Appendix B Aquila Networks plc

B.1 Summary

Alan Taylor and Gordon Roberts audited Aquila from 5th to 9th August 2002. Over the past seven years Aquila has invested heavily in control and incident management systems which have, at its core, a network model which provides real-time physical customer connectivity to the LV network. No inconsistencies were found during the audit of Aquila's LV connectivity model and it can therefore be concluded that the company's estimate that its connectivity model is accurate to at least 98.9% is correct. We can therefore conclude that Aquila has inherently accurate measurement systems in place.

We have no reason to doubt that the company's customer counting procedure using CRNs is 100% accurate, however the categories of MPANs included in this count are not consistent with the RIGs definitions and the accuracy of counting primary-traded MPANs is therefore likely to be less than 100%. The company is, however, reviewing this and is intending to meet the RIGs definition shortly. In all other material aspects we believe Aquila to be compliant. In complying it should be noted that Aquila interprets the beginning of re-interruption timing to be from when the last customer in a particular restoration stage involved in an incident is back on-supply.

The audit of HV and LV incidents showed that a number of errors had been made, although these were mainly due to procedures that have been replaced and automated from the 2002/03 reporting year onwards. Any remaining concerns are of a minor nature.

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 assistance given by Aquila staff to the audit team was extensive.

B.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. The company 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 three regions: North, South and Central, although there are plans to move to two. One control room, located at Tipton, is used to manage the real-time operation of the HV, EHV and 132 kV networks. There are also currently three incident rooms, one per region, from where dispatchers allocate field agents to investigate incidents. The Tipton incident room operates twenty four hours, the Worcester and Stoke incident rooms operate only during working hours and storm conditions.

Incidents are identified through calls to the Power Loss Helpline (PLH), situated at Tipton, or from manual or SCADA operations. Incidents are logged into the Control and Incident Room Automation System (CIRAS) from where appropriate actions are initiated and reporting undertaken. For 132/EHV and HV incidents switching and restoration stages associated with an incident are usually 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 input manually into a fault reporting system. The capability of CIRAS and the fault reporting system used have both changed since the last reporting year (2001/02) and the Interim Review report. Details of these changes and the impact on reporting accuracy are discussed in detail in the main part of this report. However, the principal changes are:

- For reports prepared for 2002/03 onwards the HV, EHV and 132kV networks are managed and controlled and reported in real time through CIRAS. The incidents are timed and reported automatically from within CIRAS, which incorporates actual connectivity data, thus substantially increasing reporting accuracy.
- Prior to 2002/03, incident information was gathered in CIRAS and manually input into a mainframe based fault interruption reporting system (FIRS). For 2002/03 onwards PC-NaFIRS is in use, although data is still manually input from CIRAS reports. The earlier process did not support the collection of re-interruption data. This shortcoming is rectified in the latest system. Data associated with the past fifteen years' incidents have been downloaded from FIRS to PC-NaFIRS. An automated report writing algorithm exists in PC-NaFIRS, which was used to produce the 2001/02 Medium Term Performance Report. Future reports will also be produced this way.
- 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 will be 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 routes. The use of the LV model for fault reporting will greatly improve the counting accuracy for LV incidents.

B.3 Audit Process

This section defines the step-by-step progress of the audit.

B.3.1 Resources

The visiting auditors were:

- Alan Taylor of Mott MacDonald
- Gordon Roberts of British Power International

The Aquila audit team members were:

- Jeff Douglas
- Jonathan Ashcroft
- Mike Wood
- Tony Peters

- Mark Porter
- Peter Walker
- Ruth Turton
- David Higgs

A number of other Aquila personnel were available during the course of the week.

B.3.2 Induction

An introduction to the company's systems was provided on the first morning of the audit. This included presentations on:

- MPAN creation and maintenance
- the connectivity model
- Control and Incident Room Reporting System (CIRAS)
- IIP appreciation and fault audit
- training.

Introductions to other critical processes linked to the audit and associated with the creation of incident reports were made at appropriate times during the week by viewing procedures. Demonstrations of key processes were also made during the week and are reported in the sections dealing with the questionnaires.

B.3.3 Questionnaires

A set of questionnaires was used to record the progress of the company since the interim review. The four questionnaires covered the following areas:

- MPANs: checking the company's progress in correctly counting MPANs.
- Connectivity model: checking the company's progress in accurately locating MPANs on its network.
- RIG definitions: checking the company's interpretation of the OFGEM guidelines.
- Template: checking the company's routines for providing OFGEM with the information it requires.

The MPAN and connectivity model questionnaires support Stage 1 of the Audit Framework. The questionnaire used to determine how the company has interpreted the RIGs definitions supports both Stage 1 and Stage 3 of the Audit Framework.

The template questionnaire is designed to check that the company has interrogated its incident data correctly and summated the requisite information before populating the template used to report to Ofgem. The Template questionnaire thus stands apart from the Audit framework.

The audit process consisted principally of responding to the four questionnaires indicated above and carrying out an examination of a representative sample of EHV/132kV, HV and LV incidents. The examination of these incidents was carried out in order to determine the accuracy that the company reported customer interruptions and customer minutes lost.

Aquila team members were fully involved in discussing the responses to the questionnaires and in producing the initial drafts. Consequently, the resulting completed questionnaires form an agreed response by both parties.

B.4 Accuracy of Measurement Systems and Reporting Process

B.4.1 Stage 1 of the Audit Framework - Accuracy of the Measurement Systems

(i) MPANs

Aquila has identified its primary MPANs by firstly allocating MPANs according to the MPAN principles/guidance detailed in the Master Registration Agreement (MRA). Customers are identified by a customer reference number (CRN) and each customer has only one CRN, immaterial of the number of MPANs associated with its installation. Customer details including MPAN and status are stored in the Network Records System (NRS). NRS allocates the CRNs to customers who are then attached to the connectivity model using these CRNs. All customer counting, including identifying customers affected by incidents is from the connectivity model and is based on the CRN, which is a proxy for a primary MPAN.

Aquila's method of counting customers is approved by OFGEM. A customer is defined in the RIGs as an energised or de-energised entry or exit point where metering equipment is used. For the year 2001/02 Aquila included in its count of customers all primary MPANs (1-skeleton, 2-cancelled, 3-registered not energised, 4-energised, 6-meter removed and 7-de-energised) excluding those disconnected that are automatically excluded, although only 4 and 7 fit the RIGs definition. This approach will have given an over-count of total customers compared to the RIGs definition.

For 2002/03, it is intended that Aquila will count category 4 and 7 MPANs and report them when carrying out LV counts. However, HV counts and the derivation of total customer numbers will still include all primary MPANs. In the near future Aquila expects to have software in place to be able to permit counting of only category 4 and 7 MPANs in association with all three elements of its connectivity model.

Some customers may have more than one MPAN (e.g. import and export meters, off-peak customers). All MPANs are included in the NRS database and where multiple MPANs occur these are mapped to an individual CRN. Consequently multiple MPANs are only counted once in the customer counting process.

The only customers omitted from the process of customer identification by MPAN are unmetered supplies (e.g. street lighting, tenant sites that are metered in bulk etc) and since these comply with MRA rules there is no impact on the accuracy of the customer count.

There have not been any changes in the method of counting customers since the Interim Review and at that time there were no inconsistencies in counting customers.

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 NRS. Sufficient checks exist within the OFGEM audited system to ensure complete accuracy. There is a high level of confidence in this accuracy assumption within the company.

The only possible source of error in customer numbers from counting CRNs is associated with services that have been disconnected and not reported to Aquila by suppliers. Installation of services etc. is carried out by Aquila at present and hence installation reporting is internal and, unlike disconnections, will have a very low probability of not being reported.

The MPAN data flows from suppliers, meter operators and from Aquila's work programming systems feed directly into NRS and automatically update the information relating to new and deleted customers. Changes to NRS are then sent through the interface to the connectivity model on a daily basis. The impact of this automated and regular data flow is to maintain the accuracy of the model.

As a check on the accuracy of the CRN relationship with the connectivity model, four domestic and one commercial CRN were selected at random and their addresses were checked in the model to ensure that they were connected to the correct feeder and substation. The four domestic CRNs were found to be correctly connected. The commercial CRN was incorrectly connected: it was connected to the billing address, which was provided by the Supplier via the data transfer network, rather than the premises. Such dataflows have now ceased but clearly there will be random errors of this nature.

The process used by the company for handling the receipt of the request for the issue of core MPANs was described and discussed. It is an electronic process and as such it is not possible for the company to demonstrate it since it would automatically raise an MPAN for the address used in the demonstration. However, we have no reason to believe that the declared processes are not being followed.

The process used by Aquila to authorise the connection of a new customer to the live network is relatively straightforward at present since Aquila fits all of the services and meters and will energise the supply only if a supplier is appointed. This situation is expected to change, however, once other contractors become involved in connections and metering.

In general we have found no inconsistencies during our checking procedures, even though one error in address matching to the connectivity model was found. We therefore have no reason to doubt that the company's customer counting procedure using CRNs is 100% accurate, however the categories of MPANs included in this count are not consistent with the RIGs definitions and the accuracy of counting primary-traded MPANs is therefore likely to be less than 100%.

(ii) Connectivity Model

Aquila has developed a connectivity model that goes down to the LV mains node that identifies the customer's point of service connection with the LV main. This was implemented between 1995 and 1998. The Network Records System (NRS) maps MPANs to the historic Customer Reference Numbers (CRN) which are used in the connectivity model hence the model effectively only incorporates the primary-traded MPAN.

The connectivity model used by Aquila has the following main elements:

(a) An LV source model in which customers are physically connected to a service joint which contains a source ID. The source ID in turn identifies the distribution substation LV feeder way from which the customers attached to that source are supplied.

(b) An HV model in which a customer's metering information is associated to the HV busbar of the consumer supply circuit breaker or the HV switch fuse unit.

(c) An EHV model in which customers are identified using the plant reference number (PRN) of the customer's HV circuit breaker.

These elements are fully interconnected and provide connectivity throughout the network under normal feeding arrangements. For (b) and (c) correct connectivity is dynamically maintained through CIRAS. Recent improvements incorporate reporting of customers on individual LV feeders. During 2001/02 however, feeder customer numbers were derived by dividing the number of customers connected to a substation by the number of feeders. The LV model is updated within three days for permanent changes.

Customer numbers are updated when a customer record in NRS (Network Records System) has a CRN and a structured address. It is queued on the NRS Interface Table. An application runs daily to bring these changes into the connectivity model and CIRAS. New connections will be connected to the model by an operator, whilst deletions/modifications will be automatically actioned by the software. Such daily updating of customer numbers maintains the accuracy of the model. Daily updating exceeds the update frequency requirement of 14 days required by the RIGS. An SQL routine is available that can be run at any time to provide the current state of customers in the model and these updated figures are reported monthly in the Network Data Services (NDS) report.

Updating the model with operational (temporary) and permanent network changes is achieved in the operational model (CIRAS) in real-time for all non-LV network switching operations. The underlying database (GIS model) is updated using well-defined procedures, requiring a System Operation Requirement (SOR) document for planned changes to HV and EHV networks, which records the required change and is used to update the model once it has passed through the relevant review channels. Temporary changes to the HV model are made directly by the control centre into CIRAS and when necessary a NAN (Network Alteration Notice) passed into NDS to produce a new permanent patch. Changes to the LV model are first sent to Quality Assurance to ensure that the required information to apply the change has been provided before the alteration is sent to the LV team for updating of the LV model. Temporary alterations at LV that are going to be on the system for five days or more or that significantly affect the customer connectivity to the LV model are forwarded to the LV team by fax to be incorporated into the model.

The accuracy level of the connectivity model is predicted by Aquila to be 98.9% as at 30 July 2002. The inaccuracy of 1.1% represents 25,089 customers that are in the model but not connected to a defined cable since insufficient address information exists to place them. The number of unconnected customers has been reduced from 140,000 in August 1997 and 37,000 at the time of the interim audit and resources are in place to maintain a 1.5% internal target figure for unconnected customers in the model. During the 12 months period 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, representing less than 0.02% of the total customers affected.

Reconciliation between the customer database (NRS) and the numbers of connected and unconnected customers via the model verifies the company's estimated level of accuracy. The connectivity model continues to be validated electronically and manually through the application of ISO certified procedures.

The connectivity model contains 2,864 linked customers connected to more than one feeder in the model since their exact linkage is unknown. This is done to ensure complete carding for planned interruptions. These customers could be incorrectly included in an incident. The total customer count is not affected by this.

The overall accuracy of modelling is also affected because there are 40,000 customers in NRS whose addresses are not sufficiently structured. These customers are not in the connectivity model and hence have not been included in either fault reporting or customer numbers and will therefore have no impact upon reported accuracy of network performance. The implementation of the industry Standard Address Format (SAF) compliant addresses has resolved this issue for recent and future customers but there remains a backlog of addresses that require improvement before they can be processed.

As part of the audit process, customer counts for five randomly selected LV feeders were checked against the numbers of customers indicated by the connectivity model diagram. This diagram showed the OS mapping of the area, LV mains, customer connection points and number of customers connected at each location. In each case the customer counting process derived the same number of customers as was counted from the connectivity diagram. One out of the five LV feeder examples could not be reconciled due to a major re-generation (demolition and re-build) of the area affecting the supplies. This would lead to inaccuracies in customer numbers until the work was complete and all the details had been entered into the model, but the inherent accuracy of the connectivity model is not affected by this. We therefore have no reason to disagree with the company's estimate of 98.9% for the accuracy of its integrated connectivity model.

(iii) Conclusions

OFGEM has approved Aquila's method of identifying customers by customer reference numbers (CRN), which act as a proxy for primary MPANs. In 2001/02 MPANs in categories that do not relate to connections that agree with the RIGs definition of a customer i.e. energised or de-energised entry or exit points where metering equipment is used, are counted as customers. Examples of these categories could include skeleton, cancelled, registered not energised, disconnected and meter removed MPANs. Consequently, Aquila's reported customer numbers would be high by the amount represented by these classes of MPAN. In future it is the company's intention to filter the counting procedure so that only MPANs in the energised and de-energised categories are counted, thus aligning the customer count with the RIGs definition.

We have no reason to doubt that the company's customer counting procedure using CRNs is 100% accurate, however the categories of MPANs included in this count are not consistent with the RIGs definitions and the accuracy of counting primary-traded MPANs is therefore likely to be less than 100%. Furthermore, there are 40,000 customers whose addresses are insufficiently structured to be included in the network model from where the MPAN count is undertaken. However, these errors would also be replicated in the number of customers impacted by faults and hence negated in reporting network performance.

Our check of customer counts for five randomly selected LV feeders against the numbers of customers indicated by the connectivity model diagram produced no variances so we have no reason to believe that the connectivity model accuracy is other than 98.9% as estimated by the company.

We can therefore conclude that Aquila has inherently accurate measurement systems in place.

B.4.2 Stage 3 of the Audit Framework - Accuracy of the Reporting Process

(i) Audit of HV Incidents

A list of all faults at 11 kV, 33 kV, 66 kV and 132 kV was provided by the company from which a statistically significant sample of nine faults and one pre-arranged interruption were identified for detailed audit. The work was mainly carried out by one member of the audit team accompanied by Aquila staff members. The work took approximately two working days due to the large number of restoration stages on two of the faults, making the replication of the incidents a time consuming exercise.

The company provided all the documentation necessary to carry out the audit; which included a schematic diagram, which was invaluable to replicate the fault; the control log; system event log, giving all the dates and times of operations; and switching schedule and control logs.

Each restoration stage was reviewed for duration and customer numbers. This was a difficult exercise due to network configuration changes. Small differences in customer numbers could be attributed to customer ‘churn’, but larger differences were more difficult to account for in a real time environment without a robust tracking system to identify the network on the day.

For each HV, EHV and 132kV incident, the audited customer and incident durations were entered into the incident auditing workbook for comparison with the reported figures. Where large variances were encountered between the reported customer numbers and the current system numbers for the same part of the network, further detailed investigation was carried out to establish the cause.

During the course of the HV, EHV and 132kV incident audit, no incidents were encountered that were ultimately too complex to resolve, partly due to the companies desire to resolve all issues, Some, however, took a substantial amount of time to review due to the large number of restoration stages.

The following comments can be made relating to the HV, EHV and 132kV incident audit:

- Of the ten incidents audited, the agreed CI figure reconciled exactly to the reported figure in six incidents.
- One incident over-reported customer numbers by 21%. The audit was unable to determine any network changes that would have caused this variance to be so high and it was concluded that customer numbers were erroneously reported. Another incident also had incorrect reporting of customer numbers.
- One incident was reported in error: low volts were reported but it was not a fault.
- One fault missed out a re-interruption stage.
- The pre-arranged incident relied on manual input of information. This will be automated through CIRAS in future.
- Differences and errors in CML were largely the result of errors arising from CI differences, missed restoration stages and re-interruptions.
- For most HV, EHV and 132kV interruptions time stamping of the incident is applied by the telecontrol system, except where switching is carried out using non-telecontrolled devices. However, currently transfer of information into PC-NaFIRs requires manual intervention with the possibility of transcription errors.

In the sample of two HV incidents, one contained a significant human error arising from the process used at the time, which may not be representative of the system as a whole. This process has now been automated, which will avoid such an error reoccurring.

(ii) Audit of LV Incidents

In a similar manner to the HV audit, the company provided a list of all LV incidents from which 110 were chosen to represent a statistically significant sample for review. The incidents were divided for analysis between the two auditors, who were each accompanied by one member of staff from Aquila. The LV audits were carried out in parallel. The work took approximately one and a half days.

The company provided copies of:

- the PC-NaFIRS data (although PC-NaFIRS was not in use during the 2001/02 reporting year, FIRS data was downloaded to PC-NaFIRS later, before it was decommissioned)
- the CIRAS log: restored phase list detailing the switching history
- the telephone call history from CIRAS
- fault history printout (from CIRAS)
- LV fault report (only Tipton incidents, not Stoke and Worcester).

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

- To arrive at the customer numbers used in the reporting process for 2001/02, the company divided the number of customers connected to a distribution substation obtained from the HV connectivity model by the number of LV distributors. This approach assumes that the customers are connected evenly across the feeders. This proved not to be the case and resulted in the large inaccuracies in some of the figures, as noted above. The company has improved its LV counting process and is now using the physical connectivity model to identify customers against LV feeders. This model has existed since 1998 but was not previously used due to the lack of integrated systems required for reporting. Use of the model will improve the accuracy from 2002/03.
- Of the 110 incidents audited the agreed CI figure reconciled exactly with the reported figure in 30 incidents. A further 15 incidents were within the range of acceptable ‘customer churn’. There were therefore material errors in 55% of the incidents reported.
- One incident could not be audited as there was insufficient information.
- In 13 incidents the customer numbers had been input incorrectly when transferring from CIRAS reports to PC-NaFIRS.
- Nine incidents had restoration stages missing, which had a significant effect on CML. The errors were caused by a failure to interpret the notes correctly even though the restoration stages were clearly identified. One incident reported an additional restoration stage.
- Re-interruptions were not reported but included in a bulk adjustment at the year-end. This affected one incident from the sample. Re-interruptions will be included in future.
- In two incidents CML were not included when the customer agreed to stay off supply overnight. These should have been included.

- The duration of incidents was generally well reported. The most significant errors were due to issues highlighted above relating to incorrect customer numbers, missed restoration stages and incorrectly reported start times. The mis-reported start times were generally due to the company recording the time the company first became aware of the incident i.e. damage but no loss of supply, rather than time the customer lost supply due to fuses being pulled. These errors altogether have had a significant effect on the accuracy of the CML reported.

(iii) Interpretation and implementation of the definitions and guidance from the RIGs

In order that Aquila staff become conversant with the IIP process and the RIGs, training has been instituted on a structured basis so that employees have the levels of understanding required for their individual responsibilities. Training has been delivered to electricity business centres (to clerks, engineers etc), Network Data Services (responsible for updating source information), Network Operations staff and managers, and to other distribution offices and contractors. Also, structured courses are now available through the training centre. Training has also been given to PC-NaFIRS users to ensure compliance with the RIGs. A guidelines document has also been issued: 'Processes and Guidelines for the Collation and Reporting of Network Performance Information'.

Aquila is operating generally in accordance with RIGs requirements. Its definition of an incident is aligned with the RIGs, which are built into PC-NaFIRS so that the measurement and reporting systems only contain the relevant information. All incidents of three minutes or longer are recorded in PC Nafirs in accordance with Engineering Recommendation G43/3.

The start time of an incident is the first report of an abnormality involving a physical break in the circuit, which is either obtained from a customer phoning the Power Loss Help Line or from the time an event is logged by the Primary Control System (PCS). This information is then fed into the Secondary Control System (SCS). For 132, EHV and HV, the start and completion of an incident is noted in real-time whereas manual inputting of data from field reports is used for LV.

Short interruptions are recorded by interrogation of remote control devices to obtain incident details and association with the network model to determine customer numbers. Detailed descriptions of short interruption reporting are given in Section B.7.

The start and end of a restoration stage are recorded automatically in real time for 132, EHV and HV incidents, except where reported verbally when field operations take place. For LV incidents, field reports to the incident room form the basis of the company's recording of restoration stages.

The derivation of customer numbers involved in restoration stages differs at HV and LV and has changed since 2001/02. For 2001/02, from the start of the year, for 132, EHV and HV incidents a non real time connectivity model was used and there was a progressive change from this to a real-time model from mid-year.

For LV incidents in the 2001/02 reporting year customer numbers for each feeder were obtained by dividing the total substation customers by the number of feeders. The customer numbers were derived from the HV connectivity model. For the 2002/03 operating year, a connectivity model is being used, which is updated every 24 hours.

The identification of the number of customers re-interrupted has been a problem for many DNOs in the past. For Aquila, in 2001/02 re-interruptions were not individually identified. At the beginning of

2002/03 an estimate of the re-interruption rate was made and retrospectively applied to 2001/02 data. A re-interruption rate of 3.5% was applied to the total number of customer interruptions.

At LV for 2002/03, re-interruptions after all customers are restored are not automatically reported as re-interruptions but as new incidents. Consequently a retrospective adjustment is made monthly to the PC-NaFIRS records. This re-adjustment is based on an electronic search and manual correction. At 132, EHV and HV, the preliminary fault reports identify re-interruption stages, which are then entered into PC NaFIRS correctly first time, without the need for adjustment later.

To ensure that all unplanned incidents are reported, all system operations and customer calls are fed into CIRAS. Training of key incident room staff has been implemented to ensure that every unplanned incident lasting for three minutes or longer is subsequently recorded on PC-NaFIRS.

Similarly, the process for pre-arranged work requires that all pre-arranged incidents are prior approved by the incident room. The incident room staff then log the incident in CIRAS as planned work, which is then recorded in PC-NaFIRS.

For the reporting of incidents on other systems, grid control and other distribution control systems are in contact with the Aquila control centre and records of an incident are then made in the primary control system in CIRAS to produce a preliminary fault report for entry into PC-NaFIRS. Similarly, incidents are recorded in CIRAS for the various voltage levels. CIRAS reports are again input to PC-NaFIRS.

Recording of incidents and re-interruptions is now automatically recorded in CIRAS in real-time for 132, EHV and HV incidents. Prior to 2002/03, incident reporting was manually recorded with reference to CIRAS. LV incidents are recorded from customer calls and reports from field staff and manually recorded in CIRAS. CIRAS paper reports are used to input data into PC-NaFIRS for the compilation of reports to OFGEM. Other changes since the Interim Review include PC-NaFIRS replacing an existing mainframe fault reporting system (FIRS) in April 2002. Also, an LV connectivity model for LV fault reporting is in use for 2002/03 reports, rather than an approximation method, as discussed earlier.

In order to confirm the accuracy of the overall reporting process a fault reporting audit procedure has been introduced to check 5% of HV and 1% of LV fault reports produced by PC-NaFIRS. This process incorporates visits to staff at all three incident rooms.

Aquila interprets the commencement of timing for a re-interruption to be 3 hours (18 hours if restoration uses temporary supply arrangements) after restoration of all customers; re-interruptions are further identified as customers who have experienced an interruption during previous restoration stages of the same incident before all customers have been restored. Some other companies commence the timing from the moment that the re-interrupted customer is restored.

(iv) Conclusions

General conclusions on the audit of HV, EHV and 132kV incidents:

- A major source of error in 2001/02 was in the reporting of customer numbers because for part of the year operators had to obtain customers numbers affected by an incident by summing customer numbers at individual substations along affected feeders. For 2002/03 this process is automated and this source of error will be greatly reduced.

- In 2001/02 re-interruptions were not logged as they occurred. Instead, a reconciliation was made at year-end by increasing CI numbers by 3.5%. This clearly will have introduced an error. For 2002/03 re-interruptions will be reported automatically and the associated customer numbers will also be automatically available, thus removing this source of error.
- Pre-arranged incident data relied on the switching programme for reporting outage times etc. In future pre-arranged incident events will be correctly reported by a manual logging process in CIRAS.
- Transcription of data into FIRS was manual, as it is currently into PC-NaFIRS. Although no errors were found in this process at HV during the audit, some were at LV.
- Some incidents were difficult to audit. Better knowledge of the system configuration at the time of the incident would aid future audits. This could possibly be achieved by screen-printing the system at the time of the incident.

General conclusions on the audit of LV incidents:

- The derivation of customer numbers for LV incidents caused significant errors in 2001/02. A direct counting capability of customers related to feeders has been introduced into the LV reporting process and should greatly reduce this source of error.
- In some instances the timing of no-supply loss incidents begins when the incident is reported, not when the customer is interrupted. This could be due to a misinterpretation of reports or due to a lack of understanding of RIGs requirements.
- Re-interruptions were not reported in 2001/02. In future re-interruptions will still be reported from the incident rooms for input to PC NaFIRS. It is necessary for staff to understand the RIG requirements in this area.
- Customers who agree to remain off-supply overnight are not being considered correctly in terms of CML.

In terms of interpretation and implementation of the RIGs, we conclude that Aquila is not currently counting MPANs in accordance with OFGEM approved procedures and is aiming to ensure that in future only primary traded MPANs are included in line with the RIGs requirements. Aquila interprets the beginning of re-interruption timing to be from when the last customer involved in an incident is back on-supply, and also from when customers were restored in a previous restoration stage before all customers have been restored.

B.5 Overall Impressions

Aquila is devoting considerable resources to IIP. The requirements of IIP are well understood within the company and any limitations present in existing procedures are identified and are being addressed. There is an impressive and versatile connectivity model available, which is being increasingly adopted together with further automation of CIRAS in the network performance reporting processes. Training has been implemented, although judging from the results of the HV and LV incident audits, in common with other DNOs, more may need to be done to ensure that incident data is correctly derived, noted, interpreted and input into NaFIRS.

B.6 Conclusions

Table B-1 presents the results of the 2002 audit of Aquila Networks plc in-line with the auditing framework. Under- and over-reporting are indicated in the table. The overall accuracy results have been determined by extrapolating the audit sample variances to estimated variances in the annual total figures reported to Ofgem and then summing the LV and HV estimated variances to give an estimated overall variance, which is then used to determine accuracy against overall reported figures.

Table B-1

Stage	Item	Accuracy
Stage 1	MPAN Measurement	100%*
Stage 1	LV Connectivity Model	98.9%
Stage 1	HV Connectivity Model	98.9%
Stage 3	LV Incident Reporting Accuracy – CI	81% (under)
Stage 3	LV Incident Reporting Accuracy – CML	88% (under)
Stage 3	HV Incident Reporting Accuracy – CI	87% (over)
Stage 3	HV Incident Reporting Accuracy – CML	87% (over)
Stage 3	Overall Incident Reporting Accuracy – CI	92% (over)
Stage	Overall Incident Reporting Accuracy – CML	94% (over)

* Aquila's process for counting customers is considered to be 100% accurate but at present, a number of incorrect categories of MPANs are included in the customer count so accuracy of counting primary-traded MPANs in accordance with the RIGs is likely to be less than 100%.

The methods available for counting customer numbers associated with HV and LV faults, together with the procedures for identifying re-interruptions will be more accurate for the 2002/03 reporting year and more accurate incident reporting can therefore be expected.

Aquila expressed concern that the accuracy of any conclusions drawn on the basis of 132, EHV and HV fault incident sample data would be open to serious doubt. EHV and 132kV faults accounted for 5% of CML and 16% of CI with a sample size of seven whilst HV amounts to over 62% of CML and 67% of CI but only a sample of two were audited. Of these two, one contained a significant human error arising from the process used at the time, which may not be representative of the system for HV reporting as a whole. This process has now been automated and will avoid such an error reoccurring. In addition 110 LV faults were audited which account for 17% of total CML and 11% of CI.

B.7 Reporting to Ofgem's information template

Aquila uses the PC-NaFIRS software to collate IIP reporting data and to automatically produce reports in the format required by OFGEM. OFGEM has approved the format of reports and process associated with this software. As mentioned earlier, PC-NaFIRS was used from the beginning of the 2002/03 reporting year. A mainframe based reporting system (FIRS) was used prior to this, which had certain reporting limitations. The FIRS data were migrated to PC-NAFIRS in April 2002 and the 2001/02 information submitted to Ofgem was prepared in PC-NaFIRS using this migrated data.

A questionnaire was discussed with Aquila associated with the company's reporting procedures relating to the 2001/02 template data. The comments below relate to the responses to the audit questions in the questionnaire.

B.7.1 Interruptions

The total number of customers reported is the total number of primary MPANS i.e. number of customer reference numbers (CRNs) attached to the connectivity model on the 30th September 2001. As discussed in Section B.4.1(ii), there are currently 40,000 addresses in NRS which are not in the connectivity model due to insufficient address details. The number of CRNs affected by incidents in 2001/02 is also drawn from CRN numbers in the model.

This excepted, all primary MPANS are attached to the model regardless of their status and therefore they are all included in customer counts even though they may not relate to energised or de-energised metered entry points. This does not have a significant effect on accuracy as the additional untraded MPANs represent less than 1% of total customers and are included in both the total customer count and the number of customers affected by faults. The result of this process is currently to exaggerate slightly total customer numbers and equally those affected by faults. In 2002/03 it is expected that primary MPANS relating to energised or de-energised meters only will be included in the customer count.

HV circuits associated with interruptions are automatically identified in PC-NaFIRS since each fault report contains both the primary substation and feeder designation. PC-NaFIRS automatically disaggregates the interruption data into HV circuit totals as part of the year end template production process. A check of the template indicated that the total number of circuits having faults at HV was equal to the number of individual faulted HV circuits shown in the template.

During 2001/02 re-interruptions were not identified in Aquila's systems. As a result, the year end customer re-interrupted figure was derived by multiplying total interruptions by 0.035. This is based upon experience during April/May 2002 of the level of re-interruptions.

From 2002/03, re-interruptions are calculated as the total of customer interruptions on restoration stages flagged as re-interruptions in PC-NaFIRS and where the duration of the restoration stage is three or more minutes. Re-interruptions are then summed across the relevant categories i.e. 132, EHV/HV, LV and pre-arranged outages. The value obtained is multiplied by 100 and divided by the total connected customers for the company to calculate the total number of re-interruptions per year per 100 customers. In future the numbers will be accurately reported automatically by PC-NaFIRS.

Customers interrupted are calculated as the total of customer interruptions on all restoration stages and where the duration of the restoration stage is three or more minutes. Customers interrupted are then summed across the 132, EHV/HV and LV outages to give the total number of customers interrupted in unplanned incidents. Re-interruptions in 2001/02 were counted as interruptions. The process is now automated within PC-NaFIRS and has been approved by OFGEM.

CML are calculated as the total of (customer interruptions * duration in minutes) on restoration stages where the duration of the restoration stage is 3 or more minutes. CML are then summed across the 132, EHV/HV, LV incidents to give the total CML in unplanned incidents.

Customers interrupted (CI) in all prearranged incidents are calculated as the total of customer interruptions on all restoration stages, and where the duration of the restoration stage is three or more minutes, as described above. Customers interrupted are then summed for the interruptions flagged as PA in PC-NaFIRS to give the total number of customers interrupted in pre-arranged incidents.

Similarly, total CML are calculated as the total of (customer interruptions * duration in minutes) on restoration stages where the duration of the restoration stage is three or more minutes, as described above. CML are then summed for the interruptions flagged as PA in PC-NaFIRS to give the total customer minutes lost in pre-arranged incidents.

CI and CML data for NGC, embedded generation and other system incidents are derived in a similar manner.

B.7.2 Short Interruptions

The sum of the number of customers interrupted in short interruptions for the various reporting categories is given below:

(i) Automatic disconnection and restoration

At 11 kV the following items are taken into account:

1) Reclosing circuit breakers with SCADA - Retrieval of SCADA counter readings logged in the mainframe system are used to determine reclosing operations for the devices in any half hour period.

2) Reclosing circuit breakers without SCADA - There are very few of these devices and no data were gathered for 2001 but an average number of reclosing operations was assumed based on average reclosing operations of circuits breakers with SCADA.

3) Pole mounted reclosers (with remote control) - A model has been developed which uses data in the remote control log to determine devices causing short interruptions and the date and time of these short interruptions. The model distinguishes between short interruptions and permanent faults and also groups multiple operations within three minutes together to give the number of short interruptions.

4) Pole mounted reclosers (without remote control) - Annual counter readings are taken during site inspection, values previously recorded in the mainframe asset register (PRMS) are used as an interim measure. The manual readings have been recorded on a set of Excel spreadsheets, in the future they will be recorded in a new asset register (SAP).

For items 1, 2 and 4 a comparison is made with a retrieval from the control room system, CIRAS, which identifies when these devices tripped to lockout such that the counts associated with permanent faults can be subtracted.

The real-time network model is used to identify the number of customers downstream of a device on any day i.e. adjusting for any abnormal network running. Where the date of an interruption is known this procedure is used to identify the number of customers. Where the date of an interruption is not known the normal network running arrangements are assumed.

Recently an automatic switching scheme on the 11 kV network has been introduced which would fall into this category. Work is underway to determine the best way to capture this data. It is expected to use a similar method to the remote control high-speed auto reclosers i.e. by examining the log of the communications equipment to the remote control devices.

At LV the only devices capable of automatic disconnection and re-connection are the ‘re-zaps’. These are sometimes connected for a short time to a single LV feeder after a fault. There is no monitoring regime for these devices at present and associated short interruptions are not counted.

At higher voltages the control system models cannot be used to determine whether short interruptions on the EHV system cause short interruptions on the HV system. No such events were identified using manual systems for 2001/02. The appropriate manual searches will, however, be used to identify short interruption events if they occur in 2002/03 and the customer numbers will then be identified. In future it is expected that an automatic system will be available to count these customers.

(ii) Automatic operation of switchgear and subsequent restoration by manual or remote switching

For the 2001/2 return the data from CIRAS was examined and it was found that while switches can be operated by remote control the time taken to execute the switching exceeded 3 minutes and therefore there are no items in this category.

In future, for such interruptions, as the date and time of the interruption would be known, the real-time network model would be used to identify the number of customers downstream of a device on any day, adjustments could be made for abnormal operating conditions where necessary.

There are no remote controlled devices at LV or devices which would automatically disconnect such that restoration could be made manually within three minutes.

(iii) Manual or remote operation of switchgear

Deliberate short interruptions which affect an entire distribution substation are identified by retrieving data from the control room system CIRAS. This identifies operations such as the connection and disconnection of non-synchronising generators, installation and removal of cross-over links etc. The sum of the number of customers affected is taken to be the number of customers supplied from the distribution substation.

There is no way of recording short interruptions which are instigated manually on the LV system i.e. those which only affect part of a distribution substation. These are thought to be insignificant as deliberate disconnections on this system are unlikely to be for less than 20 minutes e.g. to allow digging in an area of faulty cable.

(iv) Operation of switchgear on other connected systems

For 2001/2 there were no less than three minute losses of infeeds from National Grid from where the primary substations are supplied or from other DNOs at primary voltages.

However, if there were, these would be identified in the control room. As these are such rare events it would be practical to examine them manually to determine the extent of the affected network. The 11 kV source circuit breakers for the 11 kV network could be identified. The date and time of the events would be known so the real-time network model would be used to identify the number of customers downstream of the source circuit breakers i.e. adjusting for any abnormal network running.

There are no infeeds at LV on the Aquila network.

B.7.3 Interruptions Disaggregated by Voltage Level

The reporting template requires reporting by source and by voltage level. Reporting of CI and CML numbers by voltage level is carried out by PC-NaFIRS based upon the appropriate incident flag input with the incident data, in a similar manner to that described for interruptions by source. However, PC-NaFIRS currently has no facility to identify planned LV incidents as service or non-service. In the extraction of IIP data all planned LV incidents are assumed to be non-service.

B.8 Recommendations

The following points were identified areas for further improvement:

- Incident logs, particularly at LV, should contain sufficient information for the sequence of events during the incident to be understood.
- Attention is required to getting incident start times correct at LV.
- Knowledge of network details at the time of incidents would be useful for auditing purposes, particularly if abnormal situations exist.
- Incident start times associated with customers who agree to be of-supply overnight should be treated correctly.
- Staff reporting LV incidents need to ensure that re-interruptions are reported correctly.

B.9 Learning Points

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

- It was found that the use by Aquila 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 took a half day and was very worthwhile.
- For future audits the companies need to provide a more robust audit trail in order to replicate network configuration at the time.