Information and Incentives Project

Audit of Incident Reporting for 2001/02

Final Report

February 2003

British Power International

Office of Gas and Electricity Markets
9 Millbank
London
SW1P 3GE

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Mott MacDonald
Victory House
Trafalgar Place
Brighton BN1 4FY
United Kingdom

Tel 01273 365000
Fax 01273 365100

British Power International
Century House South
Riverside
Colchester CO1 1RE
United Kingdom

Tel 01206 719430
Fax 01206 719432

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Glossary

BPI	British Power International
CI	Customer Interruptions
CML	Customer Minutes Lost
DNO	Distribution Network Operator
EME	Eastern Midlands Electricity Distribution
ENMAC	Energy Network Management and Control System
EPN	Eastern Power Networks
GIS	Geographical Information System
HV	High Voltage
IIP	Information and Incentives Project
IT	Information Technology
LPN	London Power Networks
LV	Low Voltage
MPAN	Metering Point Administration Number
NaFIRS	National Fault and Interruptions Reporting Scheme
NEDL	Northern Electric Distribution Ltd
Ofgem	Office of Gas and Electricity Markets
RIGs	Regulatory Instructions and Guidance
SCADA	Supervisory Control and Data Acquisition
SP	Scottish Power
SPN	Seeboard Power Networks
SSE	Scottish & Southern Energy
UU	United Utilities
WPD	Western Power Distribution
YEDL	Yorkshire Electricity Distribution Limited

Summary

The incident reporting systems used by the Distribution Network Operators (DNOs) for the 2001/02 reporting year were audited during June, July and August 2002 in accordance with the framework developed by the consortium of Mott MacDonald, British Power International and ERA Technology on behalf of Ofgem. It should be noted that most of the DNOs introduced new measurements systems for LV incidents during the course of the 2001/02 year and, as a result, accuracy results in future audits are expected to be substantially higher than for the 2001/2 reporting year.

The audits were very successful with each audit team completing a review of the DNO's reporting systems (Stage 1 of the audit framework) and the randomly-selected sample of incidents (Stage 3 of the audit framework) within the allocated time. The success of the audits was due largely to the extensive preparation undertaken by the companies prior to the audit visits and the resources made available by the companies. All of the DNOs have adopted a positive attitude towards the Ofgem Information and Incentives Project.

Review of the DNOs' reporting systems highlighted that all companies have implemented accurate procedures for identifying customers by primary-traded Metering Point Administration Numbers (MPANs), with all companies reporting accuracy of MPAN count greater than 99%. The procedures used by the companies for counting MPANs have been formally approved by Ofgem.

With the exception of two licence areas, connectivity models associating MPANs with LV feeders were implemented by 1 April 2002. The models for the two remaining areas are in the process of being completed. The systems employed vary across DNOs but the majority provide highly accurate identification of customers affected by supply interruptions. Most of the DNOs have an ongoing task of associating customers to feeders where insufficient address or location details were available in the initial population exercise, accounting for a large proportion of the connectivity model inaccuracies at the time of the audits.

The accuracy of both MPAN counting and connectivity models was reviewed during the audits, including spot-checks on a small number of sample addresses. In the majority of cases, the visiting auditors were able to agree with the DNOs' accuracy estimates for counting of MPANs and connectivity models.

The audit of incident reports was the most time-consuming component of the audit visits, in particular the review of one hundred LV incidents for each licence area. With the exception of a few complex incidents, the visiting auditors, working with the company representatives, were able to review all incidents and agree audit numbers for customers interrupted and incident duration. The resulting numbers were used to determine audit results for accuracy of incident reporting.

Incident reporting at higher voltage levels was found to be highly accurate due to the level of automation used by most DNOs in operating the higher voltage networks. All except three licence areas achieved accuracy results above 90% for reporting of Customer Interruptions (CI) and all except two achieved a similar level for reporting of Customer Minutes Lost (CML). A mixture of over- and under-reporting of CI and CML at higher voltage levels was witnessed across the DNOs.

On the low voltage (LV) network, the audit highlighted a trend towards under-reporting for both CI and CML with only one licence area over-reporting CI and three licence areas over-reporting CML. Accuracy results varied widely between licence areas with around half below 90% for both CI and

CML, the lowest results being 55% and 58% for CI and CML respectively. The low accuracy results at LV are due largely part to the fact that the audit for most companies compared customer numbers generated by the new connectivity models with customer reports prepared using the DNOs' previous, less accurate systems, thereby including the effect of system changes in the accuracy results. This effect was expected when the audit framework was developed. Two other main sources of inaccuracy identified during the audits were as follows:

- Manual intervention during any stage of the reporting process has the potential to cause errors, either through pure mistakes in transcription or through misinterpretation of information;
- Incidents affecting only part of an LV feeder are inherently difficult to report accurately due to the reliance of the office-based dispatch staff on information provided by a field operative, particularly in relation to the number of customers interrupted.

Incident reports for the current reporting year and future years will have the benefit of the new connectivity models for determining the number of customers impacted by network incidents and future audits will compare like-with-like. We therefore expect LV reporting accuracy results in future audits to be substantially higher than for the 2001/02 reporting year.

The audits highlighted a number of areas where improvements could be made by the DNOs to incident reporting procedures to improve accuracy and to improve transparency for auditing purposes; these recommendations were made to the DNOs in the company-specific reports written for each audit. A key recommendation is to ensure that high quality information is recorded at the time of the incident as trying to resolve incidents historically can be difficult. Recording of abnormal network feeding arrangements and customer changes was identified as important for the completion of future audits.

The need for modifications to the Regulatory Instructions and Guidance notes (RIGs) highlighted by the audits was limited to a small number of key points, the most important being clarification of the definitions and guidance for re-interruptions. It became apparent during the audits that a number of different interpretations of the current guidelines for recording re-interruptions are used by the DNOs.

Prior to undertaking the 2001/02 audits it was agreed with Ofgem that the accuracy results for Stage 1 and Stage 3 of the audits would not be combined to give the final accuracy results as per the audit framework, due to the fact that most of the DNOs had introduced new reporting systems during the course of the reporting year, thereby making it inappropriate to combine results for old and new systems. In future work, we recommend that the methodology for combining the Stage 1 and Stage 3 should be finalised for comparison against the minimum levels of accuracy specified by the RIGs. The methodology should also include procedures for excluding single large variance results which may distort the overall results (outliers) and for determining a tolerance on the accuracy results which adequately reflects the potential for error in the audit process.

The audit process was found by the DNOs and the consortium to be generally robust, however a number of improvements are recommended for future audits, including the following key points:

- In determining the sample of incidents to be audited, consideration should be given to basing the statistical analysis on CI and CML rather than customers and duration as the DNOs targets for reporting accuracy are based on CI and CML.
- The size of future incident samples should take into consideration the number of restoration stages per incident.

- Customer numbers generated by connectivity models at the time of the audit should be used as the audit customer numbers unless the DNOs can prove that the network was working abnormally at the time of the incident or that changes in customer growth have occurred since the time of the incident.

1 Introduction

1.1 Background

Mott MacDonald 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).

The IIP is designed to address a number of concerns with the distribution price control framework and in particular to strengthen the incentives on DNOs to deliver the appropriate quality of service to customers.

The Regulatory Instructions and Guidance (RIGs) document was published by Ofgem in February 2001 and has been subsequently revised, the latest revision occurring in March 2002[1]. The RIGs set out detailed definitions and guidance for the reporting requirements that the DNOs are expected to meet under the IIP. They also provide a framework for the collection and provision of accurate and consistent data across the distribution businesses.

The scope of the information that is required 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.

Ofgem has specified minimum levels of accuracy for the information reported on interruptions of three minutes or longer (Table 1-1). Distribution companies are required to meet both the low voltage (LV) and overall minimum levels of accuracy to comply with the IIP licence condition. The LV target includes service cables supplying properties. Overall accuracy includes all voltage levels. Voltages above LV are referred to as higher voltages.

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

In addition to these requirements the DNOs are also requested to estimate the level of accuracy with which they report short interruptions to supply and the speed of telephone response. The companies were expected to have the necessary measurement systems to report to the required levels of accuracy in place by April 2002. The consortium completed a series of audits of these systems between June and August 2002 the findings of which are collated in this report.

[1] Information and Incentives Project, Regulatory Instructions and Guidance, Ofgem, March 2002

1.2 Aims of the Incident Auditing

The audit of the companies' measurement systems and the first full year of data reported by them was carried-out during the period June to August 2002. The 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 comment on the companies' ability to meet the required levels of accuracy;
- to gather lessons learnt 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

The 2001/2002 audit of the companies' measurement systems and the first full year of information reported under IIP followed a significant amount of development work. The consortium, working closely with Ofgem, developed the framework for the 2001/2002 audit based on the results of an interim review of the company systems in 2000/2001, a number of industry workshops and piloting of the various elements of the audit at SP Distribution, SP Manweb, SPN, United Utilities and WPD. A trial of Stage 3 of the audit framework was then undertaken at East Midlands Electricity.

The 2001/2002 audit entailed the following:

- Stage 1: audit of the measurement systems. This focused on assessing the potential accuracy of companies' 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 companies' 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 distribution licensees to assess the accuracy of the sample data.

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, however the accuracy results for stage 1 and stage 3 are also presented in Section 3 of this report.

It should be noted that short interruptions were not assessed as part of the 2001/2002 audit. Therefore, no analysis or conclusions relating to short interruptions appear in this report.

1.3.2 Speed of Telephone Response

The IIP Interim Review visits, carried-out in 2001, included an initial examination of the telephony systems that the distribution companies use to respond to calls from customers. The Interim Review highlighted the different telephony systems and different measurement systems that the companies use. It was therefore suggested that further study would be necessary before meaningful comparisons could be drawn between companies.

As part of the 2002 IIP audit, Ofgem retained Mott MacDonald and British Power International to further study the companies' telephony systems and their associated measurement systems.

The scope of this part of the audit work involved the following:

- Initial review. A questionnaire was sent to the companies in early May designed to provide a better understanding of the design of companies' telephony systems, the way in which they record data on the speed of response and how companies have implemented the definitions and guidance set out in the RIGs. A review of the results of the questionnaires has been completed in order to begin identifying inconsistencies across companies and understand how different companies' systems work.

- Preparation and analysis of further questionnaires. Further questions to supplement the original questionnaire were sent to the companies and the responses analysed.

- Make recommendations for further questions, analysis and examination that are necessary to enable a full understanding of the various telephony systems and the associated measurement systems.

The findings of the additional work on speed of telephone response will be included in a separate report to Ofgem.

1.4 Report Structure

This report on the 2001/2002 IIP audits of the interrupting reporting process 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 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 5 contains lessons learnt from the audits and proposes modifications to the audit framework to be used in future years.
- The report includes fourteen company specific appendices. These describe the findings relating to the measurement and reporting systems in place at each of the companies visited.

2 Methodology

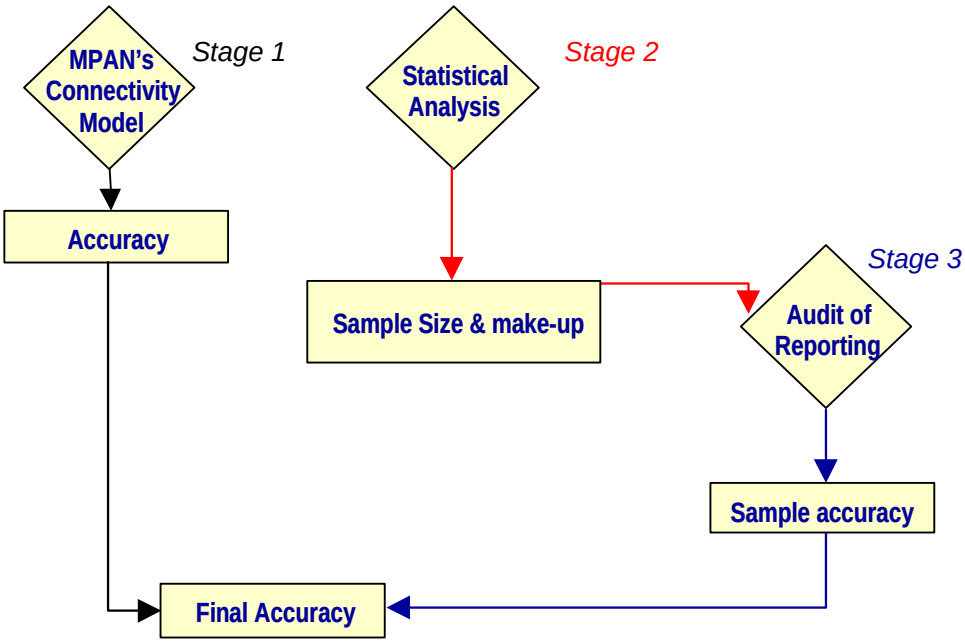
2.1 Overview

This section provides details of each stage of the audit framework. It also gives details of internal processes/procedures that were in place to ensure that consistent and accountable audits took place.

2.2 Methodology

The audit of incident reporting was a three-stage process as represented in Figure 2-1. This framework was derived through development work undertaken in the year prior to the 2001/2002 audit, including the findings of the interim review and the piloting work undertaken at East Midlands Electricity. As most DNOs were in the process of introducing new connectivity models during 2001/02 the stage 1 and stage 3 accuracies have not been combined. This is because stage 3 of the audit will have picked up inaccuracies in the old connectivity models in addition to reporting errors.

Figure 2-1: Audit Framework



2.2.1 Stage 1: Accuracy of Measurement Systems

A series of four questionnaires was developed in order to assess the accuracy of the measurement systems. The four questionnaires covered the following areas:

- MPANs
- Connectivity model
- RIG definitions

- Ofgem template.

The MPAN questionnaire was designed to explore how a company identifies and manages customers as defined in the RIGs, drawing out any potential sources of inaccuracy such as errors, inconsistencies and uncertainties. Under the RIGs, a customer is effectively defined as a primary traded MPAN and the questionnaire examines how these are produced, managed and removed from the system. Examples of the above processes were also required to complete the questionnaire. The information gathered from each company regarding its processes was used to assess the correctness of the company's assessment of accuracy of its MPAN count.

Similarly, **the connectivity model questionnaire** set out a series of structured questions to explore the progress of the company with regards to accurately locating the MPANs on its electricity distribution network. By considering questions exploring the estimated accuracy of the connectivity model, progress since the Interim Review, any inconsistencies or errors and how the system works and is maintained the auditors were able to evaluate each company's reported level of accuracy for its connectivity model.

In addition to this, random checks of information contained in the connectivity model were completed as a series of 'dip-stick' tests of the accuracy. Under the IIP, DNOs were required to have measurement systems in place by 01 April 2002 that could deliver the accuracy levels set out in the RIGs on an ongoing basis. It was therefore assumed that each company would have an IIP-compliant connectivity model in place by 01 April 2002 and that the sample incidents would be audited against this model.

Upon completion of the above two questionnaires, the auditors assessed the company's estimates of the accuracy of their systems. **The RIGs questionnaire** was used to determine how the company has interpreted the definitions and guidance contained in the RIGs and how these are incorporated into its measurement systems. It includes consideration of how each company determines reportable incidents, incident start time, incident completion, short interruptions (although a full assessment of these was not made) and any mechanisms to ensure that all the reportable incidents are captured and reported. The findings from this questionnaire are used to assess each company's compliance with the RIGs.

The template questionnaire was designed to check that the company's routines for providing Ofgem with the requisite information are operating correctly. It investigates the ways in which each company extracts and processes data from its incident reporting system in order to populate the template used to report this information to Ofgem. This questionnaire required the company to demonstrate how the system worked and any inconsistencies or uncertainties were checked.

The information generated through the completion of all the questionnaires supports the completion of Stage 1 of the audit framework and provides the context against which Stage 3 was completed.

2.2.2 Stage 2: Statistical Analysis

A detailed methodology for this Stage of the audit framework was provided in the Information and Incentives Project Stage 2 Pilot Report of May 2002. In summary, the aims of this stage of the audit framework are associated with determining the most appropriate statistical distribution for incident data and the incident sample size to be audited at Stage 3 of the audit framework.

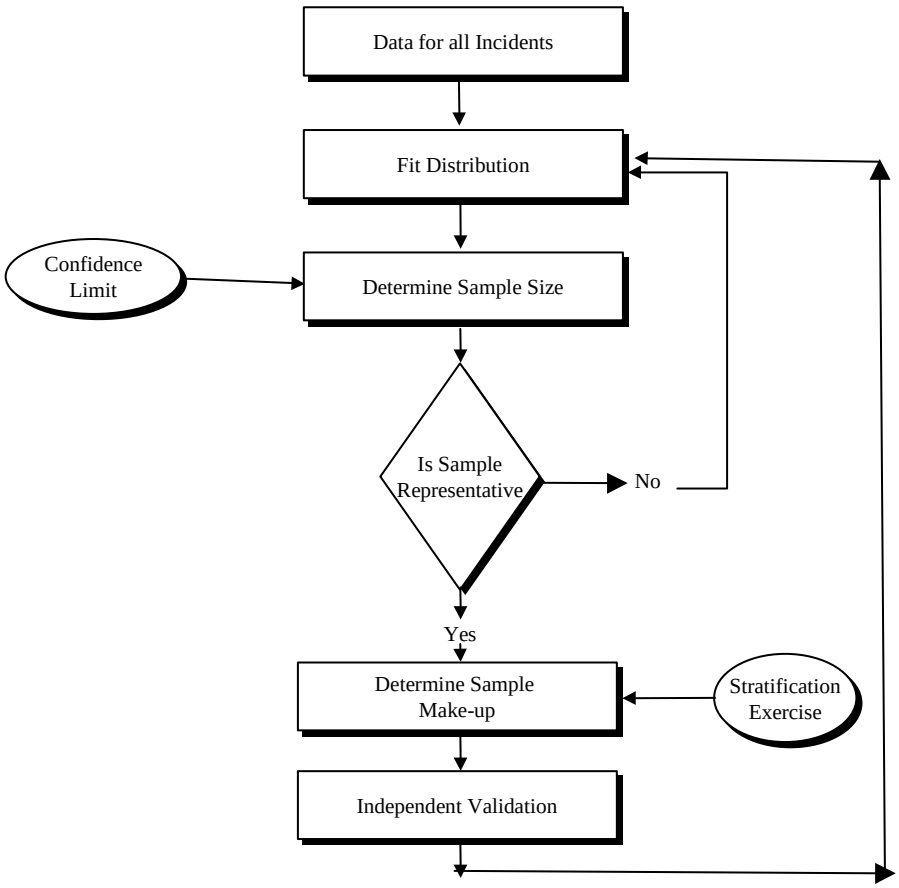
The approach involved the following steps:

- 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 and are explained in more detail in the May 2002 report. The data regarding incidents was received from the companies and the statistical analysis completed prior to the audits.

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

Figure 2-2: Methodology



The 2001/2002 reporting year is the first full year that was subjected to an IIP audit. It was agreed that the statistical sampling for this reporting year would be carried out to a 90% confidence limit and that this could be reviewed for subsequent years.

2.2.3 Stage 3: Audit of Incident Reports

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).

The audits were carried out during a seven-week period from late June to early August 2002. It is emphasised that each audit team comprised both company representatives and visiting auditors. 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 their 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.

An audit workbook was developed to assist in the compilation of the results for this part of the analysis. An example of the workbook is shown in Figure 2-3. Each of the audit teams completed these workbooks for their respective companies. In the case of customer numbers, the auditors recorded the following:

- the "audit" column showed the number of customers that the company should have reported based on the information available at the time.
- the "system" column was added to identify the number of customers that the company's systems would report when the incident was recreated during the course of the audit. This may be considerably different from the audit number if a new connectivity model was introduced between the time of the incident and the time of the audit.
- the "agreed" column was used to record the agreement reached between the company representatives and the visiting auditors on the actual number of customers affected by the incident.

Where possible, new customers, network reconfiguration and removal of multiple MPANs were identified and taken into consideration in determining the agreed customer numbers.

The DNOs have been developing improved connectivity models to aid with the assessment of the numbers of customers that are affected by an incident. The majority of DNOs completed these

connectivity models and began to use them during the 2001/2002 reporting year, i.e. during the period 01 April 2001 to 31 March 2002, the first reporting year to be the subject to an IIP audit.

It has therefore been recognised that the accuracy results for the 2001/2002 reporting year will be a combination of reporting errors and old system inaccuracies. Incident reports for the current year and future years will have the benefit of the new connectivity models for determining the number of customers affected by network incidents. We therefore expect the accuracy levels for the current year and future years to be substantially higher.

During the course of the audit visits it emerged that the two SP licence areas, SP Distribution and SP Manweb, do not yet have their proposed LV connectivity models in place and will not have them in place until September 2002 for SP Distribution and March 2003 for SP Manweb. This raises concerns for next year's audit and recommendations on this subject are included in Section 5.7.

As a general observation, it should be accepted that all companies are likely to make modifications to their connectivity models as time progresses and some further changes in reported customer numbers may be experienced. However, any such future changes are expected to be minor when compared with the initial impact of installing a connectivity model that can meet the required levels of accuracy.

2.3 Audit Preparation

Considerable preparation occurred prior to the audit visits to ensure that the approach taken by each audit team was as consistent and efficient as possible. The questionnaires provided to the auditors equipped them with a practical and consistent method for assessing each company's measurement systems, interpretation of RIGs definitions and reporting via the Ofgem template.

Auditing of the sample of incident reports was standardised through the use of an incident auditing workbook with detailed guidance notes on its use. A training day was held on 20 June 2002 in Brighton to brief the visiting auditors on the purpose of the audit, what to expect at the companies, the methodology for the audit and the required outputs. Two of the core team also undertook the first of the audits at WPD South Wales earlier than the other audits and issued the report as a template for all audit teams to follow. The intention of the preparation work was to achieve consistency across the audit visits and to leave the companies with the impression that they had been audited in a fair and consistent manner.

Further measures taken to provide for consistency across audit visits included:

- providing for a team of two visiting auditors per visit
- a mix of skills and backgrounds between visiting team members
- alternating visiting auditors between teams
- in most cases, providing for one of the visiting auditors to a particular company to have visited that same company as part of the 2001 Interim Review
- members of the core team being available throughout the period of the audit visits to answer questions arising and to arbitrate on any points of contention
- having people from Ofgem's IIP team present at many of the audit visits

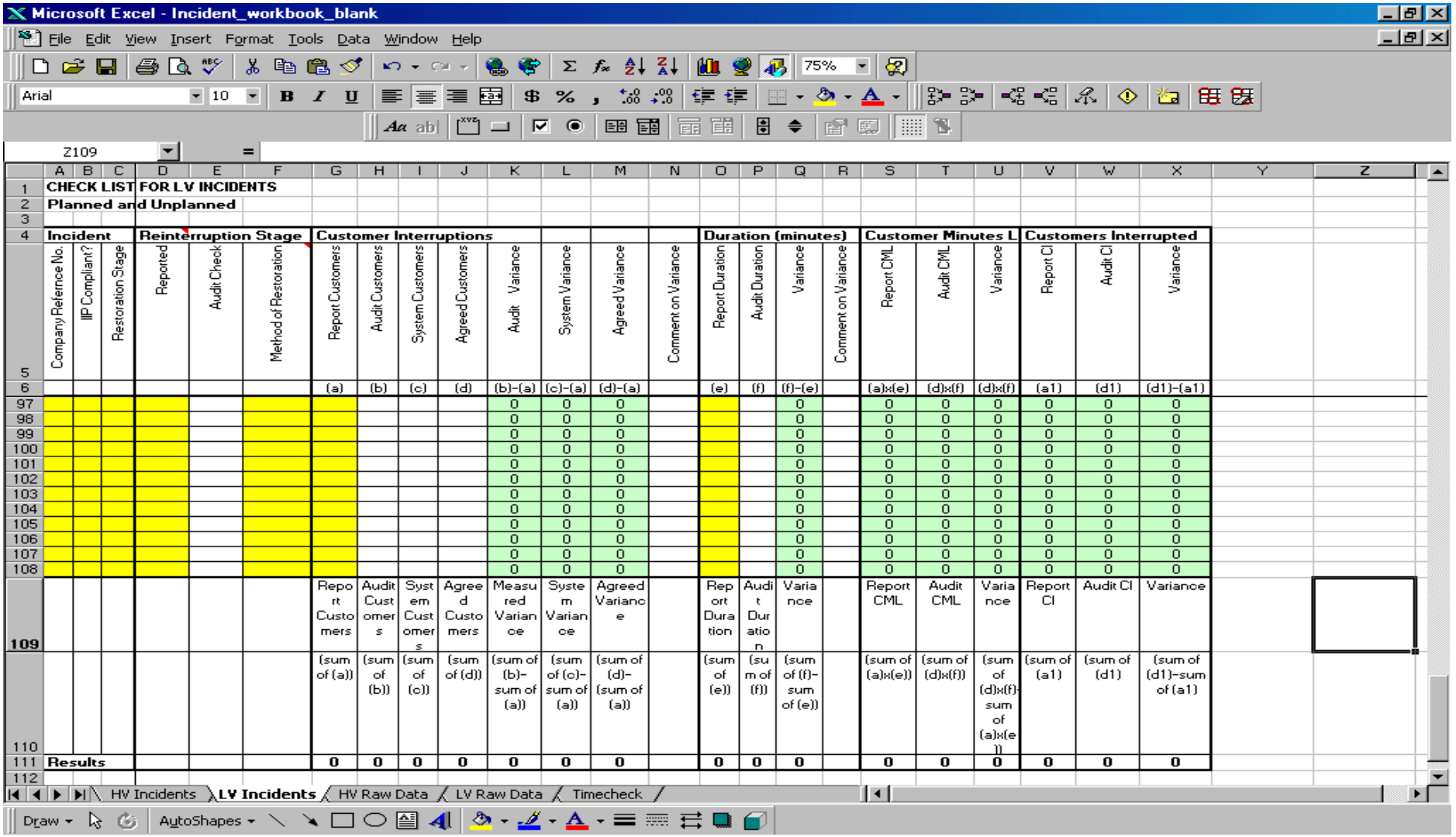
Where a company owned two licensed areas and had common measurement systems across both, it was felt by those companies that having the same audit team for both audits would have saved time in

the induction phase. Whilst we can see the merits of this argument, the benefits of mixing the teams are also apparent, such as injecting a fresh perspective for the second audit to avoid complacency through familiarity. Recommendations for future audit teams are provided in Section 5.

The time available to determine the audit sample under Stage 2 of the audit framework was limited but most companies were advised of the incidents to be audited a week prior to the arrival of the visiting auditors. This allowed the companies to populate the incident auditing workbook and to gather the supporting information prior to the start of the audit.

The results summarised in this report are a result of the open, honest and committed atmosphere and co-operative relationship that has been established between the DNOs, Ofgem and the Auditors. The absence of such an approach and commitment would have had a detrimental effect on the progress of this work.

Figure 2-3: Example of the Stage 3 Workbook



3 Summary of Audit Results

3.1 Overview

The audits of the distribution companies were generally completed during July 2002, with the first audit visit starting in late June and the last audit visit finishing in early August. The time taken to complete the various parts of the audits was generally as indicated in Table 3-1:

Table 3-1: Audit Timing

Task	People	Time Taken	Man Days Required
Company familiarisation prior to visit	2	0.5 days	1 day
Travelling time[1]	2	1 day	2 days
Induction and introduction to company systems	2	0.5 days	1 day
Assessment of MPAN system accuracy (Stage 1)	1	1 day	1 day
Assessment of connectivity model accuracy (Stage 1)	1	1 day	1 days
Audit of 100 LV incidents (Stage 3)	1	2 days	2 days
Audit of 10 – 50 higher voltage incidents (Stage 3)[2]	1	1 day	1 day
Interpretation of RIGs definitions and progress since Interim Review	1	0.5 days	0.5 days
Reporting to the Ofgem template	1	0.5 days	0.5 days
Total			10 days

Notes 1. Travelling time varied between audits.

2. The incident sample size at the higher voltages varied between companies dependant upon the results of the Stage 2 statistical analysis.

From Table 3-1 it can be seen that the audits took around 10 man-days on average including company familiarisation prior to the audit visit and travelling time. Where two licensed areas were owned by the same company and the same measurement systems and processes used for both areas, the visit to the second company was one day less than for the first.

In all companies, the visiting auditors were impressed with the level of support provided for the audit and the resources allocated to IIP.

3.2 Stage 1: Accuracy of Measurement Systems

The following sections summarise the results of the audits of the fourteen distribution companies completed during 2002. Detailed results from the individual audits are contained in the appendices to this report.

3.2.1 Summary of Findings

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

Some accuracy figures are quoted as 100% and, whilst it is recognised that the systems are unlikely to be perfect, it is believed by the company and the visiting auditors that any errors are sufficiently minor in nature as to have no significant effect upon accuracy.

The results in Table 3-2 are the company estimates of accuracy as confirmed by the visiting auditors. Further details can be found in the company specific information appended to this report.

Table 3-2: Summary of Stage 1 Results

Company	MPAN Measurement Accuracy	LV Connectivity Model Accuracy	Higher Voltages Connectivity Model Accuracy
Aquila[1]	100 %* (see footnote)	98.9 %	98.9 %
EME	100 %	95 – 98.2 %	95 – 99.2 %
EPN[2]	Approx. 100 %	90.52 % (feeder level) 94.39 % (transformer level)	Estimate had not been made at time of audit (considered to be higher than LV)
LPN[2]	Approx. 100 %	93.45 % (feeder level) 98.03 % (transformer level)	Estimate has not been made at time of audit (considered to be higher than LV)
SPN	100 %	94 %	98.5 %
SP Distribution[3]	99.5 %		
SP Manweb[3]	99.5 %		
NEDL	99 %	93 %	96 %
SSE – Scottish Hydro	100 %	99.9 %	99.9 %
SSE – Southern	100 %	98.5 %	99.9 %
United Utilities	99.99 %	97.2 %	99.5 %
WPD South Wales	100 %	98.5 %	99.8 – 99.9 %
WPD South West	100 %	98.5 %	99.8 – 99.9 %
YEDL	99.3 %	96.5 %	96.5 %

Notes:

1. While the auditors found no reason to disagree with Aquila's stated accuracy of MPAN count in the checks undertaken, a number of customer categories are incorrectly included in the count of MPANs at present which are likely to make the accuracy of counting MPANs in accordance with the RIGs less than 100%.
2. LPN and EPN have undertaken further work to determine connectivity model accuracy figures including an estimate of accuracy at HV. For EPN estimated accuracy is 94.9% at LV feeder level, 95.6% at transformer level and 96.1% at HV feeder level. At the time of issuing this report, we are awaiting the updated LPN figures.
3. SP Distribution and SP Manweb did not have their new connectivity models in place so it was not possible to assess accuracy of their new model during the audit. Further work will be carried out to assess the accuracy of their models in due course.

3.2.2 Inaccuracy in Counting MPANs

During the audit, no significant deviations were found in the methods of identifying customers by primary traded MPAN as approved by Ofgem. Only one case was found where the information collected was not in accordance with the RIGs, although it should be noted that this problem had already been identified and procedures put in place which were intended to resolve this problem. This high level of accuracy of counting customers by primary traded MPANs is reflected in Table 3-2.

The systems being used for MPAN management were generally found to be robust. Errors that did occur were minor in nature and arose as a result of reliance upon either an external system for data or incomplete data. MPAN inaccuracies represent either:

- where the customers are connected but are not being traded; or
- multiple feeder sites where it has proved impossible to distinguish between primary and secondary MPANs.

3.2.3 Inaccuracy in the Connectivity Model

Aquila: Inaccuracy in the connectivity model relates to the counting process and is caused by 25,000 customers being in the model and not connected to a defined cable since insufficient address information exists to place them. The impact of the 25,000 unconnected customers produces an undercounting inaccuracy of 1.1% in reported customer numbers affected by an incident. Experience suggests incorrectly connected customers produce a further 0.02% inaccuracy. These figures substantiate the company's claimed accuracy level of 98.9%.

EME: Errors stem from a number of factors:

- 20,000 MPANs not allocated to the connectivity model (0.8%);
- a further 25,000 MPANs (1% approximately) are assigned to the model at HV level but are not attached to an LV feeder. These are assigned to a default LV feeder in the model, but are not included in counts of customers affected by faults on LV feeders. These will be assigned when additional information becomes available.
- Main source of error is the manual input of feeder details into the system.
- It was not possible to determine the exact accuracy of the model. The company estimates that the MPANs are recorded onto the connectivity model with an accuracy greater than 95% hence the range 95% - 98.9% and 95% - 99.5% for LV and higher voltages respectively.

EPN: At present 0.75% of MPANs are not allocated to the model due to a deficiency in the postcode/address data on which the system relies. Remedial action is being taken regarding this. EPN estimates a level of accuracy of 90.52% at LV feeder level and 94.39% at distribution transformer level. These comparatively low figures stem from a significant number of MPANs being assigned to Feeder 0 which require manual review and subsequently assigning to the correct feeder.

LPN: 0.79% of MPANs are not allocated to the model due to a deficiency in the postcode/address data on which the system relies. Measures are in place to proactively reduce this figure. LPN estimates an accuracy of 93.45% at LV feeder level and 98.03% at distribution transformer level.

SP Distribution: The programme for the completion of the proposed connectivity model for SP Distribution was intended to be April 2002 but due to unforeseen difficulties the target completion date was extended to September 2002. The visiting auditors were able to confirm that the new connectivity model was accurate against existing mains records for five randomly selected feeders. However, the visiting auditors were unable to confirm the overall accuracy of the new connectivity model as it had not been completed at the time of the audit.

SP Manweb: The accuracy of the proposed LV connectivity model could not be assessed owing to the delays with the development of the connectivity model. Work on the connectivity model for SP Manweb is not scheduled to finish until March 2003. The visiting auditors were unable to confirm the

accuracy of the company's new connectivity model as it had not been completed at the time of the audit.

UU: The level of inaccuracy error for the LV connectivity model relates to those properties which have been placed on a post-code centroid due to only having partial postcode details.

WPD South West: The level of inaccuracy represents either invalid feeder or invalid substation references.

WPD South Wales: The level of inaccuracy represents either invalid feeder or invalid substation references.

YEDL: The 3.5% inaccuracy represents MPANs that have not been counted due to problems with connectivity issues within the GIS systems.

SPN: Accuracy figures were generated using a statistical model developed for SPN.

NEDL: Levels of inaccuracy are related to inconsistencies in the logical connectivity model. For example:

- a new LV main on a different feeder being laid nearer to the premises than the original feeder;
- more than one main on a different LV feeder-way runs close to the property;
- LV network operating arrangements are different to the planned running regime.

Over time as knowledge of the systems grows procedures are in place to improve this accuracy.

SSE Southern: The level of inaccuracy in the connectivity model is due to the difficulties associated with street ends and corners, twin cables and proximity to substations and link boxes.

SSE Scottish Hydro: The minor inaccuracy in the connectivity model represents work in progress by SSE in processing new MPAN applications.

3.2.4 Interpretation of RIGs Definitions

The visiting audit teams generally found that the companies were interpreting the RIGs definitions correctly and that the companies had the systems in place to operate in accordance with them. There were, however, cases found where aspects were lacking or the correct interpretation of the RIGs did not appear to be applied consistently. The key findings are shown below.

One company was found to be including all primary MPANs, regardless of status, in their connectivity model for the reporting year 2001/2. This will be rectified for 2002/3.

One company was not individually identifying re-interruptions during the 2001/2 reporting year. It made an estimate of the re-interruption rate and applied this retrospectively to the 2001/2 figures for the number of interruptions.

After auditing a number of companies it became apparent that there was more than one way to interpret the three-hour rule for re-interruptions. Some companies had interpreted this to mean that a re-interruption occurs if a customer loses supply within three hours of when its supply was restored

following any prior interruption during the same incident. Others, however, had interpreted this to mean that a re-interruption would only occur if any of the customers involved in an incident lost supply again up to three hours after supply was restored to all the customers involved in the incident, i.e. the completion of the incident. For protracted incidents, where the final restoration may take many hours, this second interpretation could include interruptions many hours after initial restoration in the count of re-interruptions. Some companies combine both definitions and report re-interruptions in either eventuality.

We believe that the first interpretation is the more appropriate one. This issue must be clarified in the RIGs to ensure that companies are all using the same methodology when reporting incidents.

3.2.5 Reporting into Ofgem's Template

There were generally few errors with reporting into Ofgem's template particularly where automated software is used.

3.3 Stage 3: Accuracy of Incident Reporting

3.3.1 Summary of Findings

Table 3-3 summarises the results of the auditing into the accuracy of incident reporting. It should be noted that as a result of the implementation of connectivity models throughout the period being audited, the results are generally a combination of reporting errors and old system inaccuracies. It should also be noted that these figures represent "net" accuracy with under- and over-reporting in the audited sample summed together to give a single variance figure for the sample.

The percentage accuracy results presented in Table 3-3 were derived by dividing the total reported CI and CML for the sample into the total audited CI and CML. Where over-reporting occurred and the percentage result was above 100%, the result was converted to an accuracy figure less than 100% by dividing the modulus of the variance into the audit CI or CML and subtracting this number from 100%. Over-and under-reporting are indicated in the table.

Table 3-3: Summary of Incident Auditing Accuracy Results

Company	Higher Voltages		LV		Overall Accuracy	
	CI	CML	CI	CML	CI	CML
Aquila	87 % (over)	87 % (over)	81 % (under)	88 % (under)	92% (over)	94% (over)
EME	100 %	99 % (under)[1]	99 % (over)	95 % (over)	99% (over)	99% (over)
EPN	87 % (under)	86 % (under)	57 % (under)	57 % (under)	84% (under)	79% (under)
LPN	74 %(under)	94 % (under)	70 % (under)	76 % (under)	73% (under)	83% (under)
SPN	100 %	98 % (under)	68 % (under)	62 % (under)	97% (under)	92% (under)
SP Distribution [2]	100 %	100 %	94 % (over)	96 % (under)	99% (over)	99% (under)
SP Manweb [2]	99 % (over)	98 % (under)	96 % (under)	96 % (under)	100% (under)	98% (under)
NEDL	99 %(over)	100 %	90 % (under)	89 % (under)	99% (under)	97% (under)
SSE – Scottish Hydro	100 %	100 %	99 % (under)	90 % (over)	100% (under)	99% (over)
SSE – Southern	99 % (under)	97 % (over)	78 % (under)	91 % (under)	96% (under)	99% (under)
United Utilities	97 % (under)	98 % (under)	55 % (under)	58 % (under)	87% (under)	84% (under)
WPD South Wales	93 % (over)	99 % (over)	94 % (under)	89 % (under)	94% (over)	99% (under)
WPD South West	99 % (under)	100 %	90 % (under)	98 % (over)	98% (under)	100% (over)
YEDL	92 % (under)	92 % (under)	98 % (under)	95 % (over)	93% (under)	96% (under)

Notes:

1. 99% accuracy excludes the result of incident 23-196. This was a very complex incident that involved significant changes to the network since the time of the fault. Including this incident in the audit results would have distorted the results as it is an outlier.
2. It should be noted that the proposed connectivity model was not complete for either SP Distribution or SP Manweb at the time of the audit, therefore this assessment could only check the accuracy against the old system that was still in use.

As discussed in Section 1.1, the DNOs are required to meet minimum levels of accuracy when reporting CI and CML to Ofgem. The minimum accuracy levels for incident reporting comprise an overall accuracy level and a specific accuracy level for incidents occurring at LV, and are intended to include Stage 1 system accuracy under the audit framework devised by the MM/BPI consortium. Due to the change in systems implemented by most of the companies during the course of the 2001/02 reporting year, it is not considered possible to combine the Stage 1 and Stage 3 accuracy results, however a proposed methodology for combining the Stage 3 LV and higher voltage audit results is presented in Appendix A along with a table of combined accuracy results for each company using this methodology (Table A-1). Combining Stage 1 and Stage 3 accuracy results will be considered as part of our future work.

As part of the analysis undertaken following the audit visits, various methods were considerd for identifying outliers in the audit results whose inclusion could distort the audit results. A common approach for identifying outliers in a normal distribution is to identify points beyond a certain number of standard deviations away from the mean of the sample. However, it is not clear from the audit results whether the variances between reported and audited figures are normally distributed and further work is required in this area. The results of one incident in the East Midlands Energy HV CML audit has been excluded from the accuracy calculations due to its extreme magnitude, accounting for approximately 100% of the total variance reported for the audited sample. Exclusion of outliers will be considered as part of our ongoing work.

3.3.2 Incident Reporting at the Higher Voltages

Some of the principle issues surrounding the auditing at the higher voltage levels are as follows:

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 is semi-automatic for manual switching operations and the potential for error is considered to be low.

However, the transfer of information into NaFIRS in many cases requires manual intervention and therefore the possibility of transcription errors exists. This conclusion is reinforced with variances in Customer Interruption times being primarily due to errors made by control engineers in transferring the respective incident start and end times from the switching logs to the reports.

In addition, the recognition of re-interruptions at this level is also manual in some companies and this was found to lead to significant over-reporting errors in the final CI count.

The majority of the differences found in the system count could be attributed either to changes in customer numbers or to input error. The precise reason for these differences was often difficult to determine during the audit visits, as there were no records of abnormal system configuration at the time of the incident or changes in customer numbers since the time of the incident. These points are discussed in more detail in Section 4.2.

At one company, where a paper-based logging system is used to record times for the restoration stages, transcription errors were found in the NaFIRS reporting which could then be carried through to the incident reporting.

At another company, it was found that there was the potential to double count incidents that initially occurred on the LV system but caused an associated interruption at the higher voltage level. Conversely it is possible for them to be missed entirely. A clearer understanding is required as to where to report the incident e.g. if the faulted component is on the defined LV system then it is only reported there.

3.3.3 LV Incident Reporting

Some of the principle issues surrounding the auditing at the LV level are as follows.

Where manual intervention occurs it can be a major source of inaccuracy. Inaccuracies caused by human error were wide-spread and included:

- incorrect interpretation of information recorded;
- incorrect description of the incidents;
- incident start times manually recorded then reported later;
- incorrect transcription from automated systems to reports.

It is noted that these inaccuracies will be reduced by improvements to training programmes and through increased automation of the reporting process.

The audits generally found that the accuracy of reporting was greatest where incidents affected whole LV feeders and the LV connectivity models indicated the numbers of customers affected by the operation of the associated fuse or fuses.

In the case of SP Distribution and SP Manweb, in the absence of the proposed LV connectivity model, the number of customers interrupted for a whole LV feeder was obtained by dividing the customer numbers at the distribution transformer level by the number of outgoing LV feeders. As LV connectivity models were not available for these two companies, the audit teams used the same approach so that the accuracy results for these two companies simply reflect how accurately the companies followed the procedure. They do not give any indication of accuracy against actual customer numbers as was possible for all other DNOs.

In situations where an LV incident only affects part of an LV feeder, i.e. at sub-feeder level, the potential for inaccurate reporting of customer numbers is significantly increased. This is due to the fact that the office-based dispatcher relies heavily upon the field operative to estimate the number of premises affected by the supply interruption. In several cases where an estimate from the field operative was not available, the number of customer calls received by the company was used as the reported number of customers interrupted, giving a high potential source of error.

The introduction of LV connectivity models has improved the ability of the companies to report sub-feeder faults accurately, providing the dispatcher with the number of customers on a given feeder so that any estimate made by a field operative can be validated against the connectivity model. In a number of companies the LV connectivity model is integrated with a network diagram laid over the physical layout of premises, giving the company the ability to accurately determine the number of customers affected using property addresses.

Cases were found where customers refused a temporary connection or agreed to remain off supply if the repair was not going to be convenient for them, for example during the night. It was found that at some companies the incident clock was stopped in this situation, thereby not giving an accurate record of the total duration of the incident. Other companies recorded the entire duration of the incident. There is no guidance in the RIGs on this point and it was found that the auditors used different approaches at different companies when determining the actual duration of the incident. This is an important point for both the companies and the auditors and is discussed further in Section 4.3.

The audit found that in some cases further emphasis was needed on obtaining the correct number of restoration stages for incorporation into the reports and also ensuring that where re-interruptions occurred they were recorded as such. Whilst in many cases this re-interruption error was due to a failure to recognise that a re-interruption had occurred when completing the incident report, a method to create an automated warning of when a re-interruption occurs would be useful.

The accurate reporting of incident start times has also proved to be a source of error with a number of factors leading to incorrect reporting, including:

- dispatchers using the time that the incident was first created in the incident recording system as the start time rather than the time that the company first became aware of the fault, such as via the first customer call;
- errors arising when information reported by field operatives was transferred into NaFIRs reports;
- when customer calls advise a problem with supply but that supply has not actually been interrupted.

An interesting case arose where a customer had called in to report the smell of burning despite their supply not being interrupted. The customer was advised by the person taking the call to switch off the power and the time of the call was used as the start of the incident in the incident report. However, it was apparent from the incident logs that supply was not interrupted until the field operatives arrived on site and isolated the supply and this latter time should have been used as the incident start time.

Generally it was found that the more complex the incident (more customers, more restoration stages, sub feeder, interconnected network) the greater the potential for errors. There was also greater difficulty in auditing the results due to the lack of detailed supporting information regarding the incident.

3.3.4 General Points

The ability to complete the audits and to confirm with any degree of confidence the assessment of system accuracy is dependent upon the quality of the audit trail available within the company. The quality and comprehensiveness of the field reports and notes in the incident reports was poor in a number of cases and this made auditing difficult.

The overall quality of supporting information is expected to improve in the future now that everyone has gained an understanding of how the joint IIP audits will work.

In general, the quality of information recorded at the time of the incident, such as on field reports and switching logs, is considered by the auditors to be a key issue in the subsequent accuracy of reporting. It is also a key issue in providing a robust audit trail for subsequent scrutiny.

Where good information is provided by the field operative and the dispatcher, the person completing the incident reports is required to use less judgement in interpreting the course of events. In turn, this will lead to more accurate reporting of incidents.

4 Summary of Audit Recommendations

4.1 Overview

This section presents a summary of recommendations arising from the 2002 IIP audit of the DNOs. These recommendations are sub-divided into recommendations on the procedures and practices used by the companies to generate incident reports and recommended modifications to the RIGs to clarify points of confusion or to change the emphasis of certain points. Other recommendations on the IIP are also provided.

It is recognised that the procedures used by companies to report incidents have been under development over the past few years and many improvements have been made. Recommendations were made to the companies during the audit visits where problems were discovered and we anticipate that further improvement in reporting procedures will occur as a direct result of the audits.

4.2 Recommendations for the Companies

All of the companies have embraced the IIP requirements and incorporated them into their business practices in one form or another. During the course of the audits, a number of areas where improvements could be made were identified and discussed with the company representatives. In most cases, the companies were aware that improvements needed to be made in certain areas and initiatives were being implemented to improve the awareness of IIP requirements by staff at all levels, such as training programmes and internal audits.

A common view held by the visiting auditors and the company representatives is that the greatest influence on accuracy of reporting is the quality of information recorded at the time of the incident. In almost every audit, examples were found where lack of detail provided by the field operative to the control-room based dispatcher led to inaccuracies in either customer numbers or event times, particularly on incidents affecting the LV network. In these situations, the dispatcher was required to estimate customer numbers or times based on the best available information, for example using the number of customer calls received for customers affected which clearly has high potential for error. It was noticed that some companies had established practices that were consistently used in these situations.

Considering the above, it is recommended that the companies continue their efforts to capture high quality information at the time of the incident. Use of the connectivity models should allow improved communication and agreement of customer numbers between dispatchers and field operatives using fault location details. It would also be useful for audit purposes if notes are made on how customer numbers have been derived for each incident. A number of occasions were observed where the dispatcher had misunderstood the details provided by the field operative on the cause of the fault and developing a standard phraseology between dispatchers and field operatives would reduce the chance of misunderstandings.

The audits also identified a number of areas where the companies were not able to provide sufficient information for the audit to be completed, particularly where abnormal network configurations were experienced and where considerable customer growth had occurred between the time of the incident and the audit. Without this information it is very difficult for the auditors to confirm the actual customers affected by the incident. It is therefore recommended that the companies give consideration

to methods of capturing this information for future audits. Abnormal system configurations could simply be noted on incident reports.

Having the ability to recreate incidents on company systems during the audit was very powerful and a number of companies were able to do this. Some were not, and the audit involved manual counting of customer numbers which was time-consuming and has the potential for error. We understand that the latest version of the ENMAC network management system integrates the HV network diagram with the telecontrol system and it is therefore impossible to recreate incidents in a live environment. Given that annual audits will be a feature of IIP, it is recommended that the companies give consideration to recreation of incidents during the audit.

Further possible improvements to company systems identified by the audits include the following:

- areas where electronic transfer of information could be incorporated should be identified by the companies and implemented wherever practicable to avoid manual transcription and the associated potential for inaccuracy.
- a small number of examples were found where re-interruptions were not recognised by the companies and having some form of automated warning system to highlight the occurrence of re-interruptions would assist in accurate reporting.

In addition to the above the following recommendations are made based on the experience at some companies:

- more than one person should be trained to complete IIP-compliant incident reports in each company to provide for internal cross-checking and back-up in cases of absence from work
- companies should provide better information on the actual duration of planned interruptions for the purpose of the audit.

4.3 Recommended Modifications to the RIGs

The following areas of the RIGs are identified as requiring clarification or modification:

- Re-interruptions: clarification of the three-hour rule for reporting re-interruptions rules is required. A number of companies interpret the three-hour rule as stating that any customers initially interrupted as part of an incident and then interrupted again up to three hours after all customers affected by the incident have been restored are considered as re-interrupted customers. However, we believe that the more logical interpretation of the rule is that any customers interrupted again within three hours of initially being restored at any time as part of the same incident are considered as customers re-interrupted.

- Guidance should be included in the RIGs for recording the duration of incidents where customers elect to remain off supply for reasons such as not wanting to be disturbed at night by work outside their homes. The audit highlighted that most companies stop recording the duration of incidents in this situation. We consider that the complete duration of such incidents should be recorded to ensure that reporting is as accurate and consistent as possible. We suggest that companies are generally able to effect some form of temporary supply restoration in these circumstances as provided for in the RIGs. However, in cases where no temporary supply arrangement can be effected, it might be reasonable to introduce a methodology to avoid penalising the companies, such as reducing the reported CML by the customer's voluntary interruption time. Some form of customer confirmation may be required to prevent companies falsely claiming that customers agreed to stay off supply until permanent repairs had been completed. In any event, a documented audit trail would be needed for subsequent audit scrutiny.
- Clearer guidance is required on the reporting of LV faults requiring shutdown of parts of its HV network.
- Clearer guidance is required on rounding of times generated by telecontrol systems.

5 Lessons Learned

5.1 Overview

As mentioned previously, the audits were seen as a joint company, visiting auditor exercise and this section presents the lessons learned during the course of the audits. It therefore includes lessons learned from every aspect of the work, including experiences gained through using the tools provided, the audit procedure and through comments made by the companies. This section is divided into lessons learned on the three stages of the audit framework.

5.2 Timing of Audits and Resources

The time available to complete the audits and write the reports was limited for the 2001/2002 audit. The deadline for the companies to provide performance figures to Ofgem for the year was the end of May 2002 and the deadline for Ofgem to have the audit work largely completed was the end of August 2002. For the 2002/2003 reporting period, the companies are required to provide performance figures to Ofgem by the end of April 2003 which allows an additional month for the audits to take place. Undertaking the audits in the months on May and June would avoid the holiday season of July and August which had an impact on availability of both auditors and company representatives in this year's audits. Also, completing the audits earlier would allow more time for analysis of the results and completion of the reports to Ofgem.

With the experience gained from this year's audits, we consider that it should be possible to audit a larger number of incidents in the space of a week in future audits to achieve a higher statistical confidence. This is discussed further in Section 5.4

The make-up of the audit teams for the 2001/2002 audit was generally seen as successful, providing a valuable combination of industry experience from BPI and ERA staff and analytical skills from Mott MacDonald staff. We consider that this formula should be repeated in future years. Given the number of licence areas to be audited, having seven teams do two audits each seems to be an appropriate level. Using a smaller number of auditors to complete the audits for the sake of consistency would require each person to complete three or more week-long audits in the space of two months, which could potentially jeopardise the quality of work produced. We will consider these points when developing the audits for the 2002/2003 reporting period.

5.3 Stage 1: Accuracy of Measurement Systems

Use of the questionnaires to guide discussions on the company measurement systems provided a structured approach to this stage of the audit. Asking the companies to agree the contents of the completed questionnaires and countersign the front cover provided a documented record of the understanding reached.

The factual content of all completed questionnaires was agreed by the companies but the formality of signing the front cover of the questionnaires and lodging a completed copy with the companies was not achieved for each audit. Notwithstanding the fact that the factual accuracy of the subsequent reports was also agreed with the companies, the formal completion of the questionnaire process should

be carried-out during future audits to capture the content of discussions held and agreements reached with the companies.

5.4 Stage 2: Statistical Analysis

A common view from the companies was that the higher voltage sample was not representative of the total population of incidents at these voltage levels. Under the IIP companies are required to report CIs and CMLs to the minimum levels of accuracy set out in the RIGs. For the majority of DNOs, incidents at the higher voltage levels give rise to more reported CI and CML than do incidents at the LV level and it is for this reason that they intuitively feel that more incidents at higher voltages should have been audited as part of this year's work.

The incident sampling for the 2002 audit was based upon the need for DNOs to accurately count the numbers of customers affected by an interruption and the duration (time) of the interruption. Under the IIP, DNOs are targeted on the numbers of CI and CML that their customers experience. As these are the two measures targeted for reporting and incentivisation it could be argued that future incident sampling should be based upon these two parameters.

The purpose of the IIP audit is to identify areas of potential inaccuracy in reporting. The 2002/2003 audits revealed that some interruptions contain several restoration stages while others contained only one, especially in the case of single-premise incidents. Incidents with a high number of restoration stages clearly present greater scope for error than an interruption restored in one single stage. Future audit samples should therefore give consideration to the number of restoration stages included. In addition, consideration should be given to stratification of the audit sample by LV services to appropriately handle single-premise incidents which have low probability of error in the count of customer numbers.

Given the experience of this year's audits and recognising that future audits will not have to deal with measurements systems in as much detail, we consider that a larger sample could be audited in a similar timeframe as this year's audit.

The inclusion of spare incidents in the sample was seen as useful by the companies and the auditors for replacing incidents in the original sample that were too complex or time consuming to audit.

5.5 Stage 3: Audit of Incident Reports

Modifications to the first version of the incident auditing workbook had been carried-out following constructive advice and comments from one of the companies. It was important to the work of this year's audit that the incident audit workbook was tested as part of the initial audit visit undertaken at WPD South Wales at the end of June 2002.

The workbook was thus still at an early stage of development at the time that the team training day was held on 20 June 2002

The lack of direct training in the use of the revised workbook for the audit teams has led to the slightly different interpretation that some audit teams have placed upon the use of the 'agreed customer numbers' column.

Inclusion of the 'system' column was intended to provide additional information on any step changes in customer numbers caused by the introduction of any new IIP-compliant connectivity model during the reporting year. In future, all customer numbers should be generated using IIP-compliant connectivity models so the 'system' column will not be required in the incident auditing workbook. For future use, we recommend that the system number should be used for the 'audited customer numbers' unless the company can prove otherwise, for reasons such as customer growth or unusual network configuration at the time of the incident. The companies will therefore need to establish procedures for recording these changes and these procedures may need to be audited as part of Stage 1 in future audits.

Having access to the company IT systems during the audit provided the auditors with more confidence in the figures being examined and generally assisted the audits.

A degree of judgement was required to audit incidents where insufficient detail was available, such as sub-feeder level faults. This did not present a problem during the audits as the company representatives were generally happy to work in an open and constructive manner. However, future audits should aim to reduce the amount of judgement required by defining procedures to handle all foreseeable scenarios. For example, where it is impossible to determine the location of a fault at sub-feeder level, auditors could consistently use half of the customers on the feeder as the agreed audit number.

Future audits should use a list of normal explanations for variance that must be used by the auditors to improve consistency.

All incident reports to be audited should be printed and compiled by the companies prior to the arrival of the auditors to ensure that the audit progresses as quickly as possible. This was difficult this year given the short notice that some companies had on which incidents were to be audited. Sufficient time therefore needs to be allowed in future audits for determination of the audit sample and for notification of this sample to the companies.

Where two licence areas are held by the same company, the audit teams were mixed this year in an attempt to introduce a fresh perspective in the second audit and thereby avoid complacency. This approach was criticised by the companies as induction had to be repeated to some extent for the new auditor. We will consider this argument when recommending teams for future audits.

NEDL uses neutral earth fault alarms to indicate the start times of HV incidents in remote parts of the network where other information is not available. We believe that this practice is unique to NEDL. Consideration should be given as to whether this is the first time that the company becomes aware of a fault or whether the company should use the time of the first customer call for the incident start time.

SSE uses its 33 kV network as a distribution network and NEDL uses its 22 kV network in North Northumberland as a distribution system. In addition, operation of the 132 kV is not reported through the SSE-Scottish Hydro distribution business but is reported through the transmission licence returns. Consideration of these company-specific practices needs to be given when determining future audit samples.

5.6 Analysis of Audit Results

At a meeting with Ofgem, the DNOs and the consortium, it was suggested that the method of calculating the accuracy of reporting should be a simple summation of the under-reported and over-

reported variances as determined by the audit. However, for this approach to be fully robust it is important that the variations between reported and audited values are randomly distributed and are completely symmetrical about the mean. i.e. they can be described by a 'normal' statistical distribution. Initial analysis of the audit results suggests that this may not be the case and that alternative methods of calculation should therefore be considered. For the purpose of the 2001/2002 audit, the summation approach has been used as discussed in Appendix A. However, consideration should be given to other techniques in future. Any calculation method must provide Ofgem with the appropriate outputs for assessing accuracy and adjusting reported performance to mitigate against inaccuracies.

5.7 Future Work

A number of areas have been identified as requiring further work to enable completion of the audits for the 2002/03 reporting year. The most important of these is combination of the Stage 1 and Stage 3 accuracy results from the audits to give a measure of the accuracy of reporting against the real world, predominantly in terms of customers rather than time. A number of different approaches have been considered for this calculation however further work is required to develop a methodology that will be acceptable to Ofgem and the DNOs.

The audit of incident reports is undertaken on a sample determined by statistics to be representative of the entire population of incidents, however any such sampling approach includes the possibility of individual results being non-representative of the total population. Future audit work will therefore need to include consideration of outliers (single points which may unreasonably distort the overall results) and tolerance limits when comparing the audit results with the targets. As discussed in Section 3.3.1, standard statistical approaches exist for consideration of outliers but these are usually based on normal distributions and it is not currently clear whether the audit variance results are in fact normally distributed. A number of methods for identifying outliers and setting tolerance limits have been identified but these require further work before they can be applied in future audits.

During the audits of SP Distribution and SP Manweb it became apparent that their connectivity models had not been completed by 1 April 2002 and were not available for the audit, making it difficult to audit the 2001/02 incident reporting. More importantly, the SP Distribution and SP Manweb connectivity models are not expected to be completed until September 2002 and March 2003 respectively. It was intended that the audits of 2002/03 data would be comparing customer numbers generated at the time of audit by the connectivity models with incident reports generated using the new connectivity models, thereby focussing only on pure reporting inaccuracies. However, the 2003 audits of SP Distribution and SP Manweb will compare customer numbers generated at the time of the audit by the connectivity model with incident reports generated using the old systems, therefore including the impact of the change in systems. From this year's audits, it is apparent that this impact can be very large. Further consideration and discussion is required on the 2003 audits of SP Distribution and SP Manweb to ensure that an approach is found which is fair but does not favour them above other DNOs.

Appendix A Combined Accuracy Results for Incident Reporting

This appendix presents the recommended methodology for combining the higher voltages and LV incident reporting accuracy results into an overall accuracy result consistent with the RIGs. The variances discovered in CI and CML at higher voltages and CI and CML at LV from the sample of incidents audited are extrapolated to give estimated variance in the total CI and CML figures at LV and higher voltages reported to Ofgem. Extrapolation is performed using the ratio of the total reported CI or CML over the audited CI or CML. The resulting estimated variances in the total reported HV and LV figures are then summed to give a single estimated variance in the total CI and CML figures.

Estimated overall accuracy is then determined using the estimated total variance in CI and CML and the estimated total CI and CML as illustrated in the example below. The same calculation is performed for both under- and over-reporting.

Example for Company X

Sample CI reported at higher voltages	40,849
Sample CI audited at higher voltages	38,163
Sample CI variance at higher voltages	-2,686 (over reported)
Total CI reported at higher voltages	1,275,711
Estimated overall variance at higher voltages	= - 2,686 * 1,275,711 / 40,849
	= - 83,884
Sample CI reported at LV	708
Sample CI audited at LV	754
Sample CI variance at LV	46 (under reported)
Total CI reported at LV	61,338
Estimated variance at LV	= 46 * 61,338 / 708
	= 3,985
Combined estimated CI variance	= - 83,884 + 3,985
	= - 79,899
Combined estimated CI accuracy (%)	$= 100 - \text{abs}\left[\frac{-79{,}899 * 100}{(1{,}275{,}711 + 61{,}338 + (-79{,}899)}\right]$
	= 94%

This procedure includes the netting off effect of over-reporting on higher voltages and under-reporting on LV as per the example given and vice versa for other scenarios. We understand that this is consistent with the way in which Ofgem will use the results of the audits and the method agreed for this year at the June 14 workshop.

Table A-1 presents the results of the audit using the above methodology for combining higher voltages and LV results.

Table A-1: Expected variance in Ofgem template numbers

	Expected HV and LV variance				Exptected overall variance and accuracy			
	HV CI	LV CI	HV CML	LV CML	CI	CML	CI	CML
Aquila	-276079	82622	-25094796	8419064	-193458	-16675733	92%	94%
EME	-7640	-2048	1081216	-2270945	-9688	-1189730	99%	99%
EPN	392559	141124	32639057	27384936	533683	60023994	84%	79%
LPN	209655	69150	2187278	13593263	278805	15780540	73%	83%
SPN	-585	50932	2686081	14683459	50346	17369540	97%	92%
SP Distribution	0	-7615	84522	1100712	-7615	1185234	99%	99%
SP Manweb	-4575	4584	1243955	874223	9	2118177	100%	98%
NEDL	-11147	20199	-268485	4085024	9052	3816540	99%	97%
SSE – Scottish Hydro	0	520	0	-1030456	520	-1030456	100%	99%
SSE – Southern	12931	82691	-4808802	6565316	95621	1756513	96%	99%
United Utilities	33740	127426	2065613	20944251	161166	23009864	87%	84%
WPD South Wales	-83884	3985	-768184	1287374	-79898	519191	94%	99%
WPD South West	13391	16996	165480	-733449	30387	-567969	98%	100%
YEDL	92292	3760	6644087	-1686284	96052	4957803	93%	96%

Appendix B Aquila Networks PLC

Appendix C East Midlands Electricity (EME)

Appendix D Eastern Power Networks (EPN)

Appendix E London Power Networks (LPN)

Appendix F SEEBOARD Power Networks (SPN)

Appendix G SP Distribution – South of Scotland

Appendix H SP Manweb – Merseyside & North Wales

Appendix I Northern Electric Distribution Limited (NEDL)

Appendix J Scottish and Southern Energy (SSE) – Scottish Hydro

Appendix K Scottish and Southern Energy (SSE) – Southern Electric

Appendix L United Utilities

Appendix M Western Power Distribution (WPD) – South Wales

Appendix N Western Power Distribution (WPD) – South West

Appendix O Yorkshire Electricity Distribution Limited (YEDL)