Information and Incentives Project

Audit of Incident Reporting 2002/03

Final Report

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Information and Incentives Project

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Figures

Plates - None

Drawings - None

Glossary

BPI	British Power International
CI	Customer Interruptions per 100 connected customers
CML	Customer Minutes Lost per connected customer
DNO	Distribution Network Operator
EME	Eastern Midlands Electricity Distribution
ENMAC	Energy Network Management and Control System
EPN	EDF Energy Networks (EPN) plc
GIS	Geographical Information System
HV	High Voltage
IIP	Information and Incentives Project
IT	Information Technology
LPN	EDF Energy Networks (LPN) plc
LV	Low Voltage
MPAN	Metering Point Administration Number
MPAS	Metering Point Administration System
NEDL	Northern Electric Distribution Limited
Ofgem	Office of Gas and Electricity Markets
PC-NaFIRS	National Fault and Interruptions Reporting Scheme
RIGs	Regulatory Instructions and Guidance
SCADA	Supervisory Control and Data Acquisition
SP	Scottish Power Transmission and Distribution plc
SPN	EDF Energy Networks (SPN) plc
SSE	Scottish & Southern Energy
UU	United Utilities

WPD Western Power Distribution

YEDL Yorkshire Electricity Distribution Limited

Note, within this document:

The term "higher voltage" is used to indicate all voltages greater than 1kV up to and including 132 kV.

The term "licensed area" is used, where necessary, to indicate the geographical area under consideration and to differentiate between areas in those situations where a parent company holds more than one distribution licence.

The calculations of Customers Interrupted (CI) and Customer Minutes Lost (CML) within this document are based on the formulae contained in the RIGs to reflect the CI and CML generated by the actual incidents being audited. They are as follows:

CI **the number of interruptions to supply generated by the incidents being audited** – the number of customers interrupted per 100 connected customers generated by the incidents being audited. It is calculated as:

$$\frac{\text{The sum of the number of customers interrupted for incidents being audited * 100}}{\text{The total number of connected customers}}$$

CML **the duration of interruptions to supply generated by the incidents being audited** – the number of customer minutes lost per connected customer generated by the incidents being audited. It is calculated as:

$$\frac{\text{The sum of the customers minutes lost for all restoration stages for incidents being audited}}{\text{The total number of connected customers}}$$

Where the total number of connected customers is as declared at 30th September during the relevant reporting year.

Summary

Overview

During 2001, Mott MacDonald Limited and British Power International, supported by ERA Technology (the Consortium), were commissioned by the Office of Gas and Electricity Markets (Ofgem) to develop a framework for auditing the incident reporting systems used by the Distribution Network Operators (DNOs) under the Information and Incentives Project (IIP).

At the time of contract award, it was envisaged that the Consortium's contract would extend over a period of 3 years. A significant amount of development work by the DNOs has taken place over the past 2 years, with Ofgem providing guidance and direction where appropriate. Development of incident reporting has taken place using a collaborative approach between Ofgem and the DNOs, with the Consortium providing technical and analytical support on Ofgem's behalf as required.

The purpose of the report is to summarise the work carried out and results obtained by the Consortium for the audit of incident reporting for the period 1st April 2002 to 31st March 2003. The purpose of the audit was to determine the accuracy of each DNO's incident reporting systems.

The minimum levels of accuracy that each DNO's incident reporting system is required to meet is set out in Section 5.3 of the Information and Incentives Project, Regulatory Instructions and Guidance, Version 2, dated March 2002 (RIGs). The latest version of the RIGs (Version 3) has been published by Ofgem in November 2003, however given the audit covers the period 1 May 2002 to 30 April 2003, the audit was carried in relation to RIGs Version 2.

The minimum levels of accuracy are:

Table 1: Minimum levels of Reporting Accuracy

	Minimum Level of Accuracy for LV System Interruptions (%)	Minimum Overall Level of Accuracy (%)
Customer Interruptions (CI)	90	95
Customer Minutes Lost (CML)	90	95

DNOs are also required to provide estimates of the accuracy with which they report short interruptions. As there are currently no minimum accuracy levels, their statements on the methods used to measure short interruptions and how the accuracy levels are calculated have been assessed. The IIP auditors are required to provide an assessment on the reasonableness of the estimates and whether they have been achieved.

The RIGs also require reporting of information on the speed of telephone response but do not provide any guidance as to the minimum requirements for accuracy.

Methodology

Given the time available to audit each DNO's reporting system, it was determined that no more than 200 incident restoration stages could be audited. The number of incidents and therefore restoration stages on each of the DNOs' systems is significantly greater than 200. Unlike previous years the DNOs were required to provide data at the incident restoration stage level. This resulted in a significant increase in the amount of information provided by the DNOs. There was therefore a requirement to select the 200 incident restoration stages to be audited by sampling the data provided and selecting 200 incident restoration stages that best represented the overall data provided.

It is important that the sample is representative if the reporting accuracy assessed for the audited sample is to be used as the estimate of accuracy for the full data set

Analysis of the differences between the reported and audited CI and CML indicated that these were normally distributed and symmetrical about the mean. This result is in line with what would be expected under the Central Limit Theory. It was therefore concluded that the Stage 3 accuracy could be determined based on a simple summation of the reported and audited CI and CML.

A review of reported and audited CI and CML results indicated that each DNO had outlying results. These outlying results were removed from the assessment of Stage 3 accuracy for each DNO.

The Combined accuracy of Stages 1 and 3 was obtained by adding the square of the system inaccuracy (Stage 1) to the square of the audit inaccuracy (Stage 3) and then calculating the square root of the resulting sum.

Audit Results

All audit visits were undertaken within the agreed time scale. Every DNO was well prepared for the visit and provided an appropriate level of support. Company specific reports have been prepared by the visiting auditors for each DNO.

Measurement of MPAN accuracy is either at or approaching 100%.

All DNOs are filling in the IIP templates to an acceptable level of accuracy.

The main area of concern with regard to compliance with RIG definitions is related to re-interruptions. There are a number of examples where the RIGs are being interpreted inconsistently. DNOs have previously raised the issue of stopping the clock when a customer asks for a delayed restoration of supply or there are circumstances outside the control of the DNO delaying restoration work.

It is recommended that NEDL review its change in the reporting of Pre-Arranged Interruption overruns as the change now means that its reporting is inconsistent with the requirements of section 2.15 of the RIGs

The DNOs have continued to improve the accuracy of their connectivity models and there is evidence that they are following the recommendations made during the 2001/2002 audit. There are still however, differing levels of system automation between DNOs. The lowest estimate of accuracy of a connectivity model was 93.0% made by EPN. Approximately 50% of the DNOs reporting LV connectivity model accuracy in excess of 98% and over 70% reporting similar accuracies for HV connectivity.

There are number of different sources of inaccuracies in the audit models. Some of these are specific to individual DNOs, whereas others are common to a number of DNOs. The common areas of inaccuracy relate to higher voltage incidents and include:

- Changes to customer numbers between the date of the incident and the audit.
- Network reconfigurations between the date of the incident and the model at the time of the audit.
- Manual mis-reporting and transcription error.

Although no analysis has been carried out into which of the above areas contributes the most to inaccuracy, manual reporting and transcription have resulted in significant errors being introduced.

All DNOs except for EME have met the minimum reporting accuracy requirements specified in the RIGs. EME has a reporting accuracy level of 84.3% as a result of over reporting LV CML.

The reporting accuracy results contained in the this report have been reviewed by the relevant DNOs and they have confirmed that they are content to accept these as an assessment of its reporting accuracy, as determined by the methodology outlined in this report. However, it should not be concluded from this confirmation that the DNOs necessarily agree with the methodology or that they will not in the future propose amendments to the methodology.

Short Interruptions

There is significant variation in the accuracy of reporting short interruptions between DNOs. Some DNOs do not measure short interruption reporting accuracy whilst others have provided estimates of accuracy in excess of 90%.

Significant inaccuracies are introduced due to lack of automation of recording device operation. Inaccuracies also occur due to inability to read data, operational constraints in reading data and poor data recording. Inaccuracy has the potential to occur at any point where manual handling of data is required.

General Recommendations

Based on the above conclusions the following general recommendations are made by the Consortium:

- Ofgem should consider providing clarity with regards to reporting of re-interruptions.
- Further consideration should be given to specifying what is acceptable evidence for audit purposes.
- Consideration should be given to introducing minimum reporting accuracy requirements for short interruptions, but should take into account the effort required by most DNOs to collect complete data.

Learning Points

The following learning points have been noted by the Consortium:

The audit visits are facilitated by allowing the DNOs sufficient time for preparation.

Several DNOs expressed concern about the way in which changes to customer population and networks between the time of the incident and the audit are handled.

One DNO considers that some of the questions in the questionnaires are repetitive and that refinement and consolidation of the questionnaires could occur. In addition it is urged that finalised questionnaires are circulated as early as possible and that where changes occur to questionnaires after the audits begin that these too are distributed to improve the efficiency of the audit process and reduce the potential for confusion.

With regard to the audit samples there were an unexpectedly high number of zero customer impact restoration stages. Since the purpose of the audit is to address CI and CML reporting accuracy, there seems to be little value in having a high proportion of these in the samples.

The use of restoration stages as the basis of the audit also highlighted further issues with the sample. For example, in several cases, the use of more than one stage from an incident, clarity in selecting the stage within the incident and the impact of the other stages on the audited stage.

No spare LV incidents were provided for the audit. There seems to be no reason why spares should not be provided as in the case of HV incidents.

Numerical reference numbers used do not define the difference between LV, HV and EHV and makes the analysis of the worksheet and sorting difficult, consequently large data files had to be transferred back and forth.

Due to lack of clarity in the data requests, some of the data sets contained short interruptions, i.e., interruptions less than 3 minutes in duration, which are outside the scope of the main audit. The data sets containing short interruptions had to be cleansed prior to analysis.

The LV worksheets of the audit workbooks were not completed by the audit teams in a uniform manner, which suggests that more detailed training of auditors in this area is required.

Data on recording system accuracy is contained in the audit team report and not in the audit workbook. Delays have been experienced in obtaining this data, causing a delay in calculating the combined or overall accuracy. It would save time if the system accuracy information was included in the audit workbook produced for each DNO.

1 Introduction

1.1 Background

During 2001, Mott MacDonald Limited and British Power International Limited, supported by ERA Technology (the Consortium), were commissioned by the Office of Gas and Electricity Markets (Ofgem) to develop a framework for auditing the incident reporting systems used by the Distribution Network Operators (DNOs) under the Information and Incentives Project (IIP).

At the time of contract award, it was envisaged that the Consortium's contract would extend over a period of 3 years. A significant amount of development work by the DNOs has taken place over the past 2 years, with Ofgem providing guidance and direction where appropriate. Development of incident reporting has taken place using a collaborative approach between Ofgem and the DNOs, with the Consortium providing technical and analytical support on Ofgem's behalf as required.

This report summarises the work carried out and the results obtained during the third year of the IIP. The IIP is designed to strengthen the incentives on DNOs to deliver the appropriate quality of service to customers.

The Regulatory Instructions and Guidance (RIGs) sets out detailed definitions and guidance for reporting requirements that the DNOs are expected to meet. The latest version (version 3) was published by Ofgem in November 2003. However, since the audit covers the period 1 May 2002 to 30 April 2003, the audit was carried out with reference to Version 2, dated March 2002. The RIGs provide a framework for the collection and provision of accurate and consistent data across the distribution businesses.

The required scope of the information to be reported under the IIP includes the following:

- the number of interruptions to supply per year
- the duration of interruptions to supply per year
- the number of short interruptions to supply per year
- the speed of telephone response
- customer contact details to facilitate a customer survey of the quality of telephone response.

Ofgem has specified minimum levels of accuracy for the information reported on interruptions of three minutes or longer. These minimum levels are detailed in Table 1-1. DNOs are required to meet both the overall and Low Voltage (LV) minimum levels of accuracy to comply with the IIP licence conditions. The target includes service cables supplying properties. Overall accuracy includes all voltage levels.

Table 1-1: Minimum Levels of Reporting Accuracy Specified by Ofgem

	Minimum Level of Accuracy for LV System Interruptions (%)	Minimum Overall Level of Accuracy (%)
Customer Interruptions (CI)	90	95
Customer Minutes Lost (CML)	90	95

There are currently no minimum requirements regarding accuracy of reporting short interruptions but DNOs are required to submit an assessment of accuracy. Their statements on the method used to measure short interruptions and how the accuracy levels are calculated have therefore been assessed. The visiting auditors have provided an assessment of the reasonableness of the estimates and whether they have been achieved.

The RIGs also require reporting of the speed of telephone response but do not provide any guidance as to the minimum requirements for accuracy

1.2 Aims of Incident Auditing

The audit of the DNOs' measurement systems and reporting for 2002/3 took place during the period July to August 2003. This audit had three main aims:

- to provide information to Ofgem and feedback to the DNOs on the progress companies are making in implementing their measurement systems and their reporting of IIP information to Ofgem
- to determine the overall accuracy of the DNO's measurement system, to enable the appropriate incentives to be applied by Ofgem
- to gather learning points and propose modifications to the audit framework and the RIGs to be used in subsequent years.

1.3 Scope of Work

1.3.1 Accuracy of Incident Reporting

As previously mentioned, the 2002/2003 audits represent the third year of the IIP. During the first two years a significant amount of development work was undertaken. As in previous years, the Consortium has worked closely with Ofgem and the DNOs in further developing the audit framework since the 2001/2002 audit. In parallel, the DNOs have also been developing their reporting systems with a view to increasing accuracy.

The following approach was adopted for the 2002/2003 audit:

- Stage 1: audit of the measurement systems. This focused on assessing the potential accuracy of DNOs' measurement systems by looking at the way in which companies have counted customers in their connectivity model and the underlying assumptions that companies have used to link customer information to the network model.
- Stage 2: statistical analysis. This involved statistical analysis of the DNOs' data for the number and duration of interruptions to obtain appropriate samples to be used in the final stage of the audit framework.
- Stage 3: audit of incident reporting. This final stage of the audit framework entailed a visit to all of the DNOs to assess the accuracy of the sample data. This stage also includes the calculation of DNO measurement system accuracy.

A report was prepared for each audit visit, discussing the accuracy of the various systems and the accuracy of incident reporting highlighted by the Stage 3 auditing of incident reports. The company-specific reports are included as appendices to this report. A summary of the accuracy results for Stage 1 and Stage 3 is presented in Section 3 of this report.

1.3.2 Accuracy of Reporting Short Interruptions

The RIGs do not specify the minimum level of accuracy for reporting short interruptions, but DNOs are required to submit an assessment of accuracy. Their statements on the method used to measure short interruptions and how estimated levels of accuracy are calculated have therefore been assessed. In order to facilitate this assessment a questionnaire together with guidelines for completion were developed in conjunction with Ofgem and were designed to enable DNOs to provide the necessary information. This questionnaire and its associated guidelines are shown in Appendix B.

The assessment of accuracy of DNO's estimates of short interruptions has been determined using the responses to the questionnaire and also by holding discussions with the companies during the audit visits.

Where appropriate, the Consortium also provided learning points that would result in more accurate short interruption data being available in the future.

1.4 Report Structure

This report is structured as follows:

- Section 2 explains the methodology applied for each stage of the audit providing details of the procedures, standard forms, questionnaires and workbooks that were used in order to provide consistency between audit teams and audit visits.
- Section 3 contains a summary of the key findings from the audit visits including analysis of the numerical results.
- Section 4 summarises the audit findings into the way in which the DNOs report short interruptions and the reporting accuracy.
- Section 5 contains a summary of the main recommendations that resulted from the completion of the audits. It also contains feedback on any key observations regarding the RIGs.
- Section 6 contains general and DNO specific learning points from the audits and proposes modifications to the audit framework for Ofgem's consideration.
- Appendices containing the questionnaires and guidelines, combined accuracy results and the fourteen DNO specific reports. These describe the findings relating to the measurement and reporting systems in place at each of the DNOs.

2 Methodology

2.1 Overview

In line with Ofgem's requirements, the Consortium has developed the methodology to determine reporting accuracy using a collaborative approach which has sought to ensure that the relevant parties have had the opportunity to contribute to the process to the extent which they deemed appropriate. The DNOs have been supportive of the process and have provided data in a timely manner.

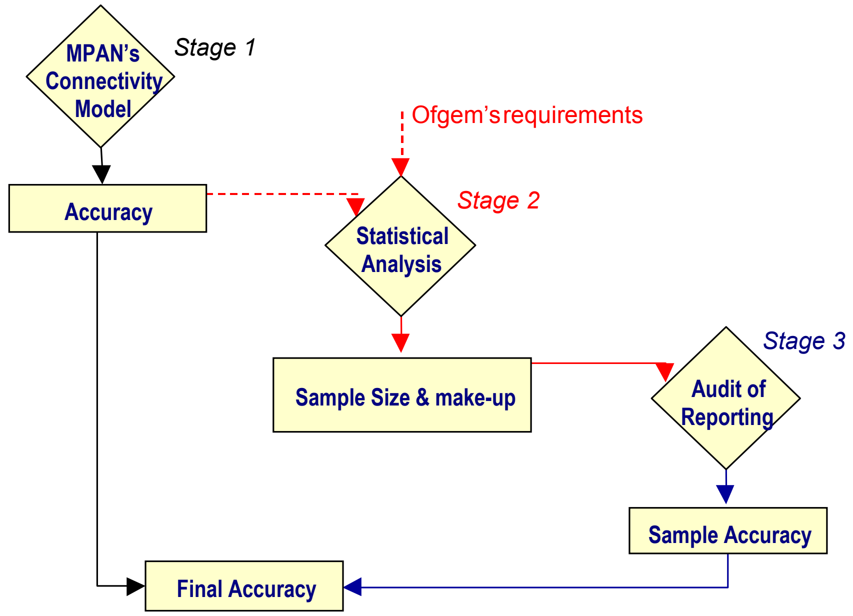
The development of the methodology has been based on lessons learned during the 2001/2002 audit, a workshop attended by DNOs, Ofgem and the Consortium, further analytical work carried out by the Consortium and guidance provided by Ofgem.

In general terms, reporting accuracy has been determined using the following steps:

- Issue of questionnaires and guidance for completing such questionnaires.
- Sampling of incidents to be reviewed and issuing list of these incidents to the DNOs.
- On-site visits to DNOs by auditors.
- Completion of draft audit reports for each DNO for comment on factual accuracy and content by DNOs.
- Determination of Stage 1 accuracy.
- Determination of Stage 3 accuracy.
- Determination of overall measurement accuracy.
- Completion of final audit reports which are contained in Appendix E to Appendix R of this report.

The framework for auditing incident reporting accuracy is the same as that developed for the 2001/2002 audit. There are, however, some differences, notably the fact that the data now used is at the restoration stage level. The framework is shown diagrammatically in Figure 2-1 below.

Figure 2-1: Audit Framework



2.2 Stage 1: Accuracy of Measurement System

2.2.1 Questionnaires

In preparation for the site visits each DNO was sent questionnaires that formed the basis of the audit. These questionnaires were developed in conjunction with Ofgem using experience gained during the 2001/2002 audit. In addition, guidelines for completing the questionnaires were provided to enable the DNOs to gain a detailed understanding of the information required. The DNOs were free to pre-populate the questionnaire if they chose.

There were three questionnaires issued. These are contained together with their associated guidelines in Appendix B. The areas covered by the questionnaires are:

(i) Changes and Updates to Measurement Systems since the 2002 audit

The purpose of this questionnaire was to determine what changes to the measurement system had been made since the 2001/2002 audit. The 2001/2002 audit made a series of recommendations regarding improvements and the questionnaire was designed to establish to what extent these had been implemented. In addition, the questionnaire was designed to ensure that any major changes to the measurement systems were detailed. These included changes to the interpretation of the RIGs, changes in the way that MPAN numbers were determined, changes to the connectivity model and the DNO's view of changes to MPAN count, HV incident and LV incident reporting accuracies.

(ii) Accuracy of Connectivity Models

The aim of this questionnaire was to provide details as to how the connectivity model was developed and verified. The questionnaire required DNOs to provide details as to errors and inconsistencies contained in the model and how any inaccuracies were accounted for when determining connectivity model accuracy.

(iii) Short Interruptions

The 2001/2002 audit did not assess short interruptions measurement accuracy. This questionnaire was therefore developed with a view to determining how a DNO captured short interruption data as part of its measuring systems, what the DNO's view was of its accuracy of measuring short interruptions, anticipated future changes and RIG compliance.

Of particular importance regarding short interruptions is the extent to which reclosing devices are used and how operation of these are recorded and reported in the measurement system. The questionnaire therefore addressed these issues and required the DNOs to provide data on reclosing device operation.

2.2.2 DNO Responses to Questionnaires

Having been issued with the questionnaires, DNOs could then pre-populate these with their responses. Not every DNO chose to pre-populate the questionnaires with some choosing to complete these as part of the Stage 3 audit visit.

Reviewing the questionnaires formed a key part of the Stage 3 audit visits and allowed the visiting auditors to form a view on the DNOs' assessment of measurement system accuracy.

2.3 Stage 2 Statistical Analysis

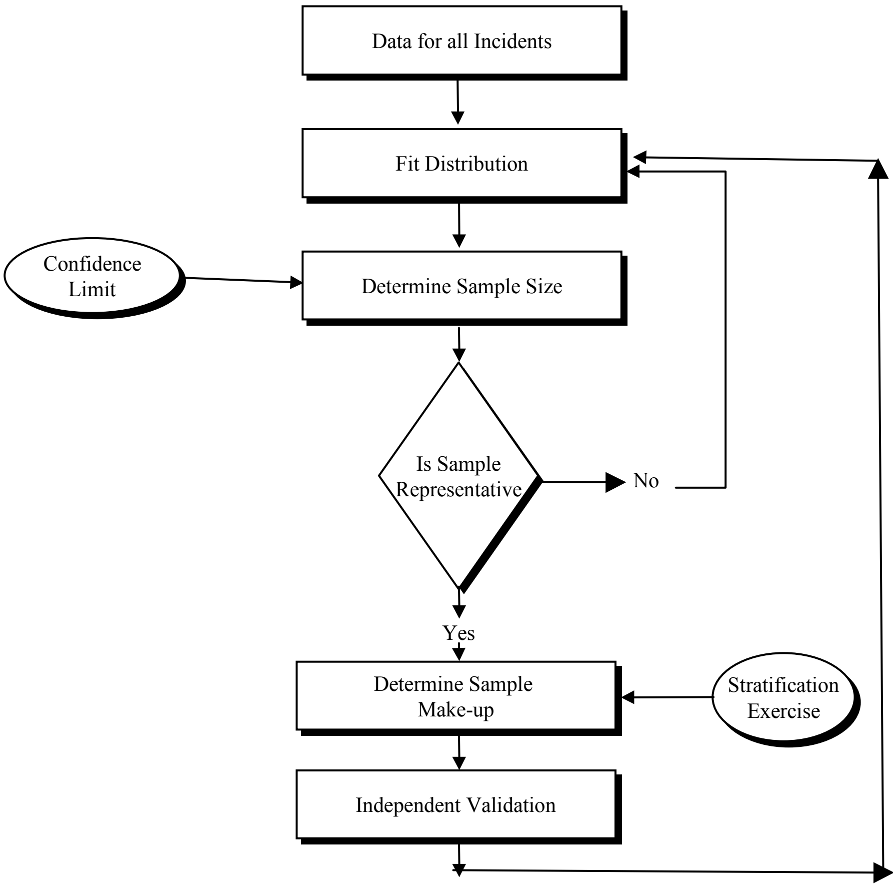
The aims of this stage of the audit framework are associated with determining the most appropriate statistical distribution for incident data and the sample size to be audited at Stage 3 of the audit framework.

The approach involved the following steps:

- gathering incident information from the companies
- analysis of the data to determine the statistical distribution that best describes it
- work to obtain a representative sample size
- study of the stratification of the sample
- independent validation of the approach.

These steps are summarised in Figure 2-2. The data regarding incidents was received from the companies and the statistical analysis completed prior to the audits.

Figure 2-2: Methodology



Each company was provided with a list of the restoration stages at both LV and the higher voltages, which would be required to be audited during the audit visit. The list also included a number of 'spare' restoration stages at the higher voltages that were to be used if any of the others proved to be too complex to assess during the audit.

2.3.1 Assessment of Statistical Distribution

The methodology was developed using data supplied from a DNO with two licensed areas.

For both licensed areas the incidents for April 2002 to March 2003 were requested in a different form than in the 2001/2002 audit. A spreadsheet was provided to the DNO in which each restoration stage of every incident was required to be inputted in a separate row. The information provided was therefore available at the restoration stage level rather the overall incident level which was used in the 2001/2002 audit.

An inspection of the data provided an indication that the distribution of results did not conform to a normal distribution commonly seen in statistical analysis. Further analysis, which is set out in Appendix A, suggested that a log-normal distribution was more appropriate.

2.3.2 Sample Stratification

From the work carried out in preparation for the 2002 audit, a number of factors were considered with regard to stratifying the sample. The main factors of statistical significance were voltage and whether low voltage incidents occurred on overhead line or underground cables. Also there was concern over the high number of low voltage incidents in the sample. The analysis discussed in Section 2.3.1 using a "lognormal" approach has indicated that sampling by voltage level is required.

In order to reflect the effect of voltages on CI, the overall sample for each DNO was stratified by calculating the total number of CI generated at each voltage level and then determining the fraction of the total CI that this represents at each voltage level. An example of this for EPN is shown in Table 2-1.

Table 2-1: Fraction of total CI by voltage for EPN

Voltage	Total CI	Total CML	Fraction CI	Number in sample	Number of restoration stages
LV	335533	140839963	0.0883	10	20034
11 kV	2901039	501364948	0.7639	84	14044
33 kV	459940	25386163	0.1211	13	638
132 kV	101236	2778979	0.0267	3	60

For each DNO the data was examined to establish whether voltage was a significant factor. The procedure described above was then used to stratify the overall sample.

A summary of the sample make–up for the overall sample of each DNO is shown in Table 2-2.

Table 2-2: Summary of Sample Make-Up

Licensed area	LV	6.6kV	11kV	20kV	33kV	66kV	132kV
SSE – Southern Electric	12%	-	72%	-	10%	-	6%
WPD South Wales	22%	-	77%	-	-	-	1%
WPD South West	15%	-	64%	-	16%	-	5%
SSE – Scottish Hydro	9%	-	63%	-	23%	-	5%
Aquila	14%	-	77%	-	-	-	9%
UU*	None	-	87%	-	2%	-	11%
LPN	31%	-	52%	-	9%	-	8%
NEDL	14%	-	35%	29%	1%	16%	5%
EME	10%	1%	80%	-	5%	-	4%
SPN	8%	4%	79%	-	3%	-	6%
SP Distribution	9%	-	71%	-	15%	-	5%
EPN	9%	-	76%	-	12%	-	3%
SP Manweb	13%	-	72%	-	12%	-	3%
YEDL	20%	-	75%	-	2%	-	3%

* No LV in overall sample for UU.

2.3.3 Sample size

Sample sizes were established for both CI and CML at both 90% and 95% confidence limits for each licensed area. The results of this exercise are given in Table 2-3. Both 90% and 95% confidence limits gave the same sample size in each case, so the more statistically robust 95% confidence limit was used in this year's audit.

Table 2-3: Sample Size Based on CI and CML for All Licence Areas

		Number of incident restoration stages	
Licensed Area		**Sample size based on CI**	**Sample size based on CML**
Aquila	Overall	110	110
	Low voltage	110	120
EME	Overall	100	100
	Low voltage	110	130
EPN	Overall	110	110
	Low voltage	90	100
LPN	Overall	90	100
	Low voltage	100	90
NEDL	Overall	110	110
	Low voltage	90	90
SPN	Overall	100	100
	Low voltage	100	90
SP Distribution	Overall	110	110
	Low voltage	110	110
SP Manweb	Overall	100	110
	Low voltage	100	120
SSE- Scottish Hydro	Overall	120	130
	Low voltage	110	110
SSE –Southern Electric	Overall	100	100
	Low voltage	110	100
United Utilities	Greater than LV	100	100
	Low voltage	90	130
WPD - South Wales	Overall	100	150
	Low voltage	75	100
WPD - South West	Overall	75	100
	Low voltage	75	110
YEDL	Overall	110	110
	Low voltage	100	120

In most of the licensed areas the sample size based on CI is smaller than sample size based on CML. On the basis that an audit sample of approximately 200 was a practical number it was concluded that a sample size based in CI rather than CML would be appropriate.

In order to more accurately reflect the total sample make-up, the LV restoration stages obtained as the sample for the LV voltage level within the overall sample were used again within the LV sample. These restoration stages were supplemented by additional ones to obtain the total number needed to form the LV sample. This is shown in Table 2-3.

The data was examined for all other licensed areas to establish whether LV overhead interruptions are significantly different from LV underground interruptions. In some cases the difference was significant and in others it was not. If the overhead and underground interruptions were not significantly different for a licensed area, a random sample was taken from the complete LV data set. If the overhead and underground interruptions were significantly different for a licensed area, the LV data was sorted into overhead and underground interruptions and the fraction of total CI for overhead and underground calculated to determine the relative proportion of restoration stages in the sample.

The additional LV restoration stages required for each licensed area indicate whether underground and overhead interruptions are significantly different. This is shown in Table 2-4.

Table 2-4: Summary of Additional LV Samples for each Licence Area

Licence Area	Significant	Overhead	Underground	Total
SSE – Southern Electric	No	-	-	98
WPD - South Wales	Yes	13	40	-
WPD – South West	Yes	16	49	-
SSE – Scottish Hydro	Yes	13	88	-
Aquila	No	-	-	83
UU	Yes	4	86	-
LPN	No	-	-	62
NEDL	Yes	6	68	-
EME	Yes	9	81	-
SPN	Yes	11	81	-
SP Distribution	Yes	5	95	-
EPN	No	-	-	80
SP Manweb	Yes	20	67	-
YEDL	No	-	-	78

2.4 Stage 3 Audit of Incident Reports

Having provided the DNOs with the questionnaires, guidelines and details of restoration stages to be audited, audit visits were then undertaken by visiting auditors. These visits were scheduled to last around 5 days. The deliverables of the visits were completed questionnaires, audit of incidents and a draft report agreed as being factually correct by both visiting auditors and DNOs. Calculation of the Stage 3 accuracy was carried out subsequently based on the information contained in the draft report. Once the Stage 3 accuracy was calculated the draft reports were then updated with the final audit visit report. These are included in this report as Appendix E to Appendix R.

The aims of this Stage of the audit framework were as follows:

- to examine the audit trail for information being reported to Ofgem
- to analyse the accuracy of the sample (Stage 3) and its relationship with the estimated accuracy of the measurement systems (Stage 1).

It is emphasised that each audit team comprised both company representatives and visiting auditors. As in previous audits, Stage 3 of the audit framework was therefore conducted as a joint activity in a spirit of co-operation and learning.

Following an introduction to the measurement systems, details regarding the inter-relationships between these systems and the company's reporting procedures, the samples of incidents at LV and higher voltage levels were audited. Consideration was given to the following during the audits:

- the number of customers affected by each incident as reported to Ofgem
- how this number relates to both the audit trail (information that the system generated at the time of the incident) and the number of customers shown on the latest connectivity model
- the reported incident duration and how this compares with the audit trail for what actually occurred
- whether each incident has been captured by the measurement systems by comparing customer and incident reports and by checking that logged network events related to the relevant incident reports
- the location of each incident within the distribution network was checked against the representation made by the measurement systems.

Audit workbooks, together with guidelines for use, were developed to assist in the compilation of the results for this part of the analysis. The workbook and guidelines are shown in Appendix C. Each of the audit teams completed these workbooks for their respective companies.

Prior to the visit companies would have pre-populated the following columns:

- 'Company Reference No.'.
- 'Restoration Stage'.
- 'Re-interruption Stage Reported'.
- 'Method of Restoration'.
- 'Report CI'.
- 'Report CML'.

During the audit visit the auditors recorded the following information:

- 'Audit Check' requires the visiting auditors to check whether or not the company has correctly identified the incident and a re-interruption stage.
- 'System CI' is the number of CI arising from re-creation of the incident on the DNO's connectivity model during the audit.
- 'Audit CI' is the confirmed number of CI in a restoration stage as checked by the audit team from the audit trail information provided by the DNO and agreed with DNO representatives.
- 'Company CI' is used where the DNO believes that a different number than the System CI number should be used for a particular restoration stage. The purpose of this column is to provide a record of the DNO's opinion on a particular stage.
- Comments on any aspects of the CI information contained in the workbook.
- 'Audit CML' is the number of CML determined by the audit team from the audit trail information. Audit CML is determined by checking the start and finish times of a restoration stage and multiplying the resulting duration in minutes by the number of customers affected by the incident as checked by the auditor "Audit CI".
- 'Company CML' is used where the DNO believes that a different number than the 'Audit CML'.
- Comments on any aspects of the CML information contained in the workbook.

2.4.1 Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an EXCEL workbook. This was populated by the DNO prior to the audit with respect to reported values. During the audit, the system values, the audited values and the company values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited), the reported or audited CI has been set to zero. For example, where the report and audit identify a restoration stage as being a re-interruption then the CI was set to zero for both the reported and audited results. In the event that the restoration stage was reported as being a re-interruption but the audit did not identify it as a re-interruption, then the reported CI was set to zero but the audited CI was included in the audited CI associated with the restoration stage. Conversely, where the restoration stage was audited as being a re-interruption but the report did not identify it as a re-interruption, then the audited CI was be set to zero but the reported CI was included in the report CI associated with the restoration stage.

The following procedure was followed for each DNO. The difference was determined between the reported and the audited values for each incident stage examined for the four measures; overall CI and CML and LV CI and CML. These four data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation. Table 2-5 below details the results of this analysis.

Table 2-5: Statistical parameters for differences between reported and audited values for each licensed area

Licensed Area		Overall		LV	
		CI	CML	CI	CML
Aquila	mean	-2.7	539	0.2	98
	median	0.0	0	0.0	0
	std dev	51.7	6044	7.0	1381
EME	mean	1.8	4265	0.6	273
	median	0.0	0	0.0	0
	std dev	14.4	27122	12.4	3269
EPN	mean	-2.9	4206	-0.13	194
	median	0.0	0	0.00	0
	std dev	169.7	51673	7.59	2259
LPN	mean	1.3	295	0.2	344
	median	0.0	0	0.0	0
	std dev	46.7	5244.5	17.9	4029.6
NEDL	mean	2.1	355	-0.3	517
	median	0.0	0	0.0	0
	std dev	15.2	2007.6	21.8	6398
SPN	mean	1.2	77	0.6	186
	median	0.0	0	0.0	0
	std dev	5.1	1183	8.2	1522
SP Distribution	mean	0.0	-223	-1.2	601
	median	0.0	0	0.0	0
	std dev	1.1	1685	15.2	5064.2
SP Manweb	mean	-0.1	-614.1	-1.4	-549.1
	median	0.0	0	0.0	0
	std dev	2.1	102.2	6.9	3285
SSE – Hydro Electric	mean	1.3	120.7	-0.1	-30
	median	0.0	0	0.0	0
	std dev	7.6	735.5	1.3	203.4
SSE Southern Electric	mean	1.3	-1237	0.2	136
	median	0.0	0	0.0	0
	std dev	17.4	9698	7.7	2415.2
UU	mean	16.3	-829.1	-1.3	-258
	median	0.0	0	0.0	0
	std dev	137.0	11027	13.0	1762.6
WPD South Wales	mean	-1.1	107	0.4	0
	median	0.0	0	0.0	0
	std dev	11.3	2758	6.8	6.807
WPD South West	mean	-1.8	-64	0.0	-7.65
	median	0.0	0	0.0	0
	std dev	10.7	258.7	4.4	395.8
YEDL	mean	0.6	202	-0.5	191
	median	0.0	0	0.0	0
	std dev	9.2	2090.3	4.6	1436.5

Examination of the above table, shows that in every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. This is confirmation of the Central Limit Theorem which states that the differences between two sets of data are normally distributed even where each of the data sets themselves are best described by non normal distributions. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, these were then removed from the data sets prior to the Stage 3 accuracies being determined. Table 3-3 shows the outlying results that were removed and Table 3-4 shows the Stage 3 accuracies.

2.5 Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area and are detailed in Table 3-2. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CI for LV incidents and by the total numbers of CI for higher voltage incidents.

Stage 3 accuracies were determined after removal of the outlying results.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the Stage 3 inaccuracy and calculating the square root of this sum. Combined accuracies were then obtained as the differences between these inaccuracy figures and 100%. These calculations are shown for each licensed are in Appendix D and summarised in Table 3-5.

2.6 Conclusions

Given the time available to audit each DNO's reporting system, it was determined that no more than 200 incident restoration stages could be audited. The number of incidents and therefore restoration stages on each of the DNO's systems is significantly greater than 200. Unlike previous years the DNOs were required to provide data at the incident restoration stage level. This resulted in a significant increase in the amount of information provided by the DNOs. There was therefore a requirement to select the 200 incident restoration stages to be audited by sampling the data provided and selecting 200 incident restoration stages that best represented the overall data provided.

It is important that the sample is representative if the reporting accuracy assessed for the audited sample is to be used as the estimate of accuracy for the full data set

Analysis of the differences between the reported and audited CI and CML indicated that these were normally distributed and symmetrical about the mean. This result is in line with what would be expected under the Central Limit Theory. It was therefore concluded that the Stage 3 accuracy could be determined based on a simple summation of the reported and audited CI and CML.

A review of reported and audited CI and CML results indicated that each DNO had outlying results. These outlying results were removed from the assessment of Stage 3 accuracy for each DNO.

The combined accuracy of Stages 1 and 3 was obtained by adding the square of the system inaccuracy (Stage 1) to the square of the audit inaccuracy (Stage 3) and then calculating the square root of the resulting sum.

3 Audit Results

3.1 Overview

The Stage 3 audit visits to the DNOs were completed during July and August of 2003. Each on-site visit was scheduled to last for 4.5 or 5.5 days (including travelling time) with two auditors being present during each visit.

The audit visit programme was as follows:

Table 3-1: DNO Audit Programme

Licensed Area	Date
SSE – Southern Electric	7th to 11th July
WPD - South Wales	7th to 11th July
SSE – Scottish Hydro	14th to 18th July
WPD – South West	14th to 18th July
Aquila	15th to 17th July and 21st to 22nd July
United Utilities	21st to 25th July
LPN	4th to 8th August
NEDL	4th to 8th August
EME	18th to 22nd August
SPN	18th to 22nd August
SP – South of Scotland	18th to 22nd August
EPN	26th to 29th August
SP – Manweb	26th to 29th August
YEDL	26th to 29th August

The visiting auditors were provided with the appropriate level of support by each DNO and it was evident that each company considered the IIP process as being important to its business.

3.2 Stage 1: Accuracy of Measurement System

The following sections summarise the results of the audits for the fourteen licensed areas during 2003. Detailed results from the individual audits are contained in Appendix E to Appendix R.

3.2.1 Summary of Findings

A summary of the results of Stage 1 of the audit process is presented in Table 3-2 below.

Table 3-2: Summary of Stage 1 Results

Licensed Area	MPAN Measurement Accuracy	LV Connectivity Model Accuracy	Higher Voltage Connectivity Accuracy
Aquila	100%	99%	99%
EME	100%	98.46%	99.40%
EPN	Approximately 100%	93.0%	96.09%
SPN	100%	94.1%	98.5%
LPN	Approximately 100%	95.6%	99.27%
NEDL	99.6%	93.5%	97.0%
SP Distribution	99.6%	96%	98%
SP Manweb	99.5%	96%	98%
SSE – Scottish Hydro	Almost 100%	99.9%	99.9%
SSE – Southern Electric	Almost 100%	98.5%	99.9%
United Utilities	100%	98.45%	99.5%
WPD South Wales	99.98%	99.55%	99.6%
WPD South West	99.88%	99.14%	99.92%
YEDL	99.6%	97.2%	97.2%

3.2.2 Inaccuracy in Counting MPANs

Most DNOs have not changed their method of counting MPANs since the 2001/2002 IIP audit. The 2001/2002 audit identified only minor errors in counting MPANs. As part of the 2002/2003 audit, all DNOs report highly accurate estimates of counting MPANs. The lowest record assessment of MPAN count accuracy is 99.6%. The visiting auditors have concluded that these high levels of accuracy can be relied upon and therefore only minor inaccuracies will arise in incident reporting due to the way in which DNOs count MPANs via the Metering Point Administration System (MPAS).

3.2.3 Inaccuracy in the Connectivity Model

(i) Aquila

Aquila's procedures for counting primary trading MPANs is highly accurate. Due to the dynamic nature of the network it is likely that there will always be a small difference between the number of MPANs included in Aquila's measurement systems and the number registered in MPRS. These differences are considered by the visiting auditors to be insignificant.

The visiting auditors found Aquila's procedure for counting MPANs to be robust and they support the company's estimated accuracy of approximately 100%.

(ii) EME

EME's connectivity model is highly accurate as the model was created manually based on existing mains and service records where available. EME has had the connectivity model in place since 1992 and since then has improved the accuracy of the model. This improvement in accuracy has been evident based on the accuracy levels quoted by EME this year as compared to the previous 2002 audit.

The internal audit carried out by overlaying the connectivity model data in Call Logging & Sorting System (CLASS) on to Geographical Information System (GIS) provided the necessary confidence levels to EME and also the visiting auditors on the accuracy of the assignment of MPANs to the connectivity model.

The visiting auditors found EME's procedure for determining the accuracy of its connectivity model to be satisfactory and support the company's estimated figures of 99.40% at HV/LV substation level and 99.46% at the LV feeder level with an overall confidence limit of 98.44%. As it is not a requirement of the RIGs to have a phase connectivity model, this aspect is not considered to be a potential source of inaccuracy for the LV feeder connectivity model.

(iii) EPN

A small number of customers are assigned to dummy LV feeders where insufficient information exists to correctly assign them. However these customers count for around only 5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct LV feeders.

EPN's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using the model outlined above. During the 2003 IIP audit, the visiting auditors reviewed the calculations performed by the model to establish overall connectivity accuracy.

During the audit of incidents the auditors discovered a small number of incidents where customers were clearly allocated to the incorrect feeder. The auditors do not believe this to significantly impact on the DNOs estimate of accuracy and therefore supports the DNOs accuracy estimates of 95.3% for HV and 93.0% for LV.

(iv) LPN

The visiting auditors found that a small number of customers are assigned to dummy LV feeders where insufficient information exists to correctly assign them, however these customers count for less than 0.5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct LV feeders.

LPN's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using the model outlined above. During the 2003 IIP audit, the visiting auditors reviewed the calculations performed by the model to establish overall connectivity accuracy.

During the audit of incidents the auditors discovered a number of incidents where customers were clearly allocated to the incorrect feeder. Although this was only observed on a small number of occasions it often involved many customers. The reasons for these anomalies are not clear and an estimate as to the number of customers affected and the impact on accuracy was difficult to make. As faults are created there is a process in place to ensure that Control Engineers identify any such customers and assign them to the correct feeders.

The presence of some discrepancies means that the accuracy figures of 98.1% for HV and 95.6% for LV in the visiting auditors' view are at the top end of expectations, although at this stage the visiting auditors do not believe the difference between estimated and actual accuracy to be material. The DNO has stressed previously that the accuracy calculations are based on prudent assumptions that may well balance off the errors found. Far fewer errors of customers being allocated to the incorrect Transformer were discovered during the audit, and as such the visiting auditors have no reason to dispute with the accuracy figure provided by LPN at transformer level.

(v) NEDL

The visiting auditors have concluded that NEDL has followed the recommendations made in last year's audit report and have continued to adopt a careful and methodical approach to making incremental improvements to the connectivity model. The explanations of the methods used were full and detailed and were provided in a clear and candid way.

The auditors agree with NEDL's accuracy estimates of 97.0% for HV and 93.5% for LV for its connectivity model.

(vi) SPN

It was not possible to fully audit the work of the external statistician. The auditors discussed estimates for current and future accuracy provided by the statistician and noted current and expected accuracy levels associated with the various categories of error-source. The independent estimates were the same as the figures quoted by SPN and the explanations given for the levels quoted, both now and future, were considered to be acceptable and in accordance with the outcome of the last review.

SPN has developed dedicated HV and LV connectivity models and implemented the associated infrastructures. All HV equipment parameters and connection arrangements are stored in the Network Management System (NMS), which handles and updates in near real-time details of HV connectivity. LV faults are first recorded in the Fault Management System (FMS) and are then related to the LV connectivity model, which is stored in the Discovery system of the Customer Connectivity Model (CCM), which holds detailed information of all LV equipment, parameters and MPANs.

The connectivity models have not changed since the 2002 IIP audit. Reported accuracy levels have also not changed. During the 2002 audit the connectivity models were audited and discrepancies were found that were consistent with the accuracy levels quoted for the models. Since no changes have been made to the models and the auditors did not note any significant discrepancies during the audit of HV and LV faults that could be definitively attributed to errors in the models, the visiting auditors support the company's estimate of LV and HV accuracy levels of 94.1% and 98.5% respectively.

(vii) SP Distribution

The visiting auditors consider that the audited inconsistencies do not impact significantly on the company's estimation of its accuracy. The sample five-feeder inaccuracy at 1.3% is less than the company's estimation of 4%. Therefore as no evidence has been found that would suggest SP Distribution's estimate of accuracy is incorrect, the company's estimation of its accuracy is judged to be reasonable.

SP Distribution's estimation of its inaccuracy is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. An addition of all of these inaccuracy levels places the overall inaccuracy level outside the declared level of 4%. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as sample selection and analysis, could produce a more robust assessment of inaccuracy.

(viii) SP Manweb

The visiting auditor's consider that the audited inconsistencies do not impact significantly on the company's estimation of its accuracy. The revised five-feeder sample inaccuracy of 1.2% is less than the company's estimation of 4%. The auditors consider that the company's estimation of its accuracy is reasonable despite the discovery of a rogue feeder.

SP Manweb's estimation of its inaccuracy is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. An addition of all of these inaccuracy levels places the overall inaccuracy level outside the declared level of 4%. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as sample selection and analysis, could produce a more robust assessment of inaccuracy.

(ix) SSE – Scottish Hydro

The visiting auditors found that connectivity model inconsistencies were attributable in the main to movements in the system numbers due to normal and acceptable operational changes giving a minor discrepancy from the reported numbers.

Overall the auditors believe that the company's estimates of accuracy of 99.9% for HV and 99.9% for LV are reasonable and based on the evidence support the company's view.

(x) SSE – Southern Electric

The visiting auditors have concluded that the inconsistencies found were primarily associated with the changing numbers of customers connected to specific parts of the network. This is normal activity and produces discrepancies between reported customer numbers and the customer numbers reviewed during the audit.

However, an unexpectedly high number of transformers within the model were discovered with zero connected customers. These were identified in the audit of HV incidents when lists of affected transformers were used to verify reported customer numbers. The company has confirmed that these arise from a number of situations:

- When a proposed new substation is introduced into the Enmac system, a new substation is created in SIMS in readiness for customers to be connected. These proposed changes can exist for many months before the substation is actually energised and customers connected. These substations appear in SIMS, but have zero connected customers.
- Substations which have no transformer (either the transformer has been removed or the substation is simply a switching station) will correctly show zero customers.
- The methodology used to populate the connectivity model used an algorithm to connect customers to the geographically nearest LV network. Where single customers are actually connected only by a service (i.e. a remote Pole Mounted Transformer with no LV main), or where a customer is a single HV metered supply (i.e. no LV main is involved in the supply) then that customer will have been allocated to the nearest LV main. These customers will generally be 'singles' and will almost certainly be connected to the correct HV feeder. Therefore the effect on accuracy will be minimal.

The auditors suggested that a process similar to the data cleansing that occurs when customers 'call with ‘no-supply’ but are allocated to a different NRN' could be extended to the planned supply interruption procedure on the LV network. The company has considered this approach, but has dismissed it on the basis that the staff involved with the interruption would have to knock doors to check whether each customer has actually been disconnected. Not only would this be ineffective in terms of access to confirm supply loss, but it would also disrupt the operational process that required the planned supply interruption in the first place. Therefore this process will not be implemented. The auditors hold the view that this is a missed opportunity to improve the accuracy of the model at a time when the customers affected should be known precisely.

Overall the auditors believe that the companies accuracy estimate of 99.9% for HV and 98.5% for LV may be slightly optimistic, but not unreasonably so.

(xi) United Utilities

The visiting auditors have concluded that UU’s connectivity models are accurate. Some 5% of customers are assigned to Post Code centroids where insufficient information exists to correctly position them, however these have no effect on the HV incident customer count and operator skill and experience ensures that, at worst, 75% of these customers are included on LV incidents. A small number of customers (0.3%) have not been placed on the LV connectivity model, and are therefore not counted for LV incidents, although these are distributed on the HV model, and thereby included for HV incidents.

UU’s connectivity models have not changed fundamentally since the 2001/2002 IIP audit, although the use of the LV connectivity model is now fully implemented. LV model accuracy has improved due to further data cleansing and improved operator skills, whilst HV model accuracy has remained constant. The visiting auditors found UU’s procedure for determining the accuracy of its connectivity to be robust and support the company’s estimated figures of 97.52% for HV incidents and 97.27% for LV incidents.

(xii) WPD – South Wales

The auditors have concluded that WPD's connectivity model is highly accurate. A small number of customers are assigned to dummy HV/LV substations and dummy LV feeders where insufficient information exists to correctly assign them, however these customers count for less than 0.5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct HV/LV substations and LV feeders.

WPD's connectivity model has not changed fundamentally since the 2001/2002 IIP audit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using customer numbers generated in the automated weekly control reports. During the 2002 IIP audit visit the weekly control reports were witnessed and the methodology was considered to be sound, but the raw numbers and the calculation were not subjected to rigorous audit. During the 2002/2003 IIP audit, the visiting auditors verified the source data used and replicated the calculation.

The visiting auditors found WPD's procedure for determining the accuracy of its connectivity to be robust and support the company's estimated figures of 99.60% at HV/LV substation level and 99.55% at the LV feeder level.

(xiii) WPD – South West

The auditors have concluded that WPD's connectivity model is highly accurate. A small number of customers are assigned to dummy HV/LV substations and dummy LV feeders where insufficient information exists to correctly assign them, however, these customers count for less than 1% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct HV/LV substations and LV feeders.

WPD's connectivity model has not changed fundamentally since the 2001/2002 IIP audit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using customer numbers generated in the automated weekly control reports. During the 2002 IIP audit visit, the weekly control reports were witnessed and the methodology was considered to be sound, but the raw numbers and the calculation were not subjected to rigorous audit. During the 2002/2003 IIP audit, the visiting auditors verified the source data used and replicated the calculation.

The visiting auditors found WPD's procedure for determining the accuracy of its connectivity to be robust and support the company's estimated figures of 99.92% at HV/LV substation level and 99.14% at the LV feeder level.

(xiv) YEDL

YEDL have followed the recommendation made in last years audit report to implement the use of the connectivity model across the Company for the counting of both HV and LV customer interruptions. The continuous audit and reconciliation processes YEDL have in place will also have made steady and continuous incremental improvements to their connectivity model throughout the audit year.

The auditors agree with YEDL's estimate of accuracy of 97.2% for both HV and LV for its connectivity model.

3.2.4 Interpretation of RIG Definitions

In general, the visiting auditors are satisfied with the way in which the DNOs are interpreting the RIGs definitions. There are however some exceptions:

The visiting auditors have consistently noted issues related to the way in which DNOs record re-interruptions. The RIGS refer to "further loss of supply to some or all of the same customers within 3 hours of the initial supply restoration". Some companies interpret this as meaning that interruptions are re-interruptions if the same customers suffer a loss of supply within 3 hours of the time that they were originally restored during the incident. Others interpret this as meaning that interruptions are re-interruptions if the customers suffered a further loss of supply within 3 hours of the time the last customer was restored. Although this will not affect the reporting of CML it could result in under-reporting of CI. Further clarification of this definition is recommended in order to ensure that re-interruptions are consistently reported by all DNOs.

Most DNOs raised the issue of stopping the clock when a customer has asked for a delayed restoration or there are circumstances outside the control of the DNO that stops the DNOs from restoring supply.

In the case of LPN and EPN, during the course of the audit it was discovered that the DNOs have been using a different interpretation of incident start and end time, where the DNO has been refused access to a property by a customer to affect repairs. The LPN audit uncovered 3 instances where the DNO had recorded an end to the incident at the time the customer refused access to a property (usually where a fault would have been repaired during the night). LPN then recorded a separate incident when access was allowed. The result of this was that for these instances the CML were under-reported. In the case of EPN, no such incidents were reviewed by the visiting auditors.

SPN reports re-interruptions if the customer or group of customers are interrupted and restored as part of an incident and interrupted anytime while the incident continues, up to 3 hours after the last customers in the incident have been restored. The count of CI does not include these customers but the count of CML does include these customers.

With regard to UU, as part of the 2001/2002 IIP audit, the visiting auditors reported a issue concerning interpretation of the RIGs, when customers agreed to delays in restoration of supplies, or indeed refused permission for access required to affect restoration. UU's practice in such situations was to "stop the clock" for the agreed or enforced period of inactivity, thereby reducing reported CML. The recommendation from the 2002 audit was that this practice should cease pending clarification by Ofgem. UU has not received the clarification and consequently has reverted to its former practice of "stopping the clock".

A further issue of UU's RIGs interpretation is the rounding of Telecontrol issued times. UU's interpretation is that such times should be rounded up or down to the nearest whole minute, although the rule is not explicit within RIGs. This could be a significant issue for example, for HV incidents when incident times of around 3 minutes could be classified as either interruptions or short interruptions, depending on the use of rounding.

It is recommended that NEDL review its change in the reporting of Pre-Arranged Interruption overruns as the change now means that its reporting is inconsistent with the requirements of section 2.15 of the RIGs

3.2.5 Reporting into Ofgem's Template

The visiting auditors are satisfied that all DNOs are populating the IIP template accurately. Most DNOs populate using automated data extraction processes exclusively but SSE requires a minimal amount of manual intervention. SSE's system should however be considered to be robust.

3.3 Stage 3: Accuracy of Incident Reporting

The first step in calculating the accuracy of incident reporting was to calculate the mean and standard deviation of the difference between reported and audited results for each of the 4 measures being considered. Any outliers were then removed. These were identified as any restoration stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. The following stages were removed from each of the DNOs data sets prior to the determination of Stage 3 accuracy:

Table 3-3: Outlying Restoration Stages removed prior Stage 3 accuracy assessment

Licence Area	OVERALL		LV	
	CI	CML	CI	CML
Aquila	002021	002021	010704 004767	010704 010090
EME	000252 000435	000416	000786 001844	000786 001492
EPN	HVF1011041 HVF1029553	HVF1029553	LVF1036951 LVF1037223	LVF1086665 LVF1037363
LPN	HVF2003317 HVF2003770	HVF2003770	LVF2039507	LVF2042680
NEDL	4303 442	4303 3800 1929	4303 5284 831	4999
SPN	30590 23983	35270 32380 LV 32380 LV	38010	26970 38010
SP Distribution	INCD-72204-X	F-48418-I	INCD-72290-X INCD-76489-X Stage 2	INCD-76489-X Stage 2
SP Manweb	F-22645-H INCD-34246-h F-3978-b Unidentified stage on line 44 of workbook J-12839-b	F-4636-a	INCD-32202-h INCD-96516-m	INCD-31248-h
SSE - Hydro Electric	52H000125	52H000125 70H000627	24 0000566	70 0001614
SSE Southern Electric	470027 470007	470167	430282 450046	450046
UU	41-330	32-64	32 2079	21 3163 32 2079
WPD - South Wales	56000082 56000164	58500851	51500452	51500452
WPD - South West	000204	000116	4501151 8500630 8500630	9500909
YEDL	67548 61804	61887	66921	66459

Accuracy was then calculated by expressing the sum of reported results as a percentage of the sum of audited results. The following Stage 3 accuracies were obtained:

Table 3-4: Stage 3 Accuracies

	Overall		LV	
	CI	CML	CI	CML
Aquila	100.4%	99.7%	100.5%	98.5%
EME	100.0%	102.2%	106.7%	115.6%
EPN	99.1%	98.0%	99.5%	99.5%
LPN	99.2%	97.2%	108.1%	99.8%
NEDL	100.0%	100.2%	104.5%	96.8%
SPN	100.3%	100.3%	99.7%	99.0%
SP Distribution	100.0%	99.2%	102.8%	93.1%
SP Manweb	100.1%	100.0%	92.4%	91.8%
SSE - Hydro Electric	101.0%	100.3%	99.3%	99.1%
SSE Southern Electric	99.6%	100.0%	100.7%	97.5%
UU	99.7%	99.6%	97.1%	97.7%
WPD - South Wales	99.4%	97.7%	99.5%	97.5%
WPD - South West	99.7%	99.4%	102.4%	101.3%
YEDL	100.1%	100.8%	99.7%	97.5%

3.4 Overall Reporting Accuracy

3.4.1 Audit Results

Table 3-5 summarises the results when the Stage 1 and Stage 3 results are combined using the methodology described in Section 2.5.

Table 3-5: Audit Reporting Accuracy Results

Licensed Area	Overall		LV	
	CI	CML	CI	CML
Minimum Reporting Accuracy	95.0%	95.0%	90.0%	90.0%
Aquila	98.9%	99.0%	98.9%	98.2%
EME	99.3%	97.7%	93.1%	**84.3%**
EPN	95.7%	95.4%	93.0%	93.0%
LPN	98.0%	96.6%	90.8%	95.6%
NEDL	96.5%	96.5%	92.1%	92.8%
SPN	98.1%	98.1%	94.1%	94.0%
SP Distribution	97.8%	97.7%	95.1%	92.0%
SP Manweb	97.7%	97.7%	91.4%	90.9%
SSE - Hydro Electric	99.0%	99.7%	99.3%	99.1%
SSE Southern Electric	99.5%	99.7%	98.3%	97.1%
UU	99.4%	99.4%	96.7%	97.2%
WPD - South Wales	99.3%	97.7%	99.3%	97.5%
WPD - South West	99.6%	99.4%	97.5%	98.4%
YEDL	97.2%	97.1%	97.2%	96.2%

From the above table it can be seen that only EME has not met the minimum reporting accuracy level. EME has an accuracy level of 84.3% when reporting LV CML. Table 3-4 indicates that this inaccuracy is due to over reporting of LV CML.

3.4.2 Incident Reporting at the Higher Voltage Levels

All DNOs operate their higher voltage systems to centralised control with a disciplined set of procedures. Within each DNO, the measurement of time is automatic on all SCADA-equipped components, such as distribution switchgear. Within the centralised control environment, the recording of time for manual switching operations is semi-automatic and depends upon trained control engineers. The potential for error is therefore considered to be low.

In general, companies were well prepared for the audit visit with many supplying folders containing relevant information for each restoration stage being audited. Adequate preparation by the DNO allowed the visiting auditors to clearly understand the restoration stages being audited with questions or queries being quickly dealt with by the DNOs. Even with adequate preparation there were occasionally restoration stages that were too complex to audit. In those cases spare restoration stages were used.

Three main sources of error have been consistently experienced during the audit visits. These are:

- Changes to customer numbers.
- Network reconfigurations.
- Manual mis-reporting and transcription error.

These are discussed in subsections (i), (ii) and (iii).

(i) Changes to customer numbers

Although mostly small in overall numbers of CI and CML, the auditors consistently found that there were differences in CI and CML that DNOs ascribed to changes in customer numbers. Where clear evidence was supplied showing changes to customer numbers the auditors accepted the reported figures. Several companies have expressed the view regarding the impracticality of tracking movement of customers connected to HV/LV sub station and a high voltage circuit. Some DNOs were able to provide the evidence at all voltage levels.

(ii) Network Reconfiguration

Inaccuracies are introduced as a result of the network reconfiguration between the time of the incident and the time of the audit. As with changes to customer numbers, where clear evidence was provide to account for such reconfiguration, the auditors accepted the reported CI and CML.

(iii) Manual Mis-reporting and Transcription error

There is always the potential for error when there is a requirement for human input when manipulating data. Inaccuracy starts during the manual transfer of information from the field into the various systems and arises every time data is manually manipulated. In the case of one DNO, its key systems are still manual and there is no automatic transfer of the time stamping by its central call handling function. Although no systematic inconsistencies were found, manual entry proved a major source of problems for one audited incident. The auditors have noted that manual transcription of data is a continuing risk to accuracy.

Other sources of inaccuracy have been identified as being:

- Incorrect automatic computer allocation of a customer to a transformer/feeder.
- Introduction of an LV connectivity model.
- Errors in the connectivity model.
- Missing restoration stages.
- HV customers not being assigned to the connectivity model.
- Not using the first customer call time.
- Stopping the clock at the agreement of the affected customer (1 incident).
- Re-interruption not recognised (reported as a new interruption).
- Using original interruption time, rather than stage time.
- Using incorrect time from the telecontrol events printer (transcription error).
- Using neutral current alarm time, rather than first customer call.

During one audit it was found that a single restoration stage had a particularly high impact on the overall sample. The DNO expressed concern that a single restoration stage could have such an impact on the audit results and expressed the view that this should be removed. The restoration stage was not removed as the auditors were of the opinion that this situation must be treated consistently as part of the central accuracy calculation. It may however be worth considering putting some limit on the size of restoration stages to ensure that a single result does not skew the results to an unacceptable extent. Although the auditors considered the restoration stage as part of the audit, it was removed as part of statistical analysis described in Section 2.4.1.

Provision of clear documentation to account for any inaccuracies between reported and audited number has been identified by several DNOs as being an important factor in ensuring a high quality audit. Ofgem may therefore consider providing guidelines as to what information should be provided. This would enable the DNOs to have a clearer understanding as to what preparation is required prior to the audit.

3.4.3 Incident Reporting at the Low Voltage Level

In general the quality of information provided by the DNOs in support of the audited restoration stages has been enhanced since the 2001/2002 audits. In some cases information systems have been improved. Good record keeping and comprehensive preparation are key to ensuring effective audits.

Generally, DNOs have put effort into enhancing their systems, more accurate recording and providing useful information. However, in one DNO, the information recorded on the PC-NaFIRS system was, in the opinion of the visiting auditors, rather cryptic and was not of a suitable quality to enable auditing to take place.

As with the HV restoration stage audits, it is clear that inaccuracies are being introduced when manual intervention or transcription is required. This is particularly the case with reporting made by field staff. In one case it was found that there were twelve restoration stages that involved manual input errors, mainly customer number and duration of interruptions. In another the auditors were concerned about the likely accuracy of some operational times reported from the field for connection of generators and application of LV backfeeds, since many were found to be rounded to whole hours.

There appear to be different practices between DNOs in stopping the clock in the case where a customer has requested deferment of restoration of supply. In addition some DNOs stop the clock when the DNO is in a position to carry out repairs but are unable to do so due to reasons outside the control of the DNO. Ofgem has clarified that the clock should not be stopped under any circumstances when customers are off supply. It is recommended that this clarification be provided to all DNOs.

It has been noted by one set of visiting auditors that reporting accuracy significantly diminished when restoration stages that occurred during the October 2002 storm were examined.

3.5 Conclusions

All audit visits were undertaken within the agreed timescale. Every DNO was well prepared for the visit and provided an appropriate level of support. Company specific reports have been prepared by the visiting auditors for each DNO.

Measurement of MPAN accuracy is either at or approaching 100%.

All DNOs are filling in the IIP templates to an acceptable level of accuracy.

The main area of concern with regard to compliance with RIG definitions is related to re-interruptions. There are a number of examples where the RIGs are being interpreted inconsistently. DNOs have previously raised the issue of stopping the clock when a customer asks for a delayed restoration of supply or there are circumstances outside the control of the DNO delaying restoration work.

It is recommended that NEDL review its change in the reporting of Pre-Arranged Interruption overruns as the change now means that its reporting is inconsistent with the requirements of section 2.15 of the RIGs

The DNOs have continued to improve the accuracy of their connectivity models and there is evidence that they are following the recommendations made during the 2001/2002 audit. There are still however, differing levels of system automation between DNOs. The lowest estimate of accuracy of a connectivity model was 93.0% made by EPN. Approximately 50% of the DNOs reporting LV connectivity model accuracy in excess of 98% and over 70% reporting similar accuracies for HV connectivity.

There are number of different sources of inaccuracies in the audit models. Some of these are specific to individual DNOs, whereas others are common to a number of DNOs. The common areas of inaccuracy relate to higher voltage incidents and include:

- Changes to customer numbers between the date of the incident and the audit.
- Network reconfigurations between the date of the incident and the model at the time of the audit.
- Manual mis-reporting and transcription error.

Although no analysis has been carried out into which of the above areas contributes the most to inaccuracy, manual reporting and transcription have resulted in significant errors being introduced.

All DNOs except for EME have met the minimum reporting accuracy requirements specified in the RIGs. EME has a reporting accuracy level of 84.3% as a result of over reporting LV CML.

The reporting accuracy results contained in the this report have been reviewed by the relevant DNOs and they have confirmed that they are content to accept these as an assessment of its reporting accuracy, as determined by the methodology outlined in this report. However, it should not be concluded from this confirmation that the DNOs necessarily agree with the methodology or that they will not in the future propose amendments to the methodology.

4 Short Interruptions

Based on the DNOs responses to the questionnaires provided and discussions with the DNOs, the following accuracies regarding reporting of short interruptions have been assessed.

Table 4-1: Accuracy of Reporting Short Interruptions

Licensed Area	Reporting Accuracy
Aquila	70% without remote control 90% - 95% with remote control
EME	98%
EPN*	As per longer interruptions
SPN	Not estimated by DNO
LPN*	As per longer interruptions
NEDL	85% to 89% without remote control 98% with remote control
SP Distribution	81%
SP Manweb	84%
SSE – Scottish Hydro	85%
SSE – Southern Electric	85%
United Utilities	96.69%
WPD South Wales	Not estimated by DNO
WPD South West	Not estimated by DNO
YEDL	Estimate as per interruption reporting – 97.2%

* For EPN and LPN short interruptions are recorded in the same way as longer interruptions and therefore the accuracy of the measurement of short interruptions will be similar to the accuracy of measurement systems discussed earlier.

From the above it can be seen that there is a significant variation in the accuracy of reporting short interruptions between DNOs. In addition, as might be expected, the results indicate that reporting accuracy can be greatly increased where there is remote monitoring of equipment.

In order to understand more fully the reasons for the differences, the visiting auditor's findings for each DNO are discussed below.

4.1 Aquila

Aquila explained that all devices that lead to short interruptions (i.e. auto re-closers and circuit breakers) have data collected regarding the number of operations and duration of operations (where known).

Data is collected in a number of different systems and then manually analysed and recomputed to remove operations associated with permanent faults, testing and multi-trips within a short interruption.

In the cases where data is not automatically collected, either visual inspections are used to collect the number of device operations or estimates are made based upon the average number of interruptions experienced by those devices where data is collected.

The various data sources for trips are compiled and entered into a transients model, where the number of customers affected by each trip can be calculated. The model is based upon the network model and identifies the customers downstream of a protection device, thus it can identify the substations and customer numbers affected by each trip.

The RIGs specify four short interruption cause categories: Auto1, Auto 2, Deliberate and Other.

Aquila has based its estimates upon judgements, and is working on reviewing methods of measurement and looking at using statistical methodologies to reinforce the estimates of accuracy

Estimates of accuracy are detailed below in Table 4-2:

Table 4-2: Aquila Estimate of Short Interruption Reporting Accuracy

Equipment item or activity	Counts	Customers
Reclosing circuit breakers with SCADA	>95%	>95%
Reclosing circuit breakers without SCADA	>90%	>95%
Pole mounted re-closers – with remote control	>95%	>95%
Pole mounted re-closers – without remote control	>70%	>97%
Deliberate disconnection (generators)	>90%	>95%

Where remotely controlled devices report back to a log the data is very accurate, but inaccuracies are introduced into the reported figures as a result of the manual adjustments and estimates for permanent faults, testing and multi-shots. The accuracy of manually read devices is believed to be reasonably accurate for those devices where readings are possible. Where readings cannot be made or have been delayed estimates need to be made. Furthermore adjustments for multi-shots and permanent faults may introduce additional inaccuracy. The result is that the DNO has estimated this accuracy to be 70%.

The transients model used to calculate customers numbers uses up to date network representation therefore it is possible that network configuration and customer numbers may have changed. This continual update of customer number introduces inaccuracy as these numbers change from the time when the restoration stage was reported to the time of the audit. However, the amount of such activity is generally minimal and therefore the estimate that the customer numbers is greater than 95% is considered to be acceptable.

The visiting auditors have concluded that Aquila has put a lot of effort into the recording and reporting of short interruptions and from the information provided and the following discussion, the visiting auditors agree with Aquila's judgement of the level of accuracy reported. Aquila remains committed to improving and enhancing its data collection and processing for short interruptions and expects to progressively refine and improve its processes. Continued work in this area will progressively improve accuracy.

4.2 EME

EME has two classifications for its recording of short interruptions:

- Individual short interruptions recording utilises the modern Pole Mounted Auto Re-closers (PMAR) type switchgear which have telemetry and are recorded via the SCADA system in real time. For devices with telemetry the protocol is such that for multi-shot operations within the same sequence i.e. one event, one short interruption will be recorded as per RIG guidelines.
- Bulk short interruption recording utilises the older oil-filled switchgear with no telemetry capability and the readings are taken annually. The counter will record each individual shot taken, which is recorded as a short interruption.

EME does not have any significant use of LV reclosing schemes. They are only used during incident management when portable re-energising devices are fitted. If such a device operates then it would be recorded by the field engineer on site and communicated back to Network Management Centre (NMC) who would create the appropriate CLASS and PC-NaFIRS report.

EME estimates its reporting of recorded short interruptions to be 100%, with 99.4% accuracy for associated customers. Its assessment of bulk short interruption reporting accuracy is in excess of 95% with a customer accuracy the same as that for the network connectivity model, i.e. 98.46%. Given that 97% of customer short interruptions were attributable to interruptions recorded in real time, this results in an overall accuracy in excess of 99%. EME has indicated that its estimate of accuracy is 98% with a high confidence level.

The visiting auditors agree with the overall estimated accuracy level of 98% for short interruption recordings as this figure is dominated by the individual short interruptions recorded in real time. Furthermore, even though the short interruption recording is RIG compliant, there is an inconsistency of short interruption recording between auto re-closers with telemetry capable of registering multi-shot operations as a single event (individual short interruptions) and auto re-closers without telemetry. The latter register each shot of a multi-shot operation as a single event (bulk short interruptions).

4.3 EPN

The operation of all devices that allow restoration of supplies to occur within three minutes are tele-controlled and are automatically recorded within the SCADA system. This system automatically date and time stamps all operations undertaken by these devices. Individual fault reports at HV are prepared manually from the SCADA logs in a similar way as other entries into the FRS are made When the fault reports are being prepared in the Fault reporting System (FRS), the control engineer uses information from the SCADA logs to enter the cause of each interruption for each restoration stage. The cause definitions used by the system are restricted to and mirror those laid down in the RIGS.

EPN makes limited use of automatic re-closing devices at the LV level. These are temporary devices installed during the fault finding process. All HV pole mounted re-closers are fitted with remote control.

Short interruptions are not treated separately for internal audit purposes, but are subject to the same processes and procedures as for reporting of all incidents.

The visiting auditors have concluded that the measurement systems relating to short interruptions are robust. The only potential sources of error are from the manual compilation of the fault reports and from the inaccuracies present in the connectivity model. While EPN has not calculated any accuracy figures for short interruption, they should be in the range of the figures found in the restoration stages audited in the HV sample (95.3%).

4.4 LPN

The operation of all devices that allow restoration of supplies to occur within three minutes are tele-controlled and are automatically recorded within the SCADA system. This system automatically date and time stamps all operations undertaken by these devices. Individual fault reports are prepared manually from the SCADA logs in a similar way as other entries into the FRS are made. When the fault reports are being prepared in FRS, the control engineer uses information from the SCADA logs to enter the cause of each interruption for each restoration stage. The cause definitions used by the system are restricted to and mirror those laid down in the RIGS. A report was run to demonstrate that all short interruptions were given one of the causes detailed in the RIGs.

LPN makes limited use of automatic re-closing devices at the LV level. Any such devices are not permanent and are only used for the post fault restoration of supplies on underground networks. It was reported that LPN did not have any 'multi-shot reclosing schemes' due primarily to the small amount of overhead lines in the licensed area.

Short interruptions are not treated separately for internal audit purposes, but are subject to the same processes and procedures as for reporting of all incidents.

The visiting auditors have concluded that the measurement systems relating to short interruptions are robust. The only potential sources of error are from the manual compilation of the fault reports and from the inaccuracies present in the connectivity model. Although the DNO has not calculated any accuracy figure for short interruptions, the auditors anticipate that this figure should be in the range of the figures found in the restoration stages audited in the HV sample (98.1%).

4.5 NEDL

NEDL records short interruptions from 3 sources:

- SCADA controlled plant for which short interruptions are reported in exactly the same way as interruptions using the same system.
- Pole mounted (PM) and ground mounted (GM) re-closers from which a manual counter reading is taken annually.
- LV "re-zappers" all of which are fitted with a modem that reports operation to the despatch office.

NEDL has calculated its accuracy for reporting short interruptions as follows:

Table 4-3: NEDL Estimate of Short Interruption Reporting Accuracy

	Reporting Accuracy
SCADA Reported	98%
PM Re-closers due to unreliable, not credible reading or unread	85%
GM Re-closers due to unreliable, not credible reading or unread	89%
LV "re-zappers"	98%

When these figures are combined by weighting them by the number of reported customer interruptions from the relevant source, the overall accuracy of reporting of short interruptions is assessed by NEDL to be 93%.

The visiting auditors agree with the NEDL figure of 93% (under reporting) accuracy of reporting of short interruptions. It is also worth noting that NEDL has chosen not to apply a correction factor for likely over reporting in the manually counted re-closer figures. The final NEDL reported figure for short interruptions is therefore likely to be closer to the actual number than the reported accuracy implies.

4.6 SPN

Operation of all tele-controlled devices with auto re-close facilities are automatically captured within NMS. Non tele-controlled devices with auto re-close facilities have their operations counted twice a year, in August and March, and counts are manually entered in NMS. Short interruptions that occur through manual switching are captured within NMS and are identified within SPN's software system, Data Net, as short interruptions from their time stamps.

All switching operations on the higher voltage networks are recorded within NMS, either automatically or manually. The method of each operation is recorded in line with the RIGs, i.e. automatic (off and on); manual off, manual/remote on; or manual/remote off, manual/remote on. The data held within NMS is passed automatically to Data Net where the IIP rules and definitions are applied and reportable data is compiled for IIP reporting.

SPN makes limited use of automatic reclosing devices at LV. Devices used are not permanently installed, but are used for post fault restorations on underground networks. Consequently, any short interruptions they cause are considered insignificant in terms of number of short interruptions and no record of such incidents is kept.

Multi-shot re-closers associated with telecontrol count one SI for every re-close sequence. For manually counted re-closers a count of the total number of trip operations is made, which is divided by two to derive an estimate of short interruptions. This allows for routine operations and lockouts.

For manually counted re-closers, year-end system operating conditions are used to determine customer numbers associated with short interruptions.

The visiting auditors agree with SPN's view that the level of accuracy of reporting those short interruptions measured via telecontrol is of the order of 100%. No overall level of accuracy is estimated by SPN. Short interruption reporting levels can be expected to improve in accuracy in the near future as manually recorded re-closers are replaced by telecontrol recorded devices.

4.7 SP Distribution – South of Scotland

In SP Distribution all short interruptions on the 6.6kV, 11kV (except 11kV auto re-closers), 33kV, 132kV, 275kV and 400kV networks are captured using incident management systems, where a fault report captures the short interruption details. Both 11kV ground mounted and pole mounted auto re-closer short interruptions are captured using periodic counter readings.

SP Distribution estimates its accuracy of reporting at approximately 81% with a low confidence level. The accuracy figure of 81% has been calculated as shown in Table 4-4:

Table 4-4: SP Distribution Estimate of Short Interruption Reporting Accuracy

Category	Accuracy	Weighting
Customer identification by MPAN	99%	33.3%
Connectivity model	90.7%	33.3%
Short interruption categories • Automatic disconnection/reconnection • Automatic disconnection/manual reconnection • Manual disconnection/manual reconnection • Transmission system, embedded generators etc.	53.3%	33.3%
Overall Accuracy	81.0%	

This low level is due to the inconsistency of data over the last two years and the company is uncertain that the method it has developed and adopted is consistent with other companies. The level of inaccuracy represents largely gaps in the data, for example, failure to read all counter readings, units without counters, exchange units due to maintenance processes and access problems preventing readings from being taken.

During the audit the DNO, expressed its uncertainty with regards to whether its methodology is consistent with that carried out at other DNOs. SP Distribution also stated that it would appreciate comments from Ofgem once all companies' audit reports have been analysed and suggested that a cross fertilisation of ideas could take place potentially resulting in consistent guidelines/approaches.

4.8 SP Manweb – Merseyside & North Wales

In SP Manweb all short interruptions on the 6.6kV, 11kV (except 11kV auto re-closers), 33kV and 132kV networks are captured using incident management systems, where a Prosper fault report captures the short interruption details. Both 11kV ground mounted and pole mounted auto re-closer short interruptions are captured using periodic counter readings.

SP Manweb estimates its accuracy of reporting at approximately 84% with a low confidence level. The accuracy figure of 81% has been calculated as shown in Table 4-5:

Table 4-5: SP Manweb Estimate of Short Interruption Reporting Accuracy

Category	Accuracy	Weighting
Customer identification by MPAN	99%	33.3%
Connectivity model	92.7%	33.3%
Short interruption categories • Automatic disconnection/reconnection • Automatic disconnection/manual reconnection • Manual disconnection/manual reconnection • Transmission system, embedded generators etc.	59.7%	33.3%
Overall Accuracy	83.8%	

This low level is due to the inconsistency of data over the last two years and the company is uncertain that the method it has developed and adopted is consistent with other companies. The level of inaccuracy represents largely gaps in the data, for example, failure to read all counter readings, units without counters, exchange units due to maintenance processes and access problems preventing readings from being taken.

During the audit, the DNO expressed its uncertainty with regards to whether its methodology is consistent with that carried out at other DNOs. SP Manweb also stated that it would appreciate comments from Ofgem once all companies' audit reports have been analysed and suggested that a cross fertilisation of ideas could take place potentially resulting in consistent guidelines/approaches.

4.9 SSE – Scottish Hydro

SHEPD gathers information for its return of short interruptions using two approaches to address the different plant types that cause short interruptions.

- Automatic circuit breakers that are monitored using the company's SCADA system, or secondary control system are monitored in the NMC and from this information an appropriately coded fault report is set up in company's measurements system. These short interruptions are automatically date and time stamped and therefore readily allocated to a reporting period in the same way as any other interruption.
- For pole and ground circuit breakers not monitored in the NMC the company uses a manual data gathering process based on an annual counter reading taken from the field. There is inevitably some uncertainty regarding the allocation of counter readings to a reporting period unless all readings are taken on the same day of the year, which would be operationally impractical.

With regard to the second approach, the company has developed an algorithm based upon its operational experience and knowledge of the schemes it has in use and as a result apply a multiplier of 0.6 to the actual count taken from the field. The company has audited this approximation based on taking a sample of feeders heavily populated with power outage detectors (PODs) and on these feeders the factor was found to be 0.59. The company continues to apply a factor of 0.6, which is considered by the auditors to be accurate across all feeders.

SHEPD estimates that its accuracy is 85%. This is based on a best estimate approach based on its algorithm, which has been verified by comparison with PODs actual results on a small sample of feeders.

The visiting auditors found no inconsistencies in the process for reporting short interruptions. The impact of the potential errors is estimated by the company to be a maximum of 15%, resulting in an accuracy assessment of 85%.

4.10 SSE – Southern Electric

SHEPD gathers information for its return of short interruptions using two approaches to address the different plant types that cause short interruptions.

- Automatic circuit breakers that are monitored using the company's SCADA system, or secondary control system are monitored in the Network Management Centre (NMC) and from this information an appropriately coded fault report is set up in company's measurements system. These short interruptions are automatically date and time stamped and therefore readily allocated to a reporting period in the same way as any other interruption.
- For pole and ground circuit breakers not monitored in the NMC the company uses a manual data gathering process based on an annual counter reading taken from the field. There is inevitably some uncertainty on the allocation of counter readings to a reporting period unless all reading are taken on the same day of the year which would be operationally impractical.

With regard to the second approach, the company has developed an algorithm based upon its operational experience and knowledge of the schemes it has in use and as a result apply a multiplier of

0.7 to the actual count taken from the field. The company has audited this approximation based on taking a sample of feeders heavily populated with Power Outage Detectors (PODs) and confirmed its accuracy.

SHEPD estimates that its accuracy is 85%, this is based on a best estimate approach based on its algorithm, which has been verified by comparison with PODs actual results on a small sample of feeders.

The visiting auditors found no inconsistencies in the process for reporting short interruptions. The impact of the potential errors is estimated by the company to be a maximum of 15%, resulting in an accuracy assessment of 85%.

4.11 United Utilites

All short interruptions at 33kV and 132kV, where higher voltage auto re-closers are tele-controlled, automatically generate an alarm and are manually recorded in PC-NaFIRS together with customer numbers affected. Short interruptions at 11/6.6kV are automatically recorded by the Short Interruptions to Supply (SIS) algorithm within the Control Room Management System.

LV reclosing devices (REZAPS) are used on approximately 10% of LV transient faults. When a REZAP is installed a Log Sheet is completed to record the number of operations/resets, and the circuit noted. When the REZAP is removed, the log sheet is retained. A sample of log sheets was taken in order to determine the average number of operations and the average number of customers affected per REZAP installation, and these averages were extrapolated to represent the total estimated occasions when REZAPS were used, and to complete the IIP report.

In the case of multi-shot and non telemetry reclosing schemes on the 6.6kV and 11kV networks, at least 2 Power Outage Detectors (PODS) are installed downstream of each device, and UU relies on these as its source of detection and IIP reporting, via the SIS algorithms. There are no manual readings of non-telemetry re-closers.

UU estimates an overall level of accuracy of 95.56% for its reporting of short interruptions.

This estimate is based on the following breakdown of reporting accuracy:

Table 4-6: UU Estimate of Short Interruption Reporting Accuracy

	Reporting Accuracy	Confidence Level	% contribution to number of short interruptions
132kV and 33kV	100%	100%	10.31%
11kV and 6.6kV	96.25%	100%	88.22%
LV	100%	50%	1.47%

The processes for recording short interruptions at HV and above are robust, although the processes for correctly recognising and recording by cause should be examined and strengthened. The process for accurately reporting short interruptions at LV does not appear sufficiently robust, since it is based on extrapolation from a sample of returned LV Rezap logs. UU needs to investigate the overall accuracy of this sample. Taking into account UU's own low level of confidence in its estimate of accuracy for LV short interruptions (50%) the visiting auditors support UU' s estimate of 95.56%.

4.12 WPD – South Wales

WPD – South Wales uses the following methodology for recording short interruptions:

- Short interruptions due to automatic operation/automatic restoration, where higher voltage auto re-closers are tele-controlled, automatically generate an alarm and are automatically captured and recorded within the company's Energy Network Management and Control System (ENMAC). A report, detailing these auto re-close operations, is automatically produced by the ENMAC system. This report is then used to manually populate the SI scheme within PC-NaFIRS.
- Short interruptions due to auto operation/manual or remote restoration and manual or remote operation and restoration are manually entered in either Fault Logs, or Trouble Call Logs or both, and are therefore subject to the same audit controls as interruptions. These logs are all manually examined and the short interruption information is manually inputted into the short interruption scheme within PC-NaFIRS.
- Short interruptions due to the transmission system operator and others could be recorded by either method.

Historically LV re-closers have not been used in WPD South Wales but several units are now being trialled.

Short interruptions where multi-shot reclosing schemes are used are recorded in the WPD South Wales operational units and the auto re-closers changed after 100 operations. However, there is currently no robust procedure for entering short interruptions due to manually read auto re-closer operations into the IIP reporting. As a result, the recording of short-interruptions is not currently RIG compliant. WPD undertook an internal assessment of short interruptions in May 2003 and concluded that the control room aspects of the process are robust but the manual counting procedures for auto re-closers need to be improved. The visiting auditors cannot therefore be confident that the IIP template has been completed accurately.

As there is no robust procedure for capturing all auto re-closer operations in South Wales, the DNO does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto re-closers, the DNO considers that the level of accuracy of reporting is the same as for interruptions.

The visiting auditors agree with the DNO's belief that the level of accuracy of reporting those short interruptions measured via tele-control at the WPD - South Wales control room, is equivalent to the accuracy of reporting of interruptions. The visiting auditors are unable to comment on the overall level of accuracy as this has not been estimated by the DNO due to the lack of a robust procedure for the manual counting of auto re-close operations and its affect upon the count of short interruptions.

4.13 WPD – South West

WPD – South Wales uses the following methodology for recording short interruptions:

- Short interruptions due to automatic operation/automatic restoration, where higher voltage auto re-closers are tele-controlled, automatically generate an alarm and are automatically captured and recorded within the company's Energy Network Management and Control System (ENMAC). A report, detailing these auto re-close operations, is automatically produced by the ENMAC system. This report is then used to manually populate the SI scheme within PC-NaFIRS.
- Short interruptions due to auto operation/manual or remote restoration and manual or remote operation and restoration are manually entered in either Fault Logs, or Trouble Call Logs or both, and are therefore subject to the same audit controls as the longer interruptions. These logs are all manually examined and the short interruption information is manually input into the short interruption scheme within PC-NaFIRS.
- Short interruptions due to the transmission system operator and others could be recorded by either method.

The majority of auto re-closers within WPD South West are directly tele-monitored with only 24 remaining to be converted to tele-monitoring.

There is currently no robust procedure for reporting short interruptions in WPD - South West. Therefore, the DNO does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto re-closers, the DNO considers that the level of accuracy of reporting is the same as for interruptions.

The visiting auditors agree with the DNO's belief that the level of accuracy of reporting those short interruptions measured via tele-control at the WPD South West control room is equivalent to the accuracy of reporting of interruptions. The visiting auditors are unable to comment on the overall level of accuracy as this has not been estimated by the DNO due to the lack of a robust procedure for reporting short interruptions.

4.14 YEDL

The protection set-up of HV auto re-close circuit breakers throughout YEDL is such that all circuit breakers back to the primary substation would be expected to operate in the event of a short interruption condition arising on any HV feeder. The number of short interruptions can therefore be captured through SCADA monitoring of the primary substation auto re-closers. All operations of SCADA controlled plant are captured by the Distribution Management System (DMS) and transferred to the YEDL PC-NaFIRS database. The source count of short interruption re-closer operations is then extracted from the PC-NaFIRS data and will exclude pre-arranged interruptions as these are separately categorised.

YEDL does not make significant use of auto re-close devices at the LV level except for safety purposes where their use would be temporarily needed when restoring customers during sustained interruption incidents. There is therefore no requirement to include counts of short interruptions from these sources.

In the view of the visiting auditors YEDL are conforming to the RIG requirements for the reporting of short interruptions. The completion of the IIP template appears to be satisfactory, and YEDL carry out an internal audit check of the final numbers entered into the template prior to submission to Ofgem.

The visiting auditors' accept YEDL's accuracy estimate of 97.2% for the reporting of short interruptions, although there may be a small extra inaccuracy due to the risk of un-quantified errors in the manual checking of short interruptions associated with sustained faults. This is probably small in comparison to the overall numbers. The risk of additional error is probably on the under-reporting side because the exact operation of downstream re-closers is not known with precision and has not been further investigated by YEDL.

4.15 Conclusions

There is a significant variation in the accuracy of reporting short interruptions between DNOs. Some DNOs do not measure short interruption reporting accuracy whilst others have provided estimates of accuracy in excess of 90%.

Significant inaccuracies are introduced due to lack of automation of recording device operation. Inaccuracies also occur due to inability to read data, operational constraints in reading data and poor data recording. Inaccuracy has the potential to occur at any point where manual handling of data is required.

5 Summary of Audit Conclusions and Recommendations

Apart from Section 1, conclusions have been provided at the end of each section of this report. These are restated below:

5.1 Methodology

Given the time available to audit each DNO's reporting system, it was determined that no more than 200 incident restoration stages could be audited. The number of incidents and therefore restoration stages on each of the DNO's systems is significantly greater than 200. Unlike previous years the DNOs were required to provide data at the incident restoration stage level. This resulted in a significant increase in the amount of information provided by the DNOs. There was therefore a requirement to select the 200 incident restoration stages to be audited by sampling the data provided and selecting 200 incident restoration stages that best represented the overall data provided.

It is important that the sample is representative if the reporting accuracy assessed for the audited sample is to be used as the estimate of accuracy for the full data set

Analysis of the differences between the reported and audited CI and CML indicated that these were normally distributed and symmetrical about the mean. This result is in line with what would be expected under the Central Limit Theory. It was therefore concluded that the Stage 3 accuracy could be determined based on a simple summation of the reported and audited CI and CML.

A review of reported and audited CI and CML results indicated that each DNO had outlying results. These outlier results were removed from the assessment of Stage 3 accuracy for each DNO.

The combined accuracy of Stages 1 and 3 was obtained by adding the square of the system inaccuracy (Stage 1) to the square of the audit inaccuracy (Stage 3) and then calculating the square root of the resulting sum.

5.2 Audit Results

All audit visits were undertaken within the agreed time scale. Every DNO was well prepared for the visit and provided an appropriate level of support. Company specific reports have been prepared by the visiting auditors for each DNO.

Measurement of MPAN accuracy is either at or approaching 100%.

All DNOs are filling in the IIP templates to an acceptable level of accuracy.

The main area of concern with regard to compliance with RIG definitions is related to re-interruptions. There are a number of examples where the RIGs are being interpreted inconsistently. DNOs have previously raised the issue of stopping the clock when a customer asks for a delayed restoration of supply or there are circumstances outside the control of the DNO delaying restoration work.

It is recommended that NEDL review its change in the reporting of Pre-Arranged Interruption overruns as the change now means that its reporting is inconsistent with the requirements of section 2.15 of the RIGs

The DNOs have continued to improve the accuracy of their connectivity models and there is evidence that they are following the recommendations made during the 2001/2002 audit. There are still however, differing levels of system automation between DNOs. The lowest estimate of accuracy of a connectivity model was 93.0% made by EPN. Approximately 50% of the DNOs reporting LV connectivity model accuracy in excess of 98% and over 70% reporting similar accuracies for HV connectivity.

There are number of different sources of inaccuracies in the audit models. Some of these are specific to individual DNOs, whereas others are common to a number of DNOs. The common areas of inaccuracy relating to higher voltage incidents include:

- Changes to customer numbers between the date of the incident and the audit.
- Network reconfigurations between the date of the incident and the model at the time of the audit.
- Manual mis-reporting and transcription error.

Although no analysis has been carried out into which of the above areas contributes the most to inaccuracy, manual reporting and transcription have resulted in significant errors being introduced.

All DNOs except for EME have met the minimum reporting accuracy requirements specified in the RIGs. EME has a reporting accuracy level of 84.3% as a result of over reporting LV CML.

The reporting accuracy results contained in the this report have been reviewed by the relevant DNOs and they have confirmed that they are content to accept these as an assessment of its reporting accuracy, as determined by the methodology outlined in this report. However, it should not be concluded from this confirmation that the DNOs necessarily agree with the methodology or that they will not in the future propose amendments to the methodology.

5.3 Short Interruptions

There is a significant variation in the accuracy of reporting short interruptions between DNOs. Some DNOs do not measure short interruption reporting accuracy whilst other have provided estimates of accuracy in excess of 90%.

Significant inaccuracies are introduced due to lack of automation of recording device operation. Inaccuracies also occur due to inability to read data, operational constraints in reading data and poor data recording. Inaccuracy has the potential to occur at any point where manual handling of data is required.

5.4 General Recommendations

Based on the above conclusions the following general recommendations are made by the Consortium:

- Ofgem should consider providing clarity with regards to reporting of re-interruptions.
- Further consideration should be given to specifying what is acceptable evidence for audit purposes.
- Consideration should be given to introducing minimum reporting accuracy requirements for short interruptions, but should take into account the effort required by most DNOs to collect complete data.

6 Learning Points

As part of each audit visit a series of learning points was produced. This enabled the DNOs to provide feedback as to how the process could be improved. The learning points from each DNO are detailed in this section of the report and relate to the auditors, and the audit process, the DNOs themselves and Ofgem. For clarity the learning points that could be applied to all DNOs have be summarised in Section 6.1.

6.1 General

The following general learning points have been noted:

- The audit visits are facilitated by allowing the DNOs sufficient time for preparation.
- Several DNOs expressed concern about the way in which changes to customer population and networks between the time of the incident and the audit are handled.
- One DNO considers that some of the questions in the questionnaire are repetitive and that there could be some refinement and consolidation. In addition, it urged that finalised questionnaires are circulated as early as possible and that where changes occur to questionnaires after the audits begin that these too are distributed to improve the efficiency of the audit process and reduce the potential for confusion.
- With regard to the audit sample there seemed to be an unexpectedly high number of zero customer impact restoration stages. Since the purpose of the audit is to address CI and CML reporting accuracy, there seems to be little value in having these in the samples.
- The use of restoration stages as the basis of the audit also highlighted further issues with the sample. For example, in the case of SSE Scottish Hydro, the use of more than one stage from an incident, clarity in selecting the stage within the incident and the impact of the other stages on the audit stage.
- No spare LV incidents were provided for the audit. There seems to be no reason why spares should not be provided as in the case of HV incidents.
- Numerical reference numbers used do not define the difference between LV, HV and EHV and makes the analysis of the worksheet difficult and sorting impossible.

6.2 Methodology Learning Points

Listed below are the leaning points specifically related to the methodology.

The data for each DNO is typically 5 Mbytes. Because the data was only uniquely identified at the incident level, each data set had to be renumbered to uniquely identify at the restoration stage level. This created another large file that had to be sent back to each DNO together with a much smaller file containing the samples required for audit. If each DNO could uniquely identify each interruption at the restoration stage level before submission, this would save time and avoid sending back 5 Mbyte files to each DNO.

Due to lack of clarity in the data requests, some of the data sets contained short interruptions, i.e., interruptions less than 3 minutes in duration, which are outside the scope of the main audit. The data sets containing short interruptions had to be cleansed prior to analysis.

The LV worksheets of the audit workbooks were not completed by the audit teams in a uniform manner, which suggests that more detailed training of auditors in this area is required.

Data on recording system accuracy is contained in the audit team report and not in the audit workbook. Delays have been experienced in obtaining this data, causing a delay in calculating the combined or overall accuracy. It would save time if the system accuracy information was included in the audit workbook produced for each DNO.

6.3 DNO Specific Learning Points

(i) Aquila

It was found that the Aquila's use of IT systems that were immediately accessible during the audit enabled the amount of paperwork to be kept to a minimum. This helped the audit process.

Completion of the questionnaires by the company before the arrival of the audit team saved considerable time.

Induction to Aquila's systems and processes was very worthwhile.

Numerical reference numbers used do not define the difference between LV, HV, and EHV and makes the analysis of the worksheet and sorting difficult.

(ii) EME

Inconsistency of SI recordings between auto re-closers with telemetry capable of registering multi-shot operations as a single event and auto re-closers without telemetry which register each shot of a multi-shot operation as a single event;

Completion of the questionnaires by the company before the arrival of the audit team saved considerable time.

Induction to EME's measurement and information systems and processes was very worthwhile.

The numerical reference numbers used by EME do not define the difference between LV, HV and EHV and makes the analysis of the worksheet difficult and sorting impossible.

(iii) EPN and LPN

There was clearly an advantage in terms of resources of having the same audit team and same EDF Energy staff audit two companies in the group. This saved significant time in understanding the systems and processes within the second company and dealing with the questionnaires, which were very similar for both companies.

Completion of the questionnaires by the company before the arrival of the audit team saved considerable time.

The induction to the DNO's systems and processes was very worthwhile.

(iv) SPN

The auditors note that SPN is one of a number of DNOs that consider a re-interruption to occur up until three hours after the last customer associated with an incident has been reconnected, even if customers connected earlier and then re-interrupted have been back on supply for more than three hours.

(v) NEDL

The availability of the connectivity model information to field staff will improve the accuracy of LV reporting and assist restoration decisions.

SPN pointed out that differences in customer numbers at the time of incidents occurring and at the time of audit can be expected since system configuration and customer numbers are continually changing. It wishes to emphasise that any "error" associated with this difference is likely to be a consequence of these changes and not a true error.

(vi) SP Distribution and SP Manweb

The following items were identified as learning points for the audit framework:

The audits of the two licence areas in two consecutive weeks, while not impossible, placed additional pressures on both SP Distribution and the auditors in terms of preparation time and resources required to complete the audits. It is noted that the preparation time allowed for each licence area overlapped (due to back to back audits) this reduced the preparation time that SP Distribution and SP Manweb had.

It was noted that some time was spent during the audit investigating changes in the customer numbers between the time of the incident and the time of the audit. SP Distribution considers that some guidance containing examples of the level of information that should be considered auditable would benefit both the DNOs and the auditors.

The DNOs noted that should new auditors be undertaking future audits this would add considerable time to the audit process as the systems would require full outlining as opposed to a summary such as was provided this year.

SP Distribution and SP Manweb considers that some of the questions in the questionnaire are repetitive and that some refinement and consolidation could occur. In addition, they urged that finalised questionnaires are circulated as early as possible and that where changes occur to questionnaires after the audits begin that these too are distributed to improve the efficiency of the audit process and reduce the potential for confusion.

Whilst ‘clock stopping’ was not audited directly by the auditors, it was recorded that the DNO’s methodology allows for this practice. It is noted that Ofgem’s view on ‘clock stopping’ differs from that of the DNO and it is recommended that further discussion on this issue takes place.

SP Distribution made the following observations regarding the sample for incident stages for SP Distribution:

- There were a number of zero CI and CML incidents. A small selection of these would not be a problem, however, 14 out of 16 EHV incident stages were like this. This meant that should an error occur the potential for the averages to mitigate the error is reduced.
- There were a number of incident stages selected from the same incident. SP Distribution were of an understanding that this should not occur. If an error occurs in an earlier stage this will have a ripple effect through the incident.
- The number of incident stages selected for audit this year is an upper limit on what can be prepared and audited within the time allowed. Completion of this sample required significant effort and resources both prior to and during the audits.

SP Manweb considers that it is unfair to include as inaccuracies the additional CML due to the practice of clock stopping when SP Manweb personnel are unable to complete the repairs required for reasons beyond their control. SP Manweb employed this practice in 2001/02 and no recommendations were made to curtail this methodology.

SP Manweb noted that there were a number of incident stages selected from the same incident. SP Manweb were of an understanding that this should not occur. If an error occurs in an earlier stage this has the potential for a ripple effect through the incident.

SP Manweb considers the total number of incident stages selected for audit this year for the two license areas are an upper limit on what can be prepared and audited within the time allowed. Completion of this sample required significant effort and resources both prior to and during the audits.

(vii) SSE – Scottish Hydro and SSE – Southern Electric

The audit sample, based on a random selection of restoration stages from the whole population contained an unexpectedly high number of zero customer impact stages. As the purpose of the audit is to address Customer Interruptions and Customer Minutes Lost these stages add little value to the process. In any future IIP audits, the sample could more usefully be based on “whole incidents” or if restoration stages are used they should be redefined as restoration stages with customer impact.

The use of restoration stages as the basis of the audit also highlighted further issues with the sample, which should be addressed if this process is used again, for example; the use of more than one stage from an incident, clarity in selecting the stage within the incident and the impact of other stages on the audit stage.

SSE believes that the process of updating the connectivity model for the longer term improvement in accuracy of the model must continue but asserts the view that this gradual refinement of the model must not be allowed to reduce its calculated accuracy of reporting due to a moving base.

(viii) United Utilities

The audit of incidents was very much facilitated by UU's preparatory work, allowing the visiting auditors sufficient time to verify the company's "replay" of the incidents, as well as the information pre-provided on the questionnaires.

No spare LV incidents were provided for audit. Although this did not present a big problem, since only a small number of incidents could not be audited, there appears to be no reason why the same approach to spare incidents as that at HV should not be taken.

A more robust and consistent method is needed for agreeing changes in customer population between incident and audit. If documentary evidence of known, newly connected customers is required then this should be made clear to the DNO prior to the audit.

(ix) WPD – South Wales and WPD South West

The audit of incidents at the higher voltages was based on a copy of the network taken on 29 May 2003. Whilst the date on the associated tape could be verified, the visiting auditors had no way of verifying this as the actual date of the data extraction as no automatic time stamping exists. This is important as the audit framework includes unproven customer number changes and changes to the distribution network as inaccuracy and therefore audits undertaken on the live system or recent data extractions will potentially include more changes than audits undertaken on data extractions from the end of the reporting year. For consistency across audits, it is suggested that each company should capture its network as it is on the last day of each reporting year, i.e. 31 March and use this information for the audit.

WPD was able to provide documentation supporting all new and re-referenced customers at the LV level where the connectivity model at the time of the audit differed from that at the time of the incident. No such records were available at the HV level but WPD believes that by implication, if it can prove new and re-referenced customers at LV, then the HV model must be accurate as it is built up from HV/LV substations and reconciled against the LV connectivity model. WPD therefore believes that it was unfair to include unproven customer growth and re-referencing at HV as inaccuracy in the audit results.

WPD feels very strongly that it is unfair to include as inaccuracy differences in customer numbers between the time of the incident and the time of the audit due to changes in the distribution network.

WPD feels that the audit procedure of including re-referenced customers as inaccuracy when evidence could not be provided unfairly penalises it for trying to improve the accuracy of its connectivity model.

The visiting auditors realised during the audit that there is an additional element to WPD's interpretation of re-interruption that was not previously understood. Like many companies, WPD considers an interruption to be a re-interruption if the customers affected were restored from a previous interruption within the last three hours. In addition, WPD considers the following scenario to be a re-interruption: when any number of customers initially interrupted and restored as part of an incident are interrupted again within three hours of the last customers from the initial interruption being restored, even if some of the customers re-interrupted were restored more than three hours earlier in separate restoration stages.

(x) YEDL

That the records retained as evidence of the incidents should be self contained and in themselves should constitute a full and verifiable record for audit purposes.

It is recommended as a result of this audit that Ofgem consider inviting views on an extension to the RIGs to give guidance for DNOs on the reporting of incidents where the customer requests a deferment of supply restoration, so as to ensure consistency across DNOs.

Appendix A Appropriate Sampling Distribution and Sampling Size

A.1 Assessing the Sample Distribution

An inspection of the data provided an indication that the distribution of results did not conform to a normal distribution commonly seen in statistical analysis. Table A1 and Table A2 below summarise the analysis undertaken in determining that the data provided was not a normally distributed data set.

Table A-1: Analysis of Normal Distribution indicators for licence area 1

	Overall		Low Voltage	
	CI	CML	CI	CML
Mean	79.4	6442	14.81	2824
Median	14	1394	4	647
Standard deviation	327.4	15592	26	9616

Table A-2: Analysis of Normal Distribution indicators for licence area 2

	Overall		Low Voltage	
	CI	CML	CI	CML
Mean	65.7	4632	13.89	2323
Median	10	1120	6	775
Standard deviation	427.7	13151	21.56	5630

In both licensed areas the data is not normally distributed: in each case the median is greater than zero and the mean does not coincide with the median. Also, the standard deviations in all cases are greater than the mean indicating that the distributions are very broad. These are all indicators that the data is "lognormally" distributed.

Lognormal distributions are described using the following characteristic values:

- MuAl (Mean antilog) – the value of 50% of the data population, equivalent to the mean on a normally distributed data set.
- SigF – Slope of the cumulative frequency distribution, equivalent to the standard deviation on a normally distributed data set.
- r^2 – "Goodness of fit" between the data and a lognormal distribution as described by MuAl and SigF and the actual data.

Random samples of 600 restoration stages were taken for each of the data elements shown below and the characteristic value (MuAl and SigF) established together with the goodness of fit (r^2). The results of this investigation are shown for the two licence areas in Table A3 and Table A4.

Table A-3: Test for Significance for licence area 1

Data Elements	MuAl	SigF	r^2	Number of restoration stages
Overall incident restoration stages	14.28	6.62	0.947	18645
All LV incident restoration stages	4.003	3.816	0.851	7134
Overall with multiple restoration stages	33.45	5.793	0.977	5333
Overall with single restoration stage	10.8	5.725	0.94	13312
LV with multiple restoration stages	9.52	4.238	0.924	939
LV with single restoration stage	3.435	3.759	0.806	6195
Overall more than one premise	26.17	5.149	0.974	14266
LV more than one premise	11.28	3.148	0.957	4141
Overall incidents with no re-interruption	13.47	6.618	0.943	17386
Overall incidents with re-interruptions	41.36	5.583	0.977	1289
All LV incidents with no re-interruption	3.728	3.784	0.838	6933
All LV incidents with re-interruptions	8.559	3.890	0.906	200
LV	5.218	4.253	0.884	600
11 kV	37.34	5.063	0.970	563
132 kV	810.3	8.232	0.778	26

Table A-4: Tests for significance for licence area 2

Data Elements	MuAl	SigF	r^2	Number of restoration stages
Overall incident restoration stages	9.747	5.699	0.943	23699
All LV incident restoration stages	5.702	3.784	0.918	14853
Overall with multiple restoration stages	17.84	6.145	0.972	6785
Overall with single restoration stage	8.418	5.027	0.939	16914
LV with multiple restoration stages	8.273	3.697	0.960	2563
LV with single restoration stage	5.886	3.777	0.937	12314
Overall, more than one premise	15.93	4.46	0.939	18827
LV more than one premise	9.969	2.767	0.970	11296
Overall incidents with no re-interruption	10.59	5.266	0.958	22545
Overall incidents with re-interruptions	20.73	6.241	0.975	1151
All LV incidents with no re-interruption	5.971	3.887	0.931	14270
All LV incidents with re-interruptions	9.405	3.834	0.946	583
LV	6.542	3.517	0.950	600
11 kV	27.02	6.758	0.976	557
33 kV	580.3	7.576	0.816	120
132 kV	9220	2.068	0.865	9

The r^2 values indicate an excellent degree (in excess of 0.9) of fit in nearly every case, indicating that treating the data set by using a "lognormal" approach is appropriate.

With reference to the MuAl figures contained in Table A3 and Table A4, it can be seen that when the MuAls of related data elements, such as "LV with multiple restoration stages" and "LV with single restoration stage", are compared there are significant differences. For example, in Table A3 "LV with multiple restoration stages" has a MuAl of 9.52 with "LV with single restoration stage" having a MuAl of 3.435. This means that the data is significantly affected by the restoration stage and that the data is therefore required at the restoration stage level.

Of particular significance are the MuAl differences between "overall incident restoration stages" and "All LV incident restoration stages". This indicates that separating these data sets is important and that sampling of both data sets is required. This is also a RIG requirement and the data set confirms that the RIG requirement is necessary.

Tests for significance were carried out on both licensed area data sets to determine the effect of voltage. For licence area 1 there was insufficient data at 33kV and 66kV levels and these have been excluded from the results shown in Table A3. The results for both licensed areas indicate that the results for different voltage levels are significantly different and therefore sampling by voltage level is required.

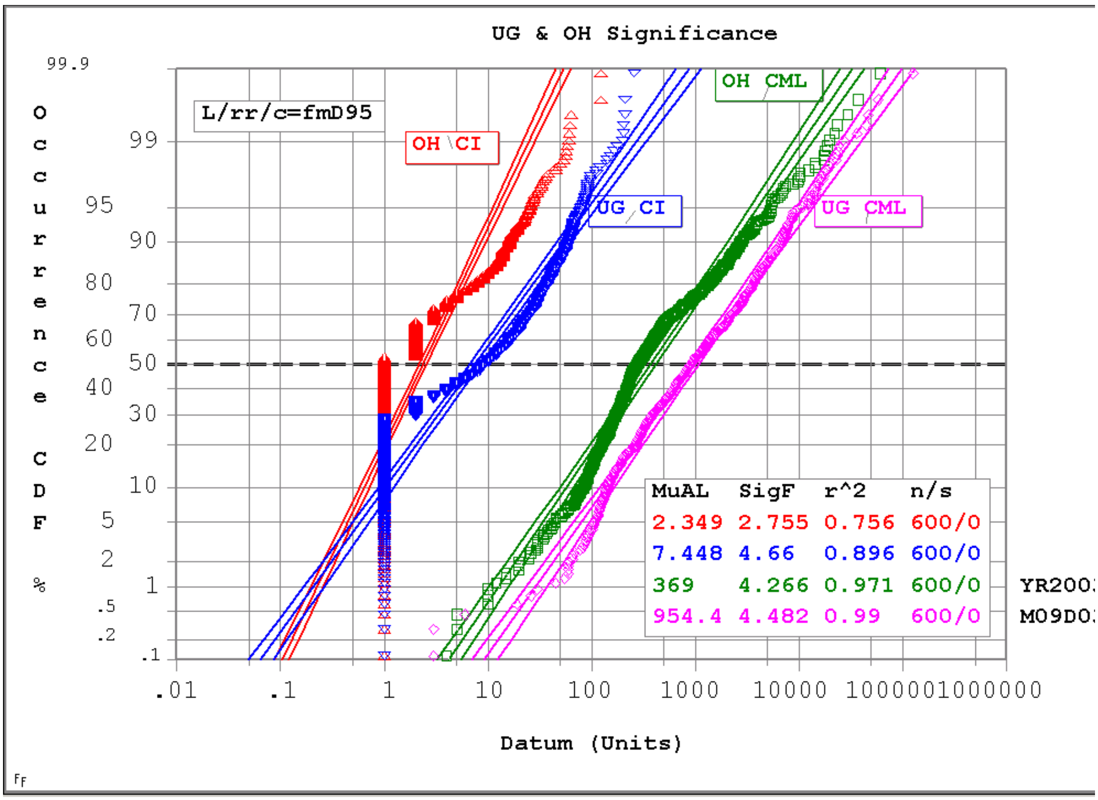
For low voltage incidents the effect of overhead and underground interruptions on both CI and CML was investigated for both licensed areas. It was found that separating data into overhead and underground was significant. The results of this analysis are shown below in Table A5 below. The actual data used in the analysis for licence area 1 is shown in Figure A1.

Table A-5: Significance of Overhead and Underground Incidents on CI and CML for Licence Area 1

Test	MuAl	SigF	r^2	Number of samples
Overhead CI	2.349	2.755	0.756	600
Underground CI	7.448	4.66	0.896	600
Overhead CML	369	4.266	0.971	600
Underground CML	954.45	4.482	0.99	600

The lack of overlap at 95% confidence limits means that underground and overhead interruptions are significantly different for this licensed area. It was therefore concluded that underground and overhead interruptions would be a second factor for stratification.

Figure A-1: Significance of Overhead and Underground Incidents for Licence Area 1



A.2 Sample Size

Sample sizes were established for both CI and CML at both 90% and 95% confidence limits for each licensed area. Sample size

Sample sizes were established for both CI and CML at both 90% and 95% confidence limits for each licensed area.

This was carried out using the following approach:

- Determining the MuAl values of LV interruptions and overall interruptions for CI and CML by taking samples of 600 at random from each complete set of data a total of ten times.
- Applying either 95% or 90% confidence limits to the 600 data set to identify an envelope range of upper and lower bounds of MuAl values.
- Taking random samples of various sizes, each taken a total of ten times.
- For each sample size chosen, the MuAl value of each of the ten trials was then compared with these upper and lower bound values to determine whether they fell within (described as a Pass) or outside the envelope (described as a Fail). An acceptable sample size was defined as achieving at least a 90% pass level.

Appendix B Audit Questionnaires and Guidelines for Completion

B.1 Changes in DNO Measurement System Questionnaire

MOTT MACDONALD | **BRITISH POWER INTERNATIONAL** | **ERA TECHNOLOGY**

OFGEM IIP PROJECT **Audit 2003**

Distribution company name : ………………………………………………

Changes and Updates to measurement systems since the 2002 audit

Team members: (distribution company) ....

(visiting auditors) ....

(visiting auditors)	**Section 1 - Methodology**
RIG N°	
	Have the recommendations from the 2002 audits been implemented? In either case, what are the impacts on the accuracy of reporting?
Ref Ch1	………
	What, if any, changes have been made to the way in which the company has interpreted the definitions and guidance contained in the RIGs?
Ref Ch2	………
	If changes have been made, what is the effect upon the company's estimate of the accuracy of its reporting on the number and duration of interruptions?
Ref Ch3	………

	Section 1 – Changes and Updates – Methodology (Continued)
2.7	What, if any, changes have been made to the way in which the company identifies customers by MPAN count?
Ref Ch4	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………
	If changes have been made, what is the effect upon the company's estimate of the accuracy of its MPAN count and upon the company's estimate of the accuracy of its reporting on the number and duration of interruptions?
Ref Ch5	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………
2.53	What, if any, changes have been made to the company's Connectivity Model?
Ref Ch6	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………
	If changes have been made, what is the effect upon the company's estimate of the accuracy of its Connectivity Model and upon the company's estimate of the accuracy of its reporting on the number and duration of interruptions?
Ref Ch7	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………
	What, if any, changes have been made to the way in which the company populates the IIP template for reporting to Ofgem?
Ref Ch8	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………………………………………………

	Section 1 – Changes and Updates – Methodology (Continued)
	If changes have been made, what is the effect upon the company's estimate of the accuracy of its reporting?
Ref Ch9	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………
5.3	What is the DNO's updated estimate of the accuracy of reporting on the number and duration of interruptions? [Note – excluding short interruptions]
Ref Ch10	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………
	What method has the company used to calculate this accuracy?
Ref Ch11	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………
	What does the level of inaccuracy represent?
Ref Ch12	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………
	What level of confidence does the company place upon its updated estimate of the accuracy of its reporting?
Ref Ch13	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………

	Section 1 – Changes and Updates – Methodology (Continued)
	What are the potential sources of error remaining in the measurement systems? [Note – this question excludes short interruptions as they re dealt with on the “Short Interruptions questionnaire]
Ref Ch14	…………………………………………
	What inconsistencies have been found that will affect the application of the methodology for measuring and reporting on the number and duration of interruptions? [Note – this question again excludes short interruptions]
Ref Ch15	…………………………………………
	What specific elements of the DNO’s measurement systems will affect the future accuracy of reporting on the number and duration of interruptions? [Note – such as ongoing data cleansing of connectivity models and the in-built learning where ‘known’ customers are re-allocated to an LV feeder]
Ref Ch16	…………………………………………
	What level of inaccuracy do these variations introduce?
Ref Ch17	…………………………………………

	Section 1 – Changes and Updates – Methodology (Continued)
	Has the DNO fully taken these variations into account when updating its estimate of the accuracy of reporting? [Note – excluding short interruptions]
Ref Ch18	………
	What future changes does the DNO intend to introduce that will further affect the accuracy of reporting?
Ref Ch19	……
	What will be the impact of these future changes on the accuracy of reporting?
Ref Ch20	……
Ref Ch21	Any further comments regarding the changes made to the company's measurement systems since the 2002 audit? ……

	<u>Section 2 – Conclusions on Changes and Updates</u>
	What, if any, inconsistencies have been found during the audit on changes to the company's measurement systems?
Ref Ch22	…………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ……………………………
	If any inconsistencies have been found, do they make a significant difference to the company's estimation of its accuracy of reporting on the number and duration of interruptions? If so, why?
Ref Ch23	…………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ……………………………
	Section 2 – Conclusions on Changes and Updates
	Do we agree with the company's estimation of its accuracy of reporting on the number and duration of interruptions? If not, why not?
Ref Ch24	…………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ……………………………………………………………………

	Section 2 – Conclusions on Changes and Updates (Continued)
	Are we confident that the IIP template has been completed accurately? If not why not? [Note – this question excludes short interruptions]
Ref Ch25	…………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ………………………………

B.2 IIP – 2003 audit visits – changes in DNO measurement systems since the 2002 audit

B.2.1 Background information

The accuracy of the MPAN counts and Connectivity Models was explored during the 2002 audit and we are not envisaging that any subsequent changes made to companies' measurement systems will have reduced the accuracy of reporting.

Our work will thus be to explore any changes and to check that no unforeseen anomalies have been introduced as a consequence of the changes to measurement systems.

Whilst some DNOs have used a connectivity model for some years, several were still in the throes of this data-cleansing work at the time of the 2002 audit visits and anticipated that the accuracy of their models would increase with time and experience in using them.

B.2.2 Aim of the Audit

In essence, our task here is to check the impact of any changes to measurement systems as any such changes may have led to either an increase or decrease in the levels of accuracy of reporting.

At the time of the 2002 audits, each DNO provided us with an assessment of the accuracy of its connectivity model and we need to explore changes to measurement systems and to challenge any inconsistencies that we may find as a result of those changes.

In the case of Scottish Power and Scottish Power Manweb more detailed analysis of the connectivity model is required because they have only introduced measurement systems with LV connectivity during the 2002 / 2003 reporting year. The audit teams looking at these companies will use the 2002 audit questionnaire to assess their connectivity models.

B.2.3 Methodology

In order to check the operation of the DNO's procedures, we will do the following:

1. Study the 2002 audit report as provided to the audit team on the audit team-training day. Following the work we did at last year's audit, the company specific appendices of the main report contain details of the various approaches adopted by the DNOs in the introduction of IIP-compliant measurement systems. Companies are continually updating their measurement systems and processes and several reports included recommendations where improvements could be made to processes or measurement systems. We therefore need to examine the work that has been done since the 2002 audits.

2. Study the information requested by the core team in advance of the audit visits on any changes that have been made to the companies' measurement systems. This will include any changes to the companies' own best estimate of the accuracy of its measurement systems plus the associated methodology from which this estimate is obtained and any further information that may be helpful.

3. Check that the proposed changes have been followed and that they have not introduced any unforeseen anomalies or resulted in any reduction in the accuracy of reporting. Investigate any reasons for changes to the DNOs plans. (This will be done though questioning as per the attached questionnaire).

4. Record all answers electronically.

B.2.4 Results

1. We will record any changes that have been made to the way in which customers have been identified by MPAN count.

2. We will record any changes that have been made to companies' measurement systems as a result of clarification of the definitions contained in the RIGs.

3. We will record any changes that have been made to companies' Connectivity Models, including any changes in the companies' estimates of the accuracy of their Connectivity Models.

4. We will consider the consequences of introducing any changes and probe to seek out any inconsistencies or unforeseen inaccuracies that may have resulted from the changes to measurement systems.

5. If any discrepancies are found, then we should probe further. We need to be sure that any discrepancies are not the norm, that there is no undue bias in the measurement systems and that there is consequently no greater degree of inaccuracy within them.

6. In the case that inaccuracies are found and we suspect that these are not reflective of a one-off situation, we conclude that we cannot corroborate the company's estimate of accuracy of its measurement systems and that we consider that the accuracy level is likely to be lower.

7. The results of these assessments should be logged on the attached sheets.

8. We will record any inconsistencies or inaccuracies found during the questioning which may point to the company's estimates of accuracy being different and potentially lower.

B.2.5 Questionnaire

The questionnaire for updates and changes is in two sections as follows :

Section 1 covers the questions for recording any changes that the DNO has introduced in the interpretation of the RIG definitions; any changes in the method used to identify customers by MPAN count; any changes to the Connectivity Model; any changes to the method used to populate the IIP Template (excluding short interruptions) and an update to the company's estimate of its accuracy of reporting. Questions are included to aid the understanding of the methodology used and the approach to the estimate of accuracy of reporting.

Section 2 contains the conclusions.

B.3 Accuracy Of Connectivity Model Questionnaire

MOTT MACDONALD	BRITISH POWER INTERNATIONAL	ERA TECHNOLOGY

OFGEM IIP PROJECT **Audit 2003**

Distribution company name : ....
Accuracy of Connectivity Models

Team members: (distribution company) ....
(visiting auditors) .... (date) ....

	Section 1 - Methodology
Ref C1	How has the specification for the connectivity model been produced? Does the LV connectivity model link to the higher voltages? If so how, what is the linkage?
	………
Ref C2	What tests have been done to verify the predicted levels of accuracy?
	………
Ref C3	What has happened since the Interim Review?
	………

	Section 1 – Connectivity Methodology (Continued)
Ref C4	Has the number of inconsistencies and uncertainties reduced? How has this been achieved? Is this a long-term trend or a one-off? [Note - as most DNOs have a number of customers for which the connections are not precisely known, this would improve the accuracy of the connectivity model]
	…………………… …………………… …………………… …………………… …………………… …………………… ……………………
Ref C5	Has the DNO actually followed the methodology presented at the Interim Review? If not, why not? Where does it vary?
	…………………… …………………… …………………… …………………… …………………… …………………… …………………… …………………… …………………… ……………………
Ref C6	What is the company's present estimate of the accuracy of its Connectivity Model?
	…………………… …………………… …………………… ……
Ref C7	What method has the company used to calculate this accuracy?
	…………………… …………………… …………………… …………………… ……………………

	Section 1 – Connectivity Methodology (Continued)
Ref C8	What does the level of inaccuracy represent?
	……………………………… ……………………………… ……………………………… ……………………………… ……………………………… ………………………………
Ref C9	What level of confidence does the company place upon the accuracy?
	……………………………… ……………………………… ………………………………
Ref C10	What are the potential sources of error in the Connectivity Model?
	……………………………… ……………………………… ……………………………… ……………………………… ………………………………
Ref C11	What inconsistencies have been found that will affect the application of the methodology?
	……………………………… ……………………………… ……………………………… ……………………………… ………………………………
Ref C12	What specific areas within the DNO affect the accuracy of the model? [Note – such as interconnected networks and multiple LV feeders passing premises]
	……………………………… ……………………………… ……………………………… ……………………………… ……………………………… ……………………………… ……………………………… ……………………………… ………………………………

	Section 1 – Connectivity Methodology (Continued)
Ref C13	What level of inaccuracy do these variations introduce?
	…… …… …… …… …… …… ……
Ref C14	Has the DNO fully taken these variations into account when assessing the accuracy of its connectivity model?
	…… …… …… …… ……
Ref C15	How does the DNO provide for updating the model with customer numbers?
	…… …… …… …… …… …… …… ……
Ref C16	What is the impact of this (i.e. C15 above) on the accuracy of the model? [Note - RIG para 2.53 mentions some time spans. Some DNOs aim to improve upon these times]
	…… …… …… …… …… ……

	Section 1 – Connectivity Methodology (Continued)
Ref C17	How does the DNO provide for updating the model with operational (temporary) and permanent network changes?
	…… …… …… …… …… …… ……
Ref C18	What is the impact of this (i.e. C17 above) on the accuracy of the model? [Note - RIG para 2.53 mentions some time spans. Some DNOs aim to improve upon these times]
	…… …… …… …… …… ……
Ref C19	Taking all factors into account, what is the consequential effect upon the level of inaccuracy on the DNO's estimate of accuracy for its connectivity model?
	…… …… …… …… …… …… ……
	Any further comments / conclusions regarding the Connectivity Model? …… …… …… …… …… …… ………………………………………………………………………………

	Section 2 – Checking five LV feeders in the Connectivity Model [Note – as mentioned in the guidance notes – this checking will only be possible in cases where service cables or service connections are shown on the DNO's LV mains records]
Ref C20	Select five LV feeders from the DNO's LV network diagram and enter the feeder references in the first column of the table below [Note – we are looking for LV feeders chosen at random]
Ref C21	From the mains records, count the number of customers that are connected to each of these LV feeders and enter these figures in the second column of table C25 below.
Ref C22	From the DNO's LV connectivity model, note the numbers of customers and enter these figures in the third column of table C25.
Ref C23	Note any variances between the entries in columns two and three in the fourth column of table C25.
Ref C24	Enter any comments on these variances in the fifth column of table C25.

Ref C25	Customer numbers			
LV feeder reference	mains records	connectivity model	Variance	Comments on variances [continue in C26 if necessary]
	(a)	(b)	(a-b)	

Ref C26	Further comments on any variances [Are these variances the norm? Is it a one-off situation?]
	…… …… …… …… …… …… …… …… …………………………………………

	Section 2 – Checking five LV feeders in the Connectivity Model (Continued)
	Any further comments regarding the checking of the five LV feeders ? …… …… …… …… …… …… …… …… ...
Ref C30	What, if any, inconsistencies have been found during the audit on Connectivity Model(s) – (Section 1 questions)?
	…… ...………………………………………………………………………………………...……………………………… ………………………………………..………………………………………..………………………………………… ………………………………………………………………………...……………………………………………… ……... ……... ………………
Ref C31	What, if any, inconsistencies have been found during the checking of the five LV feeders – (Section 2 questions)?
	…… ...………………………………………………………………………………………...……………………………… ………………………………………..………………………………………..………………………………………… ………………………………………………………………………...……………………………………………… ……... ……... ………………
Ref C32	If any inconsistencies have been found, do they make a significant difference to the company's estimation of its accuracy of its Connectivity Model(s)? If so, why?
	…… …… ………………………………………………………………………...……………………………………………… …… ...……… ..……… …………………………………………………………………………………...…………………………………

	Section 2 – Checking five LV feeders in the Connectivity Model (Continued)
Ref C33	Do we agree with the company's estimation of its accuracy of its Connectivity Model(s)? If not, why not?
	…… …… …… ...…………………………………………………………………………………………...……………………………… ……………………………………..……………………………………..……………………………………………… …………………………………………………………………...………………………………………………… ………... ………... ……………… …………………………………………………………………………………………...………………………………… … …………………………………………………………………………………………...………………………………… …

B.4 Counting "Customers Interrupted" – assessment of accuracy of a Connectivity Model

B.4.1 Background Information

If a DNO does not accurately know the number of customers affected by an interruption, it cannot report accurately to Ofgem.

Once each Distribution Network Operator (DNO) knows how many metered customers it has connected to its distribution networks in total, it next needs to know where they are connected.

Only by knowing where customers are, can a DNO report on the numbers of customers whose supplies are interrupted during an incident on a particular part of the network.

Within the industry, the customer-to-distribution network link has become known as the "Connectivity Model" as referred to in RIG paras 2.47, 2.48, 2.49 and 2.53. All DNOs have established connectivity models at the LV level.

Thus, for example, if an LV fuse operates at a distribution substation, the connectivity model is used to assess the number of customers affected by the supply interruption.

Most DNOs have developed this LV connectivity model so that it is also used to report the number of customers affected by an interruption at the successively higher voltage levels.

In their approaches to establishing the LV connectivity models, DNOs have either used known service cable records or predictive techniques (using algorithms) or a combination of the two.

Most DNOs use their LV connectivity models to calculate the number of customers interrupted at the higher voltages.

Whilst some DNOs have used a connectivity model for some years, most were still in the throes of this work at the time of the Interim Review.

B.4.2 Aim of the Audit

In essence, our task here is to check the levels of accuracy to which each DNO has represented customer connections within its Connectivity Model(s).

Each DNO has provided us with an assessment of the accuracy of its connectivity model and we need to understand any work that the DNO has done to assess if this prediction has been achieved. We need to explore the DNOs estimates and to challenge any assumptions that have been made.

B.4.3 Methodology:

In order to check the operation of the DNO's procedures, we will do the following:

- Study the Interim review report as provided to the audit team on the audit team training day. Following the work we did at last year's Interim Review, the company specific appendices of the main report contain details of the various methodologies adopted by the DNOs in producing their connectivity models. Therefore, we need to examine the work that has been done since the Interim Review.
- Study the information requested by the core team in advance of the audit visits on the companies' connectivity models. This will include the specification of the model in its operational form, the results of any tests that have been carried-out against this specification, the companies' own best estimate of the accuracy plus the associated methodology from which this estimate is obtained and any further information that may be helpful.
- Check that the proposed approaches have been followed, investigating any reasons for changes to the DNOs plans. (This will be done though questioning as per the attached questionnaire).
- In DNOs where the LV mains records contain details of service cables, it should be possible to cross-check the mains records with the connectivity model as follows: Select five LV feeders at random and compare the numbers of service connections shown on the mains records with the associated number of customers contained within the connectivity model. (Note – this is true of paper or computerised systems such as Graphic Information Systems (GIS))
- As part of our trialling of Stage 3 of the audit framework, we have concluded that we cannot use this method of cross-checking in DNOs that do not show service cable records on their mains record. We must therefore rely upon the conclusions of the work undertaken at items 1 to 4 above.
- Record all answers.

B.4.4 Results

We will determine the accuracy of the connectivity model based on the estimates provided by the companies and our findings. Accordingly, the following will take place:

- We will record any inconsistencies or inaccuracies found during the questioning which may point to the company's estimates of accuracy being different and potentially lower.
- We will record whether the five LV feeders checked provide the right customer count. In the case that all five LV feeders are correct and no inconsistencies have been found as mentioned in 1 above, then we will accept the DNO's estimate of the accuracy of its connectivity model.
- If any discrepancies are found, either during the questioning or during the checking of the five LV feeders, then the DNO should be asked to probe further. We need to be sure that any discrepancies are not the norm, that there is no undue bias in the connectivity model(s) and that there is consequently no greater degree of inaccuracy within the model(s). If time permits, selecting another five LV feeders at random may help in the assessment of whether or not this is a spurious result.
- In the case that inaccuracies are found and we suspect that these are not reflective of a one-off situation, we conclude that we can not corroborate the company's estimate of accuracy and that we consider that the accuracy level is likely to be lower.
- The results of these assessments should be logged on the attached sheets.

B.4.5 Questionnaire

The questionnaire is in three sections as follows:

- Section 1 covers the questions for checking the methodology used, including questions to aid the understanding of the methodology used.
- Section 2 covers the cross-checking to LV mains records (where possible).
- Section 3 contains the conclusions.

B.5 "Short Interruptions" Questionnaire

MOTT MACDONALD BRITISH POWER INTERNATIONAL ERA TECHNOLOGY

OFGEM IIP PROJECT

Audit 2003

Distribution company name : ....

Short Interruptions

Team members: (distribution company) ....
(visiting auditors) .... (date)
....

	Section 1 – Methodology
RIG N°	
	How does the DNO ensure that all short interruptions at the higher voltages are captured by its measurement systems?
Ref SI1	………………………………………………………………………………………………
	How does the DNO automatically record short interruptions at the higher voltages and identify them by cause?
Ref SI2	………………………………………………………………………………………………
	How does the DNO manually record short interruptions at the higher voltages and identify them by cause?
Ref SI3	………………………………………………………………………………………………

	Section 1 – Short Interruptions – Methodology (Continued)
	How much use does the DNO make of reclosing devices at the LV level? Is this significant? If 'yes', how are these recorded and reported by the measurement systems?
Ref SI4	…………………………………………………………………………………………… ……………………..……………………………………………………………………… ………………………………………..………………………………………………… ……………………………..………………………………………………………… ………………………………………………………………..……………………… ……………………………………………..……
	How does the DNO identify the number of short interruptions 'in the case of multi-shot reclosing schemes'? [Note – this could apply to both automatic and manual methods of counting the number of operations]
Ref SI5	…………………………………………………………………………………………… ……………………..……………………………………………………………………… ………………………………………..………………………………………………… ……………………………..………………………………………………………… ………………………………………………………………..……………………… ……………………………………………..……
	How does the DNO exclude 'those operations counted elsewhere' from 'a simple count of all operations of automatic reclosing devices'? [Note – this could apply to both automatic and manual methods of counting the number of operations]
Ref SI6	…………………………………………………………………………………………… ……………………..……………………………………………………………………… ………………………………………..………………………………………………… ……………………………..………………………………………………………… ………………………………………………………………..……………………… ……………………………………………..……
	Where a periodic count is used, how does the DNO identify normal circuit configuration when estimating the numbers of customers interrupted? [Note – it can be inferred from this that companies' need to record network changes so that they can recast the original network configuration some time later]
Ref SI7	…………………………………………………………………………………………… ……………………..……………………………………………………………………… ………………………………………..………………………………………………… ……………………………..………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………..…………………………………………………………………..……

	Section 1 – Short Interruptions – Methodology (Continued)
	Where a 'periodic count' is used, how does the DNO 'ensure a reasonable approximation to a 12-month total'? [Note – this principally applies to manual methods of counting the number of operations]
Ref SI8	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ………………………………………………
	What is the DNO's estimate of the accuracy of reporting short interruptions?
Ref SI9	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ………………………………………………
	What method has the company used to calculate this accuracy?
Ref SI10	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ………………………………………………
	What does the level of inaccuracy represent?
Ref SI11	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ………………………………………………
	What level of confidence does the company place upon its estimate of accuracy?
Ref SI12	…………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… …

	Section 1 – Short Interruptions – Methodology (Continued)
	What specific elements of the DNO's measurement systems will affect the accuracy of reporting short interruptions? What inconsistencies have been found? [Note – such as estimating the number of short interruptions from multi-shot schemes and estimating the numbers of customers interrupted where network changes have occurred]
Ref SI13	…………………………………………………………………………………… …………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ………………………………………………………
	What level of inaccuracy do these variations introduce?
Ref SI14	…………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………
	How has the DNO fully taken these variations into account when estimating the accuracy of reporting short interruptions?
Ref SI15	…………………………………………………………………………………… ……………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………
	What internal audits has the DNO undertaken to assess the accuracy of its estimate for the reporting of short interruptions?
Ref SI16	…………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… …………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… …………………………………………………………………………………… ……………………………………………………………………………………

	Section 1 – Short Interruptions – Methodology (Continued)
	How have the results of the internal audits been integrated into the reporting systems for short interruptions?
Ref SI17	…………………………………………………………………………………………………… ………………………………………………………………………………… ……………………………………………………………..………………………………………… …………………………………………………..…………………………………………………… ……………………………………………………………………………… ………………………………………………………………………………………… ……………..………………………………………………………………………..……
	What future changes does the DNO intend to introduce that will affect the accuracy of reporting of short interruptions?
Ref SI18	…………………………………………………………………………………………………… …………………………………………………………………………………………………… …………………………………………………………………………..………………………… ……...…………………………………………………………………………………………… ………………………...…………………………………………………………………………… ………………...…………………………………………………………………………………… …………………………………………………...………………………………………………… ………………………..……
	What will be the impact of these future changes on the accuracy of reporting short interruptions?
Ref SI19	…………………………………………………………………………………………………… …………………………………………………………………………………………………… …………………………………………………………………………..………………………… ……...…………………………………………………………………………………………… ………………………...…………………………………………………………………………… ………………...…………………………………………………………………………………… …………………………………………………...………………………………………………… ………………………..……

Ref SI20	Any further comments regarding the company's measurement systems for recording and reporting short interruptions? …………………………………………………………………………
	Section 2 – Conclusions on Short Interruptions
	Does the measurement and reporting of short interruptions comply with the RIGs? If not why not?
Ref SI21	…………………………………………………………………………
	Are we confident that the IIP template has been completed accurately for short interruptions? If not why not?
Ref SI22	…………………………………………………………………………

	Section 2 – Conclusions on Short Interruptions (Continued)
	What, if any, inconsistencies have been found during the audit on short interruptions?
Ref SI23	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………
	If any inconsistencies have been found, do they make a significant difference to the company's estimation of its accuracy of reporting short interruptions? If so, why?
Ref SI24	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………
	Do we agree with the company's estimation of its accuracy of reporting short interruptions? If not, why not?
Ref SI25	………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… ………………………………………………………………………………………………… …………………

B.6 "Short Interruptions" – assessment of accuracy of reporting

B.6.1 Background Information

RIG paragraphs 2.29 to 2.34 contain the instructions and guidance for DNOs to report on short interruptions.

The definition of a short interruption is contained in RIG paragraph 2.29: "the loss of supply of electricity to one or more customers due to automatic, manual or remote control operation of switchgear or fusegear on the distribution system or other systems, upstream of the customers interrupted, where supply is restored within three minutes".

The majority of short interruptions occur at the higher voltages, where some items of switchgear are equipped with re-closing devices that automatically re-energise circuits in the event of a fault. In situations where switchgear is monitored by SCADA or a stand-alone monitoring system these short interruptions are automatically identified and recorded.

Whilst the majority of short interruptions will occur at the higher voltages, some DNOs have introduced ‘LV re-zappers’ which take the place of a fuse and have the effect of automatically re-energising LV feeders in the event of a fault occurring. RIG paragraph 2.31 requires those DNOs that ‘make significant use of automatic reclosing devices and automatic switching at the LV level’ to include these short interruptions in the total numbers reported.

RIG paragraph 2.33 requests DNOs to identify the numbers of customers interrupted by short interruptions ‘in the same way as for incidents’. RIG 2.33 also includes the special rule of identifying the number of customers affected where a periodic (manual) count of recloser operations is used to identify short interruptions.

Where the switchgear is not monitored remotely, then a manual count has to be made of the number of occasions that the switchgear has operated. In these instances, RIG 2.34 applies and DNOs are requested to: “read annually between 1 January and 31 March to ensure a reasonable approximation to a 12-month total”.

RIG paragraph 5.4 requires DNOs to: “indicate the estimated accuracy of the reporting of short interruptions to supply”. It also states: “This should include a statement on the method used to measure short interruptions and how the estimated level of accuracy has been assessed. Ofgem’s appointed auditors will provide an assessment on the reasonableness of the estimate and whether in their view it has been achieved”.

DNOs are required to report on the number of short interruptions as part of their annual report to Ofgem under the IIP reporting template developed by our Consortium during the first phase of the IIP work.

B.6.2 Aim of the Audit

In essence, our tasks on short interruptions are to:

(a) review the way in which DNOs measure short interruptions;

(b) determine whether the DNOs are complying with the RIGs

(c) determine whether the DNOs are correctly reporting short interruptions via the IIP template

(d) examine how the DNOs estimate the accuracy of their reporting and

(e) provide an opinion on the reasonableness of their estimates of the accuracy of reporting.

Each DNO will provide us with an estimate of the accuracy of its reporting the number of short interruptions. We need to understand how this estimate was calculated and any work such as internal audit that the DNO has done to assess if the estimate is accurate. We need to explore the DNOs’ estimates and challenge any assumptions that have been made.

The numbers of customers affected by short interruptions will be identified from the DNOs’ connectivity models. The accuracy of the DNOs’ connectivity models was reviewed last year and we are not required to repeat this work. However, we will need to understand how DNOs identify the numbers of customers affected by short interruptions where reference is made to an historic network configuration as required under RIG paragraph 2.33.

B.6.3 Methodology

For task (a) we will consider how the DNOs identify that an interruption is ‘short’, i.e. of less than three minutes duration and how they ensure that all short interruptions are captured by the measurement systems.

For task (b) we need to cross check the answers to the questionnaire with the requirements of the RIGs.

For task (c) we will explore how the DNO populates the short interruptions section of the IIP template

For task (d) we need to examine the DNOs’ estimates of accuracy of reporting short interruptions, including the methods of calculation and any assumptions made.

There may be significant differences between the reporting accuracies of those short interruptions that are measured by automatic means and those that are measured manually and the questionnaire is designed to explore and identify any differences.

For task (e) we need to consider the DNOs’ estimates in the light of our findings as part of tasks (a) and (b) as well as against the methods of calculation reviewed as part of task (d).

As a start-point we will ask the DNOs to pre-populate the Short Interruption Questionnaire, which includes the provision of the estimate of accuracy of the reporting of short interruptions, including the method of calculation and any assumptions made.

B.6.4 Results

If we can find no glaring anomalies or inconsistencies then, subject to any inaccuracies being identified in items 1 to 5 above, we should accept the DNO’s estimate of the accuracy of its reporting of short interruptions.

If any discrepancies are found then the DNO should be asked to probe further. We need to be assured that any discrepancies are not the norm, that there is no undue bias in the measurement system and that there is consequently no greater degree of inaccuracy within it.

Taking all factors into account, what is the consequential effect of the level of inaccuracy on the DNO’s estimate of accuracy for reporting of short interruptions?

B.6.5 Questionnaire

The questionnaire for short interruptions is in two sections as follows :

- Section 1 covers the questions for checking the application of the RIG definitions, the methodology used to identify all short interruptions and the company's estimate of its accuracy of reporting. Questions are included to aid the understanding of the methodology used and the approach to the estimate of accuracy of reporting.
- Section 2 contains the conclusions.

Appendix C Workbook and Guidelines

C.1 Audit of Incident Sample For All Voltages

AUDIT OF INCIDENT SAMPLE FOR ALL VOLTAGES												
Planned and Unplanned												
Incident		**Reinterruption Stage**			**Customer Interruptions**					**Customer Minutes Lost**		
Company Refernce No.	Restoration Stage	Reported	Audit Check	Method of Restoration	Report CI	System CI	Audit CI	Company CI	Comments	Report CML	Audit CML	Company CML

C.2 Audit of Incident Sample for Low Voltage

AUDIT OF INCIDENT SAMPLE FOR LOW VOLTAGE
Planned and Unplanned

Incident		Reinterruption Stage			Customer Interruptions				
Company Refernce No.	Restoration Stage	Reported	Audit Check	Method of Restoration	Report CI	System CI	Audit CI	Company CI	Comments

C.3 CML Calculator

Start Time	Restored Time	Minutes	Customers	CML
04-Mar-03 14:23	05-Mar-03 07:11	1008	26	26208

C.4 Ofgem IIP 2003 Audits – Guidelines on Incident Auditing Workbook

These notes explain the main features of the Incident Auditing Workbook. The workbook has been created based on the work undertaken prior to the 2002 audits and the experience gained in the 2002 audits.

Separate worksheets are provided for the overall voltage sample and the LV incident sample. The overall voltage sample should be audited first as this is the most important for the accuracy results.

The following conventions have been used when referring to columns:

- ‘Report’ and ‘Reported’ relate to information from the DNO’s incident reports. It is the same data as submitted in the IIP template.
- ‘Audit’ relates to information entered by the audit teams based on review of the audit trail information.

DNOs should populate the following columns in advance of the audit:

- Column A – Incident, Company Reference No.
- Column B –Restoration Stage of Incident
- Column C – Is the stage reported as a re-interruption? (see notes below on definition of a re-interruption)
- Column E –Method of Restoration. Does the stage include a temporary restoration?
- Column F – Report Customer Interruptions for each stage
- Column K – Report Customer Minutes Lost for each stage.

The titles of these columns have been shaded yellow in the blank master workbook.

C.5 Basis of the Audit

In a modification to last year’s approach, the audit sample for 2003 is comprised of individual restoration stages rather than entire incidents containing varying numbers of restoration stages. Auditors need only record audit numbers for the restoration stage selected in the sample, however an understanding of the entire incident will be necessary to verify that the restoration stage has been correctly reported.

It is possible that restoration stages may be missed in the incident reports prepared by the DNOs or single stages split incorrectly into two or more stages and the restoration stage being audited may be confused as a result. In this situation, auditors should include the entire incident in the audit so that the overall count of CI for the incident is captured and the DNOs are not unduly penalised for incorrect allocation of CI between restoration stages. To include an entire incident, auditors should add sufficient rows to the workbook to accommodate all stages of the incident and populate the rows with the information normally reported by the company (columns A, B, C, E, F and K as described above), then add the audit results as normal.

The following describes the main sections of the workbook.

C.6 Incident

This section records the DNO's incident reference number and the number of the restoration stage being audited in the incident.

C.7 Re-interruption Stage

This section records whether a particular restoration stage relates to restoration of customers who were re-interrupted. It should be noted that there is at least two different interpretation of the RIGs definitions relating to re-interruptions. Ofgem has deferred issuing clarification on which interpretation should be used until the next price review. Auditors are therefore required to ask the DNO how it currently interprets re-interruptions and to use that interpretation when checking re-interruptions.

The two main interpretations of the RIGs definitions of re-interruptions for the 3-hour rule are as follows:

- If a customer or group of customers is interrupted and restored as part of an incident and then interrupted again within three hours of being initially restored and the incident has not finished, this is classified as a re-interruption. The count of Customers Interrupted (CI) should not include these customers but the count of Customer Minutes Lost (CML) should include the product of customers and duration for these customers.
- If a customer or group of customers are interrupted and restored as part of an incident and then interrupted again at any time while the incident continues up to three hours after the last customers in the incident have been restored, this is classified as a re-interruption. The count of Customers Interrupted (CI) should not include these customers but the count of Customer Minutes Lost (CML) should include the product of customers and duration for these customers.

A second rule known as the 18-hour rule applies to customers re-interrupted following restoration via a temporary supply arrangement (a non-permanent change to network feeding arrangements or the use of backup generation). Re-interruptions of this nature can occur when the network feeding arrangements are returned to normal. As with the 3-hour rule, the auditors should use the interpretation used by the DNO when checking re-interruptions.

Columns C and D of the workbook should contain one of the following entries for each restoration stage:

- 'No' – a re-interruption did not occur.
- 'Yes' – a re-interruption occurred under the 3-hour rule described above.
- 'Temp' – a re-interruption occurred within 18 hours of the initial restoration that involved a temporary connection.

Column E of the workbook captures the restoration method as recorded in PC-NaFIRS. A '4' or '8' in this column indicates that a form of temporary connection was used, usually at higher voltage levels. At LV, DNO's may record a simple 'yes' or 'no' in this column to identify if a temporary restoration (generator or backfeed) was used to restore customers. If a DNO does not record restoration method this column should be left blank.

C.8 Customer Interruptions

This section of the workbook captures the total customer interruptions related to a restoration stage. ‘Report CI’ is the number of CI reported by the DNO for a given restoration stage. ‘System CI’ is the number of CI arising from recreation of the incident on the DNO’s connectivity model during the audit. ‘Audit CI’ is the confirmed number of CI in a restoration stage as checked by the audit team from the audit trail information provided by the DNO and agreed with the DNO’s representatives.

In the case of a restoration stage that is a re-interruption, CI contribution from that stage should strictly be zero according to the RIGs definitions for counting CI. However, for the purpose of the audit the actual numbers for customer affected should be entered into the workbook as per a normal restoration stage.

In the majority of restoration stages audited, the Audit CI number should be equal to the System CI number, i.e. the number of customers that the DNO’s customer connectivity model indicates would be interrupted if the incident occurred today. The Audit CI result should only differ from the System CI result if the DNO can prove with appropriate records one of the following:

- that significant changes in customer numbers occurred between the date of the incident and the audit due to for example construction of a new housing estate or a change in the network configuration
- abnormal feeding arrangements existed at the time of the incident.

The auditors should record in the comments column a reference to documentation provided by the DNO to support its claim. This will ensure an adequate audit trail for our work. If the DNO claims that a difference between Report CI and System CI is due to one of these causes but cannot provide sufficient paperwork to support this, then the connectivity model numbers should be used for the Audit CI result without any negotiation of figures or alternative numbers being used. This is important to achieve consistency across the audit teams.

In the case of small changes in customer numbers that the DNO claims are due to normal growth which cannot be substantiated with documentation, it has been agreed with Ofgem that the connectivity model numbers at the time of the audit (System CI) should be used as the Audit CI result. In these instances a comment should be included in the comment column to indicate that the cause of the variance given by the DNO is natural customer growth. This is important to achieve consistency across audits. If, however, the DNO can prove that the difference is due to normal customer growth, then it is likely that the Report CI number used at the time of the incident was correct and this number should be used in the Audit CI column.

Where the DNO believes that a different number than the System CI number should be used for a particular restoration stage under the scenarios discussed above, this number should be entered into the ‘Company CI’ column to provide a record of the DNOs opinion on a particular stage.

Auditors should make notes on all differences identified between Report CI, System CI and Audit CI in the comments column provided. Good comments are essential to the robustness of the audit process and it is very difficult to revisit individual incidents after the audits without good comments. This is also important for the quality of the audit trail for our work.

C.9 Customer Minutes Lost

This section of the workbook captures the customer minutes lost related to a restoration stage. ‘Report CML’ is the number of CML reported by the DNO for a given restoration stage. ‘Audit CML’ is the number of CML determined by the audit team from the audit trail information. Audit CML should be determined by checking the start and finish times of a restoration stage and multiplying the resulting duration in minutes by the number of customers affected by the incident as checked by the auditor (Audit CI). A CML calculator is included in the audit workbook to assist the auditors.

It should be noted that the RIGs definition for reporting the start of an incident is the time when the DNO first becomes aware of the incident by whatever means, which may differ from the time when supply was actually interrupted.

As with Customer Interruptions, a column named Company CML is provided to record the DNO’s opinion of CML where this differs from the Audit CML. Clear comments on the cause of difference between Report CML and Audit CML should be provided in Column N.

Appendix D Combined Accuracy Calculations

	Audit Accuracies (Rep/Aud)				System Accuracies/Inaccuracies				Combined Accuracies/Inaccuracies			
	OVERALL		LV						OVERALL		LV	
	CI	CML	CI	CML	LV	Overall	HV	fract LV	CI	CML	CI	CML
WPD - South Wales	99.4%	97.7%	99.5%	97.5%	99.55%		99.60%		99.3%	97.7%	99.3%	97.5%
Inaccuracy	0.6%	2.3%	0.5%	2.5%	0.45%	0.41%	0.40%	0.22	0.7%	2.3%	0.7%	2.5%
SSE - Hydro Electric	101.0%	100.3%	99.3%	99.1%	99.90%		99.90%		99.0%	99.7%	99.3%	99.1%
Inaccuracy	1.0%	0.3%	0.7%	0.9%	0.10%	0.10%	0.10%	0.09	1.0%	0.3%	0.7%	0.9%
WPD - South West	99.7%	99.4%	102.4%	101.3%	99.14%		99.92%		99.6%	99.4%	97.5%	98.4%
Inaccuracy	0.3%	0.6%	2.4%	1.3%	0.86%	0.20%	0.08%	0.15	0.4%	0.6%	2.5%	1.6%
SSE - Southern Electric	99.6%	100.0%	100.7%	97.5%	98.50%		99.90%		99.5%	99.7%	98.3%	97.1%
Inaccuracy	0.4%	0.0%	0.7%	2.5%	1.50%	0.27%	0.10%	0.12	0.5%	0.3%	1.7%	2.9%
Aquila	100.4%	99.7%	100.5%	98.5%	99.00%		99.00%		98.9%	99.0%	98.9%	98.2%
Inaccuracy	0.4%	0.3%	0.5%	1.5%	1.00%	1.00%	1.00%	0.14	1.1%	1.0%	1.1%	1.8%
United Utilities	99.7%	99.6%	97.1%	97.7%	98.45%		99.50%		99.4%	99.4%	96.7%	97.2%
Inaccuracy	0.3%	0.4%	2.9%	2.3%	1.55%	0.50%	0.50%	0.00	0.6%	0.6%	3.3%	2.8%
LPN	99.2%	97.2%	108.1%	99.8%	95.60%		99.27%		98.0%	96.6%	90.8%	95.6%
Inaccuracy	0.8%	2.8%	8.1%	0.2%	4.40%	1.87%	0.73%	0.31	2.0%	3.4%	9.2%	4.4%
NEDL	100.0%	100.2%	104.5%	96.8%	93.50%		97.00%		96.5%	96.5%	92.1%	92.8%
Inaccuracy	0.0%	0.2%	4.5%	3.2%	6.50%	3.49%	3.00%	0.14	3.5%	3.5%	7.9%	7.2%
EME	100.0%	102.2%	106.7%	115.6%	98.46%		99.40%		99.3%	97.7%	93.1%	**84.3%**
Inaccuracy	0.0%	2.2%	6.7%	15.6%	1.54%	0.69%	0.60%	0.10	0.7%	2.3%	6.9%	15.7%
SPN	100.3%	100.3%	99.7%	99.0%	94.10%		98.50%		98.1%	98.1%	94.1%	94.0%
Inaccuracy	0.3%	0.3%	0.3%	1.0%	5.90%	1.85%	1.50%	0.08	1.9%	1.9%	5.9%	6.0%
SP Distribution	100.0%	99.2%	102.8%	93.1%	96.00%		98.00%		97.8%	97.7%	95.1%	92.0%
Inaccuracy	0.0%	0.8%	2.8%	6.9%	4.00%	2.18%	2.00%	0.09	2.2%	2.3%	4.9%	8.0%
EPN	99.1%	98.0%	99.5%	99.5%	93.00%		96.09%		95.7%	95.4%	93.0%	93.0%
Inaccuracy	0.9%	2.0%	0.5%	0.5%	7.00%	4.19%	3.91%	0.09	4.3%	4.6%	7.0%	7.0%
SP Manweb	100.1%	100.0%	92.4%	91.8%	96.00%		98.00%		97.7%	97.7%	91.4%	90.9%
Inaccuracy	0.1%	0.0%	7.6%	8.2%	4.00%	2.26%	2.00%	0.13	2.3%	2.3%	8.6%	9.1%
YEDL	100.1%	100.8%	99.7%	97.5%	97.20%		97.20%		97.2%	97.1%	97.2%	96.2%
Inaccuracy	0.1%	0.8%	0.3%	2.5%	2.80%	2.80%	2.80%	0.20	2.8%	2.9%	2.8%	3.8%

Appendix E Aquila Network Services

E.1 Summary

Tony Higbee and Gordon Roberts carried out the audit of Aquila Network Services commencing 15th July 2003. Following the 2002 Audit, Aquila undertook an extensive training programme for all staff involved in the creation of fault reports. This continuous programme is supported by ongoing work to ensure improvement in fault data. Aquila now meets the RIG definition of customers and the model only contains primary traded MPANs. The MPAN count remains 100% and the removal of the non-compliant CRNs from the connectivity model has further improved the accuracy of reporting. The focus for the connectivity model has remained on improving the 98.9% level of accuracy by continuing to connect customers to their actual service joint or metering position. The estimated accuracy has increased to 99.0%. We can therefore conclude that Aquila has inherently accurate measurement systems in place.

The audit of HV and LV incidents showed that a number of errors had been made, although these were mainly due to manual transcription. EHV fault reporting still requires a large amount of manual inputting which could have a large impact on the final result. Aquila is in the process of introducing more automation which will improve the accuracy of reporting EHV faults.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table E-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.9%	99.0%	98.9%	98.2%
Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

Short interruptions at high voltage are captured from data collected from devices that can lead to a short interruption (i.e. auto-reclosers and circuit breakers). The data is collected and then manually analysed and recomputed to remove operations associated with permanent faults, testing and multi-trips within a short interruption.

Aquila records short interruptions at high voltage and identifies them in line with the RIG definitions. The company bases its estimates for the accuracy of reporting short interruptions upon judgement with >95% accuracy where remote monitoring takes place to >70% for manual counting.

Aquila is working on reviewing methods of measurement and looking at using statistical methodologies to reinforce the estimates of accuracy.

At LV Aquila uses auto-reclosers at the LV level but they are only installed on circuits where intermittent faults have been identified. Currently Aquila does not record the number of operations of such devices.

The audit team felt that Aquila is devoting considerable resources to IIP. The requirements of IIP are well understood within the company and any limitations present in existing procedures have been identified and are being addressed.

The audits results for Quality of Telephone Response data are included in a separate report. The assistance given by Aquila staff to the audit team was extensive

E.2 Introduction

Aquila (formerly Midlands Electricity) holds a distribution licence for Shropshire, Staffordshire, the West Midlands, Herefordshire, Worcestershire, Gloucestershire and parts of Warwickshire and Oxfordshire. Aquila is responsible for approximately 2.3 million customers. Information reporting under IIP is the responsibility of the Performance Management Department of the Commercial Department, which obtains information from Control and Incident Management.

Aquila is currently organised based on two regions: North and South. One control room, located at Tipton, is used to manage the real-time operation of the HV and EHV networks. There are also currently two incident rooms, from where dispatchers allocate field agents to investigate incidents. The Tipton incident room operates twenty four hours, the Worcester incident room operates only during working hours and storm conditions.

The audit team consisted of Gordon Roberts and Tony Higbee from British Power International. Aquila provided appropriate staff to assist in the work throughout the visit.

This report presents the findings of the Aquila Network Services audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

E.3 Stage 1: Measurement Systems and Template

E.3.1 Summary of Measurement Systems

Incidents are identified through calls to the Power Loss Helpline (PLH), situated at Tipton, or from manual or SCADA logging of operations. Incidents are logged into the Control and Incident Room Automation System (CIRAS) from where appropriate actions are initiated and reporting undertaken. For HV incidents, switching and restoration stages associated with an incident are logged and reported by CIRAS automatically since CIRAS contains SCADA and switching schedule operations. For LV incidents, CIRAS is updated manually after operational information is received in the incident room from the field. The basis of information for IIP reporting purposes is CIRAS reports, from which data is inputted into PC NaFIRS.

Improvements have been made to the LV incident reporting process. Before 2002/03 the number of customers associated with an LV incident was derived by dividing the number of customers associated with a substation by the number of LV ways at that substation. From 2002/03, the LV connectivity model is used directly to identify the number of customers associated with each LV way.

The LV connectivity model shows customers linked to their connection point and there also exists detailed electronic geographical records that show actual service positions. The use of the LV model for fault reporting has greatly improved the counting accuracy for LV incidents.

CIRAS contains a real time model of the network, so restoration information is based on the actual state of the network, even if the network is running abnormally. By using this model and not the preferred state model, fault information is recorded accurately at the time of fault.

Further work is underway to extend CIRAS/PC Nafirs interface to EHV and restoration stages for multi-stage LV faults. In addition, the introduction of the interface between the Primary Control and Secondary Control systems within CIRAS will remove the manual effort required to calculate customer numbers affected by primary faults.

E.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

At the last audit the customer counting procedure using Customer Record Numbers (CRNs) was 100% accurate but there were concerns about the categories of MPANs being passed to the connectivity model. This has now been addressed and the model only contains traded MPANs.

Estimate of Accuracy

The company believes that the accuracy of its customer count is essentially 100% as identified by CRNs. This is because the Meter Point Registration System (MPRS) is maintained daily by an automatic update process from Network Record System (NRS). There is a high level of confidence in this accuracy assumption within the company. We therefore have no reason to doubt that the company's customer counting procedure is 100% accurate.

Auditors Conclusions

Aquila's procedures for counting primary trading MPANs is highly accurate. Due to the dynamic nature of the network it is likely that there will always be a small difference between the number of MPANs included in Aquila's measurement systems and the number registered in MPRS. These differences are considered by the visiting auditors to be insignificant.

The visiting auditors found Aquila's procedure for counting MPANs to be robust and they support the company's estimated accuracy of 100%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The only change to the connectivity model has been a minor software change to provide additional functionality for tracking linking operations and customer connections in the LV network model.

The focus for the connectivity model has remained on improving its accuracy by continuing to connect customers to their actual service joint or metering position. "Quick-fix" solutions, such as scattering or clustering customers to nearest LV feeder by approximation have not been employed as they degrade overall accuracy and negatively impact on customer service functions including the Power Loss Helpline.

Estimate of Accuracy

Aquila's current estimate of accuracy of the Connectivity model is 99.0%. This has increased from 98.9% at the last audit.

At the last IIP Audit there were 25,089 customers that were in the connectivity model but were not connected to a defined LV cable due to quality of address data. By July 2003 this number had reduced to 22,539 with a further 45,481 customers being attached to the connectivity model in the past 12 months as a result of new connections.

Again at the last audit there were a further 40,000 customers with poor address structure and were not included in the Connectivity model and hence not included in either fault reporting or customer numbers. Consequently they had no impact upon the accuracy of network reporting. This figure has now reduced to 14,869 customers.

The benchmark used at the last audit to measure confidence in the claimed estimated accuracy was that during the 12 months July 01 to June 02, only 454 of the 2,907,959 customers affected by faults were found to be incorrectly connected in relation to the connectivity model. This represents 0.016% of the total customers affected. During the 12 month period July 02 to June 03, only 460 of the 2,726035 customers affected by faults were incorrect. This represents a consistent level of confidence to last year, which remains high.

Auditor's Conclusions

Aquila's connectivity model is highly accurate. Major initiatives are underway to ensure total connectivity of customers to a geographic location on the LV network. Temporary teams have been established to process the backlog of postal addresses from local authorities and to connect customers with improved addresses to the connectivity model.

The visiting auditors found Aquila's procedure for determining the accuracy of its connectivity to be robust and support the company's estimated figures of 99% at the LV feeder level.

(iii) RIG Definitions

With the exception of the definition of 'customers', no changes have been necessary to Aquila's interpretation of the RIGs. Aquila only uses registered energised and de-energised customers in the model.

(iv) IIP Template

There have been no changes to the way the IIP template has been populated. As was the case last year all incident data is entered into PC NaFIRS. Year end reports are produced programmatically by PC NaFIRS.

When the Ofgem template changes, updates to PC NaFIRS are supplied by the software development company, Langhorne Computers. Langhorne work closely with the industry and Ofgem to ensure compliance with all requirements before updates are released

A full reconciliation of the data in the IIP template with Aquila's PC-NaFIRs database was completed during the 2002 IIP audit visit, when no errors were identified. Aquila confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. Aquila's estimate of its accuracy of reporting is 100% and is unchanged from last year.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to Aquila, the visiting auditors can support Aquila's estimate of the accuracy of its measurement systems. The visiting auditors are also satisfied that Aquila has correctly interpreted the RIG definitions and that the company continues to operate in accordance with them.

Aquila has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an automated data extraction from PC-NaFIRs, which both Aquila and the visiting auditors consider to be robust.

E.4 Stage 3: Accuracy of Reporting

Please note that the methodology for the Stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

E.4.1 Incidents at the Higher Voltages

To enable the audit process to run smoothly Aquila arranged the following to assist in the tracking of incidence.

- A comprehensive information pack for all incidents.
- An experienced CIRAS operator with a dedicated workstation.
- A support team to search and supply additional support documentation if required.

All incidents were tracked through all restoration stages during the audit. The auditors found the system easy to understand and interrogate. All audit questions were quickly dealt with and queries resolved.

This information was sufficient to understand the incident and track through the various restoration stages. It was noted that Aquila's efforts to improve the accuracy of reporting had resulted in improved descriptive notes for restoration stages. In general, the audit trail for incidents at the higher voltages was therefore sufficient for the purposes of the audit.

The higher voltage restoration stages selected for the audit sample were reasonably straightforward and only 7 stages at HV and EHV were too complex to resolve. It was necessary to request additional samples to complete the audit. Whilst one particular incident took some time to understand, Aquila had reviewed each of the selected stages prior to the audit visit and was able to explain each incident examined

Of the 85 stages audited the reported CI figure reconciled exactly with the reported figure in 61 stages. A further 12 stages were within the range of acceptable 'customer churn'.

The most frequent cause of difference between reported and actual was due to customer growth. The company demonstrated the method by which they tracked changes in the number of customers connected. Variances were observed in a further 8 of the 85 stages audited which were due mainly to increase in numbers of customers since the original report. However most involved only small numbers so the overall effect on the results was not significant. The company was able to demonstrate to the audit team's satisfaction that the majority of figures were correct at the time of reporting. The most significant reporting inaccuracy discovered was one stage at EHV which should have been six stages. This was due to a manual transcription input error. Apart from this one stage the accuracy of Aquila's reporting at the higher voltages was seen to be very high and a substantial improvement on the last audit.

E.4.2 Incidents at LV

In a similar manner to the HV audit, the company provided a list of all LV incidents from which 95 were chosen to represent a statistically significant sample for review.

The company provided a copy of the CIRAS log: restored phase list detailing the switching history and access to the geographical display of the LV network together with an experienced operator.

The following comments can be made relating to the LV incident audit:

- Of the 109 stages audited the reported CI figure reconciled exactly with the reported figure in 83 stages. A further 6 stages were within the range of acceptable 'customer churn'.
- 12 stages involved manual input errors mainly customer numbers and duration of fault
- Two stages could not be audited due to significant network changes since fault

Since the 2002 IIP audit visit, much effort has been placed on recording accurate and useful information in the incident log and the PC-NaFIRs report and the improvement was apparent during the 2003 IIP audit visit. The LV model has been used for fault reporting throughout 2002/03. This connects customers to the network at their service joint and therefore is more geographically accurate for faults affecting partial feeder ways. There has been a significant improvement in the accuracy of reporting.

E.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table E-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
002021	002021	010704	010704
		004767	010090

The final Stage 3 reporting accuracy results are therefore:

Table E-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.4%
Stage 3	Overall sample – CML	99.7%
Stage 3	LV-only sample – CI	100.5%
Stage 3	LV-only sample – CML	98.5%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table E-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.4%	0.4%
		CML	99.7%	0.3%
	LV	CI	100.5%	0.5%
		CML	98.5%	1.5%
Stage 1		LV	99.0%	1.0%
		Overall		1.0%
		HV	99.0%	1.0%
LV Fraction				14.0%
Combined Accuracy	Overall	CI	98.9%	1.1%
		CML	99.0%	1.0%
	LV	CI	98.9%	1.1%
		CML	98.2%	1.8%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table E-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.9%	99.0%	98.9%	98.2%
Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

E.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

E.5.1 Methodology

Aquila describes all the devices that lead to short interruptions (i.e. auto-reclosers and circuit breakers) have data collected regarding the number of operations and duration of operations (where known).

Data is collected in a number of different systems and then manually analysed and recomputed to remove operations associated with permanent faults, testing and multi-trips within a short interruption.

In the cases where data is not automatically collected either visual inspections are used to collect the number of device operations or estimates are made based upon the average number of interruptions experienced by those devices where data is collected.

The various data sources for trips are compiled and entered into a transients model, where the number of customers affected by each trip can be calculated. The model is based upon the network model and identifies the customers downstream of a protection device, thus it can identify the substations and customer numbers affected by each trip.

The RIGs specify four short interruption cause categories: Auto1, Auto 2, Deliberate, Other.

(i) Auto 1 – Automatic Trip & Automatic Restoration

Aquila interprets the Auto 1 cause as those short interruptions where the device trips automatically and based upon its protection settings automatically recloses after a short period of time, without any human intervention. There are a number of different types of equipment capable of leading to such automatic operations.

1) ***Pole mounted reclosers – with remote control***

Every operation of a pole mounted remote control device is logged and available for interrogation on Aquila's Control intranet site. This log stores the date and time of every operation and thus allows all short interruptions to be identified. The extraction of log data allows criteria to be defined to distinguish between short interruptions and permanent faults and it also groups multi-shots within a 3 minutes period to give a true reflection of the number of short interruptions. Certain short interruptions may involve manual reclosure, therefore these need to be identified (by comparing against control room logs), excluded and reported under auto 2 cause.

2) Pole mounted reclosers – without remote control

There is no automatic collection of data for these devices. Annual counter readings are taken by site inspection during January to March and an annual number of operations calculated. The only data available from site is the number of operations therefore it is not possible to identify when each operation occurred. The number of short interruptions is estimated by subtracting known permanent faults and adjusting for multi-shots. Counts are converted to short interruptions by assuming an average number of multi-shots per short interruption for each device dependent on the number of reclose operations the device can perform before lockout.

3) ***Reclosing circuit breakers with SCADA***

Trips of reclosing circuit breakers are logged in Aquila's mainframe LOAD system. The data is stored in half hourly periods therefore it identifies the number of trips within a half hourly period, not an exact time. This log records all trips which includes short interruptions, permanent faults and trip testing. A retrieval of the readings is manually compared against the Control Room CIRAS system to exclude those operations associated with permanent faults and testing.

4) ***Reclosing circuit breakers without SCADA***

There is no automatic collection of data for these devices. There are very few of these devices therefore an estimate is made based upon the average number of short interruptions experienced by circuit breakers with SCADA.

(ii) Auto 2 – Automatic Trip & Manual Restoration

Aquila interprets the Auto 2 cause as those short interruptions where the device trips automatically and requires human intervention to initiate the close action. Data for all short interruption operations on remotely controlled equipment is automatically logged and can be interrogated via the Control Systems intranet site. Remote control devices are operated via functionality within the control room CIRAS system. Therefore when an auto-recloser trips and locks out (reaches the maximum number of automatic operations), it is possible to reclose the device by remote control thus restoring supplies within 3 minutes. The short interruptions identified in the automatic log are compared against CIRAS restoration stages of less than 3 minutes duration to identify manually restored operations.

(iii) Deliberate

There is no automatic collection of data on deliberate short interruptions. These are identified by retrieving data from the control room system CIRAS and performing textual searches on switching schedule operations. This is used to identify operations such as the connection and disconnection of non-synchronising generators, installation and removal of cross over links.

(iv) Other Networks

There is no automatic or manual collection of data on short interruptions due to other networks

LV networks

Aquila do not have any permanent devices installed on the LV network that could lead to short interruptions. However they are making use of Rezap devices which act as low voltage circuit breakers. They are only installed on circuits where intermittent faults have been identified. Aquila do not currently record the number of operations of such devices

Multi-shot Reclose Schemes

The log of remotely interrogated devices allow multi-shots within a specified time band (say 3 minutes) to be classed as one interruption. This is carried out within the intranet based report.

For reclosers without remote control, while the number of trips can be calculated, it is impossible to determine how many short interruptions have occurred. For example the trip counter of a four shot recloser may have advanced by 20 which could represent 20 short interruptions (20 x 1 shot) or 10 short interruptions (10 x 2 shot) or any other combination.

For this reason trip counts are converted to short interruptions by assuming an average number of trips/short interruption for each device dependent on the number of reclose shots the device can perform. This is thought to improve accuracy over simply reporting the total number of trips which would over-estimate the number of short interruptions.

General Comment

The compilation of short interruptions results is complex with data being collected from many sources requiring significant manual processing and interpretation. In certain cases (manual read counters) there will always be a number of assumptions required (e.g. the network configuration because actual date of operation will not be known). Aquila believes that where assumptions have been used these are well reasoned and representative therefore the actual levels of inaccuracy are limited. Aquila remains committed to improving and enhancing its data collection and processing for short interruptions and expects to progressively refine and improve its processes. Continued work in this area will progressively improve accuracy. Nevertheless the auditors were confident that the IIP template has been completed accurately for short interruptions and that the measurement and reporting complies with the RIG definitions.

E.5.2 Estimate of Accuracy

Aquila has based its estimates upon judgements, and is working on reviewing methods of measurement and looking at using statistical methodologies to reinforce the estimates of accuracy

Estimates of accuracy are summarised as follows:

- Reclosing circuit breakers with SCADA – Counts > 95%, Customers >95%.
- Reclosing circuit breakers without SCADA – Counts > 90%, Customers > 95%.
- Pole mounted reclosers – with remote control – Counts > 95%, Customers >95%.
- Pole mounted reclosers – without remote control – Counts > 70%, Customers > 95%.
- Deliberate disconnection (generators) – Counts > 90%, Customers >95%.

E.5.3 Recloser Operation Counts

Where remotely controlled devices report back to a log the data is very accurate, but inaccuracies are introduced into the finally reported figure as a result of the manual adjustments and estimates for permanent faults, testing and multi-shots. For circuit breakers without SCADA estimates on short interruptions are made based upon the average number experienced by those with SCADA. The actual activity on these circuits is unknown therefore the confidence in the accuracy of counts is less but is believed to be a fair representation of the possible activity.

The accuracy of manually read devices is believed to be reasonably accurate for those devices where readings are possible. Where reading cannot be made or have been delayed estimates need to be made. Furthermore adjustments for multi-shots and permanent faults may introduce further inaccuracy. It is estimated that 70% is a reasonable representation of the accuracy. The estimate of deliberate disconnections is slightly lower at 90% because the identification of short interruptions due to this cause is based upon textual searches within records of operations. Work is continuing to standardise text to improve data retrieval.

Counts of Customer Interruptions

The transients model used to calculate customers numbers uses up to date network representation therefore it is possible that network configuration and customer numbers may have changed. This continual update in customer number introduces inaccuracy as these numbers change from the time when the restoration stage was reported to the time of the audit. However, the amount of such activity is generally minimal and therefore the estimate that the customer numbers is greater than 95% is considered to be acceptable.

E.5.4 Auditor's Conclusions

Aquila has put a lot of effort into the recording and reporting of short interruptions and from the information provided and the following discussion, the auditors agree with their judgement of the level of accuracy reported.

Aquila remains committed to improving and enhancing its data collection and processing for short interruptions and expects to progressively refine and improve its processes. Continued work in this area will progressively improve accuracy.

E.6 Overall Impressions

Aquila has a strong focus on accurate reporting of incidents. It has undertaken an extensive training programme for all staff involved in fault reporting. In addition it carried out detailed internal audits on complex faults throughout 2002/03 and which is ongoing. A noticeable improvement in the quality of recorded information on incidents was apparent during the 2003 IIP audit visit, with the knock-on effect of improved accuracy of reporting. Aquila's internal auditing programme has had the double benefit of educating operators on where mistakes are made and providing an opportunity to correct errors made in the reported CI and CML. These learning opportunities have been built into the staff training programmes

Aquila was very open and helpful during the audit visit and provided a good audit trail of information for the selected restoration stages. Prior to the arrival of the visiting auditors, Aquila had self-audited the selected restoration stages to ensure that the incidents involved were well understood and the supporting information was readily available.

E.7 Conclusions

Table E-6 below presents the results of the 2003 audit of Aquila Network Services in-line with the auditing framework.

Table E-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100%
Stage 1	LV Connectivity Model	99%
Stage 1	HV Connectivity Model	99%
Stage 3	Overall sample – CI	100.4%
Stage 3	Overall sample – CML	99.7%
Stage 3	LV-only sample – CI	100.5%
Stage 3	LV-only sample– CML	98.5%
	Short Interruptions	70 to95%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table E-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.9%	99.0%	98.9%	98.2%
Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

E.8 Recommendations

Although Aquila carried out audits on the reporting during the year, it would benefit by developing a more formal approach to the self audit process. For example, introducing a monthly programme.

From the audit it became clear that more effort needs to be placed on accuracy of reporting of incidents at the EHV voltage levels as these will have major effects on results. However changes have already been put in place to the recording process which will be further improved with the introduction of the PCSSCS interface

E.9 Learning Points

The following points were identified as learning points for the audit process:

- It was found that Aquila'a use of IT systems that were immediately accessible during the audit enabled the amount of paperwork to be kept to a minimum. This helped the audit process.
- Completion of the questionnaires by the company before the arrival of the audit team saved considerable time.
- Induction to Aquila's systems and processes was very worthwhile.
- Numerical reference numbers used do not define the difference between LV, HV and EHV and makes the analysis of the worksheet difficult and sorting impossible.

Appendix F East Midlands Electricity (EME)

F.1 Summary

East Midlands Electricity was audited during the week beginning 18 August 2003 at its headquarters at Castle Donington.

There were no changes made to EME's measurement systems since the 2002 IIP audit visit, when the visiting auditors found EME's measurement systems to be both robust and inherently accurate. EME has continued with its effort taking the appropriate actions for all the recommendations raised during the 2002 IIP audit. In particular, EME has carried out an internal audit to determine the confidence levels on the accuracy of the assignment of MPANs to the connectivity model. The estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 100%.
- Connectivity model (HV/LV substation level): 99.40%.
- Connectivity model (LV feeder level): 98.46%.

EME's incident reporting was found to be highly accurate for the 2002/03 reporting year. The small differences in customer numbers between the reported and audited figures were mainly due to customer 'churn'. At present it has no way of verifying the actual numbers at the time of incident. In the future, the OMS system that replaced CLASS would have the capability of storing the relevant sections of the connectivity model with the customer numbers affected by that incident.

At the higher voltage and low voltage levels, the misreporting were due to manual transcription errors, wrong customer numbers or time of incident stated for a particular restoration stage. At LV level in particular, there were two cases of misreporting of customer numbers due to faults on a feeder section. For pre-arranged incidents, it was noted that half the samples had the actual start and end times identical to that proposed on the work schedule.

With the exception of LV CML, EME's reporting was found to be within the minimum reporting accuracy requirements.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table F-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	93.1%	84.3%
Stage 3 Results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

For all individual short interruption (SI) recordings, EME estimates that to be approximately 100% accurate as these are recorded via the SCADA system in real time while the number of customers affected would have the HV accuracy level of 99.4%. For all the annual bulk SI recordings, EME estimates accuracy to be 95% including the inaccuracy of the network connectivity model. In the 2002/03 reporting year, 96.93% of customers affected by SI were recorded in real time, thus on this basis EME estimates an overall accuracy level of 98% for short interruption (SI) recordings.

F.2 Introduction

East Midlands Electricity was audited during the week beginning 18 August 2003 at its headquarters in Castle Donington. EME holds a single electricity distribution licence for the East Midlands, covering the region from Chesterfield in the north, to Boston in the East, Milton Keynes in the south, and Derby in the west.

Responsibility for IIP reporting is clearly defined within the EME corporate structure, with reporting links to Asset Development and the System Performance team. Overall responsibility for IIP reporting rests with the Managing Director. Gordon Roberts of British Power International and Chee K. Lee of Mott MacDonald undertook the audit in conjunction with a number of EME audit team members.

This report presents the findings of the EME audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

F.3 Stage 1: Measurement Systems and Template

F.3.1 Summary of Measurement Systems

The EME distribution business has its headquarters at Castle Donington where it provides a series of centralised services. These include an Incident Management Centre (IMC), a HV control room and a Customer Contact Management Centre. The IMC and HV control room activities have been re-organised into the Network Management Centre (NMC). The NMC dispatch work orders to four geographical Field Operating Centres (FOC) at Moorgreen, Sleaford, Hinckley and Northampton. These are responsible for the 24-hour repair and restoration of supplies. The HV control centre carries out real-time management of the 11kV, 33kV and 132kV networks and the IMC provides a 24-hour power outage and emergency call centre, rapid dispatch and customer relations service.

During the 2002/03 incident reporting year, EME used the same information systems that were reported in the 2002 IIP audit visit. The process from when the incidents are initially raised up to final restoration is as follows:

- Incidents are raised in the Call Logging and Sorting System (CLASS), following receipt of either an alarm from the Control Room Graphical Operating System (CORGOS) or through 'loss of supply' related calls. All emergency calls are routed through the Call Handling System administered by staff from the Customer Contact Management Centre or by an external contractor when there are any call overflows from the Centre where the customer's name and telephone number is captured on to CLASS.
- Details of the incident are entered into CLASS manually by IMC staff. Incidents are automatically date and time stamped as they are raised in CLASS. Each supplied premise is allocated a unique reference number in the Customer Information System (CIS), that is linked to a transformer and associated feeder at HV or LV level (this is the 'connectivity model'). The CLASS system can then access this information for incident management. Fault reports are then adjusted manually by IMC staff using additional information from fault switching schedules (for HV, EHV and 132kV), field engineer notes, the CORGOS event log, and the connectivity model.
- An automatic file transfer ensures that core data, for e.g. date & time of incident, number of customers affected and device reference is transferred into the PC-NaFIRS reporting system on a daily basis. Other relevant data regarding the incident (e.g. final restoration time, restoration stages & times and equipment involved) are manually transferred from CLASS into PC-NaFIRS.
- The Geographic Information System (GIS) gives a graphical record of the network and topology within the EME area, and is also used to gain a greater understanding of the structure of the network, particularly useful when looking at more complex faults.

Since 1st April 2003, the NMC has replaced CORGOS and CLASS with GE Harris's Energy Network Management and Control System (ENMAC) and LeT System's eRespond Outage Management System (OMS) respectively. OMS has the advantage over it's predecessor of being able to transfer the relevant incident data into PC-NaFIRS automatically thus reducing any potential manual transcription errors. Furthermore, the OMS has more mandatory fields thus reducing the need for manual input.

F.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology for the identification of its primary traded MPANs remains the same as that agreed with Ofgem during the Interim Review in September 2001. No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, EME's estimate of accuracy of customer count by primary traded MPANs was close to 100% and it placed an extremely high level of confidence in these figures. The number of MPANs registered to a supplier are extracted directly from the Metering Point Registration System (MPRS) with the relevant exclusions – Heatwise MPANs, unmetered supplies, export MPANs and half hourly multiple MPANs. The audit team in 2002 determined that the potential sources of error in the count are small and saw no evidence to conclude that the company's estimate of accuracy was incorrect.

During the 2003 IIP audit visit, EME has stated that its estimated accuracy of customer count by primary trading MPAN is 100%.

Auditors conclusions

The estimated accuracy of MPAN count provided by EME last year was verified by the audit team during the 2002 audit. Since the methodology for counting MPANs has not changed since the 2002 IIP audit visit, the visiting auditors support the company's estimated accuracy of 100% during this 2003 audit.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The structure and operation of the company's connectivity model has not changed since the 2002 IIP audit visit. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

EME's current estimate of accuracy of its connectivity model is as follows (last year's results in brackets):

- HV/LV Substation 99.40% (95.0 to 99.2%)
- LV Feeder 98.46% (95.0 to 98.2%)

The accuracy of 99.4% at the HV/LV substation level (HV connectivity) has been determined by reconciliation between the customer numbers from MPAN and the HV connectivity model. On 30th September 2002, the total number of primary MPANs was 2,445,398 while the total number of customers in the HV Connectivity model was 2,430,388. This difference of 15,010 represents 0.6% of the total primary MPANs. This has reduced from 0.8% identified during the 2002 IIP audit and should continue to reduce as additional information enables MPANs to be assigned to their correct place within the model. The difference is due to various reasons such as customer 'churn' and not being able to match postal addresses.

In addition to the above, there are a further 23,000 customers at LV that are allocated to the relevant HV/LV substation (distribution transformers) but it is not known for certain to which LV feeder ways they are connected to. At present, EME allocates such LV customers to dummy "Feeder 99" at the

HV/LV distribution substation until such a time the information is available, for e.g. when such customers reports a loss of supply incident. These 23,000 customers represent a further inaccuracy of 0.94% at LV thus the overall accuracy of the LV connectivity (feeder level) was calculated to be 98.46%.

There are also approximately 2,600 HV customers allocated to Feeder 99 who are supplied from HV/LV transformers and in such cases, that customer owns the transformer thus there is only one customer at that HV/LV substation. Therefore, in calculating the accuracy of the HV Connectivity model, this number is not considered.

Furthermore, there are approximately 195,000 LV customers allocated to Feeder 99 who are supplied from HV/LV pole mounted transformers and it is highly likely that in such cases, there is only a single feeder way fed off such transformers. Therefore, in calculating the accuracy for the LV Connectivity model, only the number of LV customers connected to Feeder 99 of distribution transformers are considered.

In May 2003, EME conducted an internal audit of its connectivity model in accordance to BS6001. This involved auditing a sample of 500 from 44,000 HV/LV substations comprising of a total of 15,602 premises (MPANs) by overlaying the CLASS data over the mains cable record in GIS. The customer premise/address was then matched between the two systems and a measure of confidence was prescribed for each virtual customer service connection to the mains. The confidence levels established by EME's internal audit are as follows:

- 24.58% of total sampled premises: Very High – the mains feeder to which the customer premise is connected to is the only conductor within 50m.
- 67.27% of total sampled premises: High – the mains feeder to which the customer premise is connected to is the closest conductor.
- 3.36% of total sampled premises: Medium – apart from that mains feeder to which the customer premise is connected to, there is another conductor closer by less than 10m.
- 3.22% of total sampled premises: Low – apart from that mains feeder to which the customer premise is connected to, there is another conductor closer by more than 10m.
- 1.56% of total sampled premises: Not connected – the customer premise could not be connected to a mains feeder.

Therefore, the confidence level quoted by EME is 98.44% in the allocation of MPANs to the connectivity model that takes into account of all connected MPANs. Hence, the company's conservative estimate of 95% on the accuracy of the assignment of MPANs to the connectivity model during the 2002 audit no longer applies since the company is now confident of the connectivity model.

Auditors conclusions

EME's connectivity model is highly accurate as the model was created manually based on existing mains and service records where available. EME has had the connectivity model in place since 1992 and since then has improved the accuracy of the model. This improvement in accuracy has been evident based on the accuracy levels quoted by EME this year as compared to the previous 2002 audit.

The internal audit carried out by overlaying the connectivity model data in CLASS on to GIS provided the necessary confidence levels to EME and also the visiting auditors on the accuracy of the assignment of MPANs to the connectivity model.

The visiting auditors found EME's procedure for determining the accuracy of its connectivity model to be satisfactory and support the company's estimated figures of 99.40% at HV/LV substation level and 99.46% at the LV feeder level with an overall confidence level of 98.44%. As it is not a requirement of the RIGs to have a phase connectivity model, this aspect is not considered to be a potential source of inaccuracy for the LV feeder connectivity model.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which EME has interpreted the definition and guidance contained in the RIGs.

During the 2003 IIP audit, the visiting auditors re-confirmed EME's interpretation of re-interruption which is as follows – "when any customers restored within an incident are re-interrupted up to three hours after all the customers within that incident are restored". This includes any single or multiple re-interruptions experienced by any customer regardless of whether the customer was last restored within or above three hours during that incident and would not be reported as a new incident unless it occurred beyond three hours after all the customers within that incident are restored.

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the company's routines used to populate the IIP template, which continues to rely on automatic data extraction from PC-NaFIRs apart from the changes required to reflect on revisions to the format of the template by Ofgem for the 2002/03 reporting year.

(v) Conclusions

Based on the base data provided by EME and the confidence levels derived from the internal audit, the visiting auditors agree with EME's estimate of the accuracy of its measurement systems (MPAN Count and Connectivity Model).

The visiting auditors are also satisfied that EME has correctly interpreted the RIG definitions and confident that the company is populating the IIP template accurately.

F.4 Stage 3: Accuracy of Reporting

Please note that the methodology for the Stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

F.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, EME had printed out a schematic diagram of each HV incident, copies of the control logs with the other information available on-line through the various systems as it was required. This information included connectivity model information and CLASS information (including field notes). This was checked against the PC-NaFIRS system to ensure information had been calculated and transcribed correctly.

By working through the control logs or notes in CLASS, it was possible to ‘replicate’ the incident on the schematic diagram to identify sections of the network affected by each restoration stage. The connectivity model was then used to equate these sections affected to numbers of customers affected. The network configuration during the occurrence of the incident did not change significantly as compared to the present network configuration. However where there were temporary changes, for e.g. abnormal feeding arrangements, it was identified in the field notes and if there were permanent changes to the network since the incident occurred, EME’s Central Records Update Facility (CRUF) provided the necessary audit trail.

The small differences in customer numbers between the reported and audited figures were mainly due to customer ‘churn’, however there were six incidents identified to be misreporting due to manual transcription errors or wrong customer numbers stated for a particular restoration stage. The visiting auditors were informed that the OMS system that replaced CLASS would have the capability of storing the relevant sections of the connectivity model with the customer numbers affected by that incident. Hence, if there were any network changes or any number of customer ‘churn’ between the time of the incident and audit period, there would be a record of the affected customer numbers.

Apart from the differences in CMLs due to errors in the CI count, there were an additional three audited incidents involved misreporting of the time of incident occurrence, time of the restoration stage or the fault completion time. One of these included an over reporting of CMLs of over 200,000 minutes, however this was perceived to be an outlier and not considered in the reporting accuracy of the overall incident sample.

One incident in the audit sample was not audited as it was deemed too complex, hence one of the spare audit sample was used to replace that.

The pre-arranged incident audit involved 13 samples at both HV and LV levels. All the incidents exactly reconciled to the audited figures except for one which is though to be customer ‘churn’. A point noted was that half the samples had the actual start and [end] times identical to that proposed on the work schedule. This raises some doubt to whether these times correspond to actual start/end times.

F.4.2 Incidents at LV

For each incident at LV, all the relevant information required was provided on-line. The audit process consisted of checking the figures submitted through PC-NaFIRS against each individual incident stored in the CLASS system (including incident notes) and the connectivity model.

From the 100 unplanned LV incidents audited, it was found that the reported number of customers interrupted for 78 of the incidents exactly reconciled to the audited figures. Of that number, two incidents had the re-interruption stage missed and one incident had a restoration stage raised unnecessarily. A further two incidents were within the range of ‘acceptable customer churn’.

A further 18 incidents were identified with errors due to the following reasons:

- misreporting of customer numbers for that restoration stage audited either misinterpreting the customer numbers from the connectivity model or from the incident notes.
- in one incident, the customer numbers was over-reported for the entire feeder even though the fault just affected one phase.
- in two incidents, the customer numbers was over-reported for the entire feeder even though the fault just affected one section of that feeder. In one incident, the field engineer had estimated the number of customers still off-supply after isolating the faulted section but the IMC staff had used the customer numbers derived from the connectivity model. In the other incident, the incident notes stated that two fuses were replaced at the link box to back feed some customers from that link box up to the open circuit fault. Utilising the GIS system the audit team was able to identify that link box and a judgement was made to the number of customer premises connected to the affected section of the feeder which was quite a lengthy process. The IMC staff had just applied 2/3 of the total feeder customers from the connectivity model.

The final two incidents were not audited due to lack of information. In the first incident, the audit team suspects that the substation number entered into CLASS was wrong and hence could not verify the customers affected. This was during a trial run carried out on the new OMS system and when the information was transferred back on to CLASS, the error occurred and furthermore the incident notes were not transferred over. For the second incident, the audit team were not able to identify the number of customers involved in the incident as there were conflicting numbers reported in the incident notes, connectivity model and CLASS input.

Apart from the differences in CMLs due to errors in the CI count, there were an additional four audited incidents involved misreporting of the time of incident occurrence, time of the restoration stage or the fault completion time. This may be due to typing error or misinterpretation of the data by the IMC staff.

F.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table F-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
000252	000416	000786	000786
000435		001844	001492

The final Stage 3 reporting accuracy results are therefore:

Table F-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	102.2%
Stage 3	LV-only sample – CI	106.7%
Stage 3	LV-only sample – CML	115.6%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table F-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.0%	0.0%
		CML	102.2%	2.2%
	LV	CI	106.7%	6.7%
		CML	115.6%	15.6%
Stage 1		LV	98.5%	1.5%
		Overall		0.7%
		HV	99.4%	0.6%
LV Fraction				10.0%
Combined Accuracy	Overall	CI	99.3%	0.7%
		CML	97.7%	2.3%
	LV	CI	93.1%	6.9%
		CML	84.3%	15.7%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table F-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	93.1%	84.3%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

F.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

F.5.1 Methodology

EME has two classifications for its recording of Short Interruptions (SIs):

- Individual SI recording utilises the modern Pole Mounted Auto Reclosers (PMAR) type switchgear which have telemetry and are recorded via the SCADA system in real time. For devices with telemetry the protocol is such that for multi-shot operations within the same sequence i.e. one event, one SI will be recorded as per RIG guidelines.
- Bulk SI recording utilises the older OYT type oil-filled switchgear with no telemetry capability and the readings are taken annually. The counter will record each individual shot taken, which is recorded as a SI.

For individual SIs, each event is automatically date and time stamped by the HV control system. Each event is then transferred into a control centre daily log and recorded in the CLASS system with specific SI codes to record the effect on customers. For those SIs which are not recorded via SCADA, e.g. deliberate disconnections associated with embargoed equipment then the information is recorded manually by control engineers and entered into the control centre daily log and recorded in CLASS. The information in CLASS containing the type and cause of the SI is manually populated by the control engineers in accordance with the RIG classifications. SI reports are then created in PC-NaFIRS using the control centre daily log and CLASS reports.

For annual periodic reading of devices with no telemetry, a spreadsheet record of all devices with associated details such as location, feeder, customers, counter readings and dates read is kept and updated by the System Performance team. Each year this spreadsheet is split by FOC area and issued to the real time operations team to take on site readings and feed back information. All of these entries are updated in bulk at the end of the reporting year.

EME does not make significant use of LV reclosing schemes, they are only used during incident management when portable re-energising devices are fitted. If such a device operates then it would be recorded by the field engineer on site and communicated back to NMC who would create the appropriate CLASS and PC NaFIRS report.

F.5.2 DNO's estimate of accuracy

EME estimates the accuracy of individual Sis recorded in real time to be approximately 100% accurate as either the device has telemetry or the control centre procedures record the event and network configuration is known. With respect to the number of customers affected, the accuracy is that of the HV connectivity model which is estimated to be 99.4%.

With respect to the accuracy of annual bulk SI recordings, this mainly depends on the timing of the "annual" count and the possible double counting of SI "incidents" with permanent faults as EME does not at present link the downstream non-telemetry device incidents with the operation of the upstream device and therefore the incident will be incorporated in the annual bulk reading and appear as an additional SI. EME considers the timing of the count to be the major element in determining the accuracy and feels that once the periodic collection sequence is underway (notwithstanding systematic errors), then approximately 12 month intervals will be achieved. Consequently, EME estimates the accuracy to be greater than 95%. With respect to the number of customers affected, as the actual date and time of the SI in the periodic bulk count is unknown then the ability to correctly identify the network configuration at the time of the SI is not possible. However, as such devices are typically fitted to networks which undergo negligible change, normal network configuration is assumed for all SIs in the periodic bulk count and the number of customers is taken from the network connectivity model which has an estimated accuracy level of 98.46%.

In the 2002/03 reporting year there were a total of 2,666 real time and 227 "bulk" SI entries into PC NaFIRS. The total number of customers involved was 1,674,954 of which 96.93% were attributable to real time recorded short interruptions. Consequently, EME estimates the overall accuracy to be greater than 98% with a very high level of confidence.

EME is currently introducing Power Outage Detection (POD) devices with telemetry to monitor and count the operations of conventional reclosing devices such as OYTs which are presently incorporated into the bulk update periodic count. Furthermore, EME has an ongoing programme for replacing non-telemetry devices such as OYTs with PMARs which will also reduce the volume of devices in the bulk periodic count.

F.5.3 Auditors Conclusions

The visiting auditors agree with the overall estimated accuracy level of 98% for SI recordings as this figure is dominated by the individual SI recordings in real time. Furthermore, even though the SI recordings are RIGs compliant, there is an inconsistency of SI recordings between auto reclosers with telemetry capable of registering multi-shot operations as a single event (individual SIs) and auto reclosers without telemetry which register each shot of a multi-shot operation as a single event (bulk SIs).

F.6 Overall Impressions

EME has again demonstrated a high level of commitment to IIP. This was evident from the preparation of the audit materials and the number of staff involved in the audit. Furthermore, EME has taken aboard all the recommendations and learning points of the 2002 audit and has thus improved on the accuracy of the measurement systems and reporting for the 2002/2003 reporting year. This included an internal audit carried out by EME to assess confidence levels on the assignment of MPANs to the connectivity model, additional training for staff, creation of NMC, introduction of the eRespond OMS system and local management instructions to record permanent network changes. Some of these additions may not have yet had an impact during the 2002/2003 reporting year depending on when such systems were introduced.

F.7 Conclusions

Table F-6 presents the results of the 2003 audit of the EME licence area in-line with the auditing framework.

Table F-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100.00%
Stage 1	LV Connectivity Model	98.46%
Stage 1	HV Connectivity Model	99.40%
Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	102.2%
Stage 3	LV-only sample – CI	106.7%
Stage 3	LV-only sample– CML	115.6%
	Short Interruptions	98.00%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table F-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	93.1%	84.3%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

F.8 Recommendations

With the introduction of the eRespond OMS system, the transfer of the relevant incident data into PC-NaFIRS will be done automatically thus reducing any potential manual transcription errors. Furthermore, the OMS has more mandatory fields thus reducing the need for manual input and the system can store the connectivity model information on the customers affected so that any future audit with regards to differences in customer 'churn' should be proven.

Examples of areas for further improvement include the following:

- with regards to pre-arranged incidents, further staff training and awareness to ensure that the actual start and end times should be reported back to the NMC rather than proposed times stated on the work schedules.
- a consistent approach in determining customer numbers on feeder section incidents at the LV level from the GIS system or field engineer's estimate.

F.9 Learning Points

The following items were identified as learning points for the audit framework:

- inconsistency of SI recordings between auto reclosers with telemetry capable of registering multi-shot operations as a single event and auto reclosers without telemetry which register each shot of a multi-shot operation as a single event
- completion of the questionnaires by the company before the arrival of the audit team saved considerable time
- induction to EME's measurement and information systems and processes was very worthwhile
- numerical reference numbers used do not define the difference between LV, HV and EHV and makes the analysis of the worksheet difficult and sorting impossible.

Appendix G EDF Energy Networks (EPN) plc

G.1 Summary

EDF Energy Networks (EPN) plc's (referred to as EPN throughout this report) licence area was audited during the week beginning 25 August 2003 at the Fore Hamlet offices in Ipswich.

EPN's measurement systems have changed little since the 2002 IIP audit visit, when the visiting auditors found EPN's systems and procedures to be both robust and accurate. EPN's continuing commitment to improving the quality of the data within these systems has reduced the number of customers not assigned to a feederway within the connectivity model and also the number of customers assigned to the 'dummy' feeder (Feeder 0). The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 100%.
- Connectivity model (HV): 96.09%.
- Connectivity model (LV feeder level): 93.0%.

Approximately 0.7% (24,216) of MPANs are not assigned to a feederway within the connectivity model at all. This has been taken account of in the accuracy figures above.

Although a small number of discrepancies were found with the connectivity model during the course of the audit of incidents, we do not believe these to be significant enough to justify disputing EPN's assessment of the accuracy of its systems.

A number of errors were discovered during the audit of incidents both at LV and higher voltage levels. These appeared to be due to a combination of manual transcription errors, misinterpretation of the fault information and at LV level, obtaining incorrect numbers from the connectivity model. One missing restoration stage was found at LV level. Incorrect incident start times or end times were the most common source of error at LV, whereas at higher voltages the most common problem was changes to the interpretation of the connectivity model.

The link between the Network Management System (NMS) and the Fault Reporting System (FRS) has clearly helped reduce transcription errors at higher voltages. At LV in particular the audit trail was often not robust enough to support the information contained in the fault reports audited. Without a comprehensive audit trail the reasons for the differences were not always clear, although clearly some of these would have been the result of customer 'churn' or network changes.

EPN is in the process of procuring a system that will automate the generation of fault reports which will eliminate many of the manual errors witnessed.

The combined Stage 1 and Stage 3 overall and LV accuracy results are as follows:

Table G-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
95.7%	95.4%	93.0%	93.0%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

The DNO believes that its count of Short Interruptions at HV is 100% accurate because of telecontrol. The associated CI reporting accuracy will be similar to the reporting accuracy of other incidents in that there is the likelihood of similar types of error to those noted above.

The DNO has interpreted the RIGs consistently with last year. The only interpretation issue identified was when the DNO attempts to effect a repair to a customers supply but is denied access. In this instance the DNO records the end of an incident at the time the customer refuses access, and commences another incident when the DNO is admitted to the property in the morning. This was different to the interpretation adopted by the auditors which is that the 'clock' runs from the time a customer is interrupted to the time they are finally restored. We do not believe this issue to have had a material impact on reporting. The auditors do however note that Ofgem's position is that based on the RIGs, there should be no clock stopping.

G.2 Introduction

EDF Energy Networks (EPN) plc's (referred to as EPN in this report) licence area was audited during the week beginning 25 August 2003 at the Fore Hamlet offices in Ipswich. The audit team consisted of Gordon Roberts from British Power International and David Holding from Mott MacDonald. EPN provided appropriate staff to assist in the work throughout the visit.

This report presents the findings of the EPN audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

G.3 Stage 1: Measurement Systems and Template

G.3.1 Summary of Measurement Systems

EDF Energy (Networks Branch) holds three separate electricity distribution licences, those for EDF Energy (LPN) Plc, EDF Energy Networks (EPN) plc and EDF Energy (SPN) Plc. Clearance for the acquisition of Seeboard by the LE Group (subsequently renamed EDF Energy Networks Branch) was given on 18 June 2002.

EDF Energy (Networks Branch) operates from two integrated operations centre at Fore Hamlet (EPN / LPN) and Wealden House (SPN). These call centres cover Network Control, Emergency Dispatch, Call Centres, Emergency Planning, Customer Relations and Management Information.

A range of integrated systems are used to provide end-to-end functionality for the processes required by EPN. The process starts with an extraction of the number of customers originally stored in the Meter Point Registration System (MPRS), which is then routed to PANTHER, a repository database containing data relating to MPANs and customer connectivity.

Customers are inputted into a table and are arranged together with their Line Loss Factor Code (LLFC) and their current status. A lookup function is used to identify and separate primary MPANs from secondary MPANs. Automatic overnight updates from MPRS to PANTHER reconcile information on transfers, connections and disconnections from the previous day's transactions within MPRS. Any exceptions are identified.

The initial geo-spatial disposition of MPANs in the connectivity model was carried out through an algorithm that links customers to the nearest cable without manual intervention. This was carried out through the association tool STRUMAP.

The Network Management System (ENMAC) provides information on real time data, network performance, customer history and real time customer information. The drawing office uses MMS to complete updates of network changes, field diagrams and the corresponding screen geo-spatial display.

EPN uses "TroubleCall" as its Fault Management System, with faults being created manually using the Fault Reporting System (FRS). There is a manual process of transferring information from the FRS (with IIP details generated from a range of standard reports) into the IIP template. The FRS was developed in-house.

G.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which EPN identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that approved by Ofgem during 2001.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, EPN's estimate of the accuracy of its customer count by primary traded MPAN was 100%. This was based on ongoing audits of EPN's systems and its MPRS database.

During the 2003 IIP audit visit, EPN has restated its estimated accuracy of customer count by primary traded MPAN as 100.00%.

The only potential source of error remains the same as last year in that the DNO is reliant on external systems (MPRS) to a certain extent. There is a possibility that an MPAN may become energised within the 14 day period allowed in the RIGs for the connectivity model to be updated. (This is likely to be an exception rather than the rule and will not have an effect on the count of MPANs).

No major changes to EPN's procedures are planned for the future.

Auditors Conclusions

EPN's procedures for counting primary traded MPANs is robust. Due to the dynamic nature of systems and small time lags involved there will always be a small difference between the number of MPANs included in EPN's measurement systems and the number registered in MPRS. These differences are not considered by the visiting auditors to be a significant source of inaccuracy.

The visiting auditors support EPN's estimated accuracy of approximately 100%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The structure and operation of EPN's connectivity model has not changed since the 2002 IIP audit visit. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit, although it was established that ongoing cleansing of data would continue.

DNO's Estimate of Accuracy

EPN's current estimate of accuracy for those customers allocated to its connectivity model is as follows:

HV Level	96.09%
LV Feeder	93.0 %

It should be noted that 24,216 or 0.7% (0.75% last year) of MPANs are not currently assigned to a LV feederway in the model due to poor address data. This has been confirmed through the MVM Address Matching Report.

EPN has included calculations from a model (which was reviewed as part of last year's audit) for calculating accuracy within its connectivity model. For each MPAN an accuracy level is assigned depending on the configuration of the network in a tightly defined radius of the premise. This model includes those customers currently assigned to a Feeder 0 at feeder level (where insufficient data is available), although it is thought these are correctly assigned at Transformer level. A total of 178,000 (down from 260,000) customers were assigned to Feeder 0. These seem to be associated with Pole Mounted Transformers. Not all HV customers appear in the connectivity model, but are included in the overall count of MPANs and there is an on-going programme to assign the remaining HV customers to the connectivity model.

Auditor's Conclusions

A small number of customers are assigned to dummy LV feeders where insufficient information exists to correctly assign them. However these customers count for around only 5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct LV feeders.

EPN's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using the model outlined above. During the 2003 IIP audit, the visiting auditors reviewed the calculations performed by the model to establish overall connectivity accuracy.

During the audit of incidents the auditors discovered a small number of incidents where customers were clearly allocated to the incorrect feeder. We do not believe this to significantly impact on EPN's estimate of accuracy.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which EPN has interpreted the definitions and guidance contained in the RIGs.

However, in a similar way to EDF Energy LPN, EPN has been using a different interpretation of incident start and end time, where the DNO has been refused access to a property by a customer to affect repairs. The DNO records an end to the incident if a customer refuses access to a property (usually where a fault would have been repaired during the night). The DNO then records a separate incident when access is allowed.

The DNO uses the following interpretation of a re-interruption (option 2). "If a customer or group of customers are interrupted and restored as part of an incident and then interrupted again at any time while the incident continues up to three hours after the last customers in the incident have been restored, this is classified as a re-interruption. The count of Customers Interrupted (CI) should not include these customers but the count of Customer Minutes Lost (CML) should include the product of customers and duration for these customers."

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the mechanism used to populate the IIP template, which continues to be populated manually from extract of figures produced from a standard report within EPN's FRS.

Reports were rerun in the presence of the auditors and the figures were reconciled with the figures in the Ofgem template. The auditors checked the figures from the FRS to the IIP Template for Short Interruptions and an exact match was made.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to EPN, the visiting auditors support EPN's estimate of the accuracy of its measurement systems.

The visiting auditors are also satisfied that EPN has correctly interpreted the RIG definitions with the exception of its termination of an incident at the point where a customer refuses access to the DNO to affect repairs.

EPN has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to manually populate the template.

G.4 Stage 3: Accuracy of Reporting

G.4.1 Incidents at the Higher Voltages

For HV faults there is a single transfer of data from NMS into the FRS. This means there is reduced manual transcription of information and the customer numbers are automatically created in the Fault Report (through the NMS) recording the number of customers as they showed in the connectivity model at the time of the incident.

For each incident at the higher voltages, EPN had prepared a file of information containing the fault report from the FRS system, the incident log recording the actions taken by the operator and the SCADA switching log recording the switching actions performed on the network. Network diagrams were also available online for each incident. Details relating to telephone calls received were available through the network.

For incidents at HV level customer numbers are automatically recorded in the switching log by the system as the various switching operations take place. The connectivity model was used to identify the numbers of customers assigned to each transformer, once the exact network configuration had been agreed and these represented the number of customers as they stood at the time of the audit – the System number.

In around 1/3 of the 100 HV incidents the Audited CML differed from the Reported CML. This was due to a variety of reasons. In order of materiality these were: -

- Errors occurred with the connectivity model. HV customers do not appear in the connectivity model. There were clearly differences within the connectivity model due to the continuous updating.

- Missed restoration stages.
- Assumed customer growth / network changes between the incident and audit were not verifiable through additional evidence.
- HV customers not being assigned to connectivity model.
- Transcription errors.

G.4.2 Incidents at LV

For each incident at LV, EPN provided the FRS fault report and the incident log. A record of telephone calls received was available through the system. Full incident logs were available on-line through the Troublecall system. Hand written incident logs produced by the Control Engineers were available if required.

Fault reports are created manually usually by the Control Engineer.

Since the last audit it was clear that additional information had been entered onto the system to better identify restoration stages and re-interruptions. The following key points emerged from the audit of LV incidents:

In approximately 1/2 of the incidents audited the CMLs were different to the reported figures. The most common cause for these differences was the reporting of start and end times. There were a variety of reasons for this:

- Due to a telephone system problem in some cases the fault was being created against the second call, rather than the first call. This has now been resolved.
- In some cases the start time was recorded as the time the fault was logged in the system rather than the start time as defined by the RIGs.
- In many cases there was no audit trail to support the time recorded in the Fault Report.
- There was a significant ‘error’ rate in the recording of Service Faults which were not being logged by a Control Engineer.

Other reasons for discrepancies are shown below:

- There was often no audit trail where the number of customers shown by the connectivity could be reconciled to the audit report.
- A couple of incidents had clear examples of the number of phases not being taken into account in the calculation of customer numbers.
- One incident was discovered that had a missing restoration stage.

It was noted that the accuracy and robustness of reporting diminished significantly during the ‘exceptional’ storm of October 2002. Four LV incidents included in the sample occurred during this period. Auditing of two of these had to be aborted due to a lack of information, whilst the other two incidents had significant discrepancies.

The accuracy of reporting for Service Faults was poor during the early part of the year. It appears that this was the result of these faults being created by an administrator, rather than a Control Engineer. Problems with recording of start and end times were the most common issues.

G.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table G-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
HVF1011041	HVF1029553	LVF1036951	LVF1086665
HVF1029553		LVF1037223	LVF1037363

The final Stage 3 reporting accuracy results are therefore:

Table G-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.1%
Stage 3	Overall sample – CML	98.0%
Stage 3	LV-only sample – CI	99.5%
Stage 3	LV-only sample – CML	99.5%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination of the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table G-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.1%	0.9%
		CML	98.0%	2.0%
	LV	CI	99.5%	0.5%
		CML	99.5%	0.5%
Stage 1		LV	93.0%	7.0%
		Overall		4.2%
		HV	96.1%	3.9%
LV Fraction				9.0%
Combined Accuracy	Overall	CI	95.7%	4.3%
		CML	95.4%	4.6%
	LV	CI	93.0%	7.0%
		CML	93.0%	7.0%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table G-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
95.7%	95.4%	93.0%	93.0%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

G.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

G.5.1 Methodology

The operation of all devices that allow restoration of supplies to occur within three minutes are tele-controlled and are automatically recorded within the SCADA system. This system automatically date and time stamps all operations undertaken by these devices. Individual fault reports at HV are prepared manually from the SCADA logs in a similar way as other entries into the FRS are made. When the fault reports are being prepared in FRS, the control engineer uses information from the SCADA logs to enter the cause of each interruption for each restoration stage. The cause definitions used by the system are restricted to and mirror those laid down in the RIGS.

EPN makes limited use of automatic re-closing devices at the LV level. These are temporary devices installed during the fault finding process. All HV Pole mounted reclosers are fitted with remote control.

SIs are not treated separately for internal audit, but are subject to the same processes and procedures as for reporting of all incidents.

G.5.2 DNO's estimate of accuracy

Due to the automatic nature of the process relating to the link between the tele-controlled devices and the SCADA system, it is thought that the count of SIs is 100% accurate. It is possible that inaccuracies will be introduced by the manual nature of the process involved in creating the fault reports in FRS. Similar types of inaccuracies were discovered during the creation of fault reports for LV and HV incidents. The other inaccuracy that will be evident in the reporting of CIs during SIs is due to the inaccuracies in the connectivity model, discussed in more detail in Section G.3.2(ii).

EPN has a procurement process underway to implement a system that facilitates automatic creation of Fault Reports from the source data. This will significantly reduce the potential inaccuracies caused by human error.

G.5.3 Auditor's Conclusions

We conclude that the measurement systems relating to Short Interruptions are robust. The only potential sources of error are from the manual compilation of the fault reports and from the inaccuracies present in the connectivity model. While EDF Energy has not calculated any accuracy figure for short interruptions, they should be in the range of the figures found in the restoration stages audited in the HV sample.

G.6 Overall Impressions

EPN maintains a strong emphasis on IIP within its organisation, reinforced by continuous training and awareness programmes. Improvements to the data and the processes have been made. The primarily automatic generation of Fault Reports at HV level ensures that accuracy of reporting is superior to that at LV. This will be greatly assisted by the full automation of the process, for which a system is now being procured.

The absence of a detailed audit trail to identify changes within the connectivity model, especially at the LV level, made it difficult to establish definite reasons for a number of differences identified between reported and audit numbers of customers. The DNO is committed to add more information to its fault reports thus enabling the audit trail to be easier to follow.

G.7 Conclusions

Table G-6 presents the results of the 2003 audit of the EPN area in line with the auditing framework.

Table G-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100%
Stage 1	LV Connectivity Model	93.0%
Stage 1	HV Connectivity Model	96.09%
Stage 3	Overall sample – CI	99.1%
Stage 3	Overall sample – CML	98.0%
Stage 3	LV-only sample – CI	99.5%
Stage 3	LV-only sample– CML	99.5%
	Short Interruptions	Not estimated by DNO

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table G-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
95.7%	95.4%	93.0%	93.0%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

G.8 Recommendations

EPN's systems appear generally robust. However, errors were apparent during the audit and measures could be taken to reduce these. Examples of areas for further improvement include the following:

- Reduce reliance on manual recording and transcription – this is being addressed by the DNO through the procurement of a package that will facilitate automatic creation of faults.
- Re-emphasise to Control Engineers the importance of correcting any customers not on the correct feeders, when identified during the creation of a fault report.
- Attempt to produce a more robust audit trail especially with respect to recording of start and end times, during the process of creating a report by getting the Control Engineer to add comments explaining any assumptions made in the creation of the report.
- Improve the audit trail by making record of network changes, and customer "churn". (It was pointed out by the DNO that the costs associated with providing a comprehensive audit trail may outweigh the benefits).
- Discuss with Ofgem interpretation of the end of an incident when the customer denies access to property.

G.9 DNO Comments

The following items were identified by the DNO as areas of concern / further discussion.

- EPN wanted to make it clear that some differences from last years audit would be due to the new connectivity model being used for the first time to produce the "reported" figures used in the audit of incidents.
- EPN raised concerns about how the accuracy figures were going to be calculated. These concerns relate to the fact that figures for the improvements in the accuracy of the connectivity model are asked for and are then not allowed when auditing the restoration stages.
- EPN queried the costs and benefits associated with providing a more comprehensive audit trail. Who would pay?

G.10 Learning Points

The auditors identified the following key learning points from the audit:

- There was clearly an advantage in terms of resources of both the audit team and EPN of having the same audit team audit two DNOs (EPN and EDF Energy London) from the same group. This saved significant time in understanding the systems and processes within the second DNO and dealing with the questionnaires, which were very similar for both DNOs.
- It was found that the use by EDF of their IT systems that were immediately accessible during the audit enabled the amount of paperwork to be kept to a minimum. This helped the audit process.
- Completion of the questionnaires by EPN before the arrival of the audit team saved considerable time.

Appendix H EDF Energy Networks (LPN) plc

H.1 Summary

EDF Energy (LPN) plc's (referred to as LPN in this report) London licence area was audited during the week beginning 3 August 2003 at the Fore Hamlet offices in Ipswich.

LPN's measurement systems have changed little since the 2002 IIP audit visit, when the visiting auditors found LPN's systems and procedures to be both robust and accurate. LPN's continuing commitment to improving the quality of the data within these systems has reduced the number of customers not assigned to an LV feederway within the connectivity model and also the number of customers assigned to the 'dummy' feeder (Feeder 0). The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 100%.
- Connectivity model (HV) 99.27%.
- Connectivity model (LV feeder level) 95.6%.

In addition to the above 0.47% of MPANs are not assigned to an LV feederway within the connectivity model at all. This has been taken account of in the accuracy figures above.

We agree with the DNOs estimate of accuracy at Transformer Level. However, during the course of the audit of incidents a number of instances of customers being assigned to the incorrect feeder way were discovered. The connectivity model is based on a complex algorithm (an approach agreed by Ofgem) and it was not clear the reason for these discrepancies. We conclude that the DNOs estimate for accuracy at LV feeder level is at the top end of our expectations although we do not have evidence to suggest that there is a material difference between estimated and actual accuracy.

A number of errors were discovered during the audit of incidents both at LV and higher voltage levels. These appeared to be due to a combination of manual transcription errors, misinterpretation of the fault information and in particular obtaining incorrect numbers from the connectivity model. Two LV incidents in the audit sample were discovered to have missing restoration stages and two restoration were not identified as re-interruptions. Incorrect incident start times or end times were picked up on approximately 15 incidents from a range of different sources and a problem with the telephone reporting system was identified resulting in the second call time being used.

On approximately half of the incidents the numbers of customers reported differed from the audited figure. Without a comprehensive audit trail the reasons for the differences was not always clear, although clearly some of these could have been the result of customer 'churn' or network changes. The DNO is in the process of procuring a system that will automate the generation of fault reports which will eliminate many of the manual errors witnessed.

The calculated combined Stage 1 and Stage 3 LV and overall accuracy results are as follows:

Table H-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.0%	96.6%	90.8%	95.6%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

The DNO estimates that its count of Short Interruptions at HV is 100% accurate because of telecontrol. The associated CI and CML reporting accuracy will be similar to the reporting accuracy of other incidents in that there is the likelihood of similar types of error to those noted above.

The DNO has interpreted the RIGs consistently with last year. The only interpretation issue identified was when the DNO attempts to effect a repair to a customers supply but is denied access. In this instance the DNO records the end of an incident at the time the customer refuses access, and commences another incident when the DNO is admitted to the property in the morning. This was different to the interpretation adopted by the auditors which is that the ‘clock’ should run from the time the customer is interrupted to the time they are finally restored. We do not believe this issue to have had a material impact on reporting.

H.2 Introduction

EDF Energy (LPN) PLC’s (referred to as LPN in this report) London licence area was audited during the week beginning 3 August 2003 at the Fore Hamlet offices in Ipswich. The audit team consisted of Gordon Roberts from British Power International and David Holding from Mott MacDonald. LPN provided appropriate staff to assist in the work throughout the visit.

This report presents the findings of the LPN audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

H.3 Stage 1: Measurement Systems and Template

H.3.1 Summary of Measurement Systems

EDF Energy (Networks Branch) holds three separate electricity distribution licences, those for EDF Energy (LPN) Plc, EDF Energy Networks (EPN) plc and EDF Energy (SPN) Plc. Clearance for the acquisition of Seeboard by the LE Group (subsequently renamed EDF Energy Networks Branch) was given on 18 June 2002.

EDF Energy (Networks Branch) operates from two integrated operations centre at Fore Hamlet (EPN /LPN) and Wealden House (SPN). These call centres cover Network Control, Emergency Dispatch, Call Centres, Emergency Planning, Customer Relations and Management Information.

A range of integrated systems are used to provide end-to-end functionality for the processes required by LPN. The process starts with an extraction of the number of customers originally stored in the Meter Point Registration System (MPRS), which is then routed to PANTHER a repository database containing data relating to MPANs and customer connectivity.

Customers are inputted into a table and are arranged together with their Line Loss Factor Code (LLFC) and their current status. A lookup function is used to identify and separate primary MPANs from secondary MPANs. Automatic overnight updates from MPRS to PANTHER reconcile information on transfers, connections and disconnections from the previous day's transactions within MPRS. Any exceptions are identified.

The initial geo-spatial disposition of MPANs in the connectivity model was carried out through an algorithm that links customers to the nearest cable without manual intervention. This was carried out through the association tool STRUMAP.

The Network Management System (ENMAC) provides information on real time data, network performance, customer history and real time customer information. The drawing office uses DINIS to complete updates of network changes, field diagrams and the corresponding screen geo-spatial display.

LPN uses "TroubleCall" as its Fault Management System, with faults being created manually using the Fault Reporting System (FRS). There is a manual process of transferring information from the FRS (with IIP details generated from a range of standard reports) into the IIP template. The FRS was developed in-house.

H.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that approved by Ofgem during 2001.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO’s Estimate of Accuracy

At the time of the 2002 IIP audit visit, LPN’s estimate of accuracy of its customer count by primary traded MPAN was 100%. This was based on ongoing audits of the company’s systems and the company’s MPRS database.

During the 2003 IIP audit visit, LPN has restated its estimated accuracy of customer count by primary traded MPAN as 100.00% for the London licensed area. LPN has commissioned a report by a company called MVM that produced a document reconciling the MPANs produced from LPN’s systems and a reconciliation of MPAN numbers.

In terms of the accuracy of the MPAN count, the DNO believes this to be 100% accurate as reported in last year’s audit. The only potential source of error remains the same as last year in that the DNO is reliant on external systems (MPRS) to a certain extent. There is a possibility that an MPAN may become energised within the 14 day period allowed in the RIGs for the connectivity model to be updated. (This is likely to be an exception rather than the rule and will not have any effect on the count of MPANs).

No major changes to LPN’s procedures are planned for the future.

Auditors Conclusions

LPN’s procedures for counting primary traded MPANs is robust. Due to the dynamic nature of systems and small time lags involved there will always be a small difference between the number of MPANs included in LPN’s measurement systems and the number registered in MPRS. These differences are considered by the visiting auditors to be not a significant source of inaccuracy.

The visiting auditors support the company’s estimated accuracy of approximately 100%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The structure and operation of the company’s connectivity model has not changed since the 2002 IIP audit visit. However, it should be noted that although the connectivity model was in place at the time of last year’s audit this is the first year that the new connectivity model has been used to produce the customer numbers for the incidents to be audited. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit, although it was established that ongoing cleansing of data would continue.

DNO's Estimate of Accuracy

LPN's current estimate of accuracy for those customers allocated to its connectivity model is as follows:

HV Level	99.27%
LV Feeder	95.6%

It should be noted that 10,594 or 0.47% (0.79% last year) of MPANs are not currently assigned to an LV feederway within the model due to poor address data. This has been confirmed through the MVM Address Matching Report.

LPN has included calculations from a model (which was reviewed as part of last year's audit) for calculating accuracy within its connectivity model. For each MPAN an accuracy level is assigned depending on the configuration of the network in a tightly defined radius of the premise. This model includes those customers currently assigned to a Feeder 0 at feeder level (where insufficient data is available), although it is thought these are correctly assigned at Transformer level.

Auditor's Conclusions

A small number of customers are assigned to dummy LV feeders where insufficient information exists to correctly assign them, however these customers count for less than 0.5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct LV feeders.

LPN's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using the model outlined above. During the 2003 IIP audit, the visiting auditors reviewed the calculations performed by the model to establish overall connectivity accuracy.

During the audit of incidents the auditors discovered a number of incidents where customers were clearly allocated to the incorrect feeder. Although this was only observed on a small number of occasions it often involved many customers. The reasons for these anomalies are not clear and an estimate as to the number of customers affected and the impact on accuracy was difficult to make. As faults are created there is a process in place to ensure that Control Engineers identify any such customers and assign them to the correct feeders.

The presence of some discrepancies means that the accuracy figures quoted by LPN in our view are at the top end of our expectations, although at this stage we do not believe the difference between estimated and actual accuracy to be material. The DNO has stressed previously that the accuracy calculations are based on prudent assumptions that may well balance off the errors found. Far fewer errors of customers being allocated to the incorrect Transformer were discovered during the audit, and as such we have no reason to dispute with the accuracy figure provided by LPN at Transformer level.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which LPN has interpreted the definitions and guidance contained in the RIGs.

However, during the course of the audit it was discovered that the DNO has been using a different interpretation of incident start and end time, where the DNO has been refused access to a property by a customer to affect repairs. The audit uncovered 3 instances where the DNO had recorded an end to the incident at the time the customer refused access to a property (usually where a fault would have been repaired during the night). The DNO then recorded a separate incident when access was allowed. The result of this was that for these instances the CMLs were underreported.

The DNO uses the following interpretation of a re-interruption (option 2). "If a customer or group of customers are interrupted and restored as part of an incident and then interrupted again at any time while the incident continues up to three hours after the last customers in the incident have been restored, this is classified as a re-interruption. The count of Customers Interrupted (CI) should not include these customers but the count of Customer Minutes Lost (CML) should include the product of customers and duration for these customers."

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the mechanism used to populate the IIP template, which continues to rely on a manual extract of figures produced from a standard report within the DNO's FRS.

Reports were rerun in the presence of the auditors, and the figures were reconciled with the figures in the Ofgem template. The auditors checked the figures from the FRS to the IIP Template for Short Interruptions and an exact match was made.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to LPN, the visiting auditors largely support LPN's estimate of the accuracy of its measurement systems. The one concern would be errors discovered in the connectivity model at LV Feeder level. It is difficult to assess how significant this is on the accuracy figure although our assessment based on work carried out during the audit of incidents concludes that it is not likely to be significant. In addition improvements to the quality of the data are being continually made.

The visiting auditors are also satisfied that LPN has correctly interpreted the RIG definitions with the exception of its termination of an incident at the point where a customer refuses access to the DNO to affect repairs.

LPN has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to populate the template manually.

H.4 Stage 3: Accuracy of Reporting

H.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, LPN had prepared a file of information containing the fault report from the FRS system, the incident log recording the actions taken by the operator and the SCADA switching log recording the switching actions performed on the network. Network diagrams had been printed off with the part of the network relevant to the restoration stage being audited, highlighted. Details relating to telephone calls received were available through the network.

The connectivity model was then used to identify numbers of customers assigned to each transformer, once the exact network configuration had been agreed.

Two of the higher voltage restoration stages selected for the audit sample were agreed to be too complex to audit and two of the spares were therefore used.

Due to the dynamic nature of the model there were a large number of instances where customer numbers demonstrated by the model were different from those shown in the FRS. In most of these instances the DNO could not provide 'sufficient' (from the auditors point of view) evidence to substantiate the figures shown on the FRS reports, although the DNO argued that this would have been either due to network changes or customer 'churn'. Where the figures shown in the connectivity model differed from the figures shown in the FRS reports, and could not be verified, the connectivity model figures were used as the 'Audit' figures. For most incidents at HV level customer numbers shown by the connectivity model were the same as those reported.

The most errors occurred on the large number of HV incidents where the numbers of customers was shown as 0. In these incidents there were a large number of errors on recording of incident start and end times, although this would not cause a problem in terms of CML.

H.4.2 Incidents at LV

For each incident at LV, LPN provided the FRS fault report, the incident log and a printout of the customer calls received. Telephone calls received were also viewed through the live system. Hand written incident logs produced by the Control Engineers were available if required.

Since the last audit it was clear that additional information had been entered onto the system to identify restoration stages. The following key points emerged from the audit of LV incidents:

- In approximately half of incidents the customer numbers reported on the fault reports differed from the figure shown by the connectivity model. It was only possible to verify the original figures with an audit trail in a few of these cases. Some of the differences could have been due to customer 'churn' and network changes but some were clearly errors as a result of either Control Engineer misinterpretation or typos.
- Two examples were found of restoration stages not correctly identified as re-interruptions.
- Two examples were found of missing restoration stages.
- Approximately 15 incidents had errors in start or end times (although some of these were in restoration stages not in the sample but within the relevant incident). 3 of these were due to a different interpretation of the RIGs where a customer would not allow access to the premises as discussed in Section H.3.2(iii) and the incident was terminated at this point. Other errors in times were a mixture of using the time the event was created in the system instead of the first call time (a problem with the recording of call times has been rectified by DNO) and transcription errors.

H.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table H-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
HVF2003317	HVF2003770	LVF2039507	LVF2042680
HVF2003770			

The final Stage 3 reporting accuracy results are therefore:

Table H-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.2%
Stage 3	Overall sample – CML	97.2%
Stage 3	LV-only sample – CI	108.1%
Stage 3	LV-only sample – CML	99.8%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table H-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.2%	0.8%
		CML	97.2%	2.8%
	LV	CI	108.1%	8.1%
		CML	99.8%	0.2%
Stage 1		LV	95.6%	4.4%
		Overall		1.9%
		HV	99.3%	0.7%
LV Fraction				31.0%
Combined Accuracy	Overall	CI	98.0%	2.0%
		CML	96.6%	3.4%
	LV	CI	90.8%	9.2%
		CML	95.6%	4.4%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table H-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.0%	96.6%	90.8%	95.6%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

H.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

H.5.1 Methodology

The operation of all devices that allow restoration of supplies to occur within three minutes are tele-controlled and are automatically recorded within the SCADA system. This system automatically date and time stamps all operations undertaken by these devices. Individual fault reports are prepared manually from the SCADA logs in a similar way as other entries into the FRS are made. When the fault reports are being prepared in FRS, the control engineer uses information from the SCADA logs to enter the cause of each interruption for each restoration stage. The cause definitions used by the system are restricted to and mirror those laid down in the RIGS. A report was run to demonstrate that all SIs were given one of the causes detailed in the RIGs.

LPN makes limited use of automatic re-closing devices at the LV level. Any such devices are not permanent and are only used for the post fault restoration of supplies on underground networks. It was reported that LPN did not have any 'multi-shot reclosing schemes' due primarily to the small amount of overhead lines in the licensed area.

SIs are not treated separately for internal audit, but are subject to the same processes and procedures as for reporting of all incidents.

H.5.2 DNO's Estimate of Accuracy

Due to the automatic nature of the process relating to the link between the tele-controlled devices and the SCADA system, it is thought that the count of SIs is 100% accurate. It is possible that inaccuracies will be introduced by the manual nature of the process involved in creating the fault reports in FRS. Similar types of inaccuracies were discovered during the creation of fault reports for LV and HV incidents. The other inaccuracy that will be evident in the reporting of CIs during SIs is due to the inaccuracies in the connectivity model, discussed in more detail in Section H.3.2(ii).

LPN has a procurement process underway to implement a system that facilitates automatic creation of Fault Reports from the source data. This will significantly reduce the potential inaccuracies caused by human error.

H.5.3 Auditors Conclusions

We conclude that the measurement systems relating to Short Interruptions are robust. The only potential sources of error are from the manual compilation of the fault reports and from the inaccuracies present in the connectivity model. . While EDF Energy has not calculated any accuracy figure for short interruptions, they should be in the range of the figures found in the restoration stages audited in the HV sample.

H.6 Overall Impressions

LPN maintains a strong emphasis on IIP within its organisation, reinforced by continuous training and awareness programmes. Improvements to the data and the processes have been made, however, the manual nature of the process of compiling fault reports has contributed to a number of errors uncovered during the audit of incidents. This will be greatly assisted by the automation of the process, for which a system is now being procured.

The absence of a detailed audit trail made it difficult to establish definite reasons for a number of differences identified between reported and audit numbers of customers. The DNO is committed to add more information to its fault reports thus enabling the audit trail being easier to follow.

LPN was very open and helpful during the audit visit and the supporting information was readily available. The problem and cost effectiveness of producing a full and detailed audit trail for each event may remain.

H.7 Conclusions

Table H-6 presents the results of the 2003 audit of the London licence area in-line with the auditing framework.

Table H-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100%
Stage 1	LV Connectivity Model	95.6%
Stage 1	HV Connectivity Model	99.27%
Stage 3	Overall sample – CI	99.2%
Stage 3	Overall sample – CML	97.2%
Stage 3	LV-only sample – CI	108.1%
Stage 3	LV-only sample– CML	99.8%
	Short Interruptions	Not estimated by DNO

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table H-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.0%	96.6%	90.8%	95.6%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

H.8 Recommendations

LPN's systems appear generally robust. However, errors were apparent in the audit and measures could be taken to reduce these. Examples of areas for further improvement include the following:

- Reduce reliance on manual recording and transcription – this is being addressed by the DNO through the procurement of a package that will facilitate automatic creation of faults.
- Re-emphasise to Control Engineers the importance of correcting any customers not on the correct feeders, when identified during the creation of a fault reports.
- Attempt to produce a more robust audit trail, during the process of creating a report by getting the Control Engineer to add comments relating to for example, what assumptions were made when calculating customer numbers from the model, at what location was any 'cut' made etc.
- Improve the audit trail by making record of network changes, and customer "churn". (It was pointed out by the DNO that the costs associated with providing a comprehensive audit trail may outweigh the benefits.).
- Discuss with Ofgem interpretation of an end of an incident when the customer denies access to property.

H.9 DNO Comments

The following items were identified by the DNO as areas of concern / further discussion.

- LPN wanted to make it clear that some differences from last years audit would be due to the new connectivity model being used for the first time to produce the "reported" figures used in the audit of incidents.
- LPN had concerns over the sampling methodology adopted, in relation to the need for an Overall sample and LV sample. LPN also had concerns relating to problems in delivering the correct sample to them.
- LPN has concerns over how the accuracy figures will be calculated – maybe this could be made more transparent for next year.
- LPN feels strongly that it is unfair to include as inaccuracy differences in customer numbers between the time of the incident and the time of the audit due to changes in the distribution network and general customer 'churn'. Due to the length of time between the audit and some of the incidents (up to 16 months) some customer churn was inevitable. LPN and the auditors disagreed as to what constituted sufficient evidence for customer growth.
- LPN raised concerns about how the accuracy figures were going to be calculated. These concerns relate to the fact that figures for the improvements in the accuracy of the connectivity model are asked for and are then not allowed when auditing the restoration stages (churn within the model and new MPANs not taken account of). See above bullet point.
- LPN raised concern over the number of restoration stages within the overall sample with zero customers and the effect this would have on the calculation of accuracy.
- LPN queried the costs and benefits associated with providing a more comprehensive audit trail. Who would pay?

H.10 Learning Points

The auditors identified the following key learning points from the audit:

- It was found that the use by EDF of their IT systems that were immediately accessible during the audit enabled the amount of paperwork to be kept to a minimum. This helped the audit process.
- Completion of the questionnaires by the company before the arrival of the audit team saved considerable time.
- Induction to EDFs systems and processes was very worthwhile.

Appendix I EDF Energy Networks (SPN) plc

I.1 Summary

EDF Energy Networks (SPN) plc was audited during the week beginning 18 August 2003, at the Wealden House control centre and offices in East Grinstead.

SPN has developed dedicated HV and LV connectivity models and has implemented the associated infrastructures. All HV equipment parameters and connection arrangements are stored in the Network Management System (NMS), which handles and updates in near real-time details of HV connectivity. LV faults are first recorded in the Fault Management System (FMS) and are then related to the LV connectivity model, which is stored in the Discovery system of the Customer Connectivity Model (CCM), which holds detailed information of all LV equipment, parameters and MPANs.

The connectivity models have not changed since the 2002 IIP audit. Reported accuracy levels have also not changed. During the 2002 audit the connectivity models were audited and discrepancies were found that were consistent with the accuracy levels quoted for the models. Since no changes have been made to the models and the auditors did not note any significant discrepancies during the audit of HV and LV faults that could be definitively attributed to errors in the models, we support the company's estimate of accuracy levels, which are:

- Accuracy of MPAN count: 100%.
- Connectivity model (HV/LV substation level) 98.5%.
- Connectivity model (LV feeder level) 94.1%.

The visiting auditors are satisfied that SPN has correctly interpreted the RIG definitions and that the company continues to operate in accordance with them. It should, however, be noted that SPN uses a version of the definition for re-interruptions that considers a re-interruption to occur for customers re-interrupted up to three hours following the restoration of the last customer associated with an incident, rather than up to three hours of that particular customer being restored.

SPN has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an in-house derived suite of queries that automatically populates the IIP template by extracting incident data from SPN's incident database. The visiting auditors consider this approach to be robust, as demonstrated during the 2002 audit.

SPN's reporting of incidents was found to be very accurate for the 2002/03 reporting year. Differences between customer numbers in incident reports and system numbers associated with the same network at the time of audit occurred frequently. SPN points out that this is to be expected because system arrangement and customer numbers are continually changing. Manual transcription errors were found in some incident times. Block Switching Instructions also were seen to involve inaccurate reporting of times.

The calculated combined Stage 1 and Stage 3 overall and LV accuracy results are as follows:

Table I-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.1%	98.1%	94.1%	94.0%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

The auditors agree with SPN's view that the level of accuracy of reporting short interruptions measured via telecontrol is of the order of 100%. A high level of accuracy is claimed for reporting short interruptions caused by manually recorded autoreclosers. No overall level of accuracy is estimated by SPN, but since only 10% of reclosers are counted manually it will be quite high. SI reporting levels can be expected to improve in accuracy in the near future as manually recorded reclosers are replaced by telecontrol recorded devices.

I.2 Introduction

SPN's licence area was audited during the week 18 August 2003 at the Wealden House control centre and offices in East Grinstead. The audit team were Alan Taylor and Aijuan Wang of Mott MacDonald. SPN provided appropriate staff to assist in the work throughout the visit.

This report presents the findings of the SPN audit under the following headings:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short Interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

I.3 Stage 1: Measurement Systems and Template

I.3.1 Summary of Measurement Systems

EDF Energy holds electricity distribution licences for the EDF Energy (SPN) plc, EDF Energy (LPN) plc and EDF Energy (EPN) plc franchise areas. All of EDF Energy's reporting, including Ofgem's requirements under the IIP, falls within the responsibility of the Performance Management Division.

IIP information is obtained from the Network Operations Branch, which is responsible for the operations of the three franchise areas.

Each franchise area has a Network Services Division, which is responsible for the day-to-day management of each area. An Asset Management Division is responsible for network operations, through the Network Operations Branch, for each of the three franchise areas. The HV control centre, at East Grinstead for the SPN area, carries out real-time management of the HV, EHV and 132kV networks. EDF Energy's other two franchise areas are operated from a single control centre at Fore Hamlet, Ipswich.

A Schneider manufactured system (the Network Management System – NMS) is used by SPN for telecontrol, electronic diagram production, electronic logging etc for its HV, EHV and 132 kV systems. A bespoke system called the Fault Management System (FMS), supplied by BIS, is used for LV incident logging.

The Trouble Management Centre (TMC), which includes the call centre of SPN, is located at Wealden House, East Grinstead. It is operated by SPN staff and handles all emergency calls and job dispatch for SPN. When an emergency call comes in from a member of the public, the Interactive Voice Response (IVR) system provides options to divert the call to an appropriate route in the menu. For instance, if a caller accidentally dialled the emergency number for any reason rather than reporting a fault, he or she will be diverted into the SPN general information, billing enquiry or customer relations telephone lines. For a customer who wants to report a fault the IVR detects the first seven digits of the phone number and identifies the caller's location accordingly, provided the call is dialled from a BT landline. For those customers not calling from the premises where the incidents occurred, call operators request contact numbers. Overall, 50% of calls are answered by call operators. If a fault has been reported and verified, the IVR diverts related calls to the BT MAS box, which delivers a pre-recorded message.

Details of LV faults, associated with time stamped calls, are then generated and entered manually into FMS. During the course of an incident and after a fault is repaired and cleared, the field engineer's notes, number of affected customers and incident completion time are also entered into FMS.

SPN uses an in-house derived suite of queries to populate the OFGEM IIP template from incident data held within its databases. The suite of queries was shown to provide accurate information from the databases during the 2002 IIP audit of SPN.

I.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes Since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that proposed in SPN's letter to Ofgem and subsequently approved by Ofgem in its letter dated 4 November 2002.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, SPN's estimate of the accuracy of its customer count by primary trading MPAN was 100%. During the 2002 audit SPN's procedures were reviewed and it was concluded that there was no reason to believe that the claimed accuracy level was incorrect. SPN has made no changes to the way that customer numbers are identified using MPAN count since the 2002 review, consequently the accuracy of SPN's estimate of the accuracy of its customer count remains unchanged at 100%.

Auditor's Conclusions

There has been no change in the way SPN identifies customers by primary MPAN count. During the 2002 IIP audit it was determined that the MPAN counting procedure was rigorous and robust and that the overall process and methodology used by SPN to identify MPANs is sound.

Because no procedures or processes have changed since the last audit, the visiting auditors agree with SPN 's estimate of MPAN count accuracy of 100%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

SPN has made no changes to systems, processes or procedures relating to the customer connectivity model since the last IIP audit. No specific recommendations were made during the last audit relating to improving connectivity model accuracy. The auditors' review of HV and LV incidents during the current audit has confirmed the function and integrity of SPN's customer connectivity model.

DNO's Estimate of Accuracy

SPN's current estimate of accuracy of its connectivity model for its franchise area is as follows (last year's results in brackets):

- HV 98.5% (98.5%)
- LV 94.1% (94%)

The main source of error within the connectivity model relates to MPANs with insufficient address data. Also, errors in individual customer connectivity exist. As part of the IIP process, during LV faults, operational staff are required to report customer connectivity errors that are noted. They are also required to report the status of links in LV link boxes whenever they are operated. The resulting improvements relating to these actions will take a long time to make an impression on the connectivity model's accuracy level, hence there is no change in SPN's claimed accuracy since the last review. Ultimately, SPN believes that an LV accuracy level of 97.3% can be achieved. Overall its accuracy can be expected to reach 98.4%, compared to 97.7% at present

SPN employs an external statistical consultant to derive the quoted accuracy levels. A level of confidence of 95% in the quoted accuracy levels is calculated by the consultant. In the case of the HV accuracy estimate, the inaccuracy represents the number of customers in the connectivity model whose actual HV substation is not known. These customers are assigned to the correct HV feeder and are identified in faults affecting entire HV feeders, but the correct HV/LV substation is not identified in SPENS (Site Plant and Equipment Numbering System).

The inaccuracy at LV feeder level represents customers whose property is not accurately identified in the model, together with errors in link positions in link boxes. Current accuracy levels at LV would be 1% higher if correct linking was known.

Auditor's Conclusions

It was not possible to audit fully the work of the external statistician. The auditors discussed estimates for current and future accuracy provided by the statistician and noted current and expected accuracy levels associated with the various categories of error-source. The independent estimates were the same as the figures quoted by SPN and the explanations given for the levels quoted, both now and future, were considered to be acceptable and in accordance with the outcome of the last review.

SPN has developed dedicated HV and LV connectivity models and implemented the associated infrastructures. All HV equipment parameters and connection arrangements are stored in the Network Management System (NMS), which handles and updates in near real-time details of HV connectivity. LV faults are first recorded in the Fault Management System (FMS) and are then related to the LV connectivity model, which is stored in the Discovery system of the Customer Connectivity Model (CCM), which holds detailed information of all LV equipment, parameters and MPANs.

The connectivity models have not changed since the 2002 IIP audit. Reported accuracy levels have also not changed. During the 2002 audit the connectivity models were audited and discrepancies were found that were consistent with the accuracy levels quoted for the models. Since no changes have been made to the models and the auditors did not note any significant discrepancies during the audit of HV and LV faults that could be definitively attributed to errors in the models, we support the company's estimate of LV and HV accuracy levels of 94.1% and 98.5% respectively.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which SPN has interpreted the definitions and guidance contained in the RIGs.

It should be noted, however, that SPN reports re-interruptions if the customer or group of customers are interrupted and restored as part of an incident and interrupted anytime while the incident continues, up to 3 hours after the last customers in the incident have been restored. The count of Customers Interrupted (CI) does not include these customers but the count of Customer Minutes Lost (CML) does include these customers.

(iv) IIP Template

There have been no changes since the 2002 IIP audit in the way SPN populates the IIP template. However, additional information has been supplied to OFGEM for the 2002/03 reporting year relating to disaggregated data by voltage. This required a change in the data extraction routines to provide the data in the new format although no change in the calculations of customer minutes lost or customer interruptions was made.

SPN's approach to populating the IIP template is to interrogate incident data stored within the Data Net Engine, which is fed from NMS and FMS, by an SPN derived suite of queries that populate the template. This suite has not substantially changed since the 2002 audit of the 2001/02 data, when data input to the template was verified. However, LV incident data was sourced from Mainframe-NaFIRs for 2001/02. For 2002/03 the data for the template was sourced from the Data Net database. During this audit the auditors confirmed that the data relating to LV incidents is correctly recorded in the Data Net database. Also, an audit of sample incident data in the Data Net database was made in order to confirm that the corresponding incident data had been transferred to the IIP template. Therefore, we can conclude that the IIP template retains the accuracy that was reported during the last audit.

(v) Conclusions

Based on the review of source data and discussions undertaken during the 2003 IIP audit visit to SPN, the visiting auditors can support SPN's estimate of the accuracy of its measurement systems. The visiting auditors are also satisfied that SPN has correctly interpreted the RIG definitions and that the company continues to operate in accordance with them. It should, however, be noted that SPN uses a version of the definition for re-interruptions that considers a re-interruption to occur for customers re-interrupted up to three hours following the restoration of the last customer associated with an incident.

SPN has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an in-house derived suite of queries that automatically populates the IIP template by extracting incident data from SPN's incident database. The visiting auditors consider this approach to be robust, as demonstrated during the 2002 audit.

I.4 Stage 3: Accuracy of Reporting

Please note that the methodology for the Stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

I.4.1 Incidents at the Higher Voltages

For each higher voltage incident SPN produced the following reports to assist the HV audit process:

- A Data Net incident report. This report took the form of either a Fault Incident Report or a Pre-arranged Interruption Report. These reports include basic information such as report number, date of incident, date system normal, faulted items, feeders involved, customer interruption summaries and details of restoration stages.

- A Data Net Outage Information Report that includes interruption time, restoration time, CMLs and CIs, together with details of affected transformers and the numbers of customers associated with each transformer.

- An NMS printout of the switching schedule.

This information was sufficient to understand the incident and track through the various restoration stages.

A terminal having access to live NMS data was provided for audit purposes and this was used to examine each HV incident in the pre-determined review list in order to check the accuracy of customer numbers involved in each incident and its associated restoration stages. It is worth noting that the customer numbers produced by the live HV system connectivity model may well differ from those produced at the time of any particular historical incident since network conditions and customer numbers will be continually changing.

The visiting auditors were shown the process used to extract reports and were able to confirm that date and time stamping were correct. Customer numbers associated with the first few minor HV incidents to be examined were confirmed by manually summing customer numbers associated with each transformer and comparing this check sum against customer interruption data in the incident reports. This procedure was time-consuming, consequently a search routine was written which automatically summed customer numbers on the live network associated with each incident. This routine was essential for the larger incidents since it would not have been possible to derive customer numbers for all incidents to be examined without it in the time allocated for the audit. It is therefore important to ensure that some such routine is available for this purpose for future audits also. In general, the audit trail for incidents at the higher voltages was sufficient for the purposes of the audit and it was possible to confirm underlying data issues and check customer numbers easily.

The higher voltage restoration stages selected for the audit sample were reasonably straightforward and none was too complex to resolve. The spare incidents provided were therefore not used. Whilst a few incidents took some time to understand, SPN had reviewed each of the selected stages prior to the audit visit and was able to explain each incident examined. One of the restoration stages audited confirmed that SPN defines a re-interruption to occur within three hours of the last customers to be reconnected during an incident.

Eighty-nine HV incidents were audited. Of these, forty-four had customer numbers associated with the fault differing from numbers associated with the system as existed on the day of audit. In all cases the actual differences were small numerically or in terms of percentage difference. In one case there was evidence provided by SPN that system changes had occurred and the difference was therefore discounted. SPN indicated that such differences can be expected since system configurations and customer numbers are changing on a continual basis. As a consequence, any error associated with this difference is likely to be a consequence of these changes rather than a true error.

To track all changes in order to correct the numbers at the time of audit is impractical. The numbers involved cause the error percentages associated with this difference in customer numbers to be small. Of all of the incidents showing differences in customer numbers, only one was clearly incorrect. This was because the SPN system counts one customer whenever a metering circuit breaker (MCB) is installed on the system. In the audited incident three MPANs were counted downstream of the MCB whereas the system counted only one customer. SPN indicates that the potential size of this error is extremely small since there are few MCBs.

Minor errors were noted in the time stamping for a few of the HV audit samples:

- In two incidents there was an incorrect manual intervention of incident start times because telemetry had failed. Normally NMS will automatically stamp incident start times by associating them with equipment operations. In these cases operational staff inserted incorrect times.

- Two incidents were associated with Block Switching Instructions (BSI). SPN uses BSIs to permit the person in charge of a job to instruct someone else to carry out switching. When a BSI is issued, all customers are assumed disconnected at the time of the last customer disconnection. Similarly, all customers are assumed reconnected at the time of the last customer reconnected. SPN assumes that errors in CMLs will be negligible for these cases since switch-off errors will be cancelled by switch-on errors. However, in the case of one incident, the BSI for disconnection differed from that for connection in terms of customer numbers since one substation was switched out on a BSI but reconnected on an individual instruction, thus producing some errors.

Fault reports created by the Data Net Engine show short interruptions during an incident as re-interruptions. During the audit the auditors confirmed that data collected for submission to OFGEM correctly discounted any additional CMLs associated with such re-interruptions.

I.4.2 Incidents at LV

All of the recommendations from the 2002 IIP audit are associated with LV reporting procedures. They relate to standard terminology, more details to be shown on LV incident reports, restoration stage accuracy, and reporting of incident times. SPN has addressed all of these issues for the current audit.

For each incident to be audited, the SPN audit team prepared a set of printouts that contained a Data Net LV Fault Report, FMS Call & Incident Result, FMS Customer Connectivity listing, and FMS Sub Incident Result report:

- The LV report produced by the Data Net Engine contains details of the incident reference number, incident and restoration dates and times, number of customers affected, and a calculated CML and CI based on the total number of connected customers.

- The FMS Call & Incident Result details the no supply calls received, contains notes describing actions taken to resolve the incident and details of restoration stages.

- The FMS Customer Connectivity listing contains fault details and customer numbers affected.

- FMS Sub Incident Result report lists customer calls received that can be related to this particular incident.

It is clear that much effort has been made to improve the accuracy of the LV fault reporting since the 2002 IIP audit, whilst the fault reporting procedure and methodologies applied remain unchanged.

During the 2003 IIP auditing exercise one hundred pre-selected LV incidents were reviewed, these included seven incidents that occurred during the exceptional event period of the October 2000 storms. The audited incidents cover single stages of some multi-stage faults rather than examining all stages.

LV incidents were audited by comparing customer numbers and timings given in the incident reports, which were sometimes derived from FMS and sometimes from field engineers' reports, with system numbers associated with the same network on the day of audit. System numbers were derived using the same search routine as used for HV incidents, and again it is important that some such automated routine is available for future audits.

Discrepancies in a small number of incidents were noted in interruption times, division of stages and number of customers affected. In some cases the estimated CI made by site engineers differs from the recorded CI in the current connectivity model. In such cases we used the customer numbers in the current connectivity model, although, as for HV incidents, the historical CI could have been correct at the time and system and customer changes could account for the differences. Overall, the LV incident reporting system used by SPN is robust and accurate and most errors caused in the CML count were due to errors associated with consumer numbers.

I.4.3 Accuracy of Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table I-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
30590	35270	38010	26970
23983	32380 LV		38010
	32380 LV		

The final Stage 3 reporting accuracy results are therefore:

Table I-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.3%
Stage 3	Overall sample – CML	100.3%
Stage 3	LV-only sample – CI	99.7%
Stage 3	LV-only sample – CML	99.0%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table I-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.3%	0.3%
		CML	100.3%	0.3%
	LV	CI	99.7%	0.3%
		CML	99.0%	1.0%
Stage 1		LV	94.1%	5.9%
		Overall		1.9%
		HV	98.5%	1.5%
LV Fraction				8.0%
Combined Accuracy	Overall	CI	98.1%	1.9%
		CML	98.1%	1.9%
	LV	CI	94.1%	5.9%
		CML	94.0%	6.0%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table I-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.1%	98.1%	94.1%	94.0%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

I.5 Accuracy of Measurement Systems and the Reporting Process for Short interruptions

I.5.1 Methodology

The operation of all tele-controlled devices with auto-reclose facilities is automatically captured within NMS. Non tele-controlled devices with auto-reclose facilities have their operations counted twice a year, in August and March, and counts are manually entered in NMS. Short interruptions that occur through manual switching are captured within NMS and are identified within Data Net as SIs from their time stamps.

All switching operations on the HV network are recorded within NMS, either automatically or manually. For each operation the method of operation is recorded in line with the RIGs i.e. automatic (off and on); manual off, manual/remote on; or manual/remote off, manual/remote on. The data held within NMS is passed automatically to Data Net where the IIP rules and definitions are applied and reportable data is compiled for IIP reporting.

SPN makes limited use of automatic reclosing devices at LV. The devices used are not permanently installed, but are used for post fault restorations on underground networks. Consequently, any short interruptions they cause are insignificant in terms of number of SIs and no record of such incidents is kept.

Multi-shot reclosers associated with telecontrol count one SI for every reclose sequence. For manually counted reclosers a count of the total number of trip operations is made, which is divided by two to derive an estimate of SIs. This allows for routine operations and lockouts.

For manually counted reclosers, year-end system operating conditions are used to determine customer numbers associated with SIs.

I.5.2 DNO's Estimate of Accuracy

SPN indicates that the count accuracy for reporting telecontrolled reclosers is 100%. The accuracy of counting manual recloser operations is high, although division by two to obtain SIs for these instances is empirical. However, since manually read reclosers amount to only 10% of the recloser population on the SPN system, overall the SI reporting error will not be large. Also, the current asset replacement programme contains proposals to replace all non tele-controlled reclosers by the end of 2003/04. All SIs will then be associated with real-time customer numbers and actual interruption sequences once all reclosers are tele-controlled. Consequently, SI reporting errors should be minimised relatively soon.

I.5.3 Auditors Conclusions

We agree with SPN's view that the level of accuracy of reporting those short interruptions measured via telecontrol is of the order of 100%. No overall level of accuracy is estimated by SPN, but since only 10% of reclosers are counted manually it will be quite high. SI reporting levels can be expected to improve in accuracy in the near future as manually recorded reclosers are replaced by telecontrol recorded devices.

I.6 Overall Impressions

SPN has made a noticeable improvement in LV fault reporting since the last audit. Also improvements have been made in other areas, such as:

- Secondary telecontrol (non-primary substation 11 kV system control) has been integrated with NMS so that manual transfer of data is no longer needed.
- FMS fault reporting has been simplified such that interruption stages and customer numbers can be updated during a fault, and automatic recalculation of customer numbers now occurs following each restoration stage.
- Procedures and training requirements have been reviewed, and regular meetings are held with Network Services to improve information from the field.

SPN clearly gives a high internal priority to the requirements of incident reporting. The company also is making investments to improve system performance and its monitoring.

I.7 Conclusions

Table I-6 presents the results of the 2003 audit of the SPN licence area in-line with the auditing framework.

Table I-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100%
Stage 1	LV Connectivity Model	94.1%
Stage 1	HV Connectivity Model	98.5%
Stage 3	Overall sample – CI	100.3%
Stage 3	Overall sample – CML	100.3%
Stage 3	LV-only sample – CI	99.7%
Stage 3	LV-only sample– CML	99.0%
	Short Interruptions	No overall estimate given by DNO, but 100% for telecontrolled devices.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table I-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
98.1%	98.1%	94.1%	94.0%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

I.8 Recommendations

SPN has procedures and documentation in place to ensure accurate reporting and to facilitate effective auditing. There may be room for improvement in these areas by examining the following recommendations:

- LV numbers disagree sometimes between incident reports and the connectivity model due to misreporting. The standard procedure is for the field engineer to estimate customer numbers off-supply and for this estimate to be checked against the connectivity model by the dispatchers before report data is entered into FMS. On a number of occasions errors were made e.g. by counting three fuses blown in the report but only two reported from the field, thus generating erroneous reports. The transcription procedure from field reports to IIP reports could be improved to ensure greater accuracy.

- During HV incidents it is sometimes necessary to enter the initial 'off' times manually into NMS e.g. where telecommunications has failed. Errors are occurring in this action and a means should be devised to ensure entry of the correct time.

- Recording of Block Switching Instructions leads to customer connection and disconnection times associated with a number of switching actions being grouped at the time of one connection or disconnection action. The procedures should be reviewed in this area to examine whether it is worthwhile recording actual switching times rather than using a group time and to determine the magnitude of the error if the current system is maintained. However, consideration is also required to ensure that the procedures are in accordance with the RIGs.

- Metering circuit breakers count as one customer, even if several MPANs are associated with them. This leads to an undercount of customers, although the numbers involved may be very small. This approach is contrary to the RIGs requirements and we recommend that during a future upgrade of the system this anomaly be rectified.

- Under the current IIP auditing framework, differences in customer numbers associated with system changes count as errors. SPN could reduce these apparent errors by tracking system changes and providing a reconciliation capability at the time of IIP audit.

- At the time of the next audit, it is important that, as during this audit, SPN has available the capability to sum rapidly the numbers of customers associated with complex incidents, together with the ability to permit the summation process to be spot checked.

I.9 Learning Points

The following items were identified as learning points for the auditors and audit framework:

- The auditors need to note that SPN is one of a number of DNOs that consider a re-interruption to occur up until three hours after the last customer associated with an incident has been reconnected, even if customers connected earlier and then re-interrupted have been back on supply for more than three hours.

- SPN pointed out that differences in customer numbers at the time of incidents occurring and at the time of audit can be expected since system configuration and customer numbers are continually changing. It wishes to emphasise that any "error" associated with this difference is likely to be a consequence of these changes and not a true error.

Appendix J Northern Electric Distribution Limited (NEDL)

J.1 Summary

John Woodhouse from Mott MacDonald and Robert Shackleton from British Power International audited NEDL's distribution network business between 4 August 2003 and 6 August 2003. During this visit they were given the fullest cooperation by NEDL, with staff being made available throughout the visit and dedicated office space for meetings and audit work also made available.

The New Connections processes appear to be consistent and tightly managed for both NEDL and YEDL and the Auditors agree with NEDL's overall conclusion that the accuracy of MPAN count is now 99.6%.

NEDL have followed the recommendations made in last year's audit report and have continued to devote a careful and methodical approach to making incremental improvements to the connectivity model. The Auditors agree with NEDL's estimate of accuracy of its connectivity model of 93.5% for LV and 97.0% at the HV level.

Standard terminology is needed for LV incidents so that field and office staff are clear as to what is being communicated and office supervisors need to check that sufficient details have been entered onto the IRIS report to allow subsequent audit of the incident.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table J-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
96.5%	96.5%	92.1%	92.8%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

J.2 Introduction

John Woodhouse from Mott MacDonald and Rob Shackleton from British Power International audited NEDL's distribution network business between 4 August 2003 and 6 August 2003. During this visit they were given the fullest cooperation by NEDL, with staff being made available throughout the visit and dedicated office space for meetings and audit work also made available.

From discussions with NEDL and an initial refresher period on the IRIS and TMS systems it became clear that certain of the recommendations from the last audit had been implemented by NEDL. In particular an additional compulsory field had been inserted to describe the location and nature of the fault, something that was missing before. This considerably aided the audit trail.

This report presents the findings of the NEDL audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

Please note that in this report the term "HV" applies to the 6.6 kV, 11 kV, 20 kV and 33kV networks in NEDL.

J.3 Stage 1: Measurement Systems and Template

J.3.1 Summary of Measurement Systems

NEDL has worked hard to capture the RIGs requirements and definitions in its information systems and to build the rules into these systems. The objective of this is to achieve consistency across the reports and to minimise the need for repeated human intervention and associated errors. For LV reporting this is undertaken through the Incident Reporting & Information System (IRIS). Any reportable incident is automatically captured within IRIS. This is determined by the fault type, as captured within the Trouble Management System (TMS). The user is then required to complete the IRIS report before the fault can be closed down. The principle is that the user entering the incident data does so at the time of the incident or soon after and that all information is entered at this time and does not require another operator to interpret or add or change it. Equally data is passed automatically from one system to the next without the need for another manual data entry step. This minimises the opportunity for human error to enter the process.

NEDL is required to hold details of the number of traded MPANs on each LV feeder-way and also link these feeder-ways to its associated HV transformer. 132 kV, EHV and HV metered MPANs are linked to a 132 kV/EHV/HV "(E)HV" network node point which is on its correct section of (E)HV cable or overhead line. It is the primary traded MPAN that forms the basis of incident report CIs and CMLs. For the DNO a "customer" is now a primary traded MPAN since the actual person or business entity behind this MPAN is now a matter for the supply businesses. An MPAN has two parts. The first part is known as the Core MPAN and is allocated by the DNO. The second part is added to the Core MPAN to complete the Traded MPAN.

MPANs are created in NEDL when connection contractors (currently IUS) notify the MPAS section in writing that new connections are being made within the NEDL geographic area. The information given must be sufficient for NEDL to be able to determine the geographic location of the new connection and other information such as number of phases, power requirement and if there is a requirement for two meters to be fitted. The New Connections team produces the MPAN number based on information provided by the Connections Contractor. All 13 digit MPAN numbers within NEDL start with 15 and the NEDL software generates MPAN numbers such that no two numbers are the same. There can only be one Primary Traded MPAN in NEDL per premise.

On receiving the request for an MPAN from the connections contractor the details are entered into the New Connections Database where all details are recorded and the MPAN number allocated. This is then downloaded to the Central Network Database (CNDB) each day. The CNDB then sends the information to the MPRS system where it resides whilst awaiting confirmation that the customer has signed up with the Supplier and the connection is now to be treated as a customer of NEDL.

J.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

The same MPRS (Meter Point Registration System) and NCAS (New Connections System) are now used for both NEDL and YEDL, and the process for generating new MPANs (Meter Point Administration Numbers) for both Licensees takes place at NEDL's New Penshaw offices. This section of the Audit report is therefore common to both the NEDL and YEDL licensed areas.

As set out in last year's report for NEDL new MPANs are generated for individual new connections in both NEDL and YEDL upon receipt of written notification from the connection contractors. In NEDL the practice is to issue the MPAN only when the end Customer requests the service to be scheduled in for connection, typically no more than 3 weeks prior to the specified connection date. The customer's expected electricity supplier, or energy retailer, is also recorded so that they may be notified of the creation of the new MPAN. This keeps a close control on the MPAN count whilst at the same time allowing for the Energy Retailer to provide the registration data flows, fit appropriate metering, and energise the premises prior to the customer moving in. Following the generation of the MPAN a letter is sent to the customer's premises, and in addition to the connections contractor. Previous practice in YEDL was to issue blocks of MPANs to builders but this has recently been stopped and process is now the same for both licensees.

There is a small section dedicated to the updating of plot numbers to full postal address through direct contact with builders and other relevant authorities. Since the transition to competitive market processes following market liberalisation in 1998 builders are now largely conversant with the new connections processes and notify NEDL/YEDL directly. The address updating process is reported to be working smoothly.

For NEDL the NCAS system sends daily batches of newly created MPANs to the CNDB (Central Network Database), which in turn sends a message back to create the relevant entries in MPRS. A daily reconciliation between NCAS and MPRS takes place, and any exceptions are reported and followed up immediately. In addition a quarterly reconciliation is carried out between CNDB and MPRS that produces typically 2 to 3 mismatches, which are corrected. It is worth noting that there is a private electricity distribution network in Newcastle owned by Scottish and Southern Electricity for which NEDL provides the MPAS (Meter Point Administration Service) on an agency basis. These MPANs (approx. 200 in total) are not included in the NEDL CNDB.

For YEDL the NCAS sends the new MPAN daily batches straight to the MPRS and a batch file is sent to QC Data at YEDL for input into the YEDL connectivity model (a CNDB has yet to be introduced for YEDL). Similarly, a daily reconciliation takes place.

Exception reports are produced each month for MPANs awaiting supplier registration, meter installation and energisation. These are followed up by phone with Energy Retailers. NEDL now have a special team dedicated to the follow-up of missing Retailer-owned data items in MPRS. Their work impacts in particular on the status of MPANs recorded as de-energised. This initiative is making significant progress in correcting errors in the Retailer-owned MPRS data although it only affects fault reporting where disconnected MPANs are removed. Interruptions to de-energised MPANs and those for which Retailer-owned data is missing are recorded as customer interruptions in the connectivity model.

DNO's Estimate of Accuracy

Last year's MPAN count accuracy of 99.5% has been incrementally improved as result of the initiative with Energy Retailers to identify disconnected premises. The new connections process has been improved through better follow-up with contractors.

The current NEDL estimate of accuracy of the process for creating new MPANs is 99.9% and any errors are corrected by the exception reporting and follow-up processes. The small overall inaccuracies that remain are due to the presence of a reducing number of disconnected MPANs still recorded as de-energised by suppliers resulting in a slight over reporting of connected MPANs. The continuing work by the MPAS team throughout the current audit year with Energy Retailers to correct energisation status and to identify and remove disconnected MPANs means that the accuracy of the MPAN count for NEDL is now estimated to be 99.6% overall. The small error of 0.4% is due to inaccurate supplier information, unrecorded disconnected MPANs, unauthorised connections and address errors.

In order to improve the efficiency of the MPAN generation process NEDL plan to introduce electronic data capture from the connection contractors to remove the need for double data entry, and to introduce financial incentives into the commercial arrangements with connection contractors to further improve the quality and timeliness of data provision.

Auditor's Conclusions

The New Connections processes appear to be consistent and tightly managed for both NEDL and YEDL. Live data capture was demonstrated to the Auditors for both NEDL and YEDL related MPANs and the process appeared logically organised, with the key issues well understood by the staff involved. Clear and logical explanations were provided to the Auditors covering the ongoing work with Energy Retailers to clarify the status of de-energised MPANs and identify and remove disconnected MPANs.

The Auditors agree with NEDL's overall conclusion that the accuracy of MPAN count is now 99.6%.

(ii) Connectivity Model

The LV connectivity model is based upon the link between a property (as physically located in space against a map or code reference) and an LV feeder-way (as represented by a cable or overhead line plus service cable overlaid on the map base). This model is derived from the original LV Skeletons that NEDL held as scaled drawings. These have now been digitised and are capable of being reviewed against a scanned mapped background.

The connectivity model is logically based on the proximity of a property to an LV main. It is assumed (unless there is information to the contrary) that each property will be connected to its nearest LV (cable/overhead) main. The operational configurations of the LV mains are then assessed to determine the number of properties on each LV feeder-way originating from each distribution substation. The number of mains circuits are then assessed to determine the total number of properties connected to each distribution substation. The position on the network of each HV/LV substation (and hence the number of properties) is then assessed to determine the numbers of substations on each HV circuit emanating from each Primary Substation up to the normal open points on the network.

NEDL has checked the accuracy of their connectivity model using a statistical sampling procedure based upon BS 6001. Following last year's audit NEDL has improved this procedure to align more closely with the BS process. In addition regular updates of the model from site information and data cleansing exercises will have served to improve accuracy incrementally from last year.

Changes since the 2002 IIP Audit Visits

In order to facilitate a regular cycle of Connectivity Model auditing a tracking database has been established to monitor changes to the MPAN connectivity model. The changes are sampled using the BS6001 procedure and the recommendation from last year to adopt the full BS6001 approach has been implemented. Tracking is performed from the initial MPAN generation by the New Connections Administration System (NCAS) to the point of receipt of notification of the physical connection and the capture of that connection into the Graphical Tools System. The responsibility for monitoring the new connections data lifecycle and its audit has been separated from the data maintenance section and is now carried out by an independently managed section within NEDL Records development. This has been done in response to the recommendation from last year that quality control checking should be carried out independently.

Further validation of distribution substations in the Asset Management and Network Management Systems against the connectivity model has been performed this year. In addition any Network additions or re-configurations are captured by the direct labour field recording staff or from updates received from contractors, and any LV faults that predict more than one LV feeder are investigated and corrected where errors become evident. Feedback for corrective action is also received from the staff engaged in the Pre-Arranged Interruptions process and is used to update the model.

The changes are estimated as making slight improvements to the overall accuracy levels of the connectivity model at both Substation and LV Feeder levels. As an example, of the 13,513 new connections made during 2002-2003 only 250 (1.85%) have not, at the time of writing, been incorporated into the model as either the notification of their physical connection has not yet been received, or the quality of address detail supplied is insufficient to enable accurate location. Investigations are continuing with the connections contractor to establish required detail until satisfactory resolution is made i.e. the target is 100%.

DNO’s Estimate of Accuracy

Connectivity model accuracy improvement is based on the BS6001 tested accuracy of new additions to the model during the year. The improvement estimate does not take into account the incremental improvements to the existing database that have taken place during the year since these cannot be proved numerically. The estimated connectivity model accuracies are therefore likely to on the conservative side. Also the BS6001 assessment is based on a pessimistic acceptance criterion – if in doubt fail.

NEDL estimate their Connectivity Model Accuracy to be;

- 93.5% at LV level
- 97.0% at HV level

Inaccuracies remaining are due to lack of knowledge of connection to feeder where a multiplicity of feeder choices are possible and no extra information is readily available. This is more likely to be the case for commercial/industrial than domestic premises.

NEDL are very confident that the improvements described are achieved in reality. However, opportunities for further improvement are becoming more difficult to find as accuracy gets better and network performance improves.

Currently NEDL are starting to incorporate checking of and changes to connectivity model in advance of pre-arranged interruptions. In addition NEDL plan early next year to start a review of relevant legacy Service Records to further improve geographic areas of the model identified as least accurate by the BS6001 audit exercise.

Auditor's Conclusions

NEDL have followed the recommendations made in last year's audit report and have continued to devote a careful and methodical approach to making incremental improvements to the connectivity model. The explanations of the methods used were full and detailed and were provided in a clear and candid way.

The Auditors agree with NEDL's estimate of accuracy of its connectivity model.

(iii) RIG Definitions

During last year's audit, NEDL were classifying Pre-Arranged Interruption overruns as faults. This meant that the CIs were being over reported but at very little volume. NEDL now capture interruption times and restoration times within the Pre-Arranged incident even if the interruption overruns. This has no effect on CMLs and little affect on CIs as the volume of interruptions falling outside of the planned times is very small. In addition the number of customers affected by these interruptions is low. It is however considered that any change should be consistent with section 2.15 in the RIGs which states "A pre-arranged incident which requires a number of switching operations involving an interruption to supply to customers should be treated as a single incident provided that the outage times are within the period stated on the notification provided to the customer(s)". It is recommended that NEDL review this change from last year, as its reporting is inconsistent with the requirements of section 2.15.

The NEDL interpretation of the RIG definition for re-interruptions is that any interruption occurring within 3 hours (Permanent) or 18 hours (Temporary) of the time of completion of the last restoration stage in any fault is classed as a re-interruption. Individual 3-hour timings for customer groups restored by earlier restoration stages in the relevant fault are not carried out.

(iv) IIP Template

NEDL populate the data into the template from the NaFIRs database, and the reporting methodology is unchanged from last year. The only changes that have taken place are due to data requirement changes from Ofgem to capture data on all circuits rather than simply the circuits that had a fault logged against them. The manual data extraction for the template is done twice by separate people and cross checked to ensure accuracy.

(v) Conclusions

Based on the previous sections on MPAN accuracy, connectivity accuracy and RIGs interpretation the Auditors conclude that the NEDL assessment of accuracy of measurement is both consistent and if anything slightly on the conservative side as improvement appears only to have been claimed where clearly verified by independent means.

The process for completion of the IIP template appears consistent and cross-checking is done to ensure final accuracy.

J.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all DNOs and therefore will be contained in the body of the main report.

J.4.1 Incidents at the Higher Voltages

NEDL refresh the customer numbers in NMS from the connectivity model on a weekly basis. The NMS customer numbers are then used by the control engineers for NaFIRS reporting and for the production of the audit sheets now attached to each incident to record network configuration at the time of the relevant fault.

The HV, EHV and 132 kV incidents audited were well documented and easily followed with a good audit trail. Since the last audit it is clear that the connectivity model has now been adopted as the main source of data for the control room restoration strategy. This has resulted in a much improved accuracy in the consumer count and where the times came from the SCADA system then full accuracy was achieved in all incidents audited on the backbone urban system. Inaccuracies did creep in on the rural networks where some rural substations were showing a zero connected MPAN count. This could have been due to wrong snapping (automatic-computer allocation of a customer to a transformer/feeder) or it could have been due to rural de-population following the recession and the impact of the foot and mouth problems.

In some incidents, there were differences between the customer count at the time of the incident, and the count at the time of the audit. Provided clear evidence was supplied that showed new customers being connected or disconnected to the substations concerned, then this was not used to change the customer count against the original report.

J.4.2 Incidents at LV

NEDL now has a range of IT systems available at a single display screen to enable tracking of LV faults from receipt of time-stamped customer no-supply phone calls through to visual identification of the relevant LV feeders and service cables superimposed on geographical maps showing individual customer premises. This greatly facilitated the audit process by making it very easy to establish start and finish times for incidents and to verify the relationship of reported customer interruptions relative to the present connectivity model numbers. In addition it is also possible to search for recorded new connections and disconnections on the relevant feeders to verify changes to connectivity since the time of the reported fault.

Details of what had happened on each fault were checked from the notes recorded on the spot by field staff. These notes together with details of responsible parties in cases of cable damage were also available by toggling between relevant systems on the same display screen.

Following the recommendations of last year's audit NEDL have added an extra data field for staff to record fault location by e.g. feeder number or service cable. This has greatly facilitated identification and cross checking of customer numbers and appears to have been well used and accurately completed in the majority of cases.

Field staff notes were found to be generally of good quality thus enabling an accurate fix on fault location to be established for the proof of customer numbers affected. However, in a few instances the notes were not very satisfactory and where this was associated with large customer numbers, the numbers of the connectivity model were taken as the audited number without further adjustment. The audit results therefore show significant under reporting of customer numbers in some cases. In discussions it was concluded that NEDL would benefit by initiating a follow-up with relevant field staff soon after the event for the larger LV incidents to ensure adequate restoration notes.

In most cases, it was possible to verify connectivity numbers by reference to new connections, disconnections and backup paper based records. The ready availability and quality of information from both computer based systems and backup records was impressive and in all cases there was full co-operation and commitment to accuracy demonstrated by NEDL staff.

Planned developments

In future NEDL is looking to adopt an 'X marks the spot' policy which records the physical location of the fault and then identifies the customers affected by the fault. This would be predominately for LV fault reporting. It is anticipated that this would result in a small improvement in the accuracy of reporting but would have a significant effect on open circuit fault reporting for individual customers. It would also make the auditor's task much easier in terms of verifying what happened.

In order to improve the accuracy of reporting and to facilitate direct feedback to connectivity model accuracy NEDL is planning to make the connectivity model and associated predictions of customer(s) affected available directly to field staff at the time of each fault.

Last year's audit recommended that NEDL automate the process for recording re-interruptions. This is still being examined as the process is not straightforward. In addition, NEDL are waiting confirmation by Ofgem of the definition of a re-Interruption as DNOs have interpreted the RIGs differently.

Auditor's Conclusions

The audit of LV incidents highlighted the fact that determining customer numbers on incidents that affect only part of an LV feeder can prove difficult for the field operative, as he/she often has to assess the numbers affected by manual count. Consequently, the availability of the connectivity model information to field staff will improve the accuracy of LV reporting.

Additionally, where significant LV incidents occur, involving for instance customers being off supply for periods in excess of the guaranteed standards, then it is important that these reports are clear as to what happened, where and how. Supervisors need to check that the reports have sufficient details to allow a later audit of the incident. It is preferable that this supervisor "clarity check" is done whilst the details are still fresh in operatives' minds rather than days or weeks later when it has all been forgotten or possibly confused with another job.

J.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table J-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
4303	4303	4303	4999
442	3800	5284	
	1929	831	

The final Stage 3 reporting accuracy results are therefore:

Table J-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	100.2%
Stage 3	LV-only sample – CI	104.5%
Stage 3	LV-only sample – CML	96.8%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination of the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table J-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.0%	0.0%
		CML	100.2%	0.2%
	LV	CI	104.5%	4.5%
		CML	96.8%	3.2%
Stage 1		LV	93.5%	6.5%
		Overall		3.5%
		HV	97.0%	3.0%
LV Fraction				14.0%
Combined Accuracy	Overall	CI	96.5%	3.5%
		CML	96.5%	3.5%
	LV	CI	92.1%	7.9%
		CML	92.8%	7.2%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table J-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
96.5%	96.5%	92.1%	92.8%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

J.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

J.5.1 Methodology

NEDL records short interruptions from 3 sources:

a) SCADA controlled plant for which short interruptions are reported in exactly the same way as long interruptions using the same system. A query is run annually to extract the figures taking into account the RIG definitions of not reporting shorts associated with sustained interruptions and only reporting one short for a sequence of shorts that occur within a 3-minute period. The number of customers affected is taken from the live connectivity model at the time of fault.

b) Pole mounted (PM) and ground mounted (GM) reclosers from which a manual counter reading is taken annually. Details of all such reclosers on circuit are extracted from CNDB in January of each year and field staff read the counters during March. NEDL do not apply time correction to the readings because March is a quiet month for faults and statistical scatter in the reading sequence year on year would tend to cancel out time related inconsistencies. Some counters are not readable or give rise to advances that are not credible (>50) and in these cases the advances are set to zero (Note: this could be due to the counter being misread or the recloser being changed). The annual counter advances are corrected for known sustained interruptions by subtracting the number of sustained faults multiplied by the number of shots-to-lockout for the protection zone. The result of these calculations is then multiplied by the number of customers downstream of the recloser to give the number of customer short interruptions in the year. Since it is not possible to time-stamp the recloser operations the number of customers affected is taken as the maximum reported over the previous two years (two years in order to get a reasonable sample) for faults in the relevant recloser protection zone. These numbers have been subjected to an audit check against a snap-shot of the customer numbers and "normal-running" connectivity in CNDB.

c) LV "re-zappers" all of which are fitted with a GSM modem that reports operations to the despatch office. Although the software used to record these operations is not yet fully developed, NEDL were able to extract the total number of re-zapper operations. This number was then multiplied by 30 customers per LV phase to give the total number of customer short interruptions in 2002/3 from this source. 30 customers per LV phase is based on the NEDL LV average customers per fault of 24.5 corrected for the fact that some faults only affect part of a feeder (estimated 40%) giving a probable number of 30 customers affected per recloser operation.

The IIP template is completed by manually pasting from the source calculation spreadsheet into the relevant sections. It is independently cross-checked prior to submission.

J.5.2 DNO's Estimate of Accuracy

NEDL states that all the reporting figures for short interruptions are subject to the general accuracy of the customer connectivity model. This has been assumed to be 98% (under-reporting) for the purpose of the short interruptions accuracy assessment.

The accuracy of reporting for the numbers extracted from SCADA is taken to be the same as that of HV sustained interruptions. NEDL drew attention to the fact that the SCADA figures include pre-arranged short interruptions (2200 customer short operations for 2002-03 – approx. 0.5% of total from this source). The RIGS are not clear on whether these should be included or not.

With regard to the manual counts, since the time and date of the recloser operations is not known it is not possible to determine the exact numbers of customers affected by the operation. Nor is it possible to determine if operations are isolated or part of a sequence of operations. The customer numbers used for a protection zone is the maximum number of customers reported against faults in the recloser's protection zone in the year in question or the previous year. This is used because faults and recloser operations tend to occur in the same period (i.e. recloser operations tend to be a pre-cursor for permanent faults). NEDL takes the view that it is likely to get nearer to the correct number of customers affected by this means than by using the numbers connected at a fixed snapshot of the connectivity model.

As a cross-check, the results have been audited against a snap-shot of the customer numbers and "normal-running" connectivity in CNDB. This suggests that there may have been a 2.4% under-reporting of customer numbers compared with the connected customers during "normal running" conditions. NEDL has also selectively tested the manual counter results against POD (Power Outage

Detector) readings where these are fitted. This suggests that the manual counters (representing 36% of the total count) may be over-reporting by 17% due to:

- operations as part of a sequence within sustained interruption incidents
- multiple “shots” to clear a fault within a given three minute time period.

NEDL have not corrected for these effects as it is felt that such correction could not be rigorously justified.

For 2002/03 there were 307 PM reclosers, 47 GM reclosers and 132 LV “re-zappers”. The counters on 32 PM reclosers and 4 GM reclosers were unreadable. In addition there were 8 PM reclosers that gave rise to a counter advance that was not credible.

The accuracies have been calculated by NEDL as follows:

a) SCADA reported – 98% (under reported);

b) PM reclosers – 85% (under reported) due to unreadable reclosers, there not being a credible reading, or the recloser being unread;

c) GM reclosers – 89% (under reported) due to unreadable reclosers, there not being a credible reading, or the recloser being unread;

d) LV “re-zappers” – 98% (under reported).

When these figures are combined by weighting then by the numbers of reported customer interruptions from the relevant source, the overall accuracy of reporting of short interruptions is assessed to be 93% (under reported).

NEDL are currently 50% through a programme to bring all pole mounted main-line reclosers under SCADA control and expect this to be substantially complete by the end of 2005/6. Once complete, virtually all HV short interruptions (99.5%) will be recorded by the SCADA system. This change will essentially move the reporting of short interruptions to the same level of accuracy as sustained ones. As virtually all short interruptions will be time-stamped this is likely to reduce the overall number of reported short interruptions by 6% (see above reasons for likely over counting), which will cancel out most of the estimated 7% under-reporting. In view of the short time left to get to the final position (end 2005/6) it is not considered economic to introduce alternative more accurate methods (e.g. power-fail monitors) in the interim period.

J.5.3 Auditor’s Conclusions

In the Auditors’ view NEDL complies as far as possible with the RIGS given the limitations of the counter equipment used, the extent of assumptions that can be made consistent with the coverage of the data, and the rigour with which any further correction factors can be justified. In addition some clarification is required on short pre-arranged interruptions that are presently included in the figures.

The data gathering and calculation procedures appear thorough and consistent, and the assumptions underpinning the overall calculation of reporting accuracy appear reasonable. NEDL are taking action to improve the accuracy of reporting of short interruptions over a practical time scale through the programmed phasing out of the majority of manual counter readings. This is aimed at putting the reporting of short interruptions on a level of accuracy consistent with the reporting of sustained HV interruptions.

The Auditors agree with the NEDL figure of 93% (under reporting) accuracy of reporting of short interruptions. It is also worth noting that NEDL have chosen not to apply a correction factor for likely over reporting in the manually counted recloser figures. The final NEDL reported figure for short interruptions is therefore likely to be closer to the actual number than the reported accuracy implies.

J.6 Overall Impressions

NEDL staff involved in this area of work form an enthusiastic well motivated team committed to continuous improvement with a high degree of professionalism clearly evident.

J.7 Conclusions

Table J-6 presents the results of the 2003 audit of the NEDL licence area in-line with the auditing framework.

Table J-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.6%
Stage 1	LV Connectivity Model	93.5%
Stage 1	HV Connectivity Model	97.0%
Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	100.2%
Stage 3	LV-only sample – CI	104.5%
Stage 3	LV-only sample– CML	96.8%
	Short Interruptions	85% to 89% without remote control 98% with remote control

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table J-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
96.5%	96.5%	92.1%	92.8%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

J.8 Recommendations

A standard terminology is needed for LV incidents so that field and office staff are clear as to what is being communicated. This is being looked at by NEDL as a process to be implemented in the coming months. However, in the short term, NEDL are addressing the issue of errors in LV reporting through their internal audit process and by the use of exception reports. Office supervisors need to check that sufficient details have been entered onto the IRIS report to allow subsequent audit of the incident. It is preferable that this supervisor "clarity check" is done, in particular for LV incidents involving significant CI and/or CML, whilst the details are still fresh in operatives' minds rather than days or weeks later when it has all been forgotten or possibly confused with another job.

It is recommended that NEDL review its change in the reporting of Pre-Arranged Interruption overruns as the change now means that its reporting is inconsistent with the requirements of section 2.15 of the RIGs.

J.9 Learning Points

The following point was identified by the joint audit team as learning points for the audit process:

- The availability of the connectivity model information to field staff will improve the accuracy of LV reporting and assist restoration decisions.

Appendix K ScottishPower (SP Distribution) – South of Scotland

K.1 Summary

SP Transmission & Distribution Ltd's South of Scotland license area (SP Distribution) was audited during the week beginning 18th August 2003 at their offices based in and around Glasgow.

SP Distribution's measurement systems have changed since the 2002 IIP audit visit with the completion and introduction of the LV connectivity model into its fault management system in March 2003. As SP Distribution did not have this model in place during the 2002 IIP audit, a more detailed analysis of the model has been carried out during this audit. No changes have been made to the interpretation of the RIGs, MPAN count, or in populating the Template. As part of this audit, assessments have been made of the accuracy of short interruptions, quality of telephone response data sent to Accent and HV/LV substation connectivity. The audit of the quality of telephone response data is subject to a separate report. Confirmation of the methodology used to provide the MPAN count and the reporting Template was also carried out. The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of the MPAN count - 99.5 %.
- Connectivity model (HV/LV substation level) - 98 %.
- Connectivity model (LV feeder level) - 96 %.

SP Distribution's reporting of incidents was found in general to be accurate for the 2002/03 reporting year. The most significant source of inaccuracies appears to be related to the entry of incorrect/inaccurate information in the original fault report. It is from this data that the IIP template is populated and while internal processes identify and correct some of these errors, some are not being identified. A small number of the incidents audited showed variance in numbers when compared to the current system.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table K-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.8%	97.7%	95.1%	92.0%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

SP Distribution have estimated the accuracy level of Short Interruptions at 81%. It is the opinion of the auditors that they have interpreted Ofgem's requirements and methodology for estimating accuracy of Short Interruptions reporting in a reasonable and logical manner. SP Distribution would appreciate feedback from Ofgem regarding the methodology that they have developed. It is considered that this is an area where some standardised guidance from Ofgem may be beneficial.

SP Distribution continue to work on improving the quality and accuracy of their systems, through their data cleansing processes, continuing training programmes and movement of IIP from project status through to business operations.

K.2 Introduction

SP Distribution's licence area was audited during the week beginning 18th August 2003 at their St Vincent's Crescent Office in Glasgow and the SP Power Systems control centre at Hamilton. Tony Wright of British Power International and Simon Critten of Mott MacDonald were the audit team. In addition SP made available appropriate staff and facilities throughout the audit visit. James Hope of Ofgem attended the audit for the first two days to witness the audit process undertaken by the joint team.

This report presents the findings of the SP Distribution audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

K.3 Stage 1: Measurement Systems and Template

K.3.1 Summary of Measurement Systems

SP Transmission and Distribution Ltd is responsible for two separate electricity licences – SP Distribution covering South of Scotland and SP Manweb covering Merseyside and North Wales. Information reporting under the IIP is currently under the responsibility of one System Analyst at each of the two SP Power Systems Management Centres (PSMC) – Hamilton for SP Distribution and Prenton for the SP Manweb area. This report focuses on SP Distribution. Over the coming year the operation and control of IIP related matters will be transferred from project control into the business operations in the form of a section entitled Control, Restoration and Repair (CR^2).

SP Distribution uses the GE Network Solutions (GENS) (formally GE Harris) Energy Network Management and Control System (ENMAC) for its EHV, HV and LV network. The Integrated Control Operational Diagram (ICOND) is part of the ENMAC system and contains HV connectivity, customer numbers attached to HV/LV transformers, creation of EHV and HV switching logs as well as EHV and HV control. TroubleCall is the electronic fault management system, again part of the ENMAC system and records customer incident calls, with links to the Customer Directory and LV incident management. TroubleCall also contains the LV connectivity, customer numbers at HV/LV transformers and the customers attached at LV feeder level.

Prosper fault reports for incidents created within ICOND or TroubleCall are processed by a piece of software written by (SAIC) to SP Distribution's specification. This piece of software applies and ensures compliance with the RIGs. Population of the IIP information template occurs using SP Power Systems' Business Objects reporting tool and reports against the Prosper database.

SP Power Systems, which manages the operations business is restructuring to deliver more 'focus' on its core business activities and responsibilities, moving from a regional to a functional structure with two management control centres at Hamilton (SP Distribution) and Prenton (SP Manweb). These control centres will house the control and dispatch function under one Control, Restoration and Repair Manager.

Within SP Distribution, Control Engineers and Dispatchers are responsible for interrogating ENMAC and for ensuring that incidents are dealt with promptly. Currently, this responsibility resides with personnel located at its 24 hour centre at the PSMC Hamilton.

SP Power Systems use one number in each of their license areas for their Power Outage, Security & Safety enquiry line. The calls are directed through the Thus intelligent network to one of two Distribution Call Centre (DCC) facilities located at Cathcart in Scotland and Rhostyllen (North Wales) with overflow facilities at Cathcart, Caernarfon and Warrington. The latter are used when the main distribution call centres are busy. These facilities provide the capability of dealing with 240,000 calls per hour.

K.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. SP Distribution's methodology is detailed in document IIP-13-001 Issue 2.1 and this received Ofgem approval, by letter dated 18th June 2002.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, SP Distribution's estimate of accuracy of the customer count by primary trading MPAN was 99.5%. Its estimate of accuracy for the 2003 IIP audit remains at 99.5% with a very high level of confidence.

The remaining inaccuracy (0.5%) relates primarily to work in progress coupled with possible incorrect coding of MPANs that result in the MPANs being rejected by the selection algorithms. The MPAN accuracy was considered in detail during the 2002 IIP Audits therefore, as the methodology has not changed since that time, this accuracy figure was not audited in detail as part of this year's audit.

SP Power Systems have a Data Management Section that is considered to be a "one-stop-shop" for ensuring energised MPANs feed through into their connectivity model and their fault management systems. This Section obtained ISO 9001 accreditation in March of this year and it is anticipated that this will produce small incremental improvements in accuracy into the future.

Auditor's Conclusions

SP Distribution's methodology for counting MPANs has not changed fundamentally since last year. The visiting auditors found no inconsistencies in SP Distribution's estimate of accuracy and therefore support their results.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visits

SP Distribution introduced its LV connectivity model into its fault management system TroubleCall in March 2003 as suggested in the recommendations of the 2002 IIP audit.

A detailed examination of the methodology was carried out during the 2002 IIP audit with a visit by the audit team to the Connectivity Capture Bureau at Glenrothes. The methodologies and processes have not changed since the 2002 IIP audit where they were audited to be robust.

DNO's Estimate of Accuracy

SP Distribution's methodology is set out in document IIP-13-003, the visiting auditors found no inconsistencies in the application of this methodology.

SP Distribution's current estimate of accuracy is as follows:

- HV/LV Substation 98 % (with a high confidence level)
- LV Feeder 96 % (with a high confidence level)

The confidence level attached to the LV feeder accuracy estimate is high due to the methodology adopted by SP Distribution, in terms of customers connected to the correct cable. The capture tool holds data in an "accuracy confidence level" field which allows the level of accuracy associated with any particular piece of information to be attached. During the initial capture the highest confidence level assigned in this field was 3, "decision made". This will be revised as information from planned or unplanned operational incidents becomes available. Such revisions may see the confidence level rising and attract a higher level of confidence. The maximum confidence level is 5, "verified", and occurs when the when LV feeder/ premise/ phase association is confirmed.

The capture work was carried out at the Capture Bureau but the primary route for updating customers is by Customer Directory updating Troublecall. Regular monthly reconciliation checks are carried out by the System Administrator between MPAS (Metering Point Administration System) and TroubleCall which checks the number of primary MPANs raised in the MPAS system and looks to see the same growth in Troublecall to ensure links are in place.

The Data Management "one-stop shop" section is responsible for ensuring that the premise to feeder association is made along with the notification of the MPAN status being set to energised and that the service records are updated on GIS as required. The "one-stop shop" section received ISO 9001 accreditation in March of this year for their processes.

SP Distribution consider that the level of inaccuracy of 4% is primarily attributable to the following causes:

- the capture of pole-mounted transformers (<50 kVA) using a proximity methodology
- changes in LV switching points and normally open points
- multiple LV feeders in the street/ pavement
- interconnected networks
- missing service records
- temporary network changes <14 days
- emergency work going unrecorded
- human error.

SP Distribution has applied various percentage inaccuracy figures to this basket of possible sources of inaccuracy in a subjective and judgmental way. Nevertheless the audit of individual feeders carried out this year produced an inaccuracy level of 1.3%, a result that is well within SP Distribution's estimate. The audited error was due to two sets of duplicated properties and one property missed in the capture process.

The potential sources of error that remain in the LV and HV connectivity models may be summarised as follows:

- poor quality address data
- inaccurate GIS/GND records
- normally open points fixed and future changes
- lack of service records
- incorrect application of the 7 data maintenance processes to record change, these being:
  - decommissioning of assets
  - installation of a new substation
  - network extension
  - new LV feeder
  - new connection
  - network alteration
  - disconnection.

These potential sources of error will be reduced by the ongoing work of the Data Management Section and accuracy will improve as normal open points are confirmed both from ad hoc reports and the 10-year rolling programme of link box inspections. This programme involves staff visiting link boxes for preventative maintenance purposes and also to check LV system running conditions.

A new LV fault incident log has been introduced for field staff to help provide accurate information on LV system status when incidents are transferred between resources. In addition to this SP Power

Systems has also introduced procedures involving "one-stop shop" data management processes that are targeted to capture all modifications to the EHV and HV network in a fail-safe way, using operational safety documentation as the hub in order to maintain the integrity of the HV connectivity model. The procedure is also intended to update other databases in its record systems. A similar fail-safe LV procedure is being field tested as a pilot exercise at the moment.

In selecting the five feeder samples the visiting auditors observed that there were sub-stations and/or feeders that had not been through the Quality Check process at Glenrothes. These are awaiting checking that is presently forecast to be complete by the end of September 2003. None of these feeders were selected for the sample.

During the checking of the five feeders, the auditors observed that some MPANs had been attached to feeders in the Troublecall LV connectivity model at sub-station level but not to the individual feeder way. Such MPANs are held in the capture tool and are allocated a holding reference, which is a feeder code 41, and x-y co-ordinates which places them in a holding location in the North Sea until further x-y checks can be carried out. This is part of the data cleansing process and in SP Distribution there are approximately 60,000 customers in the capture tool still to be moved to the correct LV feeder by the Data Capture Bureau. The data cleansing process is ongoing and when the bureau closes down at the end of September 2003 any outstanding work will be undertaken by Data Management.

Auditor's Conclusions

The visiting auditor's consider that the audited inconsistencies do not impact significantly on the company's estimate of its accuracy. The sample five-feeder inaccuracy at 1.3% is less than the company's estimate of 4%. Therefore, as no evidence has been found that would suggest SP Distribution's estimate of accuracy is incorrect, SP Distribution's estimate of its accuracy is judged to be reasonable.

SP Distribution's estimation of its inaccuracy is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as sample selection and analysis, could produce a more robust assessment of inaccuracy.

(iii) RIG Definitions

The 2002 IIP audit report contained no recommendations for SP Distribution to implement with the audit team reporting that SP Distribution "has generally interpreted the RIGs definitions correctly and that it is operating in accordance with them". The audit team found no evidence to suggest this should be changed this year as no changes have been made since last year. It is noted that Ofgem's and the DNO's view on 'clock stopping' differ. It is recommended that further discussion on this issue takes place.

SP Distribution interpret the RIGs definitions of reinterruptions as being "if a customer or group of customers loses supply within three hours of ALL customers being restored from a previous interruption, this is considered as a reinterruption within the same incident".

(iv) IIP Template

There were no recommendations included in the 2002 IIP audit report for SP Distribution to implement with regards to the IIP templates and the methodology itself has not changed since the last audit. The only change that has occurred since last year is the introduction of a revised Template. This change was prompted by Ofgem and has not altered how SP Distribution populates it.

A sample of incidents completed during the 2002 IIP audits confirmed that source data from the reporting system progressed through a piece of software that ensured compliance with the RIGs. Population of the IIP information template occurs using the SP Power Systems Business Objects Reporting Tool and reports written against the Prosper database.

A spreadsheet was provided by the System Analyst confirming the Template accuracy for the 2002 return.

(v) Conclusions

SP Distribution's estimates of accuracy for MPANs, connectivity and RIGs are considered to be acceptable.

The visiting auditors consider that the completion of the Template is accurate based on the linkage between prime information recorded and RIGs. Comments regarding the accuracy of the prime information as observed in the incident auditing are included in Section K.4.

K.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all DNOs and therefore will be contained in the body of the main report.

It is acknowledged by the visiting auditors that as the LV connectivity model was not introduced until March 2003 the incident auditing carried out for the 2002/2003 reporting year would compare customer numbers on the new system with customer numbers derived applying the old calculation methods. This has the potential to cause variances in the customer numbers in addition to system changes and errors in reporting. This situation is in contrast with other DNOs that had their LV connectivity model in place prior to the start of the 2002/2003 reporting year. In those cases this years audit would be comparing customer numbers generated at the time of audit using the connectivity models with incident reports generated using the same connectivity model, thereby removing the potential inaccuracies caused by the introduction of the new system.

K.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, SP Distribution had prepared a folder of information containing the Prosper report, the ICOND report, the IIP report, the incident/switching log recording the actions taken by the operator and field operative, an annotated network diagram, PS Alerts (if available), and telephone call logs from TroubleCall. This information was sufficient to understand the incident and track through the various restoration stages. The audit team had access to a live network system, an archive system and a GIS system. With the help of a control engineer the audit team were able to replicate/simulate incidents on the current and archive systems and interrogate the GIS to assess changes on the ground if necessary.

The visiting auditors were able to check the process used to extract the data from the various systems, assessing the current numbers and the archived numbers (from 2001) for each incident as they were replicated on the machines. Whilst it was not possible to assess the exact customer numbers at the time of the individual incidents, the visiting auditors were able to verify what both the current and archive systems show and cross-check this with the numbers locked into an Icond trace completed at the time of the incident. In general, the audit trail for incidents at the higher voltages was good.

The majority of higher voltage restoration stages selected for the audit sample were reasonably straightforward and none were too complex to resolve. At HV level there were a number of restoration stages that had zero CI and therefore zero CML. On discussion with Ofgem and SP Distribution it was decided that, in addition to the spares being audited, these would be audited to ensure that these stages were reported correctly. At EHV level the proportion of zero CI/CML incident stages to be audited was significant, as was the case for HV some of these were audited to check these had been correctly reported. However, for the remainder of these incidents the previous restoration stage with a reported CI was audited. This decision was made in agreement between SP Distribution, Ofgem and the visiting auditors.

Whilst a few of the higher voltage incidents took some time to understand, SP Distribution had spent some time preparing and reviewing each of the selected stages prior to the audit visit and were able to explain each incident examined.

The most frequent point of contention between the visiting auditors and SP Distribution was due to differences between the current system and the numbers reported at the time of the incident. SP Distribution demonstrated the impracticality of tracking movement of customers connected to an HV/LV substation and an HV circuit. SP Distribution was able to provide the auditors with Icond trace customer numbers attached to specific transformers from the time of the incident. Where variances were seen in the numbers attached to the same transformers on the current system this was recorded, however, as there is no way to amend the customer number count locked into the historical Icond trace this was accepted as sufficient evidence of the customer numbers at the time. It was noted that retrospective examination of a fault would often show different customer numbers attached to the transformers as the system changes over time. In the cases where additional evidence was required SP Distribution were able to provide extra information such as substation commissioning dates (and other data) and evidence from their GIS system.

Variances in CI and/or CML were observed in only 9 of the 103 HV incidents audited. Most of these inaccuracies involved only small numbers of customers.

A potential source of inaccuracy in the reporting incidents exists in the manual transfer of information from the field into the switching/incident logs. An example of this inaccuracy was recorded in a few incidents where restoration stages were not picked up in the IIP report. In these cases the text contained in the switching/incident log and telephone log indicated that there was an additional restoration stage, and the associated numbers of customers switched off and on in the logs was incorrect (i.e. did not reflect the text). These numbers are drawn through into the IIP template and therefore if they are incorrect the error is reported (if not picked up during the internal audit process).

K.4.2 Incidents at LV

For each incident at lower voltage SP Distribution provided the Prosper report, the log of calls received, the incident log and a printout of the customer numbers on the affected feeder. Since the 2002 IIP audit visit the LV connectivity model has become operational. As a result the 2003 IIP audit was completed using the current system (LV connectivity) and examining numbers reported using the old method of deriving customer numbers on a feeder (proximity approach). The proximity approach simply took the total number of customers on a transformer, divided this by the number of feeders and then further divided this by three to get the number of customers per phase. For this audit, the differences between the old and new methods of deriving numbers were included as inaccuracies in the DNO's reporting.

Variances in CI and/or CML were observed in 50 of the 112 LV incidents audited. Most of these inaccuracies involved only small numbers of customers and in some cases SP Distribution were able to produce auditable evidence to justify the changes. In a few cases these differences did lead to some more significant variances. SP Distribution considers that a large proportion of the differences were due to a combination of changes since the incident including:

- system growth
- network reconfiguration
- changes in CI distribution caused by the introduction of the LV connectivity model.

As was the case with the HV audit for many incidents SP Distribution was unable to produce auditable evidence of the customer numbers at the time of the incident other than the transformer counts completed at the time. SP Distribution noted that they accepted this approach for the auditing but require further clarification from Ofgem regarding the type and level of auditable information Ofgem expect to be to be maintained.

In the sample there were no restoration stages that were unauditable using the information made available by SP Distribution. The main areas of contention between the visiting auditors and SP Distribution were stages that showed a variance between the current system and that reported at the time and where SP Distribution were able to offer an explanation for the differences but with no auditable evidence to support the theory.

In summary the audit of LV incidents resulted in five incidents which were found to have missing restoration stages. In all cases the text in the incident log reported the incident, but the numbers of customers taken off and put back on supply did not reflect the words. As the IIP report uses these numbers to populate the template, if mistakes are not picked up during internal auditing, they are passed through as inaccuracies.

This potential source of inaccuracy was highlighted in one particular case where the restoration stage audited did not resemble what was reported in the incident log. In this case the auditors considered the whole incident and found it to differ from the reported information in both CI and CML. The differences were significant and resulted in growths of approximately 690 % in CI and 480 % in CML. The error appeared to stem from incorrect information entered into the switching log that did not match with what was reported through the words of the same report. SP Distribution agreed with the auditors that given the information that was available this appeared to have been a mistake which would usually get picked up during their internal auditing procedures. While the magnitude of this mistake is considered by the auditors to be an isolated event and not one that systematically occurs, the potential for errors to be passed through from incorrect switching logs does exist.

The inability to produce auditable evidence of the customer numbers at the time of the incident coupled with the introduction of the LV connectivity led to the greatest number of variations in CI. A small number of errors in time recording were observed, however most of the variation in CML arose from errors in the CI count.

K.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table K-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
INCD-72204-X	F-48418-I	INCD-72290-X	INCD-76489-X Stage 2
F-22645-H		INCD-76489-X Stage 2	

The final Stage 3 reporting accuracy results are therefore:

Table K-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	99.2%
Stage 3	LV-only sample – CI	102.8%
Stage 3	LV-only sample – CML	93.1%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination of the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table K-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.0%	0.0%
		CML	99.2%	0.8%
	LV	CI	102.8%	2.8%
		CML	93.1%	6.9%
Stage 1		LV	96.0%	4.0%
		Overall		2.2%
		HV	98.0%	2.0%
LV Fraction				9.0%
Combined Accuracy	Overall	CI	97.8%	2.2%
		CML	97.7%	2.3%
	LV	CI	95.1%	4.9%
		CML	92.0%	8.0%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table K-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.8%	97.7%	95.1%	92.0%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

K.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

K.5.1 Methodology

The visiting auditors consider that robust business processes are being employed to capture short interruptions at the higher voltages. In SP Distribution all short interruptions on the 6.6kV, 11kV (except 11kV auto reclosers), 33kV, 132kV, 275kV,and 400kV networks are captured using incident management systems, where a Prosper fault report captures the short interruption details. Both 11kV ground mounted and pole mounted auto recloser short interruptions are captured using periodic counter readings.

- Automatic

SCADA systems automatically bring back plant indications and associated alarms from selected 11kV circuit breakers and all 33kV and higher voltage circuit breakers. On receipt of this information, a Prosper fault report is created and populated with the supply interruption and restoration details by a control engineer. The cause is identified using codes within the Prosper fault report identifying the incident as a RIGs short interruption, i.e. automatic disconnection, automatic reconnection etc.

- Manual

Where SCADA systems are not employed i.e. on the 6.6kV and most of the 11kV networks, short interruptions are recorded by field staff who supply (report) interruption and restoration details to a control engineer. 11kV ground mounted and pole mounted auto recloser short interruptions are captured via biannual readings.

- LV Reclosing

SP Distribution does not make significant use of LV reclosing devices. Their use is limited to LV cable fault detection where portable units are temporarily connected to locate faults.

- Multi-shot

SP Distribution make extensive use of 11kv ground mounted and pole mounted multi-shot auto reclosers. The number of short interruptions they cause is identified in the following way.

A trip operations counter reading is taken between the 1st January and 31st March (CR1) and the following year during the same period a second reading is taken (CR2). After 12 months the difference between the two readings is used to identify the number of operations over a 12-month period. From this difference a subtraction is made to make allowance for permanent faults (PF) and routine switching (RS). The actual figure used for (PF + RS) is an average figure derived through analysis of a sample study of a number of auto reclosers covered by SCADA systems. The number of short interruptions is therefore derived using the following formula:

(CR2-CR1) – (PF+ RS) Avg.

This demonstrates how permanent faults and routine switching are excluded from the count; the methodology is contained in document IIP-16-001 appendix 1 and IIP-16-004.

The process to identify the customers connected downstream of each auto recloser, for the periodic count, is carried out once a year in early April, using a “static model”. The IIP circuit management process HVCI (high voltage circuit integrator) is used for this task and the individual circuit configurations are determined using data from the previous 30th September. The model used is updated every 12 months.

Although it is not a requirement of the RIGs it was noted by the auditors that SP Distribution does not currently have the capability to track network changes throughout the year and apply these changes in their reporting of auto recloser short interruptions within the manual process.

Both methodology documents were given to visiting auditors and it is considered, by the visiting auditors that SP Distribution comply with the RIGs requirement of measurement and reporting of short interruptions. SP Distribution follow the guidance given in the RIGs and schedule counter readings between 1st January and 31st March to ensure a reasonable approximation to a 12-month total.

The internal audit results are integrated into the reporting systems as follows:

- Total customers identified by a single MPAN. The IIP System administrator carries out monthly audits. The value at 30th September is included in the annual estimate of accuracy.
- Network diagram “dynamic” circuit tracing capability. Number of HV circuits with dynamic circuit tracing / Total number of HV circuits. This value is included in the annual estimate of accuracy.
- HVCI “static circuit tracing capability (for auto reclosers). Number of auto reclosers with valid HVCI trace / Total number of auto reclosers. This value is included in the annual estimate of accuracy.
- Number of auto reclosers without counters. This value is largely fixed (due to older ground mounted switchgear without counters) and is included in the annual estimate of accuracy.
- Number of auto reclosers without counter reading data. This value is calculated in early April and included in the annual estimate of accuracy.
- Accuracy associated with using (PF + RS) Avg. This value is fixed and is derived from analysis of a simple study of auto reclosers covered by SCADA systems.
- Accuracy of relevant Prosper fault reports. Monthly audits are carried out on 5% of all HV Prosper fault reports, which include short interruptions if these are embedded in the sample.

The audit team are confident that the IIP Template has been completed accurately for short interruptions. For 2002, the disaggregated number of short interruptions by “automatic operation and restored by manual switching " was examined involving 33 incidents. The customer numbers interrupted matched those reported in the Template.

A spreadsheet was provided by the System Analyst, confirming the build up of the various categories included in the short interruption Template, which matched the 2002 return.

K.5.2 DNO's Estimate of Accuracy

SP Distribution estimate accuracy of reporting at approximately 81% with a low confidence level. This low level is due to the inconsistency of data over the last two years and SP Distribution is uncertain that the method it has developed and adopted is consistent with other DNOs. The level of inaccuracy represents largely gaps in the data, for example, failure to read all counter readings, units without counters, exchange units due to maintenance processes and access problems preventing readings from being taken.

The method used to calculate the accuracy is derived from Ofgem's IIP audit framework, where a defined number of key areas associated with the relevant measurement systems are audited. The SP Distribution document containing the methodology for estimating accuracy of reporting including details of the long hand calculations for 2002 is IIP–16–005 Issue 2, the main features of this method are summarised below.

The level of inaccuracy for each key area is approximately:

- Customer identification by MPAN - Negligible inaccuracy at 1 %
- Connectivity model - Minor inaccuracy at 9.3 %[1]
- Short interruption categories - Main inaccuracy at 46.7 %
  - Automatic disconnection/reconnection
  - Automatic disconnection/manual reconnection
  - Manual disconnection/manual reconnection
  - Transmission system, embedded generators etc.

The document also includes the methodology behind the calculation of weighting factors currently set at 33% for each of the main areas in the above list, which when applied produces an overall estimated accuracy of 80.9%. SP Distribution are aware that through variation of the weightings applied the overall accuracy could be significantly altered and therefore have opted for an even split. SP Distribution would like guidance from Ofgem regarding the method employed, especially the weightings applied.

[1] The connectivity figure for short interruptions is based on the declared connectivity of 98 % modified by an accuracy formula which reflects the number of auto recloser units on the system identified with customers connected within the HVCI model against the total numbers of units shown in the plants and circuits database when the system trace was run.

In looking to the future, SP Distribution is giving consideration to a number of things, including:

- a review of the estimate of accuracy algorithms used, in particular the distribution of weighting factors
- ongoing work to validate primary MPANs
- ongoing data cleansing exercise to improve the number of successful circuit traces within the HVCI model for auto reclosers
- to improve on the number of counter readings that are captured during each inspection.

This work will have little impact on SP Distribution's assessment of MPAN accuracy. It will, however, improve the estimated accuracy of the connectivity model by approximately 3% reducing the estimated inaccuracy from 9.3% to 6.3%. It will also improve the estimated accuracy associated with the short interruption reporting categories by approximately 6% reducing the estimated inaccuracy from 46.7% to 40.7%. SP Distribution are currently installing significant volumes of HV automation schemes that may add to the volume of "automatic disconnection – automatic reconnection" short interruptions.

K.5.3 Auditor's Conclusions

No inconsistencies were found in the application of the methodology as set out in the method statement. It is the opinion of the auditors that SP Distribution has interpreted Ofgem's requirements in a reasonable and logical manner and is in compliance with the RIGs.

The key performance indicator for short interruptions derived via the 5% monthly audit of all Prosper fault reports was 95% but was based on only nine months worth of figures. SP Distribution were asked to produce twelve-month figures, which affected the accuracy level by +0.1%. This increase is negligible and has the effect of increasing the overall accuracy from 80.9% to 81%.

SP Distribution has expressed their uncertainty with regards to whether their methodology is consistent with that carried out at other DNOs. SP Distribution also stated that they would appreciate comments from Ofgem once all DNOs audit reports have been analysed and suggested that a cross fertilisation of ideas could take place potentially resulting in consistent guidelines/approaches.

K.6 Overall Impressions

The IIP project team, within SP Power Systems, has experienced a number of team member changes since the 2002 IIP audit. The current team, however, continues to be highly motivated, enthusiastic and professional as the project begins its transition into the main business.

It is the opinion of the audit team that SP Distribution's declared accuracy of their MPAN count, connectivity model and short interruptions are reasonable, acceptable and that the linkage to the reporting Template is sound.

In comparison with the 2002 IIP audits an improvement in the quality of information recorded in the incident/switching logs could be found. However, improvement was sporadic and there remain many incidents where the audit trail is very weak. SP Distribution have acknowledged that improvement in this area involves changing how staff complete the reports and therefore will take longer to implement, it is noted that SP Distribution continue to be actively training staff and that as the results of this filter through a gradual improvement should occur.

It was evident that SP Distribution had devoted significant resources in the preparation for the audit. The support continued throughout the audit and enabled the auditors to complete the audit within the timescales in place. One resource that was particularly useful was the ability to interrogate the GIS whilst undertaking the audit. This tool was able, in many cases, to support the information reported to Ofgem.

K.7 Conclusions

Table K-6 presents the results of the 2003 audit of the (name) licence area in-line with the auditing framework.

Table K-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.5 %
Stage 1	LV Connectivity Model	96 %
Stage 1	HV Connectivity Model	98 %
Stage 3	Overall sample – CI	100.0%
Stage 3	Overall sample – CML	99.2%
Stage 3	LV-only sample – CI	102.8%
Stage 3	LV-only sample– CML	93.1%
	Short Interruptions	81 %

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table K-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.8%	97.7%	95.1%	92.0%
Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

K.8 Recommendations

It was observed by the audit team that there are a large number of errors occurring when dispatchers enter information into incident logs. These errors are translated through into the IIP Template and without the internal auditing and checking that occurs this would be a significant source of inaccuracy. In addition the quality of the information recorded is also key in creating an auditable trail. The following list contains some suggestions that could improve the process of recording the incident:

- Where a fuse is removed to isolate supply record:
  - Information on the location of the fuse should be as specific as possible (i.e. sub-station, link box, pillar). This allows the customer numbers to be more accurately checked using the GIS. Without this information proving what has occurred in terms of sub-feeder isolation is difficult.
  - Whether one, two or three phases have been removed.
- If supplies are isolated by another means state what was done (e.g. line cut) and state the location (e.g. outside number 'x' 'y street'). Again this would assist in the use of the GIS to back-up what was reported.
- If the CI recorded is a field estimate note that it is, as this would allow retrospective checking, if necessary.

The recommendations from the 2002 IIP audit regarding electronic linkages should continue to be assessed and where the SP Distribution consider them to be cost-effective, practical and beneficial, be introduced.

SP Distribution should endeavour to complete the data cleansing process of approximately 60,000 customers presently located in the capture tool, attaching them to the correct LV feeder as an ongoing process.

SP Distribution's estimation of its inaccuracy of the LV connectivity is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as through sample selection and analysis, could produce supporting information for its estimated connectivity accuracy. This would also assist in the auditing process.

SP Distribution seeks to refine the methodology being applied for short interruptions, especially with regards to the weighting factors that are applied in the calculation of accuracy. It is acknowledged that SP Distribution has requested guidance from Ofgem and it is recommended that Scottish Power actively pursue this dialogue.

K.9 Learning Points

The following items were identified as learning points for the audit framework:

- The audits of the two license areas in two consecutive weeks, while not impossible, placed additional pressures on both SP Distribution and the auditors in preparation time and resources required to complete the audits. It is noted that the preparation time allowed for each license area overlapped (due to back to back audits) this reduced the preparation time that SP Distribution had.
- SP Distribution noted that some time was spent during the audit investigating changes in the customer numbers between the time of the incident and the time of the audit. SP Distribution considers that some guidance containing examples of the level of information that should be considered auditable would benefit both the DNOs and the auditors.
- SP Distribution made the following observations regarding the sample for incident stages for SP Distribution:
  - There were a number of zero CI and CML incidents. A small selection of these would not be a problem, however, 14 out of 16 EHV incident stages were like this. This meant that should an error occur the potential for the averages to mitigate the error is reduced.
  - There were a number of incident stages selected from the same incident. SP Distribution understood that this should not occur. If an error occurs in an earlier stage this will have a ripple effect through the incident.
  - The number of incident stages selected for audit this year is an upper limit on what can be prepared and audited within the time allowed. Completion of this sample required significant effort and resources both prior to and during the audits.
- SP Distribution note that should new auditors be undertaking future audits this would add considerable time to the audit process as the systems would require full outlining as opposed to a summary such as was provided this year.
- Whilst ‘clock stopping’ was not audited directly at SP Distribution, it was recorded that the DNO’s methodology allows for this practice. It is noted that Ofgem’s view on ‘clock stopping’ differs from that of the DNO and it is recommended that further discussion on this issue takes place.
- SP Distribution considers that some of the questions in the questionnaire are repetitive and that refinement and consolidation could occur. In addition they urged that finalised questionnaires are circulated as early as possible and that where changes occur to questionnaires after the audits begin that these too are distributed to improve the efficiency of the audit process and reduce the potential for confusion.

Appendix L ScottishPower (SP Manweb) – Merseyside and North Wales

L.1 Summary

SP Transmission & Distribution Ltd's Merseyside and North Wales license area (SP Manweb) was audited during the week beginning 25th August 2003 at their Prenton office, Merseyside.

SP Manweb's measurement systems have changed since the 2002 IIP audit visit with the completion and introduction of the LV connectivity model into its fault management system in March 2003. As SP Manweb did not have this model in place during the 2002 IIP audit, a more detailed analysis of the model has been carried out during this audit. No changes have been made to the interpretation of the RIGs, MPAN count, or in populating the Template. As part of this audit, assessments have been made of the accuracy of HV/LV substation connectivity, short interruptions and quality of telephone response data sent to Accent. Confirmation of the methodology used to provide the MPAN count and the reporting Template was also carried out. The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of the MPAN count - 99.5 %.
- Connectivity model (HV/LV substation level) - 98 %.
- Connectivity model (LV feeder level) - 96 %.

SP Manweb's reporting of incidents was found in general to be accurate for the 2002/03 reporting year. The most significant source of inaccuracies appears to be the entry of incorrect/inaccurate information in the original fault report. This data is used to populate the IIP template and while internal processes identify and correct some of these errors, some are not being identified. A small number of the incidents audited showed variance between the numbers reported and the current system numbers when compared. Systematic variances were identified in some incidents where SP Power Systems personnel are unable to complete the repairs required for reasons out of their control, for which the practice of clock stopping was employed.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table L-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.7%	97.7%	91.4%	90.9%
Stage 3 results indicate over reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

SP Manweb have estimated the accuracy level of Short Interruptions at 84%. It is the opinion of the auditors that they have interpreted Ofgem's requirements and methodology for estimating accuracy of Short Interruptions reporting in a reasonable and logical manner. SP Manweb would appreciate feedback from Ofgem regarding the methodology that they have developed. It is considered that this is an area where some standardised guidance from Ofgem may be beneficial.

SP Manweb continue to work on improving the quality and accuracy of their systems, through their data cleansing processes, continuing training programmes and movement of IIP from project status through to business operations.

L.2 Introduction

SP Manweb's licence area was audited during the week beginning 25th August 2003 at their Prenton Office in Merseyside. Graham Johnston, SP Power Systems IIP Project Manager, currently has overall responsibility for the IIP project within SP Manweb and SP Distribution. Tony Wright of British Power International and Simon Critten of Mott MacDonald were the audit team. In addition SP made available appropriate staff and facilities throughout the audit visit.

This report presents the findings of the SP Manweb audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

L.3 Stage 1: Measurement Systems and Template

L.3.1 Summary of Measurement Systems

SP Transmission and Distribution Ltd is responsible for two separate electricity licences – SP Manweb covering Merseyside and North Wales and SP Distribution covering South of Scotland. Information reporting under the IIP is currently under the responsibility of one System Analyst at each of the two SP Power Systems Management Centres (PSMC) – Prenton for SP Manweb and Hamilton for SP Distribution. This report focuses on SP Manweb. Over the coming year the operation and control of IIP related matters will be transferred from project control into the business operations in the form of a section entitled Control, Restoration and Repair (CR^2).

SP Manweb uses the Network Management System (NMS) for operation and control of its 132kV and EHV networks. This system sits outside the GE Network Solutions (GENS) Energy Network Management and Control System (ENMAC) which SP Manweb uses for its HV and LV networks.

The connectivity model contained within the NMS tool does not link directly with ICOND. For 132kV and EHV faults NMS is used to establish the Primary substation(s) affected by incidents and this information is manually transferred to ICOND where network tracing is carried out to establish customer numbers.

The Integrated Control Operational Diagram (ICOND) is part of the ENMAC system and contains the HV connectivity, customer numbers attached to HV/LV Transformers, creation of switching logs as well as HV control.

TroubleCall is the electronic fault management system, again part of the ENMAC system and records customer incident calls, with links to the Customer Directory and LV incident management. Troublecall also contains the LV connectivity, customer numbers at HV/LV transformers and customers attached at LV feeder level.

Prosper fault reports for incidents created within ICOND or TroubleCall are processed by a piece of software written by name (SAIC) to SP Manweb's specification. This piece of software applies and ensures compliance with the RIGs. Population of the IIP information template occurs using SP Power Systems' Business Objects reporting tool and reports against the Prosper database.

SP Power Systems, which manages the operations business is restructuring to deliver more 'focus' on its core business activities and responsibilities, moving from a regional to a functional structure with two management control centres at Prenton (SP Manweb) and Hamilton (SP Distribution). These control centres will house the control and dispatch function under one Control, Restoration and Repair Manager.

Within SP Manweb, Control Engineers and Dispatchers are responsible for interrogating ENMAC and for ensuring that incidents are dealt with promptly. Currently, this responsibility resides with personnel located at its 24 hour centre at the PSMC Prenton, and its satellite day time control room in Rhostyllen (North Wales).

SP Power Systems use one number in each of their license areas for their Power Outage, Security & Safety enquiry line. The calls are directed through the Thus intelligent network to one of two Distribution Call Centre (DCC) facilities located at Rhostyllen (North Wales) and Cathcart (Scotland) with overflow facilities at Cathcart, Caernarfon and Warrington. The latter are used when the main distribution call centres are busy. These facilities provide the capability of dealing with 240,000 calls per hour.

Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which SP Manweb identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. SP Manweb's methodology is detailed in document IIP-13-001 Issue 2.1 and this received Ofgem approval, by letter dated 18th June 2002.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, SP Manweb's estimate of accuracy of customer count by primary trading MPAN was 99.5%. Its estimate of accuracy for the 2003 IIP audit remains at 99.5% with a very high level of confidence.

The remaining inaccuracy (0.5%) relates primarily to work in progress coupled with possible incorrect coding of MPANs that result in the MPANs being rejected by the selection algorithms. The MPAN accuracy was considered in detail during the 2002 IIP Audits therefore, as the methodology has not changed since that time, this accuracy figure was not audited in detail as part of this year's audit.

SP Manweb have a Data Management Section that is considered to be a "one-stop-shop" for ensuring energised MPANs feed through into their connectivity model and their fault management systems. This Section obtained ISO 9001 accreditation in March of this year and it is anticipated that this will produce small incremental improvements in accuracy into the future.

Auditor's Conclusions

SP Manweb's methodology for counting MPANs has not changed fundamentally since last year. The visiting auditors found no inconsistencies in SP Manweb's estimate of accuracy and therefore support their results.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visits

SP Manweb introduced its LV connectivity model into its fault management system TroubleCall in March 2003 as suggested in the recommendations of the 2002 IIP audit.

A detailed examination of the methodology was carried out during the 2002 IIP audit with a visit by the audit team to the connectivity Capture Bureau at Glenrothes. The methodologies and processes have not changed since the 2002 IIP audit where they were audited to be robust.

DNO's Estimate of Accuracy

SP Manweb's methodology is set out in document IIP-13-003; the visiting auditors found no inconsistencies in the application of this methodology.

SP Manweb's current estimate of accuracy is as follows:

- HV/LV Substation 98 % (with a high confidence level)
- LV Feeder 96 % (with a high confidence level)

The confidence level attached to the LV feeder accuracy estimate is high due to the methodology adopted by SP Manweb, in terms of customers connected to the correct cable. The capture tool holds data in an "accuracy confidence level" field which allows the level of accuracy associated with any particular piece of information to be attached. During the initial capture the highest confidence level assigned in this field was 3, "decision made". This will be revised as information from planned or unplanned operational incidents becomes available. Such revisions may see the confidence level rising and attract a higher level of confidence. The maximum confidence level is 5, "verified", and occurs when the when LV feeder/ premise/ phase association is confirmed.

The capture work was carried out at the Capture Bureau but the primary route for updating customers is by Customer Directory updating TroubleCall. Regular monthly reconciliation checks are carried out by the System Administrator between MPAS (Metering Point Administration System) and Troublecall which checks the number of primary MPANs raised in the MPAS system and looks to see the same growth in TroubleCall to ensure links are in place.

The Data Management "one-stop shop" section is responsible for ensuring that the premise to feeder association is made along with the notification of the MPAN status being set to energised and that the service records are updated on GIS as required. The "one-stop shop" section received ISO 9001 accreditation in March of this year for their processes.

SP Manweb consider that the level of inaccuracy of 4% is primarily attributable to the following causes:

- the capture of pole-mounted transformers (<50 kVA) using a proximity methodology
- changes in LV switching points and normally open points
- multiple LV feeders in the street/pavement
- interconnected networks
- missing service records
- temporary network changes <14 days
- emergency work unrecorded
- human error.

SP Manweb has applied various percentage inaccuracy figures to this basket of possible sources of inaccuracy in a subjective and judgmental way. Nevertheless the audit of individual feeders carried out this year produced an inaccuracy level of 1.2 % (see below), a result that is well within SP Manweb's estimate of 4 %. The audited error was in one case due to duplicate cables in the footpath and the wrong cable being selected, and in another case, a property connected to the wrong side of an open point.

The potential sources of error that remain in the LV and HV connectivity models may be summarised as follows:

- poor quality address data
- inaccurate GIS/GND records
- normally open points fixed and future changes
- lack of service records
- incorrect application of the 7 data maintenance processes to record change, these being:
    - decommissioning of assets
    - installation of a new substation
    - network extension
    - new LV feeder
    - new connection
    - network alteration
    - disconnection.

These potential sources of error will be reduced by the ongoing work of the Data Management Section and accuracy will improve as normal open points are confirmed both from ad hoc reports and the 10-year rolling programme of link box inspections. This programme involves staff visiting link boxes for preventative maintenance purposes and also to check LV system running conditions.

A new LV fault incident log has been introduced for field staff to help provide accurate information on LV system status when incidents are transferred between resources. In addition to this SP Power Systems have also introduced procedures involving "one-stop shop" data management processes that are targeted to capture all modifications to the EHV and HV network in a fail-safe way, using operational safety documentation as the hub in order to maintain the integrity of the HV connectivity model. The procedure is also intended to update other databases in its record systems. A similar fail-safe LV procedure is being field tested at the moment.

The original five-feeder sample check resulted in an error rate of 16.8%. This was due to one feeder heavily influencing the others. The problem related to a private LV network within a caravan park which had been adopted by SP Manweb (sometime around 1994). Currently there are no cable records available for this site. One address point was identified during data capture and a map reference point was allocated to what has now been identified as a meter cubicle. In accordance with the data capture bureau guidelines and in the absence of any further cable records, all MPANs had been linked to this location. A site visit has confirmed that there are now eight metering cubicles distributed around the park with multiple meters in each cubicle. SP Manweb will pursue accurate network records for the site that will enable the grid reference for each caravan and associated MPAN to be re-aligned and attached to the correct feeder.

It is considered that this feeder is an unusual case especially considering the overall accuracy of the five feeders in SP Distribution (defined using the same methodology), and the accuracy of the SP Manweb sample with this rogue feeder taken out and replaced by a sixth selection. The audited inaccuracy for the revised five feeder sample (i.e. replacing the rogue feeder) is 1.2 %.

In the checking of the five feeders, during the audit of SP Distribution, the auditors observed that some MPANs had been attached to feeders in the Troublecall LV connectivity model at sub-station level but not to the individual feeder way. Such MPANs are held in the capture tool and are allocated a holding reference, which is a feeder code 41, and x-y co-ordinates which places them in a holding location in the North Sea until further x-y checks can be carried out. This is part of the data cleansing process and in the SP Manweb area there are approximately 40,000 customers in the capture tool still to be moved to the correct LV feeder by the Data Capture Bureau. The data cleansing process is ongoing and when the bureau closes down at the end of September 2003 any outstanding work will be undertaken by Data Management.

Auditor's Conclusions

The visiting auditor's consider that the audited inconsistencies do not impact significantly on SP Manweb's estimation of its accuracy. The revised five-feeder sample inaccuracy of 1.2% is less than the company's estimation of 4%. The auditors consider that SP Manweb's estimation of its accuracy is reasonable despite the discovery of a rogue feeder.

SP Manweb's estimation of its inaccuracy is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as sample selection and analysis, could produce a more robust assessment of inaccuracy.

(iii) RIG Definitions

The 2002 IIP audit report contained no recommendations for SP Manweb to implement with the audit team reporting that SP Manweb "has generally interpreted the RIGs definitions correctly and that it is operating in accordance with them". The audit team found no evidence to suggest this should be changed this year as no changes have been made since last year. It is noted that Ofgem's and the DNO's view on 'clock stopping' differ. It is recommended that further discussion on this issues takes place.

SP Manweb interpret the RIGs definitions of reinterruptions as being "if a customer or group of customers loses supply within three hours of ALL customers being restored from a previous interruption, this is considered as a reinterruption within the same incident".

(iv) IIP Template

There were no recommendations included in the 2002 IIP audit report for SP Manweb to implement with regards to the IIP templates and the methodology itself has not changed since the last audit. The only change that has occurred since last year is the introduction of a revised Template. This change was prompted by Ofgem and has not altered how SP Manweb populates it.

A sample of incidents completed during the 2002 IIP audits confirmed that source data from the reporting system progressed through a piece of software that ensured compliance with the RIGs. Population of the IIP information template occurs using the SP Power Systems Business Objects Reporting Tool and reports written against the Prosper database.

A spreadsheet was provided by the System Analyst confirming the Template accuracy for the 2002 return.

(v) Conclusions

SP Manweb's estimates of accuracy for MPANs, connectivity and RIGs are considered to be acceptable.

The visiting auditors consider that the completion of the Template is accurate based on the linkage between prime information recorded and RIGs. Comments regarding the accuracy of the prime information as observed in the incident auditing are included in Section K.4.

L.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all DNOs and therefore will be contained in the body of the main report.

It is acknowledged by the visiting auditors that as the LV connectivity model was not introduced until March 2003 the incident auditing carried out for the 2002/2003 reporting year would compare customer numbers on the new system with customer numbers derived applying the old calculation methods. This has the potential to cause variances in the customer numbers in addition to system changes and errors in reporting. This situation is in contrast with other DNOs that had their LV connectivity model in place prior to the start of the 2002/2003 reporting year. For those DNOs this year's audit would be comparing customer numbers generated at the time of audit using the connectivity model with incident reports also generated using the same connectivity model, thereby removing the potential inaccuracies caused by the introduction of the new system.

L.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, SP Manweb had prepared a folder of information containing the Prosper report, the ICOND report, the IIP report, the incident/switching log recording the actions taken by the operator and field operative, an annotated network diagram, PS Alerts (if available), and telephone call logs from Troublecall. This information was sufficient to understand the incident and track through the various restoration stages. The audit team had access to a live network system, an archive system and a GIS system. With the help of a control engineer the audit team were able to replicate/simulate incidents on the current and archive systems and interrogate the GIS to assess changes on the ground if necessary.

The visiting auditors were able to check the process used to extract the data from the various systems, assessing the current numbers and the archived numbers (from 2001) for each incident as they were replicated on the machines. Whilst it was not possible to assess the exact customer numbers at the time of the individual incidents, the visiting auditors were able to verify what both the current and archive systems show and cross-check this with the numbers locked into an Icond trace completed at the time of the incident. In general, the audit trail for incidents at the higher voltages was good.

The majority of higher voltage restoration stages selected for the audit sample were reasonably straightforward and whilst a few of the higher voltage incidents took some time to understand, SP

Manweb had spent some time preparing and reviewing each of the selected stages prior to the audit visit. As a result of this work none were too complex to audit.

The most frequent point of contention between the visiting auditors and SP Manweb was due to differences between the current system and the numbers reported at the time of the incident. SP Manweb demonstrated the impracticality of tracking movement of customers connected to an HV/LV substation and an HV circuit. SP Manweb was able to provide the auditors with Icond trace customer numbers attached to specific transformers from the time of the incident. Where variances were seen in the numbers attached to the same transformers on the current system this was recorded, however, as there is no way to amend the customer number count locked into the historical Icond trace this was accepted as sufficient evidence of the customer numbers at the time. It was noted that retrospective examination of a fault would often show different customer numbers attached to the transformers as the system changes over time. In the cases where additional evidence was required SP Manweb were able to provide extra information such as substation commissioning dates (and other data) and evidence from their GIS system.

Variances in CI and/or CML were observed in only 14 of the 89 HV incidents audited. Most of these inaccuracies involved only small numbers of customers.

A potential source of inaccuracy in the reporting incidents exists in the manual transfer of information from the field into the switching/incident logs. An example of this inaccuracy was recorded in an incident that was missing a restoration stage in the IIP report. In this case the text contained in the switching/incident log and telephone log indicated that there was an additional restoration stage, and the associated numbers of customers switched off and on in the logs was incorrect (i.e. did not reflect the text). These numbers are drawn through into the IIP template and therefore if they are incorrect the error is reported (if not picked up during the internal audit process). In this particular incident it was noted that the CI for the entire fault was correct, however, the CML for about 4% of the affected customers was recorded incorrectly.

There were a number of small errors associated with incidents that occurred during the storms in October 2002. This was a particularly busy time period with a large number of HV incidents recorded and SP Manweb's resources became very strained. The auditors noted that the information contained within the logs for incidents during storm periods often contained minimal information. It was also noted that after a storm event SP Manweb (and SP Distribution) routinely carry out additional internal audits targeted at those incidents that occurred during the event. The purpose of the audit being to check, correct and add additional information as it becomes available.

In many cases the October storm incidents were difficult to audit despite the fact that SP Manweb had spent considerable time completing additional auditing and correcting the figures that were initially reported. Some inaccuracies did occur in these incidents although the auditors are sure that without the additional targeted auditing the inaccuracies would have been far greater. Two interesting observations were made concerning these incidents. First a number of these inaccuracies were associated with an error in the incident start time as opposed to errors in customer numbers. Second, SP Manweb showed that where multiple faults occurred out of the same primary substation or on any given feeder, and doubt existed relating to the actual start time, SP Manweb corrected the time of the incident to the time of the master fault. This, in some cases, penalised SP Manweb especially if there were minimal phone calls received from the connected customers.

L.4.2 Incidents at LV

For each incident at lower voltage SP Manweb provided the Prosper report, the log of calls received, the incident log and a printout of the customer numbers on the affected feeder. Since the 2002 IIP audit visit the LV connectivity model has become operational. As a result the 2003 IIP audit was completed using the current system (LV connectivity) and examining numbers reported using the old method of deriving customer numbers on a feeder (proximity approach). The proximity approach simply took the total number of customers on a transformer, divided this by the number of feeders and then further divided this by three to get the number of customers per phase. For this audit, the differences between the old and new methods of deriving numbers were included as inaccuracies in the DNO's reporting.

Variances in CI and/or CML were observed in 37 of the 100 LV incidents audited. Most of these inaccuracies involved only small numbers of customers and in many cases SP Manweb were able to produce auditable evidence to justify the changes using a combination of methods including counting properties on the GIS. In a few cases these differences did lead to some more significant variances. SP Manweb considers that a large proportion of the differences were due to a combination of changes since the incident including :

- system growth
- network reconfiguration
- changes in CI distribution caused by the introduction of the LV connectivity model.

In addition SP Manweb note that a number of the more significant inaccuracies occurred during the storms of October 2002 (discussed in section L.4.1).

As was the case with the HV audit for many incidents SP Manweb was unable to produce auditable evidence of the customer numbers at the time of the incident other than the transformer counts completed at the time. SP Manweb noted that they accepted this approach for the auditing but require further clarification from Ofgem regarding the type and level of auditable information Ofgem expect to be to be maintained.

The main areas of contention between the visiting auditors and SP Manweb were stages that showed a variance between the current system and that reported at the time and where SP Manweb were able to offer an explanation for the differences but with no auditable evidence to support the theory.

In the sample there was only one restoration stage that was unauditable. In this case a single customer off supply had the clock stopped, because access could not be gained to complete the repairs. However, no record of the supplies ever being restored could be found. This incident was not auditable as no audit trail could be generated. The auditors consider that this is an isolated occurrence and not a systematic problem.

The issue of clock stopping, on the other hand is a systematic process that SP Manweb and (SP Distribution) applies. If they are in a position to complete the repairs and cannot carry them out for reasons out of their control, the clock will be stopped thereby halting the CML count. The clock is then re-started when work can continue and stopped when the customer is restored. In the sample audited, this practice occurred five times and was typically overnight. When these were reported they were reported as two incidents in the IIP template as they were more than three hours apart. Ofgem informed the auditors that if a customer is off supply, for the purposes of the IIP audit, the clock cannot be stopped for any reason until the supplies are restored. This led to a variance in the reported

CML in all 5 of the incidents where clock stopping occurred. It is noted that SP Manweb (and SP Distribution) are applying a consistent methodology to the issue of clock stopping, however, this methodology disagrees with that applied during the audit. SP Manweb disagrees with the audit methodology and considers that clock stopping should be permitted in certain situations. Additionally SP Manweb notes that this practice was reported on in the 2002 IIP Audit, no recommendations were made in the Audit report or subsequently from Ofgem regarding the continued application of this methodology, therefore SP Manweb have continued to apply it in a consistent manner for qualifying incidents. It is noted that Ofgem’s view on ‘clock stopping’ differs substantially from that of the DNO.. It is recommended that further discussion on this issue takes place.

In summary, the audit of LV incidents resulted in one incident found to have a missing restoration stage. In this case the text in the incident log reported the incident, but the numbers and times that customers were taken off and put back on supply did not reflect the words. As the IIP report uses these numbers to populate the template, if mistakes are not picked up during internal auditing, they are passed through as inaccuracies. The inability to produce auditable evidence of the customer numbers at the time of the incident coupled with the introduction of the LV connectivity led to the greatest variations in CI.

L.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table L-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
INCD-34246-h	F-4636-a	INCD-32202-h	INCD-31248-h
F-3978-b		INCD-96516-m	
Unidentified stage on line 44 of workbook			
J-12839-b			

The final Stage 3 reporting accuracy results are therefore:

Table L-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.1%
Stage 3	Overall sample – CML	100.0%
Stage 3	LV-only sample – CI	92.4%
Stage 3	LV-only sample – CML	91.8%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table L-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.1%	0.1%
		CML	100.0%	0.0%
	LV	CI	92.4%	7.6%
		CML	91.8%	8.2%
Stage 1		LV	96.0%	4.0%
		Overall		2.3%
		HV	98.0%	2.0%
LV Fraction				13.0%
Combined Accuracy	Overall	CI	97.7%	2.3%
		CML	97.7%	2.3%
	LV	CI	91.4%	8.6%
		CML	90.9%	9.1%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table L-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.7%	97.7%	91.4%	90.9%
Stage 3 results indicate over reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

L.5 Accuracy of Measurement Systems and Reporting Process for Short Interruptions

L.5.1 Methodology

The visiting auditors consider that robust business processes are being employed to capture short interruptions at the higher voltages. In SP Manweb all short interruptions on the 6.6kV, 11kV (except 11kV auto reclosers), 33kV and 132kV networks are captured using incident management systems, where a Prosper fault report captures the short interruption details. Both 11kV ground mounted and pole mounted auto recloser short interruptions are captured using periodic counter readings.

- Automatic

  SCADA systems automatically bring back plant indications and associated alarms from selected 11kv circuit breakers and all 33kv and higher voltage circuit breakers. On receipt of this information, a Prosper fault report is created and populated with the supply interruption and restoration details by a control engineer. The cause is identified using codes within the Prosper fault report identifying the incident as a RIGs short interruption, i.e. automatic disconnection, automatic reconnection etc.

- Manual

  Where SCADA systems are not employed i.e. on the 6.6kV and most of the 11kV networks, short interruptions are recorded by field staff who supply (report) interruption and restoration details to a control engineer. 11kV ground mounted and pole mounted auto recloser short interruptions are captured via biannual readings.

- LV Reclosing

  SP Manweb do not make significant use of LV reclosing devices. Their use is limited to LV cable fault detection where portable units are temporarily connected to locate faults.

- Multi-shot

  SP Manweb make extensive use of 11kV ground mounted and pole mounted multi-shot auto reclosers. The number of short interruptions they cause is identified in the following way.

  A trip operations counter reading is taken between the 1st January and 31st March (CR1) and the following year during the same period a second reading is taken (CR2). After 12 months the difference between the two readings is used to identify the number of operations over a 12-month period. From this difference a subtraction is made to make allowance for permanent faults (PF) and routine switching (RS). The actual figure used (PF + RS) is an average figure derived through analysis of a sample study of a number of auto reclosers covered by SCADA systems. The number of short interruptions is therefore derived using the following formula:

  (CR2-CR1) – (PF+ RS) Avg.

  This demonstrates how permanent faults and routine switching are excluded from the count; the methodology is contained in document IIP-16-001 appendix 1 and IIP-16-004.

The process to identify the customers connected downstream of each auto recloser, for the periodic count, is carried out once a year in early April, using a "static model". The IIP circuit management process HVCI (high voltage circuit integrator) is used for this task and the individual circuit configurations are determined using data from the previous 30th September. The model used is updated every 12 months.

Although it is not a requirement of the RIGs it was noted by the auditors that SP Manweb does not currently have the capability to track network changes throughout the year and apply these changes in their reporting of auto recloser short interruptions within the manual process.

Both methodology documents were given to visiting auditors and it is considered, by the visiting auditors that SP Manweb comply with the RIGs requirement of measurement and reporting of short interruptions. The company follow the guidance given in the RIGs and schedule counter readings between 1st January and 31st March to ensure a reasonable approximation to a 12-month total.

The internal audit results are integrated into the reporting systems as follows:

- Total customers identified by a single MPAN. The IIP System administrator carries out monthly audits. The value at 30th September is included in the annual estimate of accuracy.
- Network diagram “dynamic” circuit tracing capability. Number of HV circuits with dynamic circuit tracing / Total number of HV circuits. This value is included in the annual estimate of accuracy.
- HVCI “static" circuit tracing capability (for auto reclosers). Number of auto reclosers with valid HVCI trace / Total number of auto reclosers. This value is included in the annual estimate of accuracy.
- Number of auto reclosers without counters. This value is largely fixed (due to older ground mounted switchgear without counters) and is included in the annual estimate of accuracy.
- Number of auto reclosers without counter reading data. This value is calculated in early April and included in the annual estimate of accuracy.
- Accuracy associated with using (PF + RS) Avg. This value is fixed and is derived from analysis of a simple study of auto reclosers covered by SCADA systems.
- Accuracy of relevant Prosper fault reports. Monthly audits are carried out on 5% of all HV Prosper fault reports, which include short interruptions if these are embedded in the sample.

The audit team are confident that the IIP Template has been completed accurately for short interruptions. For year 2002, the disaggregated number of short interruptions by all four “causes” was examined involving 240 incidents. The customer numbers interrupted matched those reported in the Template.

A spreadsheet was provided by the System Analyst, confirming the build up of the various categories included in the short interruption Template, which matched the 2002 return.

L.5.2 DNO’s Estimate of Accuracy

SP Manweb estimate accuracy of reporting at approximately 84% with a low confidence level. This low level is due to the inconsistency of data over the last two years and SP Manweb is uncertain that the method it has developed and adopted is consistent with other DNOs. The level of inaccuracy represents largely gaps in the data, for example, failure to read all counter readings, units without counters, exchange units due to maintenance processes and access problems preventing readings from being taken.

The method used to calculate the accuracy is derived from Ofgem's IIP audit framework, where a defined number of key areas associated with the relevant measurement systems are audited. The SP Manweb document containing the methodology for estimating accuracy of reporting including details of the long hand calculations for 2002 is IIP–16–005 Issue 2, the main features of this method are summarised below.

The level of inaccuracy for each key area is approximately:

- Customer identification by MPAN - Negligible inaccuracy at 1%
- Connectivity model - Minor inaccuracy at 7.3%[1]
- Short interruption categories - Main inaccuracy at 40.3%
  - Automatic disconnection/reconnection
  - Automatic disconnection/manual reconnection
  - Manual disconnection/manual reconnection
  - Transmission system, embedded generators etc.

The document also includes the methodology behind the calculation of weighting factors currently set at 33 % for each of the main areas in the above list, which when applied produces an overall estimated accuracy of 83.8 %. SP Manweb is aware that through variation of the weightings applied the overall accuracy could be significantly altered and therefore have opted for an even split. SP Manweb would like guidance from Ofgem regarding the method employed, especially the weightings applied.

In looking to the future, SP Manweb is giving consideration to a number of things, including:

- a review of the estimate of accuracy algorithms used, in particular the distribution of weighting factors
- ongoing work to validate primary MPANs
- ongoing data cleansing exercise to improve the number of successful circuit traces within the HVCI model for auto reclosers
- to improve on the number of counter readings that are captured during each inspection.

This work will have little impact on SP Manweb's assessment of MPAN accuracy. It will, however, improve the estimated accuracy of the connectivity model by approximately 3% reducing the estimated inaccuracy from 7.3% to 4.3%. It will also improve the estimated accuracy associated with the short interruption reporting categories by approximately 6% reducing the estimated inaccuracy from 40.3% to 34.3%.

SP Manweb are currently installing significant volumes of HV automation schemes that may add to the volume of "automatic disconnection – automatic reconnection" short interruptions.

[1] The connectivity figure for short interruptions is based on the declared connectivity of 98 % modified by an accuracy formula which reflects the number of auto recloser units on the system identified with customers connected within the HVCI model against the total numbers of units shown in the plants and circuits database when the system trace was run.

L.5.3 Auditor's Conclusions

No inconsistencies were found in the application of the methodology as set out in the method statement. It is the opinion of the auditors that SP Manweb has interpreted Ofgem's requirements in a reasonable and logical manner and is in compliance with the RIGs. It is recommended that further discussions take place on the issue of clock-stopping.

The key performance indicator for short interruptions derived via the 5 % monthly audit of all Prosper fault reports was 95 % but was based on only eleven months worth of figures. SP Manweb did not complete an audit for October 2002 due to the Post Storm review. SP Manweb had an audited 100% accuracy for the 11 month period but down graded this figure to 95% to compensate for a perceived dip in Short Interruption reporting during the October 2002 storm period.

The DNOs calculations lead to an overall accuracy of 83.8%.

SP Manweb have expressed their uncertainty with regards to whether their methodology is consistent with that carried out at other DNOs. SP Manweb also stated that they would appreciate comments from Ofgem once all DNOs audit reports have been analysed and suggested that a cross fertilisation of ideas could take place potentially resulting in consistent guidelines/approaches.

L.6 Overall Impressions

The IIP project team, within SP Power Systems, has experienced a number of team member changes since the 2002 IIP audit. The current team, however, continues to be highly motivated, enthusiastic and professional as the project begins its transition into the main business.

It is the opinion of the audit team that SP Manweb's declared accuracy of their MPAN count, connectivity model and short interruptions are reasonable, acceptable and that the linkage to the reporting Template is sound.

In comparison with the 2002 IIP audits an improvement in the quality of information recorded in the incident/switching logs could be found. However, improvement was sporadic and there remain many incidents where the audit trail is very weak. In particular incidents audited around the period of the October storms were particularly difficult to audit. SP Manweb have acknowledged that improvement in this area involves in part changing how staff complete the reports and therefore will take longer to implement. It is noted that SP Manweb continue to actively train staff and that the results of this should filter through to a gradual improvement in reporting.

It was evident that SP Manweb had devoted significant resources in the preparation for the audit. The support continued throughout the audit and enabled the auditors to complete the audit within the timescales in place. One resource that was particularly useful was the ability to interrogate the GIS whilst undertaking the audit. This tool was able, in many cases, to support the information reported to Ofgem especially for the interconnected networks.

L.7 Conclusions

Table L-6 presents the results of the 2003 audit of the SP Manweb licence area in-line with the auditing framework.

Table L-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.5 %
Stage 1	LV Connectivity Model	96 %
Stage 1	HV Connectivity Model	98 %
Stage 3	Overall sample – CI	100.1%
Stage 3	Overall sample – CML	100.0%
Stage 3	LV-only sample – CI	92.4%
Stage 3	LV-only sample– CML	91.8%
	Short Interruptions	84%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table L-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.7%	97.7%	91.4%	90.9%
Stage 3 results indicate over reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

L.8 Recommendations

It was observed by the audit team that there are a large number of errors occurring when dispatchers enter information into incident logs. These errors are translated through into the IIP Template and without the internal auditing and checking that occurs this would be a significant source of inaccuracy. In addition the quality of the information recorded is also key in creating an auditable trail. The following list contains some suggestions that could improve the process of recording the incident:

- Where a fuse is removed to isolate supply record:
  - Information on the location of the fuse, should be as specific as possible (i.e. sub-station, link box, pillar). This allows the customer numbers to be more accurately checked using the GIS. Without this information proving what has occurred in terms of sub-feeder isolation is difficult.
  - Whether one, two or three phases have been removed and which phase(s) was removed (red, yellow or blue). This not only would help with the audit trail but would also help in refining the connectivity model and working out the customers attached to particular feeders and particular phases.
- If supplies are isolated by another means state what was done (e.g. line cut) and state the location (e.g. outside number 'x' 'y street'). Again this would assist in the use of the GIS to back-up what was reported.
- If the CI recorded is a field estimate note that it is, as this would allow retrospective checking, if necessary.

The recommendations from the 2002 IIP audit regarding electronic linkages should continue to be assessed and where SP Manweb considers them to be cost-effective, practical and beneficial be introduced.

SP Manweb should complete the corrections that are being made to the MPAN attachments at Marsh Green Caravan Park, Frodsham.

SP Manweb should endeavour to complete the data cleansing process of approximately 40,000 customers presently located in the capture tool, attaching them to the correct LV feeder as an ongoing process.

SP Manweb's estimation of its inaccuracy of the LV connectivity is based on a basket of eight specific areas with each individual area allocated its own inaccuracy level. All of these individual estimates are based on subjective judgements (understandably so in certain areas), nevertheless a more objective approach, such as through sample selection and analysis, could produce supporting information for its estimated connectivity accuracy. This would also assist in the auditing process.

SP Manweb seeks to refine the methodology being applied for short interruptions, especially with regards to the weighting factors that are applied in the calculation of accuracy. It is acknowledged that SP Manweb has requested guidance from Ofgem and it is recommended that SP Manweb actively pursue this dialogue.

SP Manweb considers that clock stopping should be permitted in certain situations. It is recommended that dialogue with Ofgem regarding this process be undertaken.

L.9 Learning Points

The following items were identified as learning points for the audit framework:

- The audits of the two license areas in two consecutive weeks, while not impossible, placed additional pressures on both SP Manweb and the auditors in preparation time and resources required to complete the audits. It is noted that the preparation time allowed for each license area overlapped (due to back to back audits) this reduced the preparation time that SP Manweb had.
- SP Manweb considers that it is unfair to include as inaccuracies the additional CML due to the practice of clock stopping when SP Manweb personnel are unable to complete the repairs required for reasons beyond their control. SP Manweb employed this practice in 2001/02 and no recommendations were made to curtail this methodology. It is recommended that further discussions on this issue take place.
- SP Manweb noted that there were a number of incident stages selected from the same incident. SP Manweb were of an understanding that this should not occur. If an error occurs in an earlier stage this has the potential for a ripple effect through the incident.
- SP Manweb noted that some time was spent during the audit investigating changes in the customer numbers between the time of the incident and the time of the audit. SP Manweb considers that some guidance containing examples of the level of information that should be considered auditable would benefit both the DNOs and the auditors.
- SP Manweb considers the total number of incident stages selected for audit this year for the two license areas are an upper limit on what can be prepared and audited within the time allowed. Completion of this sample required significant effort and resources both prior to and during the audits.
- SP Manweb note that should new auditors be undertaking future audits this would add considerable time to the audit process as the systems would require full outlining as opposed to a summary such as was provided this year.
- SP Manweb considers that some of the questions in the questionnaire are repetitive and that refinement and consolidation could occur. In addition they urged that finalised questionnaires are circulated as early as possible and that where changes occur to questionnaires after the audits begin that these too are distributed to improve the efficiency of the audit process and reduce the potential for confusion.

Appendix M Scottish and Southern (SSE) – Scottish Hydro

M.1 Summary

This report covers the Scottish Hydro Electric Power Distribution 2003 IIP audit visit in July 2003. The audit was carried out at the sister company, Southern Electric Power Distribution Network Management Centre in Portsmouth. SHEPD is one of two distribution licences held by the company Scottish and Southern Energy.

The visiting audit team of Janet Berry and Bill Slegg worked with the company's team of John Blyth, Alan Cranstone, Mike Green and Frank Shackleford to audit the company's 2002/3 IIP reporting process. The audit visit was simplified by the fact that the visiting auditors had both become familiar with SSE systems during the 2002 full IIP audit, and Janet Berry also carried out the 2002 interim review of IIP reporting systems.

Since the 2002 audit SHEPD made no changes to its interpretation of the RIGs, to its MPAN count process or to its connectivity model. It continues to apply a process to improve the accuracy of its connectivity model following incidents on the low voltage networks, although the amendments necessary are minor as the system has been in use in Scotland for around twenty years and has been rigorously maintained from an initial accurate base. Its Stage 1 accuracy therefore remains at its 2002 level. The company has taken on board the recommendations made in the 2002 audit to improve its audit trail, particularly on LV incidents, by recording more text information against incident reports and restoration stages.

The Stage 3 audit covered samples of restoration stages from incidents on the LV and higher voltage networks split to allow the accuracy of the LV network and the network overall to be calculated in accordance with the requirements of the RIGs. There were few significant errors found in the sample, most of those reporting errors that were apparent resulted from the dynamic nature of the connectivity model with natural customer changes and connectivity error correction since the reported incident causing the differences.

In the overall sample 5 stages were replaced with a spare restoration stage as network changes did not allow an adequate audit trail. No stages had to be removed from the LV sample. The company has developed a process for recording short interruptions (SIs), which the auditors found to be both RIG compliant and reported to the expected level of accuracy. The process uses a combination of SCADA data from monitored devices and factored data from devices requiring an annual visit to manually collect counter readings. The company operates the same process across both of its licensed areas but maintains the data separately and applies different factors to the manually collected data in its two areas based upon the different network arrangements and automation schemes in use.

The process for providing the data to Accent, the telephone market research company, was also reviewed in the 2003 audit. The findings of this review are discussed in a separate report on quality of telephone response information.

The audit team is of the opinion that SHEPD has, in the main, correctly interpreted the RIG definitions of an incident and that the company is operating in accordance with them.

The audit team is also of the opinion that SHEPD is continuing to operate in accordance with the procedure agreed with Ofgem for the identification of customers by primary traded MPAN.

SSE is a business focused company, with its SHEPD operation having distribution as its core. It has systems in place that allow it to provide IIP compliant reports, some of which have had to be modified, at cost to the company, to become providers of IIP compliant data. In some respects the systems, which were generally implemented prior to IIP have manual processes to provide support and audit features.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table M-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.0%	99.7%	99.3%	99.1%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

M.2 Introduction

The 2003 IIP Audit of SHEPD Scottish Electric Power Distribution took place in the SEPD Portsmouth Network Management Centre (NMC) between 7 and 18 July 2003.

The company, Scottish and Southern Energy holds two DNO licences, one for Scottish Hydro Electric Distribution area, the subject of this audit, and one for Southern Electric Power Distribution. The company operates the two licensed areas as a single managed unit with common systems and mutual support between the North and South. This unit is managed by one senior manager, Mike Green, who also has responsibility for reporting under the IIP requirements.

The audit was carried out over the period of two weeks by visiting auditors Janet Berry and Bill Slegg from British Power International. In addition SSE provided appropriate staff and facilities to assist in the work throughout the visit. Chris Watts from Ofgem joined the audit team to witness the first two days of the audit.

The findings of the 2003 audit of SHEPD are presented as follows:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 9 – Recommendations.
- Section 10 - Learning Points.

M.3 Stage 1: Measurement Systems and Template

M.3.1 Summary of Measurement Systems

The company uses common systems in the North and South for its Network Management process, which also form the basis of the measurement systems for IIP reporting. The operations are based on two Network Management Centres, one in Perth and one in Portsmouth, each having its own manager and team but using common systems and processes, with the ability to offer mutual support in the event of a heavy workload due to system incidents. This applies across the areas of responsibility of customer call handling, resource dispatch, high voltage system control and regulatory reporting. To ensure familiarity the company routinely transfers customer calls and sections of network control between the North and South in non-emergency times. These units operate around the clock with no change in process out of normal working hours. Within the two centres there is no fixed geographic split of work, for control purposes sections of the network between defined control boundaries can be allocated to any work station in Perth or Portsmouth and the customer call handling centre can offer work as a virtual single unit with automatic call transfer taking place depending upon traffic. Resource allocation and dispatch is handled on a North / South split basis for practical reasons.

The key systems in use for operational purposes and for providing IIP data are known by the acronyms ENMAC and SIMS. ENMAC is the Energy Network Management and Control System, which holds an electronic model of all higher voltage networks and receives alarms from the SCADA system to keep the model updated in real time. It is the prime tool of the control engineer who also updates the model with non-automatic information and instigates or authorises all operations on the networks. SIMS, the Supply Incident Management System, which handles customer calls and resource allocation, has a real time link from ENMAC, providing an updated list of disconnected sections of high voltage network that will result in customer supply interruptions. By means of this link customer call takers are aware of network incidents when they speak with customers. SIMS also contains the company equivalent of Nafirs / PCNafirs and collates all information reportable under Nafirs and IIP in a Nafirs coded form. SIMS is also used as the means of recording planned supply interruptions (PSI).

Short interruptions are entered in SIMS as a non-reportable (under Nafirs) incident, with the exception of counter readings taken from un-monitored pole mounted and ground mounted circuit breakers which are stored on a manual system, and combined with the automatically counted short interruptions at the time of populating the IIP reporting template.

A data extraction process using “Business Objects” enquiry software searches the SIMS data base to extract data in an IIP compliant form to populate the IIP annual return template.

M.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since 2002 Audits

The 2002 audit of SHEPD made no recommendations regarding the MPAN count, as the auditors were satisfied that the process being used was RIG compliant and robust. SSE has made no changes since the 2002 audit and therefore no changes to accuracy are reported.

DNO's Estimate of Accuracy

SHEPD's estimate of accuracy remains at or close to 100%, as reported in the 2002 audit. The only acknowledged discrepancy in the overall MPAN count is the work in progress in depots, allocating new MPANs to the connectivity model. This number is negligible, and the company operates a target of fourteen days for any MPAN change to be reflected in the model, with appropriate control measures.

Auditor's conclusions

MPAN counts were not specifically addressed in the 2003 audit and the auditors found no inconsistency in the methodology employed or individual restoration stage audits that might have been caused by an MPAN issue.

Based on the 2002 audit and 2003 review the auditors are of the view that the company's estimate of accuracy is reasonable.

(ii) Connectivity Model

Changes since 2002 Audits

There were no recommendations made in the 2002 audit of SHEPD regarding the connectivity model as the auditors were impressed by the simplicity of the hierarchical NRN (network reference number) system which has been in use and maintained regularly from its initial accurate population. The NRN model has to be maintained to retain its accuracy as network changes are made.

The only changes to the connectivity model reported by the company relate to data additions through adding and removing MPANs and data cleansing based on operational experience (gradually correcting incorrectly allocated MPANs to networks in congested areas and at network feeding boundaries). The company recognises the long-term benefit of improving accuracy of the model and is diligent in updating the model following a fault on the LV networks as new information becomes available indicating incorrectly allocated MPANs. The company is, however, conscious that the effect of making updates to the connectivity model after fault jobs are closed will result in minor reporting discrepancies.

DNO's Estimate of Accuracy

SHEPD's estimate of accuracy in 2002 was 99.9% for LV and 99.9% overall. The basis of the company's approach to their connectivity model is the NRN system, discussed above. The approach and methodology for updates has not changed since the last audit, and the company reports that its ongoing update and correction process is improving accuracy in a gradual way. The remaining inaccuracy is considered by the company to be very small at the higher voltage levels. Any remaining levels of inaccuracy are minor and corrected at the NMC as information becomes available post-incident. The company is sufficiently confident with its connectivity model to use it as the basis of planned supply interruption notification.

SHEPD has a process, which is diligently applied, to re-allocate incorrectly associated MPANs to the correct section of network when errors become obvious during an LV incident. This process was demonstrated as part of the 2003 audit. The LV fault job closing routine in SIMS prompts the user to reallocate MPANs to transformers and LV feeders when the current allocation is in question based on the incident information. The process only occurs post LV incident based on customer calls received and at current rates will take many years to correct all errors.

Auditor's conclusions

During the 2003 audit the inconsistencies found were attributable in the main to movements in the system numbers due to normal and acceptable operational changes giving a discrepancy from the reported numbers.

Overall the auditors believe that the company's estimate of accuracy is reasonable and on the evidence seen support the company's view.

(iii) RIG Definitions

There were no recommendations made in the 2002 audit of SHEPD regarding the RIG definitions and the company has made no changes to its views of the RIG definitions.

Regarding re-interruptions, the company applies the interpretation that the three hour period for a re-interruption for any customer commences from the time at which the supply to the last customer affected by the incident was finally restored.

(iv) IIP Template

There were no recommendations made in the 2002 audit of SHEPD regarding the IIP Template and the company has made no changes to its process of using Business Objects data extraction software to gather data from its SIMS data-base to populate the IIP reporting template, other than adding the routines for Short Interruption reporting.

The data presented to Ofgem in the IIP template is therefore the same as that which is held in the company's measurements system (SIMS) represented in IIP form.

(v) Conclusions

Based upon the company's interpretation of the RIGs, its processes for applying its MPAN count, and applying connectivity to its network model the auditor's take the view that the company's accuracy of reporting both overall and on LV systems in 2002 remains accurate.

The company's process for extracting data from its systems to populate the IIP reporting template is robust whilst requiring manual intervention. The Business Objects Software routines for data extraction were audited in 2002, and the company has made no changes since then, other than adding the extraction routine for Short Interruptions.

M.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

M.4.1 Incidents at HV

A sample of 102 restoration stages from incidents on the SHEPD networks was included in the 2003 overall audit. This sample consisted of 90 restoration stages from 11kV, 33kV 132kV networks. The quality of the audit trail was generally good, taking as prime documents fault log sheets from the NMC control desks and printed extracts from the ENMAC system. Field operators' switching logs are not retained long term in SHEPD and were not used as part of the audit. Audit validation used these prime documents, the live ENMAC system model and the live SIMS data base. Where validation of customer numbers depended upon LV operational information, for example, to support numbers reported on LV backfeeds the audit trail was less robust, but this was a relatively minor issue. No restoration stages in the sample provided had to be removed and substituted due to an inadequate audit trail or complex network arrangements making audit impossible, but the sample did include a large number of "repair only" stages with no customer impact and repair period of several days, making them of little value to the audit process.

There was little disagreement between the visiting auditors and the company on the audit of restoration stages in the sample, most of the differences between the auditor's figures and the company's figures being attributable to reasonable model changes

There were no issues regarding missing restoration stages or interpretation of the RIGs. An infrequent, but potentially significant, source of error results when the automatic link between ENMAC and SIMS does not perform requiring the manual transfer of data into SIMS fault reports.

M.4.2 Incidents at LV

A sample of 99 restoration stages from incidents on the SHEPD low voltage networks was included in the 2003 audit. The quality of the audit trail was generally good, taking as prime documents individual SIMS incident reports and the time stamped customer call reports. There are no network operations prime documents that confirm operation times on LV networks in the same way as HV networks. There was, however, a noticeable improvement since the 2002 audit based on the company's response to the audit recommendation to provide additional incident progress information on SIMS. In the absence of an LV operational record the progress notes, in conjunction with the GIS system, generally allowed an understanding of an incident to be developed.

There was little disagreement between the visiting auditors and the company on the audit of restoration stages in the sample, most of the differences between the auditor's figures and the company's figures being attributable to reasonable model changes. Most areas of query were substantiated through further document searches.

At LV there were no issues regarding missing restoration stages.

The company operates the procedure of "stopping the clock" in terms of CML counts were a customer specifically requests a delay to repairs or declines access (for example business premises that close out of hours). The auditor's view is that this is not within the requirements of the RIGs, but note that the company does not stop the clock if the delay is at the company's discretion (for example due to the noise or carrying out repairs overnight).

M.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table M-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
52H000125	52H000125 70H000627	24 0000566	70 0001614

The final Stage 3 reporting accuracy results are therefore:

Table M-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	101.0%
Stage 3	Overall sample – CML	100.3%
Stage 3	LV-only sample – CI	99.3%
Stage 3	LV-only sample – CML	99.1%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table M-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	101.0%	1.0%
		CML	100.3%	0.3%
	LV	CI	99.3%	0.7%
		CML	99.1%	0.9%
Stage 1		LV	99.90%	0.10%
		Overall		0.10%
		HV	99.90%	0.10%
LV Fraction				0.09
Combined Accuracy	Overall	CI	99.0%	1.0%
		CML	99.7%	0.3%
	LV	CI	99.3%	0.7%
		CML	99.1%	0.9%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table M-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.0%	99.7%	99.3%	99.1%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

M.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

M.5.1 Methodology

SHEPD gathers information for its return of short interruptions using two approaches to address the different plant types that cause short interruptions. Automatic circuit breakers that are monitored using the company's SCADA system or secondary control system are monitored in the NMC and from this information an appropriately coded fault report is set up in SIMS (coded A, M,N,E in the re-interruption field) to meet the four categories required by the RIGs. These SIs are automatically date and time stamped and therefore readily allocated to a reporting period in the same way as any other interruption. For pole and ground circuit breakers not monitored in the NMC the company uses a manual data gathering process based on an annual counter reading taken from site. There is inevitably some uncertainty on the allocation of counter readings to a reporting period unless all reading are taken on the same day of the year which would be operationally impractical. The nominal annual reading is taken between January and March of the reporting year with the variance based upon workload, operational needs, access issues and any other local requirement. The company holds the view that the error resulting from this is limited and balanced across the company as a whole. A proportion of the pole and ground circuit breaker operations are excluded from the count to allow for those already counted through association with permanent faults and the count associated with repeat operations for a single interruption on multi shot auto-reclose schemes. The company developed an algorithm based upon their operational experience and knowledge of the schemes they have in use and as a result apply a multiplier of 0.6 to the actual count taken from the field. The company has audited this approximation based on taking a sample of feeders heavily populated with PODs (power outage detectors) and on these feeders the factor was found to be 0.59. The company continues to apply a factor of 0.6, which is considered to be accurate across all feeders. Reported short interruptions are included in the internal audit of incidents, for which the monthly target is 50 HV and 50 LV incidents.

The template is completed, in accordance with the RIGs, based on data from the SIMS fault report system, extracted using Business Objects extraction software. This data is combined with the manually gathered data and entered onto the IIP template.

M.5.2 DNO's Estimate of Accuracy

SHEPD estimates that its accuracy is 85%. This is based on a best estimate approach based on their algorithm, which has been verified by comparison with PODs actual results on a small sample of feeders. With multi shot schemes and manually read counters on circuit breakers it is unrealistic to believe that accuracy will rise above around 90% and confidence limits cannot be high as there will remain a varying number of shots associated with individual permanent faults and clearance of transient faults. The remaining level of inaccuracy in the SI count will be associated with these factors.

SHEPD has plans, and a programme is under way to install remote closing and / or remote monitoring on all of its pole mounted circuit breakers by 2005, with 200 out of 900 units in SHEPD being completed by the end of the 2003/4 reporting year, and another 300 to be done over the following 2 years. There is no data cleansing required associated with the existing processes, and the inaccuracy discussed above due to the algorithm applied to manually gathered data and periodicity issues will be resolved by the completion of the remote monitoring on pole mounted circuit breakers.

M.5.3 Auditor's Conclusions

There were no inconsistencies found in the process for reporting short interruptions, with the only errors arising from the factors already discussed. The impact of the potential errors is estimated by the company to be up to 15%.

Based on the company's verification process the auditors believe that the company may be underestimating their level of accuracy but are being realistic as their confidence level cannot be high because of the small sample in the verification process.

M.6 Overall Impressions

The company has systems in place that will allow reporting in accordance with the requirements of IIP. They have taken note of the recommendations made in the 2002 audit report and implemented a more robust audit trail, particularly applied to LV incidents where they do not operate the same degree of operational recording that is used at higher voltages. All staff in the NMC are well briefed and aware of the importance of reporting in accordance with IIP.

M.7 Conclusions

Table M-6 presents the results of the 2003 audit of the SHEPD licence area in-line with the auditing framework.

Table M-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	Almost 100%
Stage 1	LV Connectivity Model	99.9%
Stage 1	HV Connectivity Model	99.9%
Stage 3	Overall sample – CI	101.0%
Stage 3	Overall sample – CML	100.3%
Stage 3	LV-only sample – CI	99.3%
Stage 3	LV-only sample– CML	99.1%
	Short Interruptions	85%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table M-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.0%	99.7%	99.3%	99.1%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

M.8 Recommendations

Based on the 2003 and previous audits of IIP compliance, application of RIGs definitions, MPAN count methodology and connectivity model the auditors believe that SHEPD has measurement systems in place that will allow reporting that under normal circumstances meets the accuracy level required under IIP, and that the company's estimates of overall accuracy can be expected to be met.

There are, however, concerns that in some cases human error can occur which undermine the otherwise robust work that the company has done. It would be prudent for the company to carry out internal audit checks on all higher voltage faults where the automatic transfer between ENMAC and SIMS does not occur for whatever reason, as the manual intervention at this stage introduces a further opportunity for human error to creep in.

SHEPD should stop the process of “stopping the clock” for prolonged faults when reporting CMLs under IIP in cases where the customer agrees to a deferred supply restoration for whatever reason. This recommendation should have no impact on the company’s procedure for dealing with Guaranteed Standards.

M.9 Learning Points

The 2003 audit was in most respects a successful exercise in assessing the overall effectiveness and accuracy of the company’s reporting systems, with the visiting auditors and the company learning useful points as the audit progressed. It must be acknowledged that for the second year in succession the company was one of the two parallel pilot companies and had limited time to prepare for the audit, and some development and clarification of the audit process was taking place in the early days of the visit.

The following learning points for the process became apparent during the visit:

- The audit sample, based on a random selection of restoration stages from the whole population contained an unexpectedly high number of zero customer impact stages. As the purpose of the audit is to address Customer Interruptions and Customer Minutes Lost these stages add little value to the process. In any future IIP audit the sample could more usefully be based on “whole incidents” or if restoration stages are used they should be redefined as restoration stages with customer impact.
- The use of restoration stages as the basis of the audit also highlighted further issues with the sample, which should be addressed if this process is used again, for example; the use of more than one stage from an incident, clarity in selecting the stage within the incident and the impact of other stages on the audit stage.
- SHEPD believes that the process of updating the connectivity model for the longer term improvement in accuracy of the model must continue but asserts the view that this gradual refinement of the model must not be allowed to reduce its calculated accuracy of reporting due to a moving base.

Appendix N Scottish and Southern (SSE) – Southern Electric

N.1 Summary

This report covers the 2003 IIP audit visit in July 2003 to Southern Electric Power Distribution, at its Network Management Centre in Portsmouth. SEPD is one of two distribution licences held by the company Scottish and Southern Energy.

The visiting audit team of Janet Berry and Bill Slegg worked with the company's team of John Blyth, Alan Cranstone, Mike Green and Frank Shackleford to audit the company's 2002/3 IIP reporting process. The audit visit was simplified by the fact that the visiting auditors had both become familiar with SSE systems during the 2002 full IIP audit, and Janet Berry also carried out the 2002 interim review of IIP reporting systems.

Since the 2002 audit SEPD made no changes to its interpretation of the RIGs, to its MPAN count process or to its connectivity model. It continues to apply a process to improve the accuracy of its connectivity model following incidents on the low voltage networks and may have opportunities to extend this process to other network operations. Its Stage 1 accuracy therefore remains at its 2002 level. The company has taken on board the recommendations made in the 2002 audit to improve its audit trail, particularly on LV incidents, by recording more text information against incident reports and restoration stages.

The Stage 3 audit covered samples of restoration stages from incidents on the LV and higher voltage networks split to allow the accuracy of the LV network and the network overall to be calculated in accordance with the requirements of the RIGs. There were few significant errors found in the sample, most of those reporting errors that were apparent resulted from the dynamic nature of the connectivity model with natural customer changes and connectivity error correction since the reported incident causing the differences. One restoration stage with a significant human error could result in SEPD's Stage 3 audit not meeting the required accuracy level, depending upon the process for calculating accuracy. The company is concerned that a single error could have this impact. Treatment of outlying results is described in the results section (N.4.3) of this report.

In the LV sample 1 stage had to be replaced with a spare restoration stage as network changes did not allow an adequate audit trail.

The company has developed a process for recording short interruptions (SIs), which the auditors found to be both RIG compliant and reported to the expected level of accuracy. The process uses a combination of SCADA data from monitored devices and factored data from devices requiring an annual visit to manually collect counter readings. The company operates the same process across both of its licensed areas but maintains the data separately and applies different factors to the manually collected data in its two areas based upon the different network arrangements and automation schemes in use.

The process for providing the data to Accent, the telephone market research company, was also reviewed in the 2003 audit. The findings of this review are discussed in a separate report on quality of telephone response information.

The audit team is of the opinion that SEPD has, in the main, correctly interpreted the RIG definitions of an incident and that the company is operating in accordance with them.

The audit team is also of the opinion that SEPD is continuing to operate in accordance with the procedure agreed with Ofgem for the identification of customers by primary traded MPAN.

SSE is a business focused company, with its SEPD operation having distribution as its core. It has systems in place that allow it to provide IIP compliant reports, some of which have had to be modified, at cost to the company, to become providers of IIP compliant data. In some respects the systems, which were generally implemented prior to IIP have associated manual processes to provide support and audit features.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table N-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.5%	99.7%	98.3%	97.1%
Stage 3 results indicate under reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

N.2 Introduction

The 2003 IIP Audit of SSE Southern Electric Power Distribution took place in the Portsmouth Network Management Centre (NMC) between 7 and 18 July 2003.

The company, Scottish and Southern Energy holds two DNO licences, one for Scottish Hydro Electric Distribution area, and the subject of this audit, Southern Electric Power Distribution. The company operates the two licensed areas as a single managed unit with common systems and mutual support between the North and South. This unit is managed by one senior manager, Mike Green, who also has responsibility for reporting under the IIP requirements.

The audit was carried out over the period of two weeks by visiting auditors Janet Berry and Bill Slegg from British Power International. In addition SSE made available appropriate staff and facilities to assist in the work throughout the audit. Chris Watts from Ofgem joined the audit team to witness the first two days of the audit.

The findings of the 2003 audit of SEPD are presented as follows:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

N.3 Stage 1: Measurement Systems and Template

N.3.1 Summary of Measurement Systems

The company uses common systems in the North and South for its Network Management process, which also form the basis of the measurement systems for IIP reporting. The operations are based on two Network Management Centres, one in Perth and one in Portsmouth, each having its own manager and team but using common systems and processes, with the ability to offer mutual support in the event of a heavy workload due to system incidents. This applies across the areas of responsibility of customer call handling, resource dispatch, high voltage system control and regulatory reporting. To ensure familiarity the company routinely transfers customer calls and sections of network control between the North and South outside times of system emergency. These units operate around the clock with no change in process out of normal working hours. Within the two centres there is no fixed geographic split of work. For network control purposes sections of the network between defined control boundaries can be allocated to any work station in Perth or Portsmouth and the customer call handling centre works as a virtual single unit with automatic call transfer taking place depending upon call volume and the availability of call taking agents. Resource allocation and dispatch is handled on a North / South split basis for practical reasons.

The key systems in use for operational purposes and for providing IIP data are known by the acronyms ENMAC and SIMS. ENMAC is the Energy Network Management and Control System, which holds an electronic model of all higher voltage networks and receives alarms from the SCADA system to keep the model updated in real time. It is the prime tool of the control engineer who also updates the model with non-automatic information and instigates or authorises all operations on the networks. SIMS, the Supply Incident Management System, which handles customer calls and resource allocation, has a real time link from ENMAC, providing an updated list of disconnected sections of high voltage network that will result in customer supply interruptions. By means of this link customer call takers are made aware of network incidents when they speak with customers. SIMS also contains the company equivalent of Nafirs / PCNafirs and collates all information reportable under Nafirs and IIP in a Nafirs coded form. SIMS is also used as the means of recording planned supply interruptions (PSI).

Short interruptions are entered in SIMS as a non-reportable (under Nafirs) incident, with the exception of counter readings taken from un-monitored pole mounted circuit breakers which are stored on a manual system, and combined with the automatically counted short interruptions at the time of populating the IIP reporting template.

A data extraction process using "Business Objects" enquiry software searches the SIMS data-base to extract data in an IIP compliant form to populate the IIP annual return template.

N.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since 2002 Audits

The 2002 audit of SEPD made no recommendations regarding the MPAN count, as the auditors were satisfied that the process being used was RIG compliant and robust. SSE has made no changes since the 2002 audit and therefore no changes to accuracy are reported.

DNO's Estimate of Accuracy

SEPD's estimate of accuracy remains at or close to 100%, as reported in the 2002 audit. The only acknowledged discrepancy in the overall MPAN count is the work in progress in depots, allocating new MPANs to the connectivity model. This number is negligible compared with the whole, and the company operates a target period of fourteen days for any MPAN change to be reflected in the model, and applies appropriate control measures.

Auditors Conclusions

MPAN counts was not specifically addressed in the 2003 audit and the auditors found no inconsistency in the methodology employed or individual restoration stage audits that might have been caused by an MPAN issue.

Base upon the 2002 audit, and the 2003 review the auditors are of the view that the company's estimate of accuracy is reasonable.

(ii) Connectivity Model

Changes since 2002 Audits

There were no recommendations made in the 2002 audit of SEPD regarding the connectivity model as the auditors were impressed by the simplicity of the hierarchical NRN (network reference number) system which has been adopted in SEPD from a long standing system in SHEPD. The NRN model has to be maintained to retain its accuracy as network changes are made.

The only changes to the connectivity model reported by the company relate to data additions through adding and removing MPANs and data cleansing based on operational experience (gradually correcting incorrectly allocated MPANs to networks in congested areas and at network feeding boundaries). The company recognises the long-term benefit of improving accuracy of the model and is diligent in updating the model following faults on the LV networks, as new information becomes available indicating incorrectly allocated MPANs. The company is, however, conscious that the effect of making updates to the connectivity model after fault jobs are closed will result in minor reporting discrepancies.

DNO's Estimate of Accuracy

SEPD's estimate of accuracy in 2002 was 98.5% for LV and 99.9% overall. The basis of the company's approach to their connectivity model is the NRN system, discussed above. The approach and methodology for updates has not changed since the last audit, and the company reports that its ongoing update and correction process is improving accuracy in a gradual way. The remaining inaccuracy is considered by the company to be very small at the higher voltage levels, but at the LV level is acknowledged in some cases to be significant. The remaining levels of inaccuracy are due to the original allocation of MPANs to network with the known difficulty in selecting the correct LV cables in urban areas, and difficulty at feeding boundaries.

SEPD has a process, which is diligently applied, to re-allocate incorrectly associated MPANs to the correct section of network when errors become obvious during an LV incident. This process was demonstrated as part of the 2003 audit. The LV fault job closing routine in SIMS prompts the user to reallocate MPANs to transformers and LV feeders when the current allocation is in question based on the incident information. The process only occurs post LV incident based on customer calls received and at current rates will take many years to correct all errors.

Auditor's Conclusions

During the 2003 audit the inconsistencies found were primarily associated with the changing numbers of customers connected to specific parts of the network i.e. new connected customers, disconnected customers and movement of customers around the network due to network reconfiguration or data cleansing. This is normal activity and produces discrepancies between reported customer numbers and the customer numbers reviewed during the audit.

However, an unexpectedly high number of transformers within the model were discovered with zero connected customers. These were identified in the audit of HV incidents when lists of affected transformers were used to verify reported customer numbers. The company has confirmed that these arise from a number of situations:

- When a proposed new substation is introduced into the Enmac system, a new substation is created in SIMS in readiness for customers to be connected. These proposed changes can exist for many months before the substation is actually energised and customers connected. These substations show in SIMS as existing, but have zero connected customers.
- Substations which have no transformer (either the transformer has been removed or the substation is simply a switching station) will correctly show zero customers.
- The methodology used to populate the connectivity model used an algorithm to connect customers to the geographically nearest LV network. Where single customers are actually connected only by a service (i.e. a remote Pole Mounted Transformer with no LV main), or where a customer is a single HV metered supply (i.e. no LV main is involved in the supply) then that customer will have been allocated to the nearest LV main. These customers will generally be 'singles' and will almost certainly be connected to the correct HV feeder. Therefore the effect on accuracy will be minimal.

The auditors suggested that a process similar to the data cleansing that occurs when customers 'call with no supply but are allocated to a different NRN' could be extended to the planned supply interruption procedure on the LV network. The company has considered this approach, but has dismissed it on the basis that the staff involved with the interruption would have to knock doors to check whether each customer has actually been disconnected. Not only would this be ineffective in terms of access to confirm supply loss, but it would also disrupt the operational process which required the planned supply interruption in the first place. Therefore this process will not be implemented. The auditors hold the view that this is a missed opportunity to improve the accuracy of the model at a time when the customers affected should be known precisely.

Overall the auditors believe that the companies estimate of accuracy may be slightly optimistic, but not unreasonably so, and would only become an issue in the marginal case.

(iii) RIG Definitions

There were no recommendations made in the 2002 audit of SEPD regarding the RIG definitions and the company has made no changes to its views of the RIG definitions.

Regarding re-interruptions, the company applies the interpretation that the three hour period for a re-interruption for any customer commences from the time at which the supply to the last customer affected by the incident was finally restored.

(iv) IIP Template

There were no recommendations made in the 2002 audit of SEPD regarding the IIP Template and the company has made no changes to its process of using Business Objects data extraction software to gather data from its SIMS data base to populate the IIP reporting template, other than adding the routines for Short Interruption reporting.

The data presented to Ofgem in the IIP template is therefore the same as that which is held in the company's measurements system (SIMS) represented in IIP form.

(v) Conclusions

Based upon the company's interpretation of the RIGs, its processes for applying its MPAN count, and applying connectivity to its network model the auditor's take the view that the company's accuracy of reporting both overall and on LV systems in 2002 remains accurate, but an opportunity may be being missed to improve further.

The company's process for extracting data from its systems to populate the IIP reporting template is robust whilst requiring manual intervention. The Business Objects Software routines for data extraction were audited in 2002, and the company has made no changes since then, other than adding the extraction routine for Short Interruptions.

N.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

N.4.1 Incidents at HV

A sample of 100 restoration stages from incidents on the SEPD networks was included in the 2003 overall audit. This sample consisted of 90 restoration stages from the higher voltage networks. The quality of the audit trail was generally good, taking as prime documents fault log sheets from the NMC control desks and printed extracts from the ENMAC system. Field operators' switching logs are not retained long term in SEPD and were not used as part of the audit. Audit validation used these prime documents, the live ENMAC system model and the live SIMS data base. Where validation of customer numbers depended upon LV operational information, for example, to support numbers reported on LV backfeeds the audit trail was less robust, but this was a relatively minor issue. No restoration stages in the sample provided had to be removed and substituted due to an inadequate audit trail or complex network arrangements making audit impossible, but the sample did include a large number of "repair only" stages with no customer impact and repair period of several days, making them of little value to the audit process.

There was little disagreement between the visiting auditors and the company on the audit of restoration stages in the sample, most of the differences between the auditor's figures and the company's figures being attributable to reasonable model changes. The only significant area of difference related to the inclusion of a single restoration stage with particularly high impact on the overall sample. The stage remains in the sample but the company is strongly of the opinion that it should be removed from the sample as an outlier on accuracy. The auditors view is that this situation must be treated consistently as part of the central accuracy calculation.

There were no issues regarding missing restoration stages or interpretation of the RIGs. An infrequent, but potentially significant, source of error (including the significant restoration stage mentioned above), results when the automatic link between ENMAC and SIMS does not perform requiring the manual transfer of data into SIMS fault reports.

N.4.2 Incidents at LV

A sample of 101 restoration stages from incidents on the SEPD low voltage networks was included in the 2003 audit. The quality of the audit trail was generally good, taking as prime documents individual SIMS incident reports and the time stamped customer call reports. There are no network operations prime documents that confirm operation times on LV networks in the same way as HV networks. There was, however, a noticeable improvement since the 2002 audit based on the company's response to the audit recommendation to provide additional incident progress information on SIMS. In the absence of an LV operational record the progress notes, in conjunction with the GIS system, generally allowed an understanding of an incident to be developed. Only one restoration stage from the sample had to be replaced as too complicated for the available audit trail to confirm.

There was little disagreement between the visiting auditors and the company on the audit of restoration stages in the sample, most of the differences between the auditor's figures and the company's figures being attributable to reasonable model changes. Most areas of query were substantiated through further document searches.

At LV there were no issues regarding missing restoration stages.

The company still operates the system of "stopping the clock" in terms of CML counts were a customer agrees to delay repairs for whatever reason. The auditors view is that this is not within the requirements of the RIGs.

N.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table N-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
470027	470167	430282	450046
470007		450046	

The final Stage 3 reporting accuracy results are therefore:

Table N-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.6%
Stage 3	Overall sample – CML	100.0%
Stage 3	LV-only sample – CI	100.7%
Stage 3	LV-only sample – CML	97.5%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table N-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.6%	0.4%
		CML	100.0%	0.0%
	LV	CI	100.7%	0.7%
		CML	97.5%	2.5%
Stage 1		LV	98.5%	1.5%
		Overall		0.3%
		HV	99.9%	0.1%
LV Fraction				12.0%
Combined Accuracy	Overall	CI	99.5%	0.5%
		CML	99.7%	0.3%
	LV	CI	98.3%	1.7%
		CML	97.1%	2.9%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table N-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.5%	99.7%	98.3%	97.1%
Stage 3 results indicate under reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

N.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

N.5.1 Methodology

SEPD gathers information for its return of short interruptions using two approaches to address the different plant types that cause short interruptions. Automatic circuit breakers that are monitored using the company's SCADA system, or secondary control system are monitored in the NMC and from this information an appropriately coded fault report is set up in SIMS (coded A,M,N,E in the re-interruption field) to meet the four categories required by the RIGs. These SIs are automatically date and time stamped and therefore readily allocated to a reporting period in the same way as any other interruption. For pole-mounted circuit breakers that are not monitored in the NMC the company uses a manual data gathering process based on an annual counter reading taken from site. There is inevitably some uncertainty on the allocation of counter readings to a reporting period unless all reading are taken on the same day of the year which would be operationally impractical. The nominal annual reading is taken within three months (either way) of the end of the reporting year with the variance based upon workload, operational needs, access issues and any other local requirement. The company holds the view that the error resulting from this is limited and balanced across the company as a whole. A proportion of the pole mounted circuit breaker operations are excluded from the count to allow for those already counted through association with permanent faults and the count associated with repeat operations for a single interruption on multi shot auto-reclose schemes. The company developed an algorithm based upon their operational experience and knowledge of the schemes they have in use and as a result apply a multiplier of 0.7 to the actual count taken from the field. The company has audited this approximation based on taking a sample of feeders heavily populated with PODs (power outage detectors) and confirmed its accuracy. Reported short interruptions are included in the internal audit of incidents, for which the monthly target is 50 HV and 50 LV incidents.

The template is completed, in accordance with the RIGs, based on data from the SIMS fault report system, extracted using Business Objects extraction software. This data is combined with the manually gathered data and entered onto the IIP template.

N.5.2 DNO's Estimate of Accuracy

SEPD estimates that its accuracy is 85%. This is based on a best estimate approach based on their algorithm, which has been verified by comparison with PODs actual results on a small sample of feeders. With multi shot schemes and manually read counters on pole mounted circuit breakers it is unrealistic to believe that accuracy will rise above around 90% and confidence limits cannot be high as there will remain a varying number of shots associated with individual permanent faults and clearance of transient faults. The remaining level of inaccuracy in the SI count will be associated with these factors.

SEPD has a programme is under way to install remote closing and / or remote monitoring on all of its pole mounted circuit breakers by 2005, with the majority of the 2000 units in SEPD being completed by the end of the 2003/4 reporting year. There is no data cleansing required associated with the existing processes, and the inaccuracy discussed above due to the algorithm applied to manually gathered data and periodicity issues will be resolved by the completion of the remote monitoring on pole mounted circuit breakers.

N.5.3 Auditor's Conclusions

There were no inconsistencies found in the process for reporting short interruptions, with the only errors arising from the factors already discussed. The impact of the potential errors is estimated by the company to be up to 15%.

Based on the company's verification process the auditors believe that the company may be underestimating their level of accuracy but are being realistic as their confidence level cannot be high because of the small sample in the verification process.

N.6 Overall Impressions

The company has systems in place that will allow reporting in accordance with the requirements of IIP. They have taken note of the recommendations made in the 2002 audit report and implemented a more robust audit trail. This is particularly applied to LV incidents where they do not record network operations to the same degree applied at higher voltages. All staff in the NMC are well briefed and aware of the importance of reporting in accordance with IIP.

N.7 Conclusions

Table N-6 presents the results of the 2003 audit of the SEPD licence area in-line with the auditing framework.

Table N-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	Almost 100%
Stage 1	LV Connectivity Model	98.5%
Stage 1	HV Connectivity Model	99.9%
Stage 3	Overall sample – CI	99.6%
Stage 3	Overall sample – CML	100.0%
Stage 3	LV-only sample – CI	100.7%
Stage 3	LV-only sample– CML	97.5%
	Short Interruptions	85%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table N-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.5%	99.7%	98.3%	97.1%
Stage 3 results indicate under reporting	Stage 3 results indicate 100% reporting accuracy	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting

N.8 Recommendations

Based on the 2003 and previous audits of IIP compliance, application of RIG's definitions, MPAN count methodology and connectivity model the auditors believe that SEPD has measurement systems in place that will allow reporting that under normal circumstances meets the accuracy level required under IIP, and that the company's estimates of overall accuracy can be expected to be met.

There are, however, concerns that in some cases human error can occur which undermine the otherwise robust work that the company has done. It would be prudent for the company to carry out internal audit checks on all higher voltage faults where the automatic transfer between ENMAC and SIMS does not occur for whatever reason, as the manual intervention at this stage introduces a further opportunity for human error to creep in, as witnessed by one significant restoration stage in the sample.

The company may benefit by reconsidering its decision not to update its connectivity model following planned interruptions on the LV network.

SEPD should stop the process of "stopping the clock" for prolonged faults when reporting CMLs under IIP in cases where the customer agrees to a deferred supply restoration for whatever reason. This recommendation should have no impact on the company's procedure for dealing with Guaranteed Standards.

N.9 Learning Points

The 2003 audit was in most respects a successful exercise in assessing the overall effectiveness and accuracy of the company's reporting systems, with the visiting auditors and the company learning useful points as the audit progressed. It must be acknowledged that for the second year in succession the company was one of the two parallel pilot companies and had limited time to prepare for the audit, and some development and clarification of the audit process was taking place in the early days of the visit.

The following learning points for the process became apparent during the visit:

- The audit sample, based on a random selection of restoration stages from the whole population contained an unexpectedly high number of zero customer impact stages. As the purpose of the audit is to address Customer Interruptions and Customer Minutes Lost these stages add little value to the process. In any future IIP audit the sample could more usefully be based on "whole incidents" or if restoration stages are used they should be redefined as restoration stages with customer impact.
- The use of restoration stages as the basis of the audit also highlighted further issues with the sample, which should be addressed if this process is used again, for example; the use of more than one stage from an incident, clarity in selecting the stage within the incident and the impact of other stages on the audit stage.
- SEPD believes that the process of updating the connectivity model for the longer term improvement in accuracy of the model must continue but asserts the view that this gradual refinement of the model must not be allowed to reduce its calculated accuracy of reporting due to a moving base.

Appendix O United Utilities

O.1 Summary

United Utilities licence area was audited during the week beginning 21 July 2003 at the Distribution System Management Centre at Manchester and at the Network Restoration Centre at Preston.

UU's measurement systems have changed little since the 2002 IIP audit visit, when the visiting auditors found UU's systems and procedures to be inherently accurate. UU's continuing data cleansing and improving staff skills have reduced the number of customers not assigned to LV feeders in the connectivity model and, at the time of the 2003 IIP audit visit, both the MPAN count and connectivity models were assessed to be highly accurate. The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 100%.
- Connectivity model (HV) 99.50%.
- Connectivity model (LV) 98.45%.

UU's reporting of incidents was found to be accurate for the 2002/03 reporting year, with the improvements from the previous year largely as a result of the comprehensive use of the LV connectivity model for LV faults, which hadn't been the case for the previous year since there wasn't a requirement to do so. Some manual transcription errors persist and the interpretation of faults affecting only part of an LV feeder is still a potential source of inaccuracy. An important system enhancement highlights the earliest customer call time, although on one occasion this had still not been used. A contentious issue, which was also highlighted in the 2002 audit report, concerns the practice of stopping the clock when delayed restoration is agreed with the customer, and it is recommended that the rule on this is clarified by Ofgem. Some operational times from the field were also a cause for concern, since some appeared to have been rounded to whole hours.

A further issue identified is the rule concerning rounding of telecontrol stamped times, which could have significant effect e.g. regarding the distinction between interruptions and short interruptions at EHV and 132kV. Incorrect reporting of non-reportable LV incidents was found on two incidents, leading to a small degree of over recording; this doesn't appear to be a widespread problem. Inaccuracy in calculating single and 2 phase affected customers was also a source of error, found on three of the audited LV incidents.

Due to the nature of the HV connectivity model, an improved audit trail is recommended of customers affected by planned HV incidents, enabling checks against the LV connectivity model.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table O-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.4%	99.4%	96.7%	97.2%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

Currently, UU does not have a robust procedure for accurately reporting short interruptions on the LV system caused by the use of REZAPs. However, procedures to report CIs and CMLs for short interruptions at HV and above are considered to be robust.

O.2 Introduction

United Utilities Norweb license area was audited during the week beginning 21 July 2003 at the Distribution System Management Centre at Manchester and at the Network Restoration Centre at Preston. John Rimell of ERA Technology and Sergio Gonzales of Mott MacDonald undertook the audit. United Utilities provided appropriate staff and facilities to assist in the work throughout the audit visits. Richard Clay of Ofgem attended the audit for the first two days to witness the audit process undertaken by the joint team.

This report presents the findings of the UU audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

O.3 Stage 1: Measurement Systems and Template

O.3.1 Summary of Measurement Systems

UU's information reporting under the IIP falls within the responsibility of the Network Management Division, which reports to the Asset O&M Directorate of UU Service Delivery. The Network Management Division comprises the Distribution System Management Centre, the Network Restoration Centre and the Customer Service Department.

The Network Management Division, which manages the day-to-day operation of the distribution system, is organised centrally but is placed across 3 physical locations. The Distribution System Management Centre is based in Manchester and is responsible for the following HV system issues: safety management, fault management, fault reporting and planned interruption reporting. It manages the single HV Control Centre at Manchester, which carries out real-time management of the HV, EHV and 132kV networks. The Network Restoration Centre is in Preston and is responsible for LV system fault management, LV fault reporting and LV planned interruption reporting. The Customer Service Department is located in both Preston and Bolton and provides the primary interface with customers.

UU uses a Control Room Management System (CRMS) as the centre of its high voltage fault and incident management process. CRMS contains fault inference software, which interrogates the current system configuration to help operators identify single incidents from diverse inputs. CRMS also holds the HV connectivity model. The key data inputs to CRMS are derived from SCADA, PODs (Power Outage Detectors), CIFMs (described below) and field staff.

UU uses a Customer Information and Fault Management System (CIFMS) as the centre of its LV fault management process; approximately 70,000 jobs are managed per annum (including non-IIP reported incidents such as meter faults). Current arrangements are that fault management and resource dispatch are handled from Preston daily between 0700 and 2330 and from the Bolton Call Centre at other times. CIFMS can be accessed from Preston, Bolton and Manchester and any other UU office. The LV fault management team comprises 3 elements:

- LV Fault Controllers – prioritise jobs, monitor restoration, establish restoration strategies and monitor restoration.
- LV Fault Dispatch – dispatch resources, chase updates of estimated arrival and restoration times from field staff and input field information into FIGS (see below) and PC-NaFIRS.
- FIGS input (integral to both of the above elements) – counts the number of customers affected and submits information to PC-NaFIRS.

UU call centre staff enter details of individual “no supply” calls directly onto CIFMS, thereby date-stamping all no supply calls received at the call centre. This “front-end” is also part of the system from which call-takers can access the latest information on the progress of an incident, enabling them to update callers as necessary. A system enhancement since the 2002 audit automatically highlights the earliest customer call time, so that this can be more easily identified as the correct incident start time.

Incidents that appear to only affect single customers are dispatched directly to a service electrician. In the event of a reported dead incoming service cable the job is transferred to the Mains Fault Screen on CIFMS, and thus reported as an LV incident.

In common with several DNOs, UU uses the Langhorne Computers software package, PC-NaFIRs, to record information on incidents. Langhorne Computers also wrote the software program that extracts the information from the incident information held in a DNO’s PC-NaFIRS database to automatically populate Ofgem’s template and UU relies on this package. At the time that the PC-NaFIRS template was installed, UU carried-out tests to verify the correct operation of the software program. By inputting known incident data into PC-NaFIRS, UU was able to verify that the output from the template agreed with its manually computed figures for CI, CML, and re-interruptions, broken down by voltage. UU confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. The populating of the IIP template was verified during the 2002 IIP audit visit to UU.

O.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that proposed by UU and subsequently approved by Ofgem.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, UU's estimate of accuracy of customer count by primary trading MPAN was 99.99%. The small level of estimated error arose from multiple feeder sites where it had proved impossible to distinguish between primary and secondary MPANs that had common meter time switch codes. There were approximately 50 such sites. The figure was also based on the results of three separate annual audits of the national MPRS system and the company's MPRS database. The visiting auditors were satisfied with UU's estimate, and that the growing total customer numbers would cause the level of accuracy to tend towards 100%.

UU has identified all MPANs by interrogating the metering codes associated with its metered service connections via the Standard Settlement Configuration. This work also identifies connections where multiple MPANs exist for an individual customer, enabling UU to eliminate these from its count of the total number of customers (MPANs) connected to its distribution system.

During the 2003 IIP audit visit, UU has stated that its estimated accuracy of customer count by primary trading MPAN has moved towards 100% from the 2002 estimate of 99.99%, since no changes have been made to the methodology used and total customer numbers have risen.

No major changes to UU's procedures are planned for the future. The company intends to maintain the ongoing attention to accuracy in data transfer for new customers.

Auditors' Conclusions

UU's procedures for counting primary trading MPANs are robust and provide highly accurate total customer numbers. Mandatory input fields within the MPAN Management System ensure that MPANs are generated and placed somewhere on the network models in a timely manner.

UU's methodology for counting MPANs has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of MPAN count provided last year was verified at that time, by checking and agreeing the total number of sites affected by the agreed source of error.

The visiting auditors found UU's procedure for counting MPANs to be robust and they support the company's estimated accuracy of 99.99 to 100%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visits

The structure and operation of the company's HV and LV connectivity models has not changed since the 2002 IIP audit visit. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit, however it was recommended that the (then) newly established LV connectivity model should be used for all LV incidents. UU has now established the policy of using the LV connectivity model for all incidents on LV mains, although in instances where the numbers of customers affected are very low, and obvious from site, the model is not used. Written guidance has been issued to appropriate staff describing this policy.

Data cleansing has continued since the 2002 IIP audit visit and is now completed for all MPANs placed on the LV connectivity model. The effect of data cleansing has been to improve LV model accuracy (see below).

UU expects to implement a GIS system during 2004/5, and that this may be used as the source of customer numbers for IIP reports in the future. GIS is not being introduced in order to improve IIP reporting, since UU believe its current systems to provide the required levels of accuracy.

DNO's Estimate of Accuracy

UU's current estimate of accuracy of its connectivity models is as follows (last year's results in brackets):

- HV Connectivity Model 99.5% (99.5%)
- LV Connectivity Model 98.45% (97.2%)

The statistical accuracy of the customer allocation in CRMS is estimated at 100%, based on the fact that MPAN placement error is 0% at the macro level i.e. all MPANs are assigned to a HV/LV substation somewhere on the network (unplaced MPANs are systematically allocated across a range of substations). The statistical argument that overall accuracy levels very quickly converge to 100%, based on asymptotic normality, was agreed by Ofgem last year and is not repeated here. The connectivity accuracy of CRMS is estimated at 99.5%. There is a very small chance that a substation could have been commissioned on the system but not commissioned on CRMS. The resulting inaccuracy of this has been pessimistically estimated at 1 in 200 situations i.e. 0.5%. The risk of this is managed through regular error reports of network abnormalities e.g. plant not connected, normally open points closed etc. The level of confidence for the estimated accuracy of the HV connectivity model is 100%.

LV customer numbers are calculated using the Fault Information Gathering System (FIGS). MPAN placement in FIGS has gone through further stages of "clean up" since the 2002 audit. From a total number of MPANs for 2002/3 of 2,281,769:

- 2,160,835 MPANs have now been placed to within 1m of the property, representing 94.7% of all MPANs.
- 114,062 are placed at the centre of the post-code centroid or on the correct street i.e. within approximately 30m of the property on average. This represents 5% of all the MPANs.
- 6,872 (0.3%) MPANs cannot be placed on FIGs.

It is likely that the majority of MPANs that are placed on the post-code centroid will be correctly assigned when the network is evaluated by the user. Experience has shown that this is normally the case as FIGS operatives are now more experienced in determining the extent of affected network and its associated properties. UU has assumed that 75% of centroid placed MPANs will be correctly assigned to an affected network. The overall estimated accuracy of the LV connectivity model is calculated as:

94.7% (placed within 1m) + (75% of 5% (placed on post-code centroid)) = 98.45%.

The combined model accuracy has been estimated based on the CI ratio for HV and LV incidents for 2002/3. Based on the CI ratio combined model accuracy is calculated as: (0.849 x 99.5%) + (0.151 x 98.45%) = 99.34%. The company has 100% confidence that the estimated accuracy levels do not exceed actual accuracy levels, since they believe that they have consistently taken pessimistic views.

UU has estimated that overall reporting accuracy from using the connectivity models has improved from 97.31% last year to 97.48% this year (based on a CI ratio between LV and HV incidents).

HV reporting inaccuracy arises from incorrect diagram operational dressing prior to customer count, estimated at 1% inaccuracy, and from incorrectly transcribing details between CRMS, the preliminary fault report (PFR) and NaFIRS, estimated at 1%. HV reporting accuracy is therefore calculated as 0.99 x 0.99 = 98.01%.

There are 2 sources of reporting inaccuracy at LV:

- Operator skill in capturing all relevant MPANs when identifying affected networks. There is a normal distribution of these errors and the combined error is therefore estimated as 0%.
- Inability to definitely assign a customer to a circuit, typically where there is more than 1 cable passing a property and there are no details of service connections. This was found to occur in 296 out of 24,240 instances during an audit, an error rate of 1.2%.

LV reporting accuracy is therefore calculated at 98.8%.

The overall accuracy of the connectivity systems is estimated by UU as follows:

HV accuracy is (0.9801 x 0.995) = 97.52%

LV accuracy is (0.988 x 0.9845) = 97.27%

Combined overall accuracy based on CI ratio is:

(97.52% x 0.849) + (97.27% x 0.151) = 97.48%

Based on CML ratio, the combined overall accuracy is estimated as 97.44%

Auditors' Conclusions

UU's connectivity models are accurate (the statistical accuracy of the HV model at the macro level having been agreed previously by Ofgem). Five per cent of customers are assigned to post code centroids where insufficient information exists to correctly position them, however these have no effect on HV incident customer count and operator skill and experience ensures that, at worst, 75% of these customers are included on LV incidents. A small number of customers (0.3%) have not been placed on the LV connectivity model, and are therefore not counted for LV incidents, although these are distributed on the HV model, and thereby included for HV incidents.

UU's connectivity models have not changed fundamentally since the 2002 IIP audit visit, although the use of the LV connectivity model is now fully implemented. LV model accuracy has improved due to further data cleansing and improved operator skills, whilst HV model accuracy has remained constant. The visiting auditors found UU's procedure for determining the accuracy of its connectivity model to be robust and support the company's estimated figures of 99.5% for the accuracy of its HV connectivity model and 98.45 for the accuracy of its LV connectivity model.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which UU has interpreted the definition and guidance contained in the RIGs.

At the 2002 IIP audit, the visiting auditors reported a contentious issue concerning interpretation of the RIGs when customers agreed to delays in restoration of supplies, or indeed refused permission for access required to affect restoration. UU's practice in such situations was to "stop the clock" for the agreed or enforced period of inactivity, thereby reducing reported CMLs. The recommendation from the 2002 audit was that this practice should cease pending clarification by Ofgem. UU did temporarily cease the practice, but then reverted to it when Ofgem failed to clarify the rule.

A further issue of RIGs interpretation is the rounding of Telecontrol issued times. UU's interpretation is that such times should be rounded up or down to the nearest whole minute, although the rule is not explicit within RIGs. This could be a significant issue for example, for HV, EHV and 132kV incidents when incident times of around 3 minutes could be classified as either interruptions or short interruptions, depending on the use of rounding.

UU interpretation of a re-interruption is:

A re-interruption is defined as the loss of supply of electricity to one or more customers for a period of 3 minutes or longer, where those same customers have experienced an interruption during previous restoration stages of the same incident.

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the mechanism used to populate the IIP template, which continues to rely on an automated data extract from PC-NaFIRs. Ofgem changed the format of the template for the 2002/03 reporting year and introduced additional templates (relating to disaggregated data). This required a change in the data extraction routines to provide the data in the new format although no change in the calculations of customer minutes lost or customer interruptions was made.

A full reconciliation of the data in the IIP template with UU's PC-NaFIRs database was completed during the 2002 IIP audit visit, when no errors were identified. UU confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. UU's estimate of its accuracy of reporting is 100% and is unchanged from last year.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to UU, the visiting auditors can support UU's estimate of the accuracy of its measurement systems. The visiting auditors recommend that Ofgem clarify the rules regarding "clock stopping" and telecontrol time rounding in order to ensure fairness and consistency across DNOs. Setting these 2 issues aside, the visiting auditors are satisfied that UU has correctly interpreted the RIG definitions (with the exception of those regarding SIs which is covered later) and that the company continues to operate in accordance with them.

UU has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an automated data extraction from PC-NaFIRs, which both UU and the visiting auditors consider to be robust.

O.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

O.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, UU had prepared a folder of information containing the PC-NaFIRs report, the incident log recording the actions taken by the operator and field operative, and the switching log recording the switching actions performed on the network. In most cases this information was sufficient to understand the incident and track through the various restoration stages. UU provided a PC with a current copy of the network management system and the customer numbers in each restoration stage in the sample were checked against this copy of the network model. It was noted that UU's action from the 2002 audit to retain switching programmes for 2 years provided a far better audit trail and that this was therefore sufficient for the purposes of the audit.

The higher voltage restoration stages selected for the audit sample were reasonably straightforward. Two of the spare incidents were used since it was unable to reconstruct 2 of the main incidents. No documents were available for one incident. UU could not make available the official paperwork from their records therefore the audit team decided to pick up one of the spare incidents. The second proved too complex to reconstruct. UU had reviewed each of the selected stages prior to the audit visit and was able to explain each incident examined, apart from the two mentioned above.

The most frequent cause of variance between reported and system customer interruptions was due to customer growth or decrease. The company demonstrated the impracticality of tracking changes in the number of customers connected to an HV/LV substation and an HV circuit. Variances were observed in 8 of the 98 stages audited due to this cause. However most involved only one or two customers so the overall effect on the results was not significant.

Sources of reporting inaccuracy included the following:

- Not using the first customer call time (the system was enhanced during the year to automatically highlight the first call, but it was confirmed that errors occurred both before and after this was introduced).
- Stopping the clock at the agreement of the affected customer (1 incident).
- Transcription error to the Preliminary Fault Report.
- Re-interruption not recognised (reported as a new interruption).
- Used original interruption time rather than stage time.
- Using incorrect time from the telecontrol events printer (transcription error).
- Used neutral current alarm time, rather than 1st customer call (company could not reasonably be expected to ascertain customer interruption from this alarm).

In addition, the visiting auditors were concerned about the likely accuracy of some operational times reported from the field, particularly for connection of generators and application of LV backfeeds, since many of these were found to be expressed as whole hours. Since it was impossible to challenge these reported times, they were accepted for the purposes of the audit.

The audit of planned interruptions raised a number of issues. Because of the nature of the HV connectivity model, planned customer numbers come from LV FIGS, which will not correspond to the HV CRMS count at the substation level. i.e. they are accurate for planned jobs, but can't be audited from the HV connectivity model. It was not possible to check system numbers from FIGS during the audit, since the planning network diagrams were not available, and so the reported number of interruption cards issued was instead used. A source of inaccuracy found for reported planned HV incidents was planned customer numbers used rather than actual number reported from the field

O.4.2 Incidents at LV

For each incident at LV, UU provided the PC-NaFIRs report, the log of calls received and the incident log. For each of the sample incidents, the extent of the affected network had been replicated onto the FIGS system prior to the audit visit. It was therefore a fairly straightforward process to agree the sequence of events relating to the incident and to agree the extent of network affected and its associated customer numbers. Since the 2002 IIP audit visit the use of FIGS has been fully implemented as the procedure for counting customers affected. Effort has been placed on recording accurate and useful information in the incident log and the PC-NaFIRs report and the improvement was apparent during the 2003 IIP audit visit. Apart from assisting UU improve the accuracy of reporting at LV, the quality of information recorded made auditing much simpler and only a small number of incidents were difficult to interpret from the information provided. Two incidents were too difficult to replicate during the audit, due to insufficient or missing details, and were not audited.

UU did not provide evidence for customers connected or disconnected between the time of the incident and the 2003 IIP audit visit. In most cases it was impossible to ascertain to what extent customer number variances were due to changes in customer populations since the incident, as opposed to sources of inaccuracy, and so these population changes were therefore excluded as a reason for variance in the audit. UU pointed out that RIGs do not require DNOs to provide this information.

Since the 2002 audit, a system enhancement to CIFMS ensures that the earliest customer call time is highlighted from the list of entered calls. This was established part way through the 2003 audit year, and was devised to remove a source of inaccuracy found during the 2002 audit.

Sources of inaccuracy found included the following:

- First customer call time not used (incident was prior to the system enhancement).
- Interpretation of the extent of the affected network.
- FIGS not used to obtain customer count (this was contrary to company written policy).
- Incorrect interpretation of customers affected by restoration stages.
- Customer installation fault wrongly included in IIP report.
- Counted as 3 phase rather than single phase fault.
- Clock stopped due to no access to affect repairs.
- Customer numbers incorrectly rounded when divided by 3 for single phase fault.
- Transcription error of customer numbers.
- Wrongly positioned MPANs.
- New MPANs not placed at time of incident.

In addition, the visiting auditors were concerned about the likely accuracy of some operational times reported from the field, particularly for connection of generators and application of LV backfeeds, since many of these were found to be rounded to whole hours. Since it was impossible to challenge these reported times, and field times are accepted under IIP rules as accurate, they were accepted for the purposes of the audit.

O.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

In the case of UU the fact that it operates 2 distinct connectivity models mean that the values obtained from the audit were for low voltage and for higher voltages. The overall accuracy calculation was obtained by a combination the LV and higher voltage accuracies weighted by the total numbers of CI for LV incidents and by the total numbers of CI for higher voltage incidents.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table O-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
41-330	32-64	32 2079	21 3163
			32 2079

The final Stage 3 reporting accuracy results are therefore:

Table O-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.7%
Stage 3	Overall sample – CML	99.6%
Stage 3	LV-only sample – CI	97.1%
Stage 3	LV-only sample – CML	97.7%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table O-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.7%	0.3%
		CML	99.6%	0.4%
	LV	CI	97.1%	2.9%
		CML	97.7%	2.3%
Stage 1		LV	98.5%	1.6%
		Overall		0.5%
		HV	99.5%	0.5%
LV Fraction				0.0%
Combined Accuracy	Overall	CI	99.4%	0.6%
		CML	99.4%	0.6%
	LV	CI	96.7%	3.3%
		CML	97.2%	2.8%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table O-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.4%	99.4%	96.7%	97.2%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

O.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

O.5.1 Methodology

All SIs at 33 and 132kV, where higher voltage auto-reclosers are tele-controlled, automatically generate an alarm and are manually recorded in PC NaFIRS together with customer numbers affected. SIs at 11/6.6kV are automatically recorded by the Short Interruptions to Supply (SIS) algorithm within the CRMS. A functional design specification for the SIS application was provided.

LV reclosing devices (REZAPS) are used on approximately 10% of LV transient faults. When a REZAP is installed a Log Sheet is completed to record the number of operations/resets, and the circuit noted. When the REZAP is removed, the log sheet is retained. A sample of log sheets was taken in order to determine the average number of operations and the average number of customers affected per REZAP installation, and these averages were extrapolated to represent the total estimated occasions when REZAPS were used, and to complete the IIP report.

In the case of multi-shot and non telemetry reclosing schemes on the 6.6 and 11kV networks, at least 2 Power Outage Detectors (PODS) are installed downstream of each device, and UU relies on these as its source of detection and IIP reporting, via the SIS algorithms. There are no manual readings of non-telemetry reclosers. .

O.5.2 DNO's Estimate of Accuracy

UU estimates an overall level of accuracy of 95.56% for its reporting of short interruptions.

At 132/33 kV all SIs are recorded on telecontrol events printers and accuracy is estimated at 100%. SIs on these systems accounted for 10.31% of the total.

On the 11/6.6 kV systems UU estimate that at any point in time PODS are installed downstream of 96.25% of all non-telemetry auto reclosers, due to the time lag behind recloser installation. (Approximately 15 new auto-reclosers are installed monthly as part of the Electricity Network Improvement Project). SIs on these systems accounted for 88.22% of the 2002/3 total.

Based on the extrapolation, LV SIs accounted for 1.47% of the 2002/3 total.

Based on the above calculations, overall SI reporting accuracy is estimated as:

1 x 0.1031 (33 and 132 kV) + 0.9625 x 0.8822 (11/6.6 kV) + 1 x 0.0147 (LV) = 96.69%

However, UU has only 50 % confidence in the accuracy of its LV estimate, based on the level of confidence that the sample of log sheets extrapolated were truly representative of the total.

UU does not intend to introduce any changes that will affect the accuracy of SI reporting.

O.5.3 Auditors' Conclusions

The processes for recording SIs at HV and above are robust, although the processes for correctly recognising and recording by cause should be examined and strengthened. The process for accurately reporting SIs at LV does not appear sufficiently robust, since it is based on extrapolation from a sample of returned LV Rezap logs. UU need to investigate the overall accuracy of this sample. Taking into account UU's own low level of confidence in its estimate of accuracy for LV SIs (50%) we agree with the methodology used to estimate accuracy levels for SI reporting.

O.6 Overall Impressions

UU has a strong focus on accurate reporting of incidents. In general it has established robust systems and procedures to accurately record and report to IIP requirements. The recommendations following the 2002 IIP audit have all been addressed, although in some areas clarification is still required by Ofgem. There was a noticeable improvement in the quality of LV incident reporting, due to the full implementation of the LV connectivity model. Inaccuracies were generally due to one-off errors rather than to systematic problems, and it was evident that UU managers are very committed to ongoing training in order to rectify this source of inaccuracy. .

UU was very open and helpful during the audit visit and provided a good audit trail of information for the selected restoration stages. Prior to the arrival of the visiting auditors, UU had self-audited the selected restoration stages to ensure that the incidents involved were well understood and the supporting information was readily available.

O.7 Conclusions

Table O-6 presents the results of the 2003 audit of the United Utilities licence area in-line with the auditing framework.

Table O-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100 %
Stage 1	LV Connectivity Model	98.45 %
Stage 1	HV Connectivity Model	99.5 %
Stage 3	Overall sample – CI	99.7%
Stage 3	Overall sample – CML	99.6%
Stage 3	LV-only sample – CI	97.1%
Stage 3	LV-only sample– CML	97.7%
	Short Interruptions	96.69 %

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table O-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.4%	99.4%	96.7%	97.2%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

O.8 Recommendations

UU's attention to ongoing improvements to all aspects of IIP reporting since the 2002 IIP audit visit has resulted in more accurate reporting for the 2002/03 reporting year. However, whilst systems and procedures are now generally robust, continuing attention needs to be given to sources of human error in order to maintain required levels of reporting accuracy. In addition some procedural aspects require investigation and improvement. Recommendations for further improvement are as follows:

- Ofgem should clarify the rules regarding the practice of "clock stopping".
- Ofgem should clarify the rules concerning how telecontrol event times should be rounded.
- Investigate the procedure for measuring LV SIs, with the objective of establishing more accurate recording and reporting processes.
- Continue to communicate to staff the importance of the accuracy of incident times reported for field operations, particularly on manual disconnection at LV and restoration by alternative sources.
- Continue to monitor and improve the performance of FIGS operators, particularly with respect to accurately establishing the extent of networks affected by incidents (it is suggested that known addresses are routinely used to check affected circuits).
- Ensure that non-reportable incidents are correctly coded, and thereby excluded.
- Due to the nature of the HV connectivity model, UU should provide a better audit trail for planned HV incidents i.e. enable the audit to verify planned numbers from the LV connectivity model.

O.9 Learning Points

The following items were identified as learning points for the audit framework:

- The audit of incidents was very much facilitated by UU's preparatory work, allowing the visiting auditors sufficient time to verify the company's "replay" of the incidents, as well as the information pre-provided on the questionnaires.
- No spare LV incidents were provided for audit. Although this did not present a big problem, since only a small number of incidents could not be audited, there appears to be no reason why the same approach to spare incidents as that at HV should not be taken.
- A more robust and consistent method is needed for agreeing changes in customer population between incident and audit. If documentary evidence of known, newly connected customers is required then this should be made clear to the DNO prior to the audit.

Appendix P Western Power Distribution (WPD) – South Wales

P.1 Summary

Western Power Distribution's South Wales licence area was audited during the week beginning 7 July 2003 at the Church Village control centre near Cardiff.

WPD's measurement systems have changed little since the 2002 IIP audit visit, when the visiting auditors found WPD's systems and procedures to be both robust and accurate. WPD's continuing efforts have reduced the number of customers not assigned to LV feeders in the connectivity model and, at the time of the 2003 IIP audit visit, both the MPAN count and connectivity model were assessed to be highly accurate. The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 99.98%.
- Connectivity model (HV/LV substation level) 99.60%.
- Connectivity model (LV feeder level) 99.55%.

WPD's reporting of incidents was found to be highly accurate for the 2002/03 reporting year, based largely on improved quality of information recorded in the incident logs for LV faults. Some manual transcription errors persist and faults affecting only part of an LV feeder are still a potential source of inaccuracy. Four LV incidents in the audit sample were discovered to have either missing or surplus restoration stages. Use of incident completion time rather than restoration time was found to be a source of inaccuracy in the reporting of CML at the LV level. At the higher voltage level, minor typographical errors were the only real source of inaccuracy highlighted by the audit. In general terms, WPD's reporting was found to be highly accurate.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table P-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	99.3%	97.5%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

Currently, WPD does not have a robust procedure for capturing all auto-reclose operations in South Wales and therefore does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto-reclosers, the DNO considers that the level of accuracy of reporting is the same as for interruptions. The number of short interruptions due to manually-read auto-reclosers is not known, therefore it is not possible to estimate the affect of these on the overall level of accuracy of reporting short interruptions.

P.2 Introduction

Western Power Distribution's South Wales licence area was audited during the week beginning 7 July 2003 at the Church Village control centre near Cardiff. Geoff Stott of British Power International and Blair Walter of Mott MacDonald undertook the audit. Western Power Distribution provided appropriate staff and facilities to assist in the work throughout the audit visit. James Hope of Ofgem attended the audit for the first two days to witness the audit process undertaken by the joint team.

This report presents the findings of the WPD South Wales audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

P.3 Stage 1: Measurement Systems and Template

P.3.1 Summary of Measurement Systems

WPD holds two separate electricity distribution licences, those for WPD South West and WPD South Wales. Information reporting under the IIP falls within the responsibility of the Business Support Division, which obtains the requisite information from across the Network Services Division.

The Network Services Division, which manages the day to day operation of the two distribution systems, is organised on a regional basis. It also manages the two HV Control Centres that carry out real-time management of the HV, EHV and 132kV networks, the Cardiff control centre being responsible for the WPD South Wales networks and the Exeter control centre being responsible for the WPD South West networks.

WPD uses the GE Harris Energy Network Management and Control System (ENMAC) computer system for recording trouble calls, planned shutdowns, incident management and network operation. ENMAC is also WPD's 132kV, EHV, HV and LV connectivity model.

WPD has employed the MM Group as its Call Centre provider for both the South West and South Wales licence areas since 1 April 2001, however all of the call centre activities are currently being moved in-house and MM Group's contract has been terminated and will expire on 1 October 2003. The call centre(s) are equipped with the 'front-end' trouble- call module of WPD's ENMAC computer system. WPD publishes two freephone contact numbers per licensed area. One number is for emergency and no-supply calls and the other is for general enquiries. Staff at the call centre enter the details of incidents received via these numbers into the ENMAC front-end, thus date-stamping all no-supply and emergency calls received at the call centre. The front-end allows call-takers to access the latest information on the progress of an incident, thus enabling them to update callers as necessary**.**

Within WPD, dispatchers are responsible for interrogating ENMAC and for ensuring that calls are converted into incidents that are then dealt with promptly. During normal office hours dispatchers at the local offices have this responsibility. Out of hours this responsibility is passed to the staff at the HV control centres.

In common with several DNOs, WPD uses the Langhorne Computers software package, PC-NaFIRs, to record information on incidents. Langhome Computers also wrote the software program that extracts the information from the incident information held in a DNO's PC-NaFIRS database to automatically populate Ofgem's template and WPD relies on this package. At the time that the PC-NaFIRS template was installed, WPD carried-out tests to verify the correct operation of the software program. By inputting known incident data into PC-NaFIRS, WPD was able to verify that the output from the template agreed with its manually computed figures for CI, CML, and re-interruptions, broken down by voltage. WPD confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. The populating of the IIP template was verified during the 2002 IIP audit visit to WPD.

P.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that proposed in WPD's letter to Ofgem dated 12 June 2001, as subsequently approved by Ofgem.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, WPD's estimate of accuracy of customer count by primary trading MPAN was 100%. This was based on the results of three separate annual audits of the national MPRS system and the company's MPRS database. Confidence in the audit results was very high and no tolerance was provided for the results as it was a qualitative rather than a calculated figure. The visiting auditors found no reason to disagree with WPD's estimate.

During the 2003 IIP audit visit, WPD has stated that its estimated accuracy of customer count by primary trading MPAN is 99.98% for the South Wales licensed area. This estimate is based on the results of automatic weekly control reports, run on each Sunday night of the year, that compare the number of primary trading MPANs in MPRS with the number in ENMAC. The estimated accuracy is the difference between the average count of MPANs in ENMAC over the year and the average count of MPANs in MPRS over the year, converted to a percentage of the average number of MPANs in MPRS. In this particular case, ENMAC contains more MPANs than MPRS. This situation has arisen where customers have been disconnected in MPRS but not in ENMAC.

The removal of multiple MPANs from the WPD database was verified during the 2003 IIP audit visit. To audit the estimated accuracy of MPAN count, the visiting auditors viewed the weekly control reports from which the weekly totals were taken and verified the calculation of the annual averages. A small number of manual transcription errors were found and these have been corrected in the results included in this report.

No major changes to WPD's procedures are planned for the future. The company intends to maintain the ongoing attention to accuracy in data transfer for new customers.

Auditor's Conclusions

WPD's procedures for counting primary trading MPANs are highly accurate. Due to the dynamic nature of the network it is likely that there will always be a small difference between the number of MPANs included in WPD's measurement systems and the number registered in MPRS. These differences are considered by the visiting auditors to be 'noise' on the system and not a significant source of inaccuracy.

WPD's methodology for counting MPANs has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of MPAN count provided last year was representative of the procedure employed and not the detailed calculation. However, for the 2003 IIP audit, the visiting auditors verified the source data used and also replicated the calculation.

The visiting auditors found WPD's procedure for counting MPANs to be robust and they support the company's estimated accuracy of 99.98%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The structure and operation of the company's connectivity model has not changed since the 2002 IIP audit visit. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit. WPD has harmonised the circuit referencing of HV feeders between WPD South Wales and WPD South West to enable the company to report CI and CML by HV feeder in accordance with Ofgem's request. This exercise has confirmed the integrity of WPD's HV connectivity model.

DNO's Estimate of Accuracy

WPD's current estimate of accuracy of its connectivity model for South Wales is as follows (last year's results in brackets):

- HV/LV Substation 99.60% (99.62%)
- LV Feeder 99.55% (98.5%)

Similarly to the procedure for MPAN reconciliation, an automatic weekly control report identifies the number of customers that are allocated to invalid HV/LV substations and invalid LV feeders. The annual averages of these weekly numbers are used to estimate the connectivity model accuracy results, stated as the percentage of customers that are assigned to the correct HV/LV substation and the percentage of customers that are assigned to the correct LV feeder. A summary of these reports is provided to the regional distribution managers on a weekly basis and their performance in reallocating these customers to correct substations and feeders is monitored.

No confidence limits were specified by the company for these accuracy estimates as they are based on actual customer numbers. In the case of the HV/LV substation estimate, the inaccuracy represents the number of customers in the connectivity model whose actual HV/LV substation is not known, currently 4244 MPANs. These customers are assigned to the correct HV feeder and are identified in faults affecting entire HV feeders, but are assigned to dummy HV/LV substations. Similarly, the inaccuracy at LV feeder level represents customers who are assigned to the correct HV/LV substation but whose actual LV feeder is not known, currently 4756 MPANs. These customers are assigned to a dummy LV feeder identified as feeder 0000 or feeder 9999.

In addition to the unknown substations and LV feeders discussed above, WPD is aware that a small number of customers are assigned to incorrect LV feeders within the connectivity model. However, it is only possible to identify and re-reference these customers when they phone WPD following a supply interruption on a different LV feeder. The impact on the accuracy of WPD's measurement systems due to these incorrectly referenced customers is considered low as they are only a potential source of inaccuracy on incidents affecting individual LV feeders. WPD re-references these customers when they are identified as a means of continually improving the accuracy of its connectivity model.

At the time of the 2002 IIP audit visit, 98.5% of customers were allocated to feeders. Work was subsequently carried out by WPD's teams to allocate the 1.5% of customers (approximately 15000 MPANs) in the "electronic bucket" to LV feeders and this is now largely complete, resulting in the improvement in LV feeder accuracy shown above.

To audit the estimated accuracy of WPD's connectivity model, the visiting auditors viewed the weekly control reports from which the weekly totals were taken and verified the calculation of the annual averages. A small number of manual transcription errors were found and these have been corrected in the results included in this report.

Auditor's Conclusions

WPD's connectivity model is highly accurate. A small number of customers are assigned to dummy HV/LV substations and dummy LV feeders where insufficient information exists to correctly assign them. However these customers count for less than 0.5% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct HV/LV substations and LV feeders.

WPD's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using customer numbers generated in the automated weekly control reports. During the 2002 IIP audit visit the weekly control reports were witnessed and the methodology pronounced sound, but the raw numbers and the calculation were not subjected to rigorous audit. During the 2003 IIP audit, the visiting auditors verified the source data used and replicated the calculation.

The visiting auditors found WPD's procedure for determining the accuracy of its connectivity to be robust and support the company's estimated figures of 99.60% at HV/LV substation level and 99.55% at the LV feeder level.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which WPD has interpreted the definition and guidance contained in the RIGs.

During the 2003 IIP audit, the visiting auditors realised that there is an additional element to WPD's interpretation of re-interruption that was not previously understood. Like many companies, WPD considers an interruption to be a re-interruption if the customers affected were restored from a previous interruption within the last three hours. In addition, WPD considers the following scenario to be a re-interruption: when any number of customers initially interrupted and restored as part of an incident are interrupted again within three hours of the last customers from the initial interruption being restored, even if some of the customers re-interrupted were restored more than three hours earlier in separate restoration stages.

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the mechanism used to populate the IIP template, which continues to rely on an automated data extract from PC-NaFIRs. Ofgem changed the format of the template for the 2002/03 reporting year and introduced additional templates (relating to disaggregated data). This required a change in the data extraction routines to provide the data in the new format although no change in the calculations of customer minutes lost or customer interruptions was made.

A full reconciliation of the data in the IIP template with WPD's PC-NaFIRs database was completed during the 2002 IIP audit visit, when no errors were identified. WPD confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. WPD's estimate of its accuracy of reporting is 100% and is unchanged from last year.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to WPD South Wales, the visiting auditors can support WPD's estimate of the accuracy of its measurement systems. The visiting auditors are also satisfied that WPD has correctly interpreted the RIG definitions and that the company continues to operate in accordance with them.

WPD has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an automated data extraction from PC-NaFIRs, which both WPD and the visiting auditors consider to be robust.

P.4 Stage 3: Accuracy of Reporting

Please note that the methodology for the Stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

P.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, WPD had prepared a folder of information containing the PC-NaFIRs report, the incident log recording the actions taken by the operator and field operative, and the switching log recording the switching actions performed on the network. This information was sufficient to understand the incident and track through the various restoration stages. WPD provided a test machine with a copy of the ENMAC network management system as it was on 29 May 2003 and the customer numbers in each restoration stage in the sample were checked against this copy of the network model. The visiting auditors were able to check the process used to extract the data for the test machine, and to verify the date shown on the associated data tape. Whilst the actual extraction of the data was not witnessed and no automatic time stamping exists, the visiting auditors were able to verify that the test machine's network model was accurate by cutting across to the 'live' ENMAC data base from the same terminal. This is discussed further in section P.9 on learning points. It was noted that WPD's efforts to improve the accuracy of reporting had resulted in improved descriptive notes for restoration stages. In general, the audit trail for incidents at the higher voltages was therefore sufficient for the purposes of the audit.

The higher voltage restoration stages selected for the audit sample were reasonably straightforward and none was too complex to resolve. The spare incidents provided were therefore not used. Whilst one particular incident took some time to understand, WPD had reviewed each of the selected stages prior to the audit visit and was able to explain each incident examined.

The most frequent cause of disagreement between the visiting auditors and WPD was due to customer growth. The company demonstrated the impracticality of tracking changes in the number of customers connected to an HV/LV substation and an HV circuit. In the case of permanently disconnected customers it is currently impossible to track changes. Variances were observed in 32 of the 80 stages audited due to this cause. However most involved only one or two customers so the overall effect on the results was not significant. The most significant reporting inaccuracies discovered in both CI and CML were due to typing errors in the PC-NaFIRs reports, but even these were not particularly large and the accuracy of WPD's reporting at the higher voltages was seen to be very high.

P.4.2 Incidents at LV

For each incident at LV, WPD provided the PC-NaFIRs report, the log of calls received, the incident log and a printout of the customer numbers on the affected feeder. Since the 2002 IIP audit visit, much effort has been placed on recording accurate and useful information in the incident log and the PC-NaFIRs report and the improvement was apparent during the 2003 IIP audit visit. Apart from assisting WPD improve the accuracy of reporting at LV, the quality of information recorded made auditing much simpler and only a small number of incidents were difficult to interpret from the information provided. A record of all new customers and re-referenced customers on the transformers included in the audit sample had been prepared from an enquiry on WPD's asset management system and this was accepted by the visiting auditors as evidence of customer growth. WPD does not track customers who are permanently disconnected and was thus not able to produce similar evidence for customers disconnected between the time of the incident and the 2003 IIP audit visit. These were therefore included as inaccuracies in the company reports. The printouts of customer numbers on affected transformers and LV feeders were checked against the live system and found to be accurate so the visiting auditors were satisfied with the audit trail provided.

Four restoration stages in the sample were not entirely clear from the information provided and one of these could not be fully audited due to a lack of information on the time of restoration. Apart from these four stages, the only areas of disagreement between the visiting auditors and WPD were stages with less customers now than at the time of the incident due to disconnections. Due to the reasons stated above, these changes in customer numbers cannot currently be proved by WPD.

Three incidents were found to have missing restoration stages and the entire incidents were included in the audit on these occasions. One incident was reported as two restoration stages when it should have been only one. Incorrect determination of customers from the connectivity model when recording incidents led to the greatest variations in CI. A small number of errors in time recording were observed, however most of the variation in CML arose from errors in the CI count.

P.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table P-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
56000082	58500851	51500452	51500452
56000164			

The final Stage 3 reporting accuracy results are therefore:

Table P-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.4%
Stage 3	Overall sample – CML	97.7%
Stage 3	LV-only sample – CI	99.5%
Stage 3	LV-only sample – CML	97.5%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table P-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.4%	0.6%
		CML	97.7%	2.3%
	LV	CI	99.5%	0.5%
		CML	97.5%	2.5%
Stage 1		LV	99.6%	0.4%
		Overall		0.4%
		HV	99.6%	0.4%
LV Fraction				22.0%
Combined Accuracy	Overall	CI	99.3%	0.7%
		CML	97.7%	2.3%
	LV	CI	99.3%	0.7%
		CML	97.5%	2.5%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table P-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	99.3%	97.5%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

P.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

P.5.1 Methodology

SIs due to cause 1 (auto operation/auto restoration), where higher voltage auto-reclosers are tele-controlled, automatically generate an alarm and are automatically captured and recorded within the WPD South Wales ENMAC system. A report, detailing these auto-reclose operations, is automatically produced by the ENMAC system. This report is then used to manually populate the SI scheme within PC-NaFIRS.

SIs due to causes 2 and 3 (auto operation/manual or remote restoration and manual or remote operation and restoration) are manually entered in either Fault Logs, or Trouble Call Logs or both, and are therefore subject to the same audit controls as the longer interruptions. These logs are all manually examined and the SI information is manually input into the SI scheme within PC-NaFIRS. Short interruptions due to cause 4 (NGC and others) could go by either route.

Historically LV re-closers have not been used in WPD South Wales but several units are now being trialled.

Short interruptions where multi-shot reclosing schemes are used are recorded in the WPD South Wales operational units and the auto-reclosers changed after 100 operations. However, there is currently no robust procedure for entering short interruptions due to manually read auto-recloser operations into the IIP reporting template within WPD South Wales. As a result, the recording of short-interruptions is not currently RIG compliant. WPD undertook an internal assessment of short interruptions in May 2003 and it was concluded that the control room aspects of the process are robust but the manual counting procedures for auto-reclosers need to be improved. The auditors cannot therefore be confident that the IIP template has been completed accurately.

P.5.2 DNO's Estimate of Accuracy

As there is no robust procedure for capturing all auto-recloser operations in South Wales, the DNO does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto-reclosers, the DNO considers that the level of accuracy of reporting is the same as for interruptions. The number of short interruptions due to manually-read auto-reclosers is not known, therefore it is not possible to estimate the affect of these on the overall level of accuracy of reporting SIs.

P.5.3 Auditor's Conclusions

We agree with the DNO's belief that the level of accuracy of reporting those short interruptions measured via tele-control at the WPD South Wales control room is equivalent to the accuracy of reporting of interruptions. We cannot comment on the overall level of accuracy as this has not been estimated by the DNO due to the lack of a robust procedure for the manual counting of auto-reclose operations and its affect upon the count of short interruptions.

P.6 Overall Impressions

WPD has a strong focus on accurate reporting of incidents. It has undertaken a programme of monthly audits over the past year that replicate Stage 3 of the IIP audit framework as introduced to the DNOs during the 2002 IIP audit visits. WPD's internal audits involved the incidents that contributed the top 50% of all CI and CML for the 2002/03 reporting year. A noticeable improvement in the quality of recorded information on incidents was apparent during the 2003 IIP audit visit, with the knock-on effect of improved accuracy of reporting. WPD's internal auditing programme has had the double benefit of educating operators on where mistakes are made and providing an opportunity to correct errors made in the reported CI and CML.

WPD was very open and helpful during the audit visit and provided a good audit trail of information for the selected restoration stages. Prior to the arrival of the visiting auditors, WPD had self-audited the selected restoration stages to ensure that the incidents involved were well understood and the supporting information was readily available.

P.7 Conclusions

Table P-6 presents the results of the 2003 audit of the South Wales licence area in-line with the auditing framework.

Table P-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.98%
Stage 1	LV Connectivity Model	99.55%
Stage 1	HV Connectivity Model	99.60%
Stage 3	Overall sample – CI	99.4%
Stage 3	Overall sample – CML	97.7%
Stage 3	LV-only sample – CI	99.5%
Stage 3	LV-only sample– CML	97.5%
	Short Interruptions	Not estimated by DNO

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table P-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.3%	97.7%	99.3%	97.5%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

P.8 Recommendations

WPD's attention to recording high quality information in incident logs and PC-NaFIRs reports since the 2002 IIP audit visit has resulted in highly accurate reporting for the 2002/03 reporting year. However, a continued effort is required to maintain the quality of information. Certain regional offices have been identified by WPD as requiring more attention than others and these offices should be focused on to ensure consistent reporting across the license area. Examples of areas for further improvement include the following:

- Determination of customer numbers on part-feeder incidents at the LV level.
- Inclusion of all restoration stages on LV incidents.
- Use of restoration time rather than incident completion time in LV incidents.
- Manual transcription errors in both LV and higher voltage incidents.

By querying its asset management system, WPD was able to provide sufficient documentation to explain differences between reported customer numbers and the connectivity model numbers at the time of the audit due to customer growth and re-referencing at the LV level. However, disconnected customers cannot currently be identified and proved. Under the IIP audit framework these differences must be counted as inaccuracy. Developing a procedure for recording disconnected customers would improve the ability of the auditors to verify differences observed during the audit.

P.9 Learning Points

The following items were identified as learning points for the audit framework:

- The audit of incidents at the higher voltages was based on a copy of the network taken on 29 May 2003. Whilst the date on the associated tape could be verified, the visiting auditors had no way of verifying this as the actual date of the data extraction as no automatic time stamping exists. This is important as the audit framework includes unproven customer number changes and changes to the distribution network as inaccuracy and therefore audits undertaken on the live system or recent data extractions will potentially include more such changes than audits undertaken on data extractions from the end of the reporting year. For consistency across audits, it is suggested that each company should capture its network as it is on the last day of each reporting year, i.e. 31 March and use this information for the audit.
- WPD was able to provide documentation supporting all new and re-referenced customers at the LV level where the connectivity model at the time of the audit differed from that at the time of the incident. No such records were available at the HV level but WPD believes that by implication, if it can prove new and re-referenced customers at LV, then the HV model must be accurate as it is built up from HV/LV substations and reconciled against the LV connectivity model. WPD therefore believes that it was unfair to include unproven customer growth and re-referencing at HV as inaccuracy in the audit results.
- WPD feels very strongly that it is unfair to include as inaccuracy differences in customer numbers between the time of the incident and the time of the audit due to changes in the distribution network.
- WPD feels that the audit procedure of including re-referenced customers as inaccuracy when evidence could not be provided unfairly penalises it for trying to improve the accuracy of its connectivity model.
- The visiting auditors realised during the audit that there is an additional element to WPD's interpretation of re-interruption that was not previously understood. Like many companies, WPD considers an interruption to be a re-interruption if the customers affected were restored from a previous interruption within the last three hours. In addition, WPD considers the following scenario to be a re-interruption: when any number of customers initially interrupted and restored as part of an incident are interrupted again within three hours of the last customers from the initial interruption being restored, even if some of the customers re-interrupted were restored more than three hours earlier in separate restoration stages.

Appendix Q Western Power Distribution (WPD) – South West

Q.1 Summary

Western Power Distribution's South West licence area was audited during the week beginning 14 July 2003 at the Exeter control centre.

WPD's measurement systems have changed little since the 2002 IIP audit visit, when the visiting auditors found WPD's systems and procedures to be both robust and accurate. WPD's continuing efforts have reduced the number of customers not assigned to LV feeders in the connectivity model and, at the time of the 2003 IIP audit visit, both the MPAN count and connectivity model were assessed to be highly accurate. The numerical estimates for accuracy of measurement systems as confirmed by the visiting auditors are as follows:

- Accuracy of MPAN count: 99.88%.
- Connectivity model (HV/LV substation level) 99.92%.
- Connectivity model (LV feeder level) 99.14%.

WPD's reporting of incidents was found to be highly accurate for the 2002/03 reporting year. The quality of information recorded in the incident logs for LV faults has improved since the 2002 IIP audit visit, however further room for improvement exists. Reporting of CI at the higher voltage levels was found to be highly accurate. Eight inaccuracies were discovered in the reporting of CML at higher voltages due to incorrect incident start or restoration times, five of which related to reporting of pre-arranged interruptions. The main source of error in reporting of both CI and CML for LV incidents was found to be missing or additional restoration stages and incorrect interpretation of the connectivity model when determining customer numbers. In general terms, WPD's reporting was found to be highly accurate.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table Q-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.6%	99.4%	97.5%	98.4%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

Currently, WPD does not have a robust procedure for reporting short interruptions in South West and therefore does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto-reclosers, the DNO considers that the level of accuracy of reporting is the same as for interruptions. The number of short interruptions due to manually-read auto-reclosers is not known, therefore it is not possible to estimate the affect of these on the overall level of accuracy of reporting short interruptions.

Q.2 Introduction

Western Power Distribution's South West licence area was audited during the week beginning 14 July 2003 at the Exeter control centre. Geoff Stott of British Power International and Blair Walter of Mott MacDonald undertook the audit. Western Power Distribution provided appropriate staff and facilities to assist in the work throughout the audit visit.

This report presents the findings of the WPD South West audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

Q.3 Stage 1: Measurement Systems and Template

Q.3.1 Summary of Measurement Systems

WPD holds two separate electricity distribution licences, those for WPD South West and WPD South Wales. Information reporting under the IIP falls within the responsibility of the Business Support Division, which obtains the requisite information from across the Network Services Division.

The Network Services Division, which manages the day to day operation of the two distribution systems, is organised on a regional basis. It also manages the two HV Control Centres that carry out real-time management of the HV, EHV and 132kV networks, the Cardiff control centre being responsible for the WPD South Wales networks and the Exeter control centre being responsible for the WPD South West networks.

WPD uses the GE Harris Energy Network Management and Control System (ENMAC) computer system for recording trouble calls, planned shutdowns, incident management and network operation. ENMAC is also WPD's 132kV, EHV, HV and LV connectivity model.

WPD has employed the MM Group as its Call Centre provider for both the South West and South Wales licence areas since 1 April 2001, however all of the call centre activities are currently being moved in-house and MM Group's contract has been terminated and will expire on 1 October 2003. The call centre(s) are equipped with the 'front-end' trouble- call module of WPD's ENMAC computer system. WPD publishes two freephone contact numbers per licensed area. One number is for emergency and no-supply calls and the other is for general enquiries. Staff at the call centre enter the details of incidents received via these numbers into the ENMAC front-end, thus date-stamping all no-supply and emergency calls received at the call centre. The front-end allows call-takers to access the latest information on the progress of an incident, thus enabling them to update callers as necessary**.**

Within WPD, dispatchers are responsible for interrogating ENMAC and for ensuring that calls are converted into incidents that are then dealt with promptly. During normal office hours dispatchers at the local offices have this responsibility. Out of hours this responsibility is passed to the staff at the HV control centres.

In common with several DNOs, WPD uses the Langhorne Computers software package, PC-NaFIRs, to record information on incidents. Langhorne Computers also wrote the software program that extracts the information from the incident information held in a DNO's PC-NaFIRS database to automatically populate Ofgem's template and WPD relies on this package. At the time that the PC-NaFIRS template was installed, WPD carried-out tests to verify the correct operation of the software program. By inputting known incident data into PC-NaFIRS, WPD was able to verify that the output from the template agreed with its manually computed figures for CI, CML, and re-interruptions, broken down by voltage. WPD confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. The populating of the IIP template was verified during the 2002 IIP audit visit to WPD.

Q.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

No changes in the way in which the company identifies customers by MPAN count have been implemented since the 2002 IIP audit visit. The methodology remains the same as that proposed in WPD's letter to Ofgem dated 12 June 2001, as subsequently approved by Ofgem.

No specific recommendations on improving MPAN count accuracy were made as a result of the 2002 IIP audit visit.

DNO's Estimate of Accuracy

At the time of the 2002 IIP audit visit, WPD's estimate of accuracy of customer count by primary trading MPAN was 100%. This was based on the results of three separate annual audits of the national MPRS system and the company's MPRS database. Confidence in the audit results was very high and no tolerance was provided for the results as it was a qualitative rather than a calculated figure. The visiting auditors found no reason to disagree with WPD's estimate.

During the 2003 IIP audit visit, WPD has stated that its estimated accuracy of customer count by primary trading MPAN is 99.88% for the South West licensed area. This estimate is based on the results of automatic weekly control reports, run on each Sunday night of the year, that compare the number of primary trading MPANs in MPRS with the number in ENMAC. The estimated accuracy is the difference between the average count of MPANs in ENMAC over the year and the average count of MPANs in MPRS over the year, converted to a percentage of the average number of MPANs in MPRS. In this particular case, ENMAC contains more MPANs than MPRS. This situation has arisen where customers have been disconnected in MPRS but not in ENMAC.

The removal of multiple MPANs from the WPD database was verified during the 2003 IIP audit visit. To audit the estimated accuracy of MPAN count, the visiting auditors viewed the weekly control reports from which the weekly totals were taken and verified the calculation of the annual averages. A small number of manual transcription errors were found and these have been corrected in the results included in this report.

No major changes to WPD's procedures are planned for the future. The company intends to maintain the ongoing attention to accuracy in data transfer for new customers.

Auditor's Conclusions

WPD's procedures for counting primary trading MPANs are highly accurate. Due to the dynamic nature of the network it is likely that there will always be a small difference between the number of MPANs included in WPD's measurement systems and the number registered in MPRS. These differences are considered by the visiting auditors to be 'noise' on the system and not a significant source of inaccuracy.

WPD's methodology for counting MPANs has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of MPAN count provided last year was representative of the procedure employed and not the detailed calculation. However, for the 2003 IIP audit, the visiting auditors verified the source data used and also replicated the calculation.

The visiting auditors found WPD's procedure for counting MPANs to be robust and they support the company's estimated accuracy of 99.88%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visit

The structure and operation of the company's connectivity model has not changed since the 2002 IIP audit visit. No specific recommendations on improving connectivity model accuracy were made as a result of the 2002 IIP audit visit. WPD has harmonised the circuit referencing of HV feeders between WPD South Wales and WPD South West to enable the company to report CI and CML by HV feeder in accordance with Ofgem's request. This exercise has confirmed the integrity of WPD's HV connectivity model.

DNO's Estimate of Accuracy

WPD's current estimate of accuracy of its connectivity model for South West is as follows (last year's results in brackets):

- HV/LV Substation 99.92% (99.99%)
- LV Feeder 99.14% (98.5%)

Similarly to the procedure for MPAN reconciliation, an automatic weekly control report identifies the number of customers that are allocated to invalid HV/LV substations and invalid LV feeders. The annual averages of these weekly numbers are used to estimate the connectivity model accuracy results, stated as the percentage of customers that are assigned to the correct HV/LV substation and the percentage of customers that are assigned to the correct LV feeder. A summary of these reports is provided to the regional distribution managers on a weekly basis and their performance in reallocating these customers to correct substations and feeders is monitored.

No confidence limits were specified by the company for these accuracy estimates as they are based on actual customer numbers. In the case of the HV/LV substation estimate, the inaccuracy represents the number of customers in the connectivity model whose actual HV/LV substation is not known, currently 1223 MPANs. These customers are assigned to the correct HV feeder and are identified in faults affecting entire HV feeders, but are assigned to dummy HV/LV substations. Similarly, the inaccuracy at LV feeder level represents customers who are assigned to the correct HV/LV substation but whose actual LV feeder is not known, currently 12416 MPANs. These customers are assigned to a dummy LV feeder identified as feeder 0000 or feeder 9999.

In addition to the unknown substations and LV feeders discussed above, WPD is aware that a small number of customers are assigned to incorrect LV feeders within the connectivity model. However, it is only possible to identify and re-reference these customers when they phone WPD following a supply interruption on a different LV feeder. The impact on the accuracy of WPD's measurement systems due to these incorrectly referenced customers is considered low as they are only a potential source of inaccuracy on incidents affecting individual LV feeders. WPD re-references these customers when they are identified as a means of continually improving the accuracy of its connectivity model.

At the time of the 2002 IIP audit visit, 98.5% of customers were allocated to feeders. Work was subsequently carried out by WPD's teams to allocate the 1.5% of customers (approximately 22000 MPANs) in the "electronic bucket" to LV feeders and this is now largely complete, resulting in the improvement in LV feeder accuracy shown above.

To audit the estimated accuracy of WPD's connectivity model, the visiting auditors viewed the weekly control reports from which the weekly totals were taken and verified the calculation of the annual averages. A small number of manual transcription errors were found and these have been corrected in the results included in this report.

Auditor's Conclusions

WPD's connectivity model is highly accurate. A small number of customers are assigned to dummy HV/LV substations and dummy LV feeders where insufficient information exists to correctly assign them. However these customers count for less than 1% of the total number of MPANs included in the connectivity model. Efforts are continuing to assign these customers to the correct HV/LV substations and LV feeders.

WPD's connectivity model has not changed fundamentally since the 2002 IIP audit visit. The estimated accuracy of the connectivity model provided last year was based on the same procedure described above using customer numbers generated in the automated weekly control reports. During the 2002 IIP audit visit the weekly control reports were witnessed and the methodology pronounced sound, but the raw numbers and the calculation were not subjected to rigorous audit. During the 2003 IIP audit, the visiting auditors verified the source data used and replicated the calculation.

The visiting auditors found WPD's procedure for determining the accuracy of its connectivity to be robust and support the company's estimated figures of 99.92% at HV/LV substation level and 99.14% at the LV feeder level.

(iii) RIG Definitions

No changes have been made since the 2002 IIP audit visit to the way in which WPD has interpreted the definition and guidance contained in the RIGs.

During the 2003 IIP audit, the visiting auditors realised that there is an additional element to WPD's interpretation of re-interruption that was not previously understood. Like many companies, WPD considers an interruption to be a re-interruption if the customers affected were restored from a previous interruption within the last three hours. In addition, WPD considers the following scenario to be a re-interruption: when any number of customers initially interrupted and restored as part of an incident are interrupted again within three hours of the last customers from the initial interruption being restored, even if some of the customers re-interrupted were restored more than three hours earlier in separate restoration stages.

(iv) IIP Template

There have been no changes since the 2002 IIP audit visit in the mechanism used to populate the IIP template, which continues to rely on an automated data extract from PC-NaFIRs. Ofgem changed the format of the template for the 2002/03 reporting year and introduced additional templates (relating to disaggregated data). This required a change in the data extraction routines to provide the data in the new format although no change in the calculations of customer minutes lost or customer interruptions was made.

A full reconciliation of the data in the IIP template with WPD's PC-NaFIRs database was completed during the 2002 IIP audit visit, when no errors were identified. WPD confirmed that this reconciliation had been carried out on the information submitted for the 2002/03 reporting year. WPD's estimate of its accuracy of reporting is 100% and is unchanged from last year.

(v) Conclusions

Based on the audit of source data and calculations undertaken during the 2003 IIP audit visit to WPD South West, the visiting auditors can support WPD's estimate of the accuracy of its measurement systems. The visiting auditors are also satisfied that WPD has correctly interpreted the RIG definitions and that the company continues to operate in accordance with them.

WPD has not changed its methodology for populating the IIP template since the 2002 IIP audit visit and continues to rely on an automated data extraction from PC-NaFIRs, which both WPD and the visiting auditors consider to be robust.

Q.4 Stage 3: Accuracy of Reporting

Please note that the methodology for the Stage 3 audit is common to all companies and therefore will be contained in the body of the main report.

Q.4.1 Incidents at the Higher Voltages

For each incident at the higher voltages, WPD had prepared a folder of information containing the PC-NaFIRs report, the incident log recording the actions taken by the operator and field operative, and the switching log recording the switching actions performed on the network. This information was sufficient to understand the incident and track through the various restoration stages. WPD provided a test machine with a copy of the ENMAC network management system as it was on 29 May 2003 and the customer numbers in each restoration stage in the sample were checked against this copy of the network model. The visiting auditors were able to check the process used to extract the data for the test machine, and to verify the date shown on the associated data tape. Whilst the actual extraction of the data was not witnessed and no automatic time stamping exists, the visiting auditors were able to verify that the test machine's network model was accurate by cutting across to the 'live' ENMAC data base from the same terminal. This is discussed further in section Q.9 on learning points. It was noted that WPD's efforts to improve the accuracy of reporting had resulted in improved descriptive notes for restoration stages. In general, the audit trail for incidents at the higher voltages was therefore sufficient for the purposes of the audit.

The higher voltage restoration stages selected for the audit sample were reasonably straightforward and none were too complex to resolve. However, due to the nomenclature and the complexity of the HV network in the South West, entire incidents were recreated in the majority of cases so that the restoration stages in the audit sample could be fully understood. This differed from the audit of WPD South Wales where most of the higher voltages incidents could be fully understood from the switching logs and incident reports without having to recreate entire incidents.

The most frequent cause of disagreement between the visiting auditors and WPD was due to customer growth. The company demonstrated the impracticality of tracking changes in the number of customers connected to an HV/LV substation and an HV circuit. In the case of permanently disconnected customers it is currently impossible to track changes. Variances were observed in 27 of the 63 higher voltage stages audited due to this cause. However most involved only one or two customers so the overall effect on the results was not significant. One restoration stage involving over 13,000 customers showed a customer number change of 85 between the time of the incident and the time of the audit and this was the single largest variance in CI identified by the audit. The second largest was a variance of 20 caused by a short interruption that was incorrectly reported as an incident. The remainder of the restoration stages audited were found to be very accurate in terms of CI.

Reporting of CML was found to be less accurate than reporting of CI but the occurrence of over-reporting and under-reporting was more balanced and the total variance was not significant in comparison to the total CML in the audit sample. A proportion of the variance in CML was caused by customer number changes in CI. However, the main source of inaccuracy in CML was found to be incorrect incident start or restoration times with errors occurring in eight of the 63 higher voltage stages audited. Five of these misreported times were in the reports associated with pre-arranged interruptions. During the audit of these interruptions it was observed that the small differences were due to inattention to detail when referring to the restoration times held in WPD's measurement systems, such as ENMAC.

Q.4.2 Incidents at LV

For each incident at LV, WPD provided the PC-NaFIRs report, the log of calls received, the incident log and a printout of the customer numbers on the affected feeder. Since the 2002 IIP audit visit, much effort has been placed on recording accurate and useful information in the incident log and the PC-NaFIRs report and the improvement was apparent during the 2003 IIP audit visit. A record of all new customers and re-referenced customers on the transformers included in the audit sample had been prepared from an enquiry on WPD's asset management system and this was accepted by the visiting auditors as evidence of customer growth. WPD does not track customers who are permanently disconnected and was thus not able to produce similar evidence for customers disconnected between the time of the incident and the 2003 IIP audit visit. These were therefore included as inaccuracies in the company reports. The printouts of customer numbers on affected transformers and LV feeders were checked against the live system and found to be accurate so the visiting auditors were satisfied with the audit trail provided.

Reporting at LV was found to be accurate with variances being generally small. However it is apparent from the audit that attention is required to reporting the correct number of restoration stages and interpreting the connectivity model. Five of the restoration stages included in the audit sample belonged to incidents with missing or additional restoration stages. Under the methodology for the audit, the entire incident was included in the audit sample where restoration stage errors were discovered and the associated balancing effect limited the variance in CI in the audit results. Determination of customer numbers affected by an incident was highlighted as a source of inaccuracy in the audit sample and efforts are required by WPD to improve interpretation of the connectivity model in reporting of CI.

A small number of errors in time recording were observed in the audit sample. However most of the variation in CML arose from errors in the CI count. The largest variance in CML was under-reporting due to two missing restoration stages in one particular incident.

Q.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and that the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table Q-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
000204	000116	4501151	9500909
		8500630	
		8500630	

The final Stage 3 reporting accuracy results are therefore:

Table Q-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	99.7%
Stage 3	Overall sample – CML	99.4%
Stage 3	LV-only sample – CI	102.4%
Stage 3	LV-only sample – CML	101.3%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This performed by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table Q-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	99.7%	0.3%
		CML	99.4%	0.6%
	LV	CI	102.4%	2.4%
		CML	101.3%	1.3%
Stage 1		LV	99.1%	0.9%
		Overall		0.2%
		HV	99.9%	0.1%
LV Fraction				15.0%
Combined Accuracy	Overall	CI	99.6%	0.4%
		CML	99.4%	0.6%
	LV	CI	97.5%	2.5%
		CML	98.4%	1.6%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table Q-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.6%	99.4%	97.5%	98.4%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

Q.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

Q.5.1 Methodology

SIs due to cause 1 (auto operation/auto restoration), where higher voltage auto-reclosers are tele-controlled, automatically generate an alarm and are automatically captured and recorded within the WPD South West XA21 monitoring system. These alarms are manually entered on a daily report by the control assistants and subsequently entered into the SI scheme within PC-NaFIRS.

SIs due to causes 2 and 3 (auto operation/manual or remote restoration and manual or remote operation and restoration) are manually entered in either Fault Logs, or Trouble Call Logs or both, and are therefore subject to the same audit controls as the longer interruptions.

SIs due to cause 4 (NGC and others) could go by either route.

The majority of auto-reclosers within WPD South West are directly tele-monitored with only 24 remaining to be converted to tele-monitoring.

In busy periods SIs due to cause 1 are ignored until the level of activity has reduced. At that time these SIs are manually recovered from the control logs before being entered into the SI scheme within NaFIRS.

Historically LV re-closers have not been used in WPD South West but several units are now being trialled.

WPD's procedures for recording and reporting all SIs are currently in their infancy, as are the associated monitoring and control regimes. Because of this, the DNO does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto-reclosers, the DNO considers that the level of accuracy of reporting is the same as for interruptions. The recording of short-interruptions is not currently RIG compliant. WPD undertook an internal assessment of short interruptions in May 2003 and it was concluded that the control room aspects of the process are robust but the manual counting procedures for auto-reclosers need to be improved. The auditors cannot therefore be confident that the IIP template has been completed accurately.

Q.5.2 DNO's Estimate of Accuracy

There is currently no robust procedure for reporting SIs in WPD South West. Therefore, the DNO does not feel it appropriate to estimate the overall accuracy of its reporting of short interruptions. However, for those short interruptions that are measured and reported due to the operation of tele-controlled auto-reclosers, the DNO considers that the level of accuracy of reporting is the same as for interruptions.

Q.5.3 Auditor's Conclusions

We agree with the DNO's belief that the level of accuracy of reporting those short interruptions measured via tele-control at the WPD South West control room is equivalent to the accuracy of reporting of interruptions. This process was demonstrated to the visiting auditors during both the 2001 interim review and the 2003 IIP audit visits.

We cannot comment on the overall level of accuracy as this has not been estimated by the DNO due to the lack of a robust procedure for reporting short interruptions due to the operation of the 24 non tele-monitored auto-reclosers.

Q.6 Overall Impressions

WPD has a strong focus on accurate reporting of incidents. It has undertaken a programme of monthly audits over the past year that replicate Stage 3 of the IIP audit framework as introduced to the DNOs during the 2002 IIP audit visits. This involved the incidents that contributed the top 50% of all CI and CML for the 2002/03 reporting year. A noticeable improvement in the quality of recorded information on incidents was apparent during the 2003 IIP audit visit, with the knock-on effect of improved accuracy of reporting.

The visiting auditors are of the opinion that WPD's continuing training and internal auditing efforts are sure to maintain the high accuracy of reporting across the company's two licensed areas into the future.

WPD was very open and helpful during the audit visit and provided a good audit trail of information for the selected restoration stages. Prior to the arrival of the visiting auditors, WPD had self-audited the selected restoration stages to ensure that the incidents involved were well understood and the supporting information was readily available.

Q.7 Conclusions

Table Q-6 presents the results of the 2003 audit of the South West licence area in-line with the auditing framework.

Table Q-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.88%
Stage 1	LV Connectivity Model	99.14%
Stage 1	HV Connectivity Model	99.92%
Stage 3	Overall sample – CI	99.7%
Stage 3	Overall sample – CML	99.4%
Stage 3	LV-only sample – CI	102.4%
Stage 3	LV-only sample– CML	101.3%
	Short Interruptions	Not estimated by DNO

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table Q-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
99.6%	99.4%	97.5%	98.4%
Stage 3 results indicate under reporting	Stage 3 results indicate under reporting	Stage 3 results indicate over reporting	Stage 3 results indicate over reporting

Q.8 Recommendations

WPD's incident reporting was found to be highly accurate during the 2003 IIP audit visit. Remaining areas for improvement include the following:

- Recording of incident start and restoration times for incidents at the higher voltage levels, particularly for pre-arranged interruptions.
- Accelerate the programme to incorporate the remaining 24 auto-reclosers to the tele-monitoring so that the process for reporting all SIs in the South West can be made robust.
- Recording of incident progress in the correct restoration stages for LV incidents.
- Interpretation of the connectivity model for the number of customers affected by LV incidents.

By querying its asset management system, WPD was able to provide sufficient documentation to explain differences between reported customer numbers and the connectivity model numbers at the time of the audit due to customer growth and re-referencing at the LV level. However, disconnected customers cannot currently be identified and proved. Under the IIP audit framework these differences must be counted as inaccuracy. Developing a procedure for recording disconnected customers would improve the ability of the auditors to verify differences observed during the audit.

Q.9 Learning Points

The following items were identified as learning points for the audit framework:

- The audit of incidents at the higher voltages was based on a copy of the network taken on 29 May 2003. Whilst the date on the associated tape could be verified, the visiting auditors had no way of verifying this as the actual date of the data extraction as no automatic time stamping exists. This is important as the audit framework includes unproven customer number changes and changes to the distribution network as inaccuracy and therefore audits undertaken on the live system or recent data extractions will potentially include more such changes than audits undertaken on data extractions from the end of the reporting year. For consistency across audits, it is suggested that each company should capture its network as it is on the last day of each reporting year, i.e. 31 March and use this information for the audit.
- WPD was able to provide documentation supporting all new and re-referenced customers at the LV level where the connectivity model at the time of the audit differed from that at the time of the incident. No such records were available at the HV level but WPD believes that by implication, if it can prove new and re-referenced customers at LV, then the HV model must be accurate as it is built up from HV/LV substations and reconciled against the LV connectivity model. WPD therefore believes that it was unfair to include unproven customer growth and re-referencing at HV as inaccuracy in the audit results.
- WPD feels very strongly that it is unfair to include as inaccuracy differences in customer numbers between the time of the incident and the time of the audit due to changes in the distribution network.
- WPD feels that the audit procedure of including re-referenced customers as inaccuracy when evidence could not be provided unfairly penalises it for trying to improve the accuracy of its connectivity model.
- The visiting auditors realised during the audit that there is an additional element to WPD's interpretation of re-interruption that was not previously understood. Like many companies, WPD considers an interruption to be a re-interruption if the customers affected were restored from a previous interruption within the last three hours. In addition, WPD considers the following scenario to be a re-interruption: when any number of customers initially interrupted and restored as part of an incident are interrupted again within three hours of the last customers from the initial interruption being restored, even if some of the customers re-interrupted were restored more than three hours earlier in separate restoration stages.

Appendix R Yorkshire Electricity Distribution Limited (YEDL)

R.1 Summary

The audit of 2002/03 IIP reporting for the YEDL Distribution Network Area was carried out at the YEDL offices in Gelderd Road, Leeds, from 26th to 28th August 2003. The Auditors were John Woodhouse of Mott MacDonald and Rob Shackleton of British Power International. James Hope of Ofgem was in attendance for the early part of the audit.

YEDL's MPAN count accuracy is up from 99.3% last year to 99.6%. Following the recommendation from last year's IIP audit the connectivity model is now used throughout YEDL to measure both HV and LV customer numbers having gone live as of 1 July 2002. Accuracy of reporting has improved as a result. YEDL estimate that the accuracy of the model has been, at least, maintained at last year's levels. Control counts from the model indicate that the current accuracy level is 97.2%, an increase of 0.7% on the estimate from last year.

It is recommended that YEDL give attention to making sure that clearer and more extensive information is recorded on NaFIRS for LV incident sheets showing fuller details of what caused the incident, the equipment involved, and where and when repairs were made. It is also recommended that the manual entry and or manipulation of data is minimised and that electronic records incorporating time and date stamped records be held as part of the audit trail.

The Auditors accept YEDL's estimate the accuracy of reporting of short interruptions to be the same as that for sustained interruptions. Any risk of additional error related to under-reporting because the exact operation of downstream reclosers is not known with precision and has not been further investigated by YEDL.

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table R-1: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.2%	97.1%	97.2%	96.2%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

R.2 Introduction

The audit of 2002/3 IIP reporting for the YEDL Distribution Network Area was carried out at the YEDL offices in Gelderd Road, Leeds, from 26th to 28th August 2003. Ofgem's Auditors were John Woodhouse from Mott MacDonald (Team Leader) and Rob Shackleton from British Power International.

The Auditors were given the fullest co-operation by YEDL, with key members of staff and dedicated office space for meetings and audit work being made available throughout the visit. James Hope from Ofgem was in attendance on 26th and 27th August.

This report presents the findings of the YEDL audit under the following structure:

- Section 3 - Stage 1: Measurement Systems and Template.
- Section 4 - Stage 3: Accuracy of Reporting.
- Section 5 - Accuracy of Measurement Systems and Reporting Process for Short interruptions.
- Section 6 - Overall Impressions.
- Section 7 – Conclusions.
- Section 8 – Recommendations.
- Section 9 - Learning Points.

R.3 Stage 1: Measurement Systems and Template

R.3.1 Summary of Measurement Systems

Incoming telephone calls from customers to report interruptions to supply are handled by the call centre at Gelderd Road, Leeds for the whole of the YEDL distribution area. Telephone operators capture the name and address of the caller in the Central Call Handling (CCH) system and the call record is automatically date and time stamped. Under high call volume conditions there is a facility to overflow customer calls to the NEDL Call Centre at the New Penshaw Offices (and vice versa) and although this has been tested it has not to date proved necessary for YEDL to use it.

Postcodes are used to link fault calls, and details of the calls received are electronically passed over to the despatch desks from which rapid response technicians are despatched in the field to provide first line investigation of incidents. The despatch centre has access to the YEDL GIS (Geographical Information System). Vehicle Tracking shows current locations of all rapid response technicians so that the optimum response strategy can be selected.

The HV control centre is located close to the call centre and despatch area and monitors all plant under SCADA control at 132kV, 66kV, 33kV and 11kV levels in 5 designated zones (North Humberside, South Humberside, Sheffield/Rotherham, Leeds, and Bradford) using the DMS (Distribution Management System). A comprehensive array of real time information is available on screen.

The connectivity model in YEDL is based round the GIS and contains full visual details of the geographical location of HV distribution systems, substations, LV feeder ways and the location of LV mains and service cables down to individual customer premises. MPAN(s) for each customer supply point are identified in the system and can be counted by initiating feeder traces between pre-selected features such as cable joints or link boxes. The GIS is maintained by YEDL's contractors, QC Data based at Castleford, who update the model with details of all engineering works carried out on the system including new connections, disconnections, and fault repairs. The system shows full details including the date of each cable joint and the name of the jointer who carried out the work.

Local office clerical staff complete NaFIRS sheets with the required statistics and records of repair work following the restoration of supplies, and QC Data carries out updates to the GIS and connectivity model from notes and sketches provided from site by the distribution engineers. Information from the NaFIRs sheet is manually transferred into the NaFIRs computer database. YEDL complete the Ofgem IIP template from data extracted from the NaFIRS database.

R.3.2 Accuracy of Measurement Systems

(i) MPAN Count

Changes since the 2002 IIP Audit Visit

The same MPRS (Meter Point Registration System) and NCAS (New Connections Administration System) are now used for both YEDL and NEDL, and the process for generating new MPANs (Meter Point Administration Numbers) for both Licensees takes place at NEDL's New Penshaw offices. This section of the Audit report is therefore common to both the YEDL and NEDL licensed areas.

New MPANS are generated for individual new connections in both YEDL and NEDL upon receipt of written notification from the connection contractors. MPANs are only issued when an Energy Retailer has been nominated and no more than 3 weeks prior to the specified connection date which keeps a close control on the MPAN count.

Exception reports are produced each month for MPANs awaiting supplier registration, meter installation and energisation. YEDL/NEDL now have a special team at the New Penshaw offices dedicated to the follow-up of missing Retailer-owned data items in MPRS and their work impacts in particular on the status of MPANs recorded as de-energised. This initiative is making significant progress in correcting errors in the Retailer-owned MPRS data although it only affects fault reporting where disconnected MPANs are removed.

For YEDL the NCAS creates a batch file of all the MPANs to be created in the following week, and this is e-mailed to QC Data (the contractors based at Castleford who maintain YEDL's Geographical Information System - GIS) for input into the YEDL GIS based connectivity model. QC Data place the addresses for newly created MPANs into the GIS and the MPANs are allocated to the address points by YEDL. Where no match to address point can be found a "phantom" MPAN is created and allocated to the relevant postcode area. Details supplied from site are used to give a geographical fix as near as possible consistent with the available information. Phantom MPANs are included in the counts for fault reporting. There are currently 13,000 MPANs that cannot be loaded into the system at all.

The System Licence Agreement (SLA) with QC Data for the completion of input of address points and the removal of disconnected MPANs is 5 working days and it is estimated that this target is achieved in over 99% of cases. In addition a monthly reconciliation of MPRS data to GIS data is carried out and this process updates the GIS where new address matches to MPAN are found, or creates and places "phantom" MPANs where any unreconciled address points are detected.

DNO's Estimate of Accuracy

Based on the figure of 13,000 MPANs where there is insufficient data to enable loading into the GIS, YEDL estimate the MPAN to address point accuracy to be 99.4%. A proportion of these could be dual MPANs. YEDL estimate that the overall accuracy of their MPAN count is 99.6%.

The small error of 0.4% is probably due to a combination of:

- inaccurate supplier information
- unrecorded disconnected MPANs
- unauthorised connections
- address errors
- a small residual of MPANs created and issued (under the previous YEDL policy – now discontinued) in blocks to property developers that have not subsequently been used.

In order to improve the efficiency of the MPAN generation process it is planned to introduce electronic data capture from the connection contractors to remove the need for double data entry in the new connections process, and to, where appropriate, introduce financial incentives into the commercial arrangements with connection contractors to further improve the quality and timeliness of data provision.

Auditor's Conclusions

The New Connections processes appear to be consistent and tightly managed for both YEDL and NEDL. During the Audit visit to NEDL (4th to 7th August 2003 – visit by the same Ofgem Auditors as YEDL) live data capture was demonstrated to the Auditors for both YEDL and NEDL related MPANs and the process appeared logically organised with the key issues well understood by staff involved. Clear and logical explanations were provided to the Auditors covering the ongoing work with Energy Retailers to clarify the status of de-energised MPANs and to identify and remove disconnected MPANs.

A clear explanation of the services provided by QC Data and the method used by YEDL to calculate MPAN accuracy was provided to the Auditors and this appeared logical and consistent.

The Auditors agree with YEDL's overall conclusion that the accuracy of MPAN count is now 99.6%.

(ii) Connectivity Model

Changes since the 2002 IIP Audit Visits

YEDL started to derive customer counts from the GIS based connectivity model in early 2002. However, prior to July 2002 this was not consistently used and a key recommendation of last year's audit report was to use the connectivity model consistently for both HV and LV customer counts. Following this recommendation the connectivity model is now used throughout YEDL to measure both HV and LV customer numbers having gone live as from 1st July 2002. Accuracy of reporting has improved as a result.

The connectivity model has been maintained continuously throughout the year with new substations, LV network changes, connections and disconnections being recorded from information from internal information, suppliers, connections contractors and from field recording contractors. Regular refreshes of MPAN changes from MPRS have also been incorporated in the model. Updates of Address Point data from the Ordnance Survey are used to update GIS address details and to confirm address locations as received from the connections contractor.

No changes to the overall methodology adopted by the connectivity model have taken place. However, YEDL plan to introduce tighter follow-up processes to ensure field engineers return relevant paperwork in the required time and this will further improve accuracy.

DNO's Estimate of Accuracy

YEDL calculates the accuracy of their LV connectivity model in a series of stages from control counts of unallocated MPANs as follows:

- Accuracy of MPAN to address point 99.4% (based on 13,000 unplaced MPANs).
- Accuracy of address point to service termination 99.2%.
- Accuracy of Service Termination to LV feeder way/substation 98.7%.
- Accuracy of mains cables to LV feeder way/substation 99.9%.
- Overall accuracy of the LV connectivity model by multiplication of the factors above - 97.2%.

From 1st July 2002 YEDL have used the GIS for counting both HV and LV customers affected by faults. The connectivity model accuracies for HV and LV are therefore the same.

YEDL Connectivity Model Estimated Accuracy

- At the LV level - 97.2%
- At the HV level - 97.2%*.

* - The auditors are satisfied with the DNO's LV accuracy assessment. However, given that the DNO's view of its HV accuracy is the same as that for LV, the auditors consider this HV estimate to be a slight under estimation regarding the accuracy level. The number provided by the company will be used for the combined accuracy calculation

The level of inaccuracy represents MPANs that should be counted as customers but have not been physically connected to the network in the model due to connectivity issues within GIS. There are also 13,000 MPANs not located within GIS because there is no known postcode or no clear address match. Whilst it is recognised that individual customer counts may be inaccurate the accuracy of the counts overall is believed to be in excess of the accuracy limits for IIP reporting.

The issues that remain surround the MPANs recorded in the system that may not be connected to the right cable.

Further incremental improvement to the connectivity model is expected moving forward as a result of continuing attention by YEDL to issues surrounding:

- MPAN cleansing.
- Disconnections.
- Address location.
- Multiple MPANs.

Auditor's Conclusions

YEDL have followed the recommendation made in last years audit report to implement the use of the connectivity model across the DNO for the counting of both HV and LV customer interruptions. The continuous audit and reconciliation processes YEDL have in place will also have made steady and continuous incremental improvements to their connectivity model throughout the audit year.

The Auditors agree with YEDL's estimate of accuracy of its connectivity model.

(iii) RIG Definitions

During the current audit year YEDL have changed their interpretation of the RIGs definition of incident start and finish times in cases where the customer requests the restoration of supply be deferred to a more convenient time. In the early part of the audit year YEDL practice was to suspend the recording of customer minutes lost for the duration of any customer requested deferment. This practice was changed during the audit year and YEDL now record the full duration of the interruption regardless of customer requested deferments, which is in accordance with the RIGs. This will have caused a slight under reporting of customer minutes lost on LV faults affecting small numbers of premises.

It was noted during the audit that further clarification of the RIGs is needed with respect to customer requested delays to restoration (see section R4.2 below).

Based upon observations from the audit of LV incidents some YEDL field staff appear to be wrongly interpreting the RIG definition with respect to re-interruptions after a temporary restoration of supply. The RIGs define re-interruptions to have taken place where customers are interrupted again to effect permanent repairs within 18 hours of the temporary restoration. In two incidents audited re-interruptions had been recorded in cases where the 18 hours had been exceeded. The reporting of customer interruptions by YEDL may therefore be slightly lower than it should be due to this effect, but the reporting of customer minutes lost will be correct. Although the extent of this problem was not further investigated by the Auditors it is recommended that YEDL make sure all field staff are aware of this and report re-interruptions correctly in these cases.

In the Auditors' view the effects of both the above inconsistencies are small and not worthy of further investigation.

(iv) IIP Template

Main interruption data is extracted from events in NaFIRS in the same way as last year. The only change is in respect of disaggregated data (per circuit information required by Ofgem – all circuits as opposed to faulted only circuits). This now requires technical parameters of all circuits as against last year where only details for those with faults reported during the year were required.

DINIS (the HV design tool) has been used for circuit characteristics for 2002/3 but the connectivity model will be used for the 2003/4 template. Manual intervention to allocate fault performance to circuit is carried out where there is a mismatch between the DINIS record and fault information.

An independent person carries out an audit check of the data extract for YEDL to ensure accuracy of template completion.

(v) Conclusions

The only inconsistencies in measurement systems noted were due to the apparent misinterpretation by some field staff of the RIGs for re-interruptions after the temporary restoration of supply and the error in reporting incident duration in the early part of the year for cases in which the customer specifically asks for the restoration of supply to be deferred. However, these factors are unlikely to give rise to significant errors in reporting of customer interruptions and in the Auditors' view do not merit further investigation. Correction of these minor inconsistencies has either already been carried out or is recommended as a result of this audit.

Subject to the above comments the Auditors conclude that the YEDL assessment of accuracy of measurement is both consistent and accurate.

The process for completion of the IIP template appears consistent and subject to the first three months of the year having the 15% uplift to reported CI and CML at the LV level removed from the reported figures (see section R.4.2 below) the Auditors believe YEDL have completed the IIP template correctly within the limits of the data from NaFIRS and the cross checks that have been carried out.

R.4 Stage 3: Accuracy of Reporting

Please note the methodology for the stage 3 audit is common to all DNOs and therefore will be contained in the body of the main report.

R.4.1 Incidents at the Higher Voltages

Due to the fact that key systems are still manual, there is no automatic transfer of the time stamping by CCH of incidents from the first notification of a fault to the call centre through to the despatchers and the control centre. Although no systematic inconsistencies were noted, the manual transcription of data is a continuing risk for accuracy. A reality-check is done on the major HV incidents but no systematically sampled audit is carried out.

This manual entry of data proved a major source of problems for one audited HV incident and produced, due to a manual data entry error, a CML figure that skewed the results of the audit. A spare incident was audited to allow the results with and without this incident to be viewed. The error considerably overstated YEDL's CML figure for that incident.

The NEDL TMS system is scheduled to go live in YEDL as from April 2004 and will see the introduction of the NEDL style of restoration strategies which summates customer numbers in logical feeder sections and from then incident start times will be automatically linked through to the NAFIRS database, which will eliminate the risk of errors through manual transcription. This method of recording is then scheduled to be automatically linked to the control centre with the introduction of a Network Management System and operating on an ENMAC platform and will subsequently provide for the automatic "substation" level of recording.

During the EHV/HV audit it was observed from the count of MPANs, for substations affected by the incident, that a number of transformers were recorded as having zero MPANs. This affected the CI data recorded at the time of the incident and also the CI data viewed for the system CI at the time of the audit. It is understood that YEDL have been unable to match the MPANs with HV customers leaving a number of transformers without any MPANs. This is being reviewed as part of the data cleansing activities.

For all of the HV faults audited the CI figures and the audit trail information was good up to a point. However, the lack of computer systems did show up the difference between the NEDL system and the YEDL system in terms of the records available. With YEDL much of the information was recorded on hand written sheets whereas in NEDL the information was all held electronically and date and time stamped. This system is scheduled to be incorporated into YEDL's system over the coming months. This will greatly improve the YEDL records and audit trail.

During the EHV/HV audit YEDL and the auditors agreed on all of the reported figures.

The errors that were observed were often due to information being recorded manually. This leads to errors in reading handwriting and errors in inputting data. In general, it is better if data can be entered from SCADA automatically or failing that entered once and transferred electronically to other applications without further manual data manipulation. There was some uncertainty over MPAN links, resulting in some guessing of customer numbers, particularly when records kept showing zero customers on a transformer (indicating MPANs snapped to another transformer).

R.4.2 Incidents at LV

Following the recommendation of last year's audit report field staff have been reminded of the need for accurate reporting of fault location, description and restoration information. Internal audits have been conducted to cross check between no supply calls and the existence of corresponding fault reports in NaFIRS to ensure completeness of reporting but the detailed input in the fault sheets has not been audited to check for the frequency of any transcription errors. Validation checks are carried out on an ongoing basis. The above actions have resulted in the improvement of overall accuracy of reporting.

The audit of LV incidents was carried out from copies of the NaFIRS sheets filled in by YEDL local office clerical staff from field notes submitted after completion of restoration work for the relevant faults. The quality of information recorded on the NaFIRS sheets was in general rather cryptic, and not as good as would be needed for audit purposes in some cases had these been the only source of information available. Nevertheless the excellent GIS records and comprehensive preparation prior to the visit meant that it was relatively easy to reconstruct what had happened and count the MPANs affected by reference to feeder layouts and repair joints recorded and dated as carried out at the time of the fault. It is recommended that YEDL give further attention to making sure that clearer and more extensive information is recorded on the NaFIRS sheets to ensure that the location of the fault is adequately described together with details of the feeder way affected and the work carried out to restore supplies.

In two of the incidents audited there had been a misinterpretation by field staff of the RIGs for recording re-interruptions after a temporary restoration of supply (see paragraph 3.2(iii) above). It is estimated that this will have only a very small effect on the numbers of customer interruptions reported and will not affect the reporting of customer minutes lost. Although the Auditors were not able to quantify this further it is recommended that YEDL make sure all field staff are aware of this and thus report re-interruptions correctly in these cases.

During the current audit year YEDL have changed their interpretation of the RIGs definition of incident start and finish times in cases where the customer requests the restoration of supply be deferred to a more convenient time. In the early part of the audit year YEDL practice was to suspend the recording of customer minutes lost for the duration of any customer requested deferment. During the year YEDL changed their interpretation so as to record all customer minutes lost regardless of customer requests for deferment, which is in strict accordance with the current version of the RIGs.

Three incidents were audited where the customer reportedly asked for the restoration to be deferred to a more convenient time and where YEDL did not report the full customer minutes lost. In one case YEDL acknowledged that the restoration could probably have been carried out straight away, and accepted the reporting error recorded by the Auditors. However, in two cases it argued that it was unfair that the Auditors were obliged to record a reporting error in customer minutes lost.

In the first case the property, which was newly constructed, had been empty for some months and the customer who was shortly to move in called to report the loss of supply as soon as the problem became apparent. On attending the site it needed to gain access to the premises but when it contacted the customer, they requested that the repair work be carried out at a more convenient time when they could be present , which was over two days later. In the second case the repair of a fault to a single phase of the three phase supply to an environmental health centre was requested by the customer to be deferred to the weekend as the repair would have involved the loss of the other two operational phases to the building thus shutting down the whole business in the middle of a working day.

R.4.3 Accuracy Results

(i) Stage 3 Accuracy Calculation

The results of the audit for each DNO were captured in an Excel workbook. This was populated by the DNO prior to the audit with respect to reported values; during the audit the audited values were inputted.

Where a restoration stage has been identified as a re-interruption (reported or audited) the reported or audited CI has been set to zero. For example where the report and audit identify a restoration stage as being a re-interruption then the CI will be set to zero for both the reported and audited results. In the event that the restoration stage is reported as being a re-interruption but the audit does not identify it as a re-interruption, then the reported CI will be set to zero but the audited CI will include the audited CI associated with the restoration stage. Conversely, where the restoration stage is audited as being a re-interruption but the report does not identify it as a re-interruption, then the audited CI will be set to zero but the reported CI will include the report CI associated with the restoration stage.

For each DNO, the difference was determined between the reported and the audited values for each incident stage examined for the 4 measures, Overall CIs and CMLs and Low Voltage CIs and CMLs. These 4 data sets were tested for symmetry by calculating the following statistical parameters: mean, median and standard deviation.

In every case the median is zero and the mean is either zero or close to zero. It can therefore be concluded that the data is symmetrical and can be described by a normal distribution. A summation technique has therefore been used to calculate the audit accuracy.

Examination of the data sets describing the differences between the reported and audited values, identified that some contained outlying results that could potentially distort the accuracy results. These outlying results were identified by examining the data sets for incident stages where the difference between reported and audited results were greater than the mean +/- 4 standard deviations. For a normal distribution this represents 0.006 % of the area under the frequency distribution curve.

Using this methodology to determine outlying results, the following incident stages have been removed from the assessment of accuracy:

Table R-2: Incident stages removed from assessment of accuracy

Overall		LV	
CI	CML	CI	CML
67548	61887	66921	66459
61804			

The final Stage 3 reporting accuracy results are therefore:

Table R-3: Stage 3 Reporting Accuracy Results

Stage 3	Overall sample – CI	100.1%
Stage 3	Overall sample – CML	100.8%
Stage 3	LV-only sample – CI	99.7%
Stage 3	LV-only sample – CML	97.5%

(ii) Overall Accuracy Calculation

Stage 1 accuracies were obtained for LV and higher voltage connectivity models during the audit of each licensed area. The LV figures were used as reported. The overall system accuracy calculation was obtained by a combination of the LV and higher voltage system accuracies weighted by the total numbers of CIs for LV incidents and by the total numbers of CIs for higher voltage incidents.

System and audit inaccuracies were calculated as the modulus of the difference between the accuracy and 100%. The principle used in determining measurement uncertainties was used to calculate the combined accuracy figures. This was calculated by adding the square of the system inaccuracy to the square of the audit inaccuracy and calculating the square root of this figure. Combined accuracies were then obtained as the differences between these figures and 100%.

The results of this analysis are shown below:

Table R-4: Combined Accuracy Calculation

			Accuracy	Inaccuracy
Stage 3	Overall	CI	100.1%	0.1%
		CML	100.8%	0.8%
	LV	CI	99.7%	0.3%
		CML	97.5%	2.5%
Stage 1		LV	97.2%	2.8%
		Overall		2.8%
		HV	97.2%	2.8%
LV Fraction				20.0%
Combined Accuracy	Overall	CI	97.2%	2.8%
		CML	97.1%	2.9%
	LV	CI	97.2%	2.8%
		CML	96.2%	3.8%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table R-5: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.2%	97.1%	97.2%	96.2%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

R.5 Accuracy of Measurement Systems and Reporting Process for Short interruptions

R.5.1 Methodology

The protection set-up of HV auto-reclose circuit breakers throughout YEDL is such that all circuit breakers back to the primary substation would be expected to operate in the event of a short interruption condition arising on any HV feeder. The number of short interruptions can therefore be captured through SCADA monitoring of the primary substation auto-reclosers. All operations of SCADA controlled plant are captured by the Distribution Management System (DMS) and transferred to the YEDL NaFIRS database. The source count of short interruption recloser operations is then extracted from the NaFIRS data and will exclude pre-arranged interruptions as these are separately categorised.

Short interruptions associated with longer sustained interruption incidents that are isolated by breakers downstream of the SCADA monitored auto-recloser have then to be eliminated from the overall SCADA count. This has been done manually by investigating the incidents (approximately 60 in total for 2002/3) associated with sustained interruptions downstream and deducting the number of customer interruptions associated with the sustained interruption from the total customer numbers associated with the relevant SCADA controlled auto-recloser. Example: Stage 1: 1,500 customers for < 3 minutes. Stage 2: 500 customers for >= 3 minutes. This would be counted as 1,000 short customer interruptions.

YEDL does not make significant use of auto reclose devices at the LV level except for safety purposes where their use would be temporarily needed when restoring customers during sustained interruption incidents. There is therefore no requirement to include counts of short interruptions from these sources.

Interruption "Type" is identified from the type of switching operation with unsolicited operations classed as automatic. Those instructed by control engineers (either directly via SCADA or by field staff) are classed as manual. Information on direct cause is available but difficult to confirm with confidence in the case of short interruptions so most go down as "cause unknown".

In the view of the auditors YEDL are conforming to the RIG requirements for the reporting of short interruptions. The completion of the IIP template appears to be satisfactory, and YEDL carry out an internal audit check of the final numbers entered into the template prior to submission to Ofgem.

R.5.2 DNO's Estimate of Accuracy

Since the transfer of data from DMS to NaFIRS is carried out manually this is subject to the risk of transcription errors. This risk will in general be the same as for the reporting of sustained interruptions so it will not give rise to additional error in the reporting of short interruptions. YEDL carry out a cross check of a sample of customer no-supply calls once per month to ensure that a corresponding report exists in the NaFIRS database. YEDL have not carried out any additional sample crosschecking to test for accuracy of transcription of data relating to short interruptions.

Even though a SCADA controlled primary breaker should operate when any short interruption to the HV network occurs, YEDL are not 100% sure that all auto reclosers discriminate correctly and so there may be occasions when the non-SCADA monitored reclosers downstream of the relevant SCADA controlled breaker operate independently. YEDL presently have no way of automatically capturing when this happens and have not carried out any independent manual audit counts of operations of the downstream reclosers (of which there are about 800) to check whether this has occurred. YEDL take the view that the numbers of customer short interruptions resulting from independent operation of downstream reclosers will be very small in comparison to the total customer short interruptions, and any significant problems would be highlighted very quickly as a result of customer feedback.

Short interruption events coming in from connections to NGC and interconnections with East Midlands Electricity would also be missed from the overall NaFIRS count, but these numbers are also thought to be insignificant.

In addition there is a small possibility of error in the manual process of associating short interruptions with longer sustained interruptions and making the appropriate adjustments to the raw numbers from NaFIRS. Out of approximately 900,000 total customer short interruptions about 147,000 had to be decided by manual interpretation. YEDL have not subjected this manual process to any audit checking.

Potential errors that remain are therefore:

- Manual transcription from DMS to NaFIRS.
- Short interruptions resulting from independent operation of non SCADA controlled reclosers.
- Short interruptions incoming from NGC and interconnections with other DNOs.
- Misinterpretations and transcription errors in the manual process for eliminating customer short interruptions associated with sustained interruptions.

YEDL estimate that their accuracy of reporting of short interruptions is in the main the same as the accuracy of reporting of sustained interruptions. YEDL accept that there will be unquantified additional errors due to (ii), (iii) and (iv) above, but the auditors accept that it seems reasonable to assume that these additional errors will be small.

It is planned to extend SCADA control to 700 out of the 800 existing non-SCADA controlled main line auto-reclosers and to install an additional 400 new SCADA controlled auto-reclosers. When this work is completed (scheduled for completion in 2006/7) this will enable accurate counts of customer short interruptions from these sources to be made automatically thus largely eliminating potential errors from the independent operation of downstream non SCADA controlled reclosers. In addition it is planned to install 100 auto-reclosers at the LV level and all these will be linked to despatchers via GSM telephone links thus enabling automatic counts of short interruption from these sources to be made.

The transfer of data to the YEDL NaFIRS database will be done automatically by TMS (the NEDL Trouble Management System) after the system is made live and operational in YEDL – scheduled for April 2004. This should eliminate any reporting errors resulting from no-supply calls received but missed in manual transcription to NaFIRS. This method of recording is then scheduled to be linked to the control centre by April 2005 and will subsequently provide for the automatic "substation" level of recording to ensure that the interaction between short and sustained interruptions within a fault are captured with enough information to ensure the short interruptions are correctly counted.

R.5.3 Auditor’s Conclusions

The Auditors’ accept YEDL’s estimate of accuracy of the reporting of short interruptions although there may be a small extra inaccuracy due to the risk of unquantified errors in the manual checking of short interruptions associated with sustained faults. This is probably small in comparison to the overall numbers. The risk of additional error is probably on the under-reporting side because the exact operation of downstream reclosers is not known with precision and has not been further investigated by YEDL.

R.6 Overall Impressions

YEDL had clearly committed considerable preparatory effort into the audit and had made sure that all the necessary information was to hand to enable the audit to proceed without unnecessary delays. During the visit the Auditors were given the fullest co-operation by YEDL. Key members of staff with in-depth experience in the systems and processes, together with dedicated office space for meetings and IT systems for audit work were made available throughout the visit. The descriptions of the systems used and the answers provided to the Auditors' questions were full and clear. Where issues were found the ensuing discussions were helpful, with YEDL showing a willingness to accept where errors had taken place and to incorporate improvements quickly into working practice.

The audit was conducted in a friendly and straightforward style, and the Auditors' overall impression was of a hard working team with a no-nonsense approach committed to customer service and the accuracy and efficiency of reporting.

R.7 Conclusions

Table R-6 presents the results of the 2003 audit of the YEDL licence area in-line with the auditing framework.

Table R-6: Stage 1, Stage 3 and Short Interruption Reporting Accuracies

Stage	Item	Accuracy
Stage 1	MPAN Measurement	99.6%
Stage 1	LV Connectivity Model	97.2%
Stage 1	HV Connectivity Model	97.2%
Stage 3	Overall sample – CI	100.1%
Stage 3	Overall sample – CML	100.8%
Stage 3	LV-only sample – CI	99.7%
Stage 3	LV-only sample– CML	97.5%
	Short Interruptions	Estimate as per interruption reporting – 97.2%

The calculated combined Stage 1 and Stage 3 accuracy results for the two samples are as follows:

Table R-7: Combined Reporting Accuracy

Overall		LV	
CI	CML	CI	CML
97.2%	97.1%	97.2%	96.2%
Stage 3 results indicate over reporting	Stage 3 results indicate over reporting	Stage 3 results indicate under reporting	Stage 3 results indicate under reporting

R.8 Recommendations

- YEDL make sure all field staff are reminded of the 18-hour rule in the RIGs. Under this rule interruptions to supply to effect permanent repairs following a temporary restoration should only be recorded as re-interruptions where they take place within 18 hours of the time of the temporary restoration.
- YEDL give further attention to making sure that clearer and more extensive information is recorded on the NaFIRS sheets for LV incidents showing fuller details of what caused the incident, the equipment involved, and where and when repairs were made.
- Manual entry and or manipulation of data is minimised and that electronic records incorporating time and date stamped records be held as part of the audit trail records.

R.9 Learning Points

This section should include the points identified by the joint audit team as learning points for the audit process.

- That the records retained as evidence of the incidents should be self contained and in themselves should constitute a full and verifiable record for audit purposes.
- It is recommended as a result of this audit that Ofgem consider inviting views on an extension to the RIGs to give guidance for DNOs on the reporting of incidents where the customer requests a deferment of supply restoration, so as to ensure consistency across DNOs.