# Appendix F SEEBOARD Power Networks (SPN)

## F.1 Summary

John Woodhouse and Dr Aijuan Wang audited the Southeast England licence area of SEEBOARD Power Networks on 22 to 26 July 2002. A key purpose of the audit was to confirm that the information systems and processes used by SPN meet the requirements of the IIP. From both the system demonstrations and questionnaires completed during the audit it was apparent that the customer measurement systems used and MPAN identification applied by SPN are inherently accurate. It was also apparent that the Information Systems employed are designed to reduce manual errors.

The audit of HV incidents indicated that it met the accuracy requirements set out in the RIGs. With respect to the LV audit, the variances in the number of customers affected by LV incidents, as identified during the workbook audit, were primarily driven by the comparison of the reported values against those derived from the new LV connectivity model. It is important to note when considering the audit results that the LV connectivity model was introduced only at the end of the reporting year from which the audits are drawn. The LV audit also indicated that there is a need for a standard phraseology to better communicate information between field staff and office based staff. There was evidence of errors in reporting the start and the end of the incident which was compounded by the lack of a standard terminology. SPN has recently introduced new protocols for communications with field staff to address this inconsistency.

SPN is a pro-active organisation with a corporate objective consistent with the requirements set by Ofgem. A high level of resource has been dedicated to the IIP, including a comprehensive training and internal audit program. An external consultant has developed a statistical model, which has been used to determine the level of accuracy being achieved.

## F.2 Introduction

SEEBOARD Group is a multi-business company that includes distribution, supply, contract services, PowerLink (a PFI initiative to manage the London Underground electricity infrastructure), generation and Public Private Partnership projects. SPN holds the electricity distribution licence for the area of Southeast England. There are four directors who report to a Managing Director and are responsible for the areas of operations, engineering, IT and finance in SPN. The responsibility for the introduction of information reporting under the Ofgem IIP was led by the Strategy and Regulation section. Ongoing information reporting is managed by PowerCare with input from other business units as necessary. PowerCare comprises:

- Network Management Centre (Control and Outage Planning)
- Trouble Management Centre (Call Centre and Dispatch)
- Customer Operations
- Network Data Management
- Emergency Planning

Powercare is based at East Grinstead, where the audit took place.

### F.3 Audit Process

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

#### 6.3.1 Resources

The visiting auditors were:

- John Woodhouse of Mott MacDonald
- Dr Aijuan Wang of Mott MacDonald.

In addition SPN provided a very high level of resources to support the Ofgem audit.

#### 6.3.2 Induction

SPN provided the visiting auditors with a thorough induction to the company organisations, showing how Ofgem's IIP requirements were met from the existing Information Systems (IS systems) at its power network control centre in East Grinstead. With the information presented both prior to the visit and during the induction it was possible to complete all of the audit questionnaires.

The induction began with an overview of SPN's management and IS systems and a demonstration of the FMS – (Fault Management Systems) used to create LV incident reports and the NMS- (Network Management System), a real-time control system, that controls and models the 132 kV, EHV and HV networks (HV networks).

The induction day also included a presentation of the process used for capturing new customers and relating them to their MPANs and for handling disconnections, changes in customer details and re-referencing of customers using the various SPN IS.

SPN has been pro-active in its approach to IIP and has established a number of controls to ensure that all IIP information is recognised and correctly reported. To support these controls a programme of internal audits has been undertaken during the course of the year. Details of the controls and audits were presented to the visiting auditors during the induction.

The final part of the induction was a description of the internal training that has been undertaken across all disciplines, initially to raise awareness of IIP, then targeted at specialist areas to ensure that Ofgem's requirements are met.

#### 6.3.3 Questionnaires

A set of questionnaires were 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 RIG's 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.

Before considering the audit results it is first worthwhile introducing the overall reporting system used in SPN. Figure F-1 illustrates the integrated IS systems. For the purpose of the IIP, the following are the key components:

- NMS – is a dedicated real-time Network Management System, providing an interactive screen based diagram, telecontrol, switching schedules and event logs and hence records all faults for the networks at HV and above. This was implemented in phases from 1997.
- FMS – is a Fault Management System that manages LV faults. This went live in 2000.
- CMPRS – Master system for MPANs registration. As explained during the audit CIS is used to create MPANs.
- Discovery – is a data warehouse that stores the customer connectivity model.
- MMS – Map Management System is a geo-schematic recording system for all distribution network components (including underground cables, overhead lines, distribution substations etc).
- DataNet – processes the fault information obtained from NMS or FMS by incorporating connectivity models to create fault report and applying the RIG definitions to raw data.

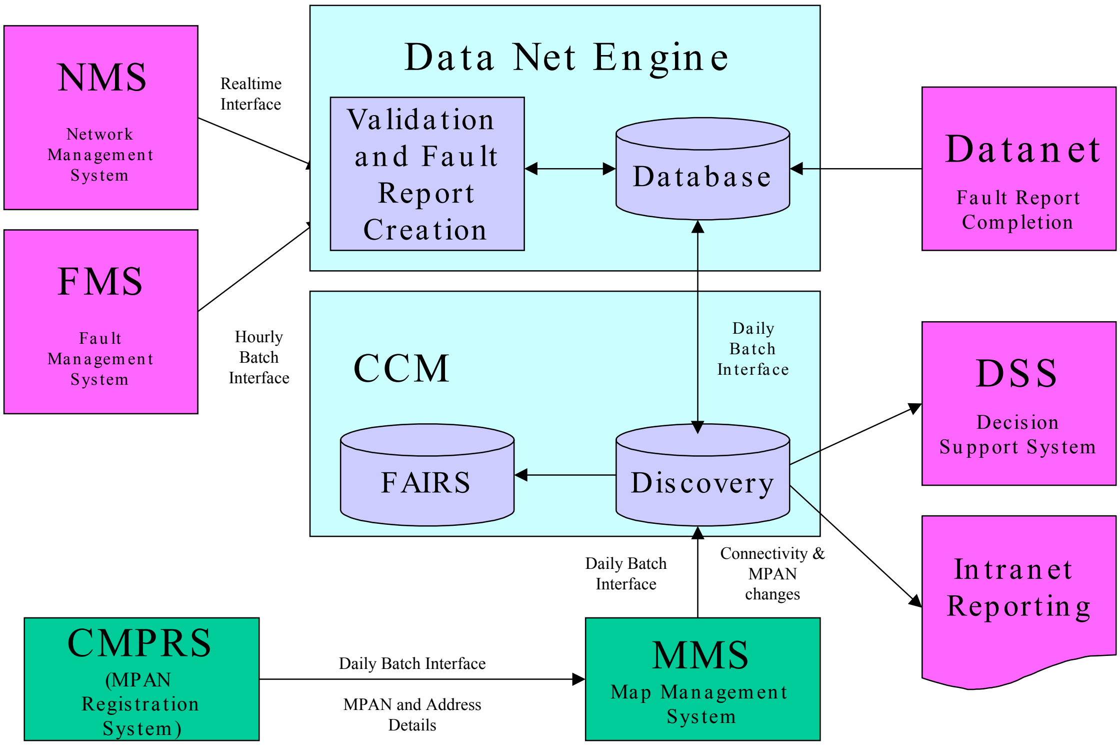


**Figure F-1: IIP Reporting System in SPN**

## F.4 Accuracy of Measurement Systems and Reporting Process-

### 6.4.1 Stage 1 of the Audit Framework - Accuracy of the Measurement Systems

#### (i) MPANs

There are some 2.15 million MPANs in SPN's area. Approximately 38,000 MPANs have been identified as secondary MPANs and are not included in the connectivity model. Therefore, for 2001/02 the number of customers identified by primary MPANs is 2.112 million. Over 98% of customers are identified by only a single MPAN. Only a small percentage of customers have more than one meter. SPN estimates the accuracy of its MPAN count as 100%.

As required in the MPANs questionnaire, the auditor randomly selected and checked four domestic MPANs and one commercial MPAN that were newly connected since February 2001. During the audit of the MPAN methodology, the opportunity was taken to witness how the company deals with the request for an MPAN. The procedure was shown to be both rigorous and robust with mandatory fields requiring completion before the system would issue a core MPAN. The mandatory fields include referencing the address to the LV network as required to update the company's connectivity model.

The type of MPAN, such as residential or commercial, is identified by the Profile Class ID in the database. There are eight different types of MPANs used by SPN, two types of domestic MPANs and six non-domestic MPANs.

This work has also identified connections where multiple MPANs exist enabling the company to eliminate these from its count of the total number of customers (MPANs) connected to its distribution system. The company has therefore identified its primary MPANs by this means. The status of the MPAN is held in the Discovery data warehouse.

It was noted that considerable work has been done to improve the accuracy of address matching of the MPANs in the database since the Interim Review. A number of secondary related MPANs are also clearly identified for the multiple MPANs. Only a small number of related MPANs that addresses are not matching are considered as primary MPANs. Overall the process and methodology used to identify MPANs by SPN is sound.

Ofgem has approved the method that SPN uses to identify its customers by Primary Traded MPANs, including updating of the count. In general this methodology has been applied. However, the original proposed definition made use of Meter Time Switch Codes in the range 5xx, which was intended to indicate that a particular meter is secondary. Hence, for each such MPAN, one would have expected to find a corresponding MPAN at the same address but with a non-5xx MTC. However, during the construction of the CCM, it was discovered that several MPANs existed, which despite having a 5xx MTC, did not correspond to any other MPAN at the same address. SPN therefore took the view that this data that is managed in the supplier domain, was on its own unreliable. Refinements to the methodology were devised and implemented with the aim of avoiding such errors. This ensures that no MPANs are inappropriately excluded from either the model or the customer count. MPANs with a 5xx MTC but for which no corresponding non 5xx MTC MPAN can be found at the same address, are now included in the customer count and in the customer connectivity model as individual customers rather than as secondary and therefore discounted MPANs. SPN is intending to write to Ofgem setting out the amendment to this methodology.

Random tests were conducted on the company's MPAN database where premises have been connected to the company's distribution system within the year under review. These tests confirmed that the selected premises have been issued with a primary trading MPAN and are included in the company's total count of its connected customers.

The process used by SPN to create a new MPAN complies with requirement set by Ofgem. The opportunity was taken to witness the handling of an MPAN request in real time. This reinforced the view that the company is following the procedure that has been agreed with Ofgem. We have no reason to disagree with the company's estimate of 100% for the accuracy of its MPAN count.

### (ii) Connectivity Model

SPN has developed dedicated HV and LV connectivity models and implemented the associated IS infrastructures. As can be seen in Figure F-1, there is a data linkage between the HV and LV connectivity models, which are now described.

The Network Management System (NMS) handles any matters and components related to the HV networks. All HV equipment in the SPN distribution network, their parameters and connecting relationship are stored in NMS. As NMS is an online control system, all dynamic data of equipment and an event occurred are captured at near-real time. Hence the HV connectivity model is also updated at near-real time.

For instance, if a fault occurs at high voltage, NMS is able to identify which connected components are affected and record associated times in every restoration stage. DataNet then validates the real-time information obtained from NMS, processes the data and generates an HV fault report. SPN states that the accuracy of its HV connectivity model is 98.5%. This figure has been derived from a statistical model developed by an external statistical consultant and the auditors believe this to be correct.

LV faults are first recorded in FMS and the LV connectivity model is stored in the Discovery system of the Customer Connectivity Model (CCM), which holds detailed information of all LV equipment and parameters, including customer MPANs.

We understand that there are around 76 000 multiple MPANs in the database. SPN estimates that the accuracy of its LV connectivity model is 94% again based on the model developed by the external consultant.

While witnessing the demonstration of the LV connectivity model, some small discrepancies were found between the number of primary traded MPANs attached to a particular LV distributor in MMS, and those allocated to the same distributor in Discovery. SPN explained that this is an ongoing problem, which will be reduced to a minimum as part of ongoing work. The number and impact of these discrepancies was consistent with the accuracy claims and the errors included in the accuracy model. We therefore consider the estimates of 98.5 accuracy for the HV connectivity and 94% accuracy for LV connectivity to be reasonable.

### (iii) Conclusions

With the exception of the improvement in correctly identifying related MPANs discussed in Section F.4.1(i), no deviations from SPN's method of identifying customers by primary traded MPAN, as approved by Ofgem, were found during the audit visit.

No inconsistencies have been found in the auditing of SPN's MPAN processes and it can therefore be concluded that the company's estimation of 100% for the accuracy of its MPAN count is correct.

No inconsistencies were found during the audit of SPN's connectivity model. We consider that SPN has correctly applied the Ofgem RIG's definitions in its fault reporting system.

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

## 6.4.2 Stage 3 of the Audit Framework - Accuracy of the Reporting Process

### (i) Audit of HV Incidents

The HV incidents were well documented and one of the SPN shift control engineers was available throughout the audit to assist the visiting auditors with both the HV and LV incidents.

The HV control centre covers the whole of SPN's service area and apart from inconsistencies caused by the incomplete LV connectivity model and a free standing telecontrol system for network devices (for example pole mounted reclosers) that did not communicate with the NMS system, all of which have now been rectified, there were no outstanding issues.

When carrying out the audit of HV incidents, it was not possible to initially verify the numbers of HV metered customers affected by particular incidents, as the numbers being derived for the purpose of the audit were produced by reference to the LV connectivity model. This meant that HV metered consumers had to be separately identified by reference to the historic HV connectivity. It should be noted that for reporting purposes this process is carried out automatically within Datanet and hence this did not affect the Ofgem reporting template. It did however cause a few problems with a few incidents where HV customers were clearly affecting CI audit numbers. This was eventually resolved.

Another incident was found where the incident start time was reported 4 minutes later than the actual start time. This was due to a manual transcription error between a free standing telecontrol system and the main NMS system. This has now been corrected so that the data is transferred across electronically rather than manually. SPN has indicated how the human interface has been removed where possible, to minimise the possibility of transcriptions errors occurring.

The following general conclusions can be drawn from the HV incident auditing:

- Measurement of time is automatic on the NMS (SCADA) system where circuit breakers have telecontrol links back to the NMS system. It is recorded by the control engineer on the NMS computer, for manual switching operations, when the field operative reports that the operation was done and telecontrol is not available. It should be noted that in line with industry practice, three times are recorded for each switching operation. One is when the instruction is checked by the Network Management System, the second is when it is given to the field operator, and the third when it is carried out. This means that field operations are also adequately recorded. Field staff are also familiar with the need to record times accurately from this requirement, which pre-dates privatisation.
- Measurement of customer numbers (MPANs) is also automatic, note: the identification of reinterruptions is automatic. As was demonstrated during the visit, all incident data is captured at source and then software algorithms are applied in Datanet to identify re-interruptions.
- There is an established phraseology that is in place between field staff and control staff and this ensures that each knows what the other is instructing or doing. This was not present at LV and the need for such a phraseology system is clear, and new protocols have recently been introduced to address this issue.

### (ii) Audit of LV Incidents

As SPN's LV connectivity model was not commissioned until the end of the reporting period, the reporting of LV incidents was inaccurate. The accuracy of the data reported from LV incidents was also affected by problems of communication between field staff and office staff and where these occurred, data entry errors resulted. However, the impact of the old connectivity model was by far the most dominant factor in the incident audit results, as summarised in Table F-1. The audit indicated that the pure reporting accuracy without the impact of the old connectivity model may have been closer to 92% and 99% for LV CI and CML respectively.

There were a number of incidents audited where errors were evident in the reporting of the incident start time. These are mostly administrative, as it is the office staff who normally received the first call of 'no supply'. However, it did indicate that more training of the office staff was required to correct this.

Several incidents had field staff's best estimates of the numbers of customers off supply, which did not have the benefit of the new LV connectivity model. These estimates were often poor, particularly where more than one street was affected by the incident. SPN commented that this would be better handled by the use of the new LV connectivity model.

Some LV incidents had restoration times that were incorrectly recorded. One LV incident, where the restoration time was not correctly recorded, indicated on first inspection that some customers had actually been left off overnight, but not reported in CML. After reconstructing the incident (as much as was possible from the audit data) and long discussion and a search of other record systems, the auditor was persuaded that this was not the case and that on the balance of the evidence available, it was likely that a restoration stage had been missed out. The correct restoration times were then agreed with the errors shown in the duration of the incident and an additional stage inserted. This error was concluded to be due to poor communication between field and office staff, compounded by a lack of information in the field notes.

For example, one incident was seen where only one phase of a feeder was recorded as affected where in actual fact all three phases must have been withdrawn. The audited customer number was therefore greater than the reported number by a factor of three.

Another LV incident was reported as a new incident when in fact it should have been reported as a re-interruption (as it was within the 18-hour rule, for changeover from emergency generation back to the normal feed).

On one incident it was clear that all the reporting to the office staff had been given after all supplies had been restored. This had produced, in the auditors' view, an inaccurate report as the field staff had given incorrect details that did not match the known facts, resulting in the office staff having difficulties in completing the incident report.

In another incident it was clear from the job notes on FMS that new customers had been inadvertently interrupted, during the repair work, by the withdrawal of the wrong LV fuses at the substation. This should have produced an additional interruption stage in the report, but due to communication problems, this had been omitted.

Some reports included the cause of the incident, which then gave the auditors a clearer picture as to what remedial action would be required. Other incidents did not. For example, one incident reported a damaged service cable, which indicated the scale of the problem to the auditors. Another incident did not state what the cause (or likely cause) of the incident was and this left the auditors having to guess how the incident had occurred, and as the rest of the data was sketchy it was difficult to verify the reasonableness of the interruption times.

The LV incidents were more challenging to audit than the HV incidents as the audit trail was often more difficult to follow. This was not helped by the fact that a standard phraseology, similar to that is used between the control engineer and field staff on the HV networks, had not yet been established in the handling of LV incidents.

In general, the way in which SPN manages the trouble crews who deal with the LV incidents was good and this came across in the audit. This resulted in the LV incidents being dealt with promptly in a prioritised manner.

It should be noted that SPN stated that all their reported incidents were IIP compliant, although the LV connectivity model was still not complete. This was justified by the fact that the application of the RIGs plus the RIGs related training were all in place across the period of the incident reporting that forms this audit. The fact that during this reporting period the LV connectivity model was not finished, which led to variances in the consumer figures reported, was considered by the company to be outside the RIGs requirements, as they stated that a connectivity model was not an explicit requirement of the RIGs for the reporting year 2001/2002.

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

In accordance with the demonstration the visiting auditors witnessed, it was considered that SPN has interpreted the incident related definitions specified in the RIGs correctly and applied them in producing the incident reports.

SPN has worked hard to train its staff in the RIGs requirements and definitions. It has also incorporated the rules into its Datanet fault reporting system. For LV reporting any reportable incident is captured within FMS. The user is then required to complete the FMS report before the fault can be closed down. The supervisor can also view all outstanding reports.

An incident is captured when either:

- a planned or unplanned interruption to supply occurs for 3 or more minutes
- a circuit or item of equipment is prevented from carrying normal load current.

In general the last item does not lead to CI or CML being reported unless supplies are interrupted. A key purpose of SPN’s FMS system is to ensure that all the RIG required processes are followed.

To ensure accuracy of reporting, the person receiving the first phone call will start an incident report in FMS. This comes from the telephone call centre. Once the initial report has been raised by the call centre it is passed to a dispatcher who is then responsible for seeing that the incident is dealt with promptly and that all the required data for IIP reporting is recorded on the FMS system.

All HV incidents (including 132 kV incidents) are recorded automatically on the NMS system where telecontrol connections are in place. In general the control engineers in the HV control centre are already experienced in ensuring that correct times are recorded to ensure RIG compliance since this was also required under NaFIRS. With the new system it is now possible to correctly record the different stages, as the previous NaFIRS system limited the number of interruption stages that could be reported.

SPN has also worked hard to remove the human operative’s error, and during the presentation showed the auditors where HV and LV data transfer had been automated to ensure RIG compliance.

### (iv) Conclusions

The following general conclusions can be drawn from the HV incident auditing. The HV incidents were well reported and recorded with only a few areas of concern. There was one incident where times were not correctly transferred between a free-standing telecontrol system and NMS. It is understood that this problem has now been rectified, as the telecontrol of equipment on the distribution network has now been integrated with NMS. Some difficulty was experienced in the audit to confirm that all HV metered customers were being counted (by MPANs) as the count for the audit was identified from the LV connectivity model. SPN explained the two reasons for such customers not being visible at LV. Firstly, in some cases these customers were shown to have been connected at the time of the fault but had been subsequently disconnected. Secondly where no customers had been found connected at LV, the historic HV connectivity was automatically utilised within Datanet.

The following general conclusions can be drawn from the LV incident auditing. Variances discovered predominantly involved under-reporting of LV incidents. LV reporting should be standardised, and this was being addressed by the recent introduction of communication protocols between field staff and dispatchers. Additionally the reporting of the incident times needs to be improved as a number of LV incidents audited were found to have time recording errors. The audit team is of the opinion that SPN has correctly interpreted the RIGs definitions and that the company is operating in accordance with them.

### F.5 Overall Impressions

SPN is a pro-active organisation with a corporate objective very much in-line with the direction being set by Ofgem. A high level of resource is dedicated to IIP, including a comprehensive training and internal audit program. SPN was very interested in the findings of the audit so that further improvements could be made to its internal processes.

SPN introduced the CCM for LV incident reporting on 1 April 2002, and hence the variances in the number of customers affected by LV incidents, identified during the audit, were primarily driven by the lack of an LV connectivity model. However, the accuracy of the HV reporting substantiates the claim that the customer premises to HV substation connectivity link is more accurate.

### F.6 Conclusions

Table F-1 presents the results of the 2002 audit of the SPN Southeast England licence area 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 F-1**

| Stage | Item | Accuracy |
|---|---|---|
| Stage 1 | MPAN Measurement | 100% |
| Stage 1 | LV Connectivity Model | 94% |
| Stage 1 | HV Connectivity Model | 98.5% |
| Stage 3 | LV Incident Reporting Accuracy – CI | 68% (under) |
| Stage 3 | LV Incident Reporting Accuracy – CML | 62% (under) |
| Stage 3 | HV Incident Reporting Accuracy – CI | 100% |
| Stage 3 | HV Incident Reporting Accuracy – CML | 98% (under) |
| Stage 3 | Overall Incident Reporting Accuracy – CI | 97% (under) |
| Stage 3 | Overall Incident Reporting Accuracy – CML | 92% (under) |

It is important to note when considering the above audit results that the LV connectivity model was introduced only at the end of the reporting year from which the audits are drawn. The audit indicated that if the LV accuracy were based only on the information available at the time, the LV CI and CML Incident Reporting Accuracy may have been around 92% and 99% respectively.

### F.7 Reporting to Ofgem's information Template

Through examining the relevant applications for identifying HV faults and processing the fault data, no discrepancies or inconsistencies have been found. The audit has also checked the input data entered in the Ofgem Report Template and found that they agreed to the numbers produced in SPN's systems.

No incidents occurred on the SPN network from either failures on the National Grid transmission system or other connected systems e.g. neighbouring distribution networks or failures associated with distributed generators during the audit period.

The audit has examined the number of customers interrupted and customer minutes lost for all voltage level faults. Detail has been recorded in the questionnaires.

Overall we consider that SPN has interpreted the RIG definitions correctly and used them appropriately while developing their IS systems.

### F.8 Recommendations

- A standard terminology is needed for LV incidents so that field and office staff are clear as to what was being communicated, and this is being addressed by the recent introduction of communication protocols.
- LV incidents need to show the details of the incident (what, where, how, why and when) to enable the auditors to follow what occurred.
- Certain inaccuracies were contained in individual restoration stages for LV fault reports. These need to be fully handled as part of the SPN internal audit.
- Variances discovered during the audit due to pure reporting inaccuracies (after acknowledging the impact of the new connectivity model) were predominantly under-reporting of LV incidents. It is recommended that the reporting of incident times be given further attention by the company.

### F.9 Learning Points

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

- Having a fully documented audit trail is essential for the successful verification of the audit sample.
- Including the cause of incidents in reports allows further insight into the progression of the incident and the various restoration stages and improves the ability of the auditors to analyse and understand the incident.