and 95
NORWEB	70	10%	63
SEEBOARD	83	17%	69
Southern	78	20%	62
SWALEC	160 (Faults only*)	15%	136 (Faults only*)
South Western	133	30%	93
Yorkshire	69	10%	62
Hydro-Electric	233	15%	198
ScottishPower	70	20%	56

\* Excluding planned interruptions



## Distribution Companies' Network Data

To assist in the evaluation of distribution system performance statistics the table below sets out details of the networks of the distribution companies as at 31 March 1998 (customer numbers are as at 30 September 1997).

COMPANY	Area sqkm	Customers ( '000s)	Overhead (Circuit km)	Underground (Circuit km)	Transformers Number	In Commission Aggregate Capacity (MVA)
Eastern	20,300	3,258	35,382	53,921	62,340	38,295
East Midlands	16,000	2,300	24,239	43,318	39,391	31,922
London	665	1,982	39	29,956	13,273	20,066
Manweb	12,200	1,382	21,532	23,591	41,488	17,005
Midlands	13,300	2,250	25,552	37,716	48,434	24,478
Northern	14,400	1,442	17,193	26,367	22,731	12,689
NORWEB	12,500	2,202	13,937	44,876	31,796	30,598
SEEBOARD	8,200	2,108	12,310	32,261	31,982	23,741
Southern	16,900	2,647	28,113	43,342	52,539	42,744
SWALEC	11,800	980	18,651	13,878	38,731	12,082
South Western	14,400	1,323	32,242	18,824	48,811	19,287
Yorkshire	10,700	2,073	15,890	39,053	31,448	30,173
Hydro-Electric	54,390	640	30,407	13,955	47,512	10,027
ScottishPower	22,950	1,860	24,300	39,644	38,538	22,752
TOTAL	228,705	26,447	299,787	460,702	549,014	335,859

## Further Information

This report is a summary of the information provided by the distribution and transmission system licensees. In some cases, companies chose to submit commentaries and explanations in support of their figures.

Copies of the reports submitted by the companies are available at cost from the OFFER library, Hagley House, Hagley Road, Edgbaston, Birmingham, B16 8QG.

The data given by the companies and used in this report is also available at cost on 3.5" floppy disk (DOS or Macintosh format) in Lotus 1-2-3 spreadsheet format (WK3) suitable for further analysis. Requests should be directed to the OFFER library.

Details may also be obtained from each reporting company.