Quality of Service Incentive Scheme – Exceptional Events

Appointed Examiner's Report			
Reporting year 2010/11			
DNO	SEPD		
Cause	Catastrophic failure of 33kV switchgear		
Date of event	26 June 2010		

Submitted to: Ofgem

Submitted by:

British Power International Limited

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Glossary

AE	Appointed Examiner
BPI	British Power International
СВ	Circuit-breaker
CI	Customer Interruptions per 100 connected customers
CML	Customer Minutes Lost per connected customer
СТ	Current transformer
DNO	Distribution Network Operator
EHV	Extra High Voltage – all voltages above 20kV up to but excluding 132kV
ENA	Energy Networks Association
HV	High Voltage – all voltages above 1kV up to and including 20kV
NEDeRS	National Equipment Defect Reporting Scheme
NEWSAC	Northern, Eastern, Western and Southern Area Consortium (The inter- DNO system for providing help across the industry)
QoS	Quality of Service
RIGs	Regulatory Instructions & Guidance
SCADA	System Control and Data Acquisition
SEPD	Southern Electric Power Distribution
SLD	Single Line Diagram
SoF	Statement of Facts
SSE	Scottish and Southern Energy
ToR	Terms of Reference

Notes:

Within this document:

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

2. The calculations of CI and CML within this document are adapted from the annual calculations contained in the RIGs to reflect the CI and CML generated by the actual incidents being audited. They are as follows:

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

CI = <u>The sum of the number of customers interrupted for incidents being audited * 100</u> The total number of connected customers

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

In both the formulae above, the total number of connected customers is as declared as at 30 September during the relevant reporting year. Any claims that occur and are audited prior to 30 September in the reporting year during which they occur will be audited using the total number of customers declared at 30 September in the previous reporting year.

Summary

Ofgem has appointed British Power International Limited (the Appointed Examiner) to audit the submission made by Scottish and Southern Energy (SSE) under the "one-off" exceptional event mechanism that an electrical failure within the current transformer (CT) chamber of a 33kV circuit-breaker panel at 23:41 on Friday, 25 June 2010 led to catastrophic failure resulting in the loss of supplies from its Portsmouth Grid Substation at 01:01 on Saturday, 26 June 2010. SSE considers that the incident materially and adversely affected the reported performance for its Southern Electric Power Distribution (SEPD) licensed area for the reporting year 2010/11.

The Appointed Examiner (AE) has visited SEPD to audit the claim against part 1 of the "one-off" exceptional event process and finds that it passes the exceptionality threshold in terms of both CI and CML.

The AE concludes that the event falls within the category of an "other event" as defined in paragraph 8.57 of Special Licence Condition CRC 8, including meeting the exceptionality requirements set out in Appendix 3 thereof.

The AE therefore proceeded to part 2 of the "one-off" exceptional event process, assessing SEPD's performance in mitigating the impact of the event upon its customers.

The AE concludes that, prior to the incident, SEPD had taken pro-active steps to check the condition of its 33kV switchboard at Portsmouth Grid Substation and was satisfied that it was fit for service.

Notwithstanding SEPD's personnel being unable to gain access to the damaged switchgear until the fire services had fully vented the switchroom and declared it safe to enter at 07:00 on Saturday, 26 June 2010, the AE concludes that SEPD's control engineers and field personnel reacted well, restoring as many supplies as possible by alternative means as swiftly as possible, approximately 94% of those affected being restored within 4 hours.

The AE concludes that SEPD's specialist personnel and contractors responded well to the emergency, attending site by 07:00 so as to begin to assess the damage and the likelihood of restoring any of the 33kV switchboard to service.

The AE also concludes that the people deployed to strip, clean, examine, test and restore to service the smoke-affected but serviceable sections of its 33kV switchgear at Portsmouth Grid Substation worked exceedingly well in adverse conditions. Consequently, SEPD was able to restore section 1 of its 33kV switchboard at 20:09 on Saturday, 26 June and section 3 of the switchboard at 09:33 on Sunday, 27 June 2010.

The AE notes the number of mobile generators that SEPD sourced and deployed so as to restore some supplies as quickly as possible.

The AE commends SEPD for installing a temporary 33kV ring-main unit at Portsmouth Grid Substation so as to optimise the security of supply available at that time.

The AE concludes that SEPD had met the criteria of Appendix 4 to paragraph 8.58 of Special Licence Condition CRC 8 and that therefore the incident is deemed to be eligible for adjustment in the DNO's reported performance.

The AE therefore recommends that an adjustment to SEPD's 2010/11 reported distribution system performance is made, in line with the part 1 audited CI and CML figures as shown in the following table:

	Audited number	Number above the threshold	Recommended adjustment	
CI	1.73	0.83	0.83	
CML	4.94	4.24	4.24	

1. Audit part 1

Summary of main facts

- 1.1 The AE's headline information log for this event is set out in Table A-1 at Appendix A. In addition, the following paragraphs summarise the main facts of the event.
- 1.2 SEPD has furnished photographic evidence to support its claim that electrical failure within the current transformer (CT) chamber of the fixed portion of C1T0, the 33kV circuit-breaker associated with the n°1 grid transformer, at its Portsmouth Grid Substation led to the catastrophic failure of the circuit-breaker.
- 1.3 SEPD has also furnished evidence to show that the catastrophic failure was accompanied by electrical arcing and an intense fire that resulted in the tripping of the 33kV circuit-breakers associated with the other two grid transformers, causing a loss of supply to five Primary Substations fed from Portsmouth Grid Substation.
- 1.4 SEPD's protection operated to clear the incident from SEPD's distribution network at each stage.
- 1.5 SEPD's standby engineer was called to site and was investigating the initial circuit trip when the other two circuit-breakers tripped, losing all incoming supplies to the site.
- 1.6 The fire service was called immediately SEPD's standby engineer discovered smoke coming from the 33kV switchroom. The fire service was content to let the fire burn out and did not apply water or foam; a fact that allowed SEPD to later restore sections of the switchboard.
- 1.7 The fire service took charge of the site and prevented access to the 33kV switchroom until it was deemed safe from fumes and other hazards.
- 1.8 Once access was permitted, SEPD personnel and contractors worked to strip, clean, inspect, test and restore the other two sections of the 33kV switchboard, the first of which was restored the same day, with the other one on the following day.
- 1.9 Mobile generation was deployed to assist in supply restoration and, subsequently, temporary 33kV switchgear was installed to optimise the available security of supply.
- 1.10 SEPD's customers were fully apprised of the situation throughout, being asked to minimise their electrical usage until firm supply was restored.
- 1.11 As a result of the incident, 50,661 of SEPD's customers' supplies were interrupted for periods of between fifty minutes and twenty hours.
- 1.12 A simplified view of the section of SEPD's 132/33kV network affected by this event is shown in Figure 1.



132kV infeeds to Portsmouth Grid Substation

Portsmouth Grid Substation - 33kV busbars at the time of the incident

Figure 1-1 – Simplified Network Diagram of SEPD's 132/33kV distribution network affected by the incident

Notes:

- 1. SEPD's distribution system affected by this incident was running normally at the time of the incident.
- 2. Supplies were initially restored via tele-switching.
- 3. Extensive manual switching was carried out at 11kV to restore many supplies.
- 4. SEPD had to re-interrupt some customers as the load built up during the day.
- 5. Mobile generators were sourced and deployed to restore supplies to some distribution substations.

Exceptionality requirements

Does the event qualify for exclusion?

- 1.13 The AE considers that the event falls within the category of an "other event" as defined in paragraph 8.57 of Special Licence Condition CRC 8, and meets the exceptionality requirements set out in Appendix 3 thereof.
- 1.14 The AE therefore considers that, subject to satisfying the requirements of Appendix 4 to CRC 8, the event qualifies for possible exclusion under the "one-off" exceptional events process.

Exceptionality test results

1.15 The number of incidents attributed to the event is shown in Table 1-1.

Number of incidents attributed to the event	Claimed number	Audited number
132kV	0	0
EHV	1	1
HV	0	0
LV	0	0
Total	1	1

Table 1-1:	Number of	incidents	attributed	to the event
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1.16 The results calculated by the AE to test this claim against Ofgem's exceptionality criteria are shown in Appendix A. A summary of the results is shown in Table 1-2.

 Table 1-2: Summary of exceptionality test results

Test	Threshold	Claimed number	Audited number	Pass / Fail	Amount above threshold
CI exceptionality	0.9	1.73	1.73	Pass	0.83
CML exceptionality	0.7	4.94	4.94	Pass	4.24

Notes:

1. Ofgem's CI and CML exceptionality criteria are set out in the AE's ToR¹.

2. The audited CI and CML used in the exceptionality test have been determined from the number of incidents attributed to the event.

3. Where the event passes either or both the exceptionality thresholds, the amount(s) above threshold is/are carried forward into the Audit part 2 assessment of DNO performance.

4. In accordance with guidance from Ofgem, the AE's calculations use the threshold values contained in the current Distribution Price Control and the number of customers connected to the DNO's network relevant to the date on which the incident occurred.

¹ Audits of Electricity Distribution Network Operators' One-off Exceptional Events Claims for 2010/11.

SEPD's views of its performance

- 1.17 SEPD's distribution system in the southwest of Portsea Island is supplied from its Portsmouth Grid Substation, which is equipped with an SF₆-insulated 33kV switchboard. Although since replaced, at the time of the incident the switchgear was Reyrolle, horizontally withdrawable, SMS type.
- 1.18 Each of the three sections of the 33kV switchboard at Portsmouth Grid Substation is fed via a 132/33kV transformer, the arrangement being P2/6 compliant.
- 1.19 The incident under review began when the remote 132kV circuit-breakers at Lovedean and Fort Widley, together with C1T0, the Grid Transformer A1MT 33kV circuit-breaker at Portsmouth Grid Substation, tripped at 23:41 on Friday, 25 June 2010. A1MT feeds the centre section (section 2) of the 33kV busbar at Portsmouth Grid Substation.
- 1.20 SEPD's standby engineer was immediately asked to attend site.
- 1.21 Whilst SEPD's standby engineer was in the relay room at Portsmouth Grid Substation investigating the cause of the trip, the 33kV circuit-breakers (C4T0A and C4T0B) associated with the other two Grid Transformers both tripped at 01:01 on Saturday, 26 June 2010, thus losing supply to the site and to five Primary Substations fed from Portsmouth Grid Substation.
- 1.22 Upon opening the door to the 33kV switchroom, SEPD's standby engineer was met with smoke and fumes being given off by burning equipment within the switchroom.
- 1.23 The local fire service was called and immediately took charge of the site. Fearing that SEPD's standby engineer had inhaled smoke and noxious gases they administered oxygen and insisted he be taken to the local accident and emergency hospital for observation, from where he was released after approximately 3 hours.
- 1.24 Whilst, for reasons of safety, the fire services prevented SEPD's personnel entering the switchroom until 07:00, supply restoration began within minutes of the loss of supplies and SEPD considered it inappropriate to use 'clock-stopping' in its incident report.
- 1.25 Furthermore, despite the fact that, due to the location of Portsmouth Grid Substation on Portsea Island, SEPD's network has limited interconnection at 132kV, 33kV and 11kV, SEPD's personnel restored supplies to approximately 94% of the affected customers within 4 hours, through a combination of tele-controlled and manual switching operations.
- 1.26 During the course of the day, SEPD sourced and deployed mobile generation to restore some customers. In total, SEPD hired in 10 x 500 kVA, 4 x 750 kVA and 2 x 1 MVA generators from hire companies. SEPD also deployed 1 x 350 kVA, 3 x 500 kVA and 1 x 750 kVA generators from its own fleet. [AE's note: whilst there is no formal arrangement for loaning mobile generators between DNO's, the inter-DNO mutual aid arrangements within "NEWSAC" would cover mobile generators where appropriate. In the case of Portsmouth Grid Substation it was quicker for SEPD to hire in mobile generators than to arrange for any loaned machines from other DNOs].

- 1.27 SEPD also moved a temporary 33kV ring main unit to its Portsmouth Grid Substation to improve the available security of supply.
- 1.28 SEPD assembled a team of engineers and contractors at Portsmouth Grid Substation, who immediately began to assess the damage to the 33kV switchgear once the fire service had given the 'all clear'.
- 1.29 It was determined that section 2 of the switchboard was irreparably damaged but that sections 1 and 3 could be stripped, inspected, cleaned, tested and possibly returned to service.
- 1.30 By working continuously, the n°1 section of the switchboard was restored at 20:09 on Saturday, 26 June and section n°3 of the switchboard was restored at 09:33 on Sunday, 27 June 2010.
- 1.31 During December 2009 and January 2010 SEPD had commissioned partial discharge testing at Portsmouth Grid Substation and is satisfied that there was no reason to believe that there were any latent defects that warranted immediate attention.
- 1.32 SEPD is pleased to note that its standby personnel responded to the incident without delay, alerting the fire service and calling upon additional resources as circumstances dictated.
- 1.33 SEPD is satisfied that it invoked its emergency procedures in a timely manner as the incident developed.
- 1.34 SEPD considers that its duty control engineers reacted well in assessing the alarms generated by the event, contacting SEPD's standby personnel, beginning to restore supplies in fifteen minutes, carefully monitoring the system loadings and reluctantly re-interrupting customers' supplies as the load built up during the day.
- 1.35 SEPD considers that its personnel and contractors worked well in adverse conditions to remove panels, inspect, clean, test and re-energise sections 1 and 3 of the 33kV busbar.
- 1.36 Apart from a problem with an intertrip signal on the 132kV feeder of A1MT, (which still cleared the fault), SEPD considers that the protection applied to its 3 132/33kV transformers at Portsmouth Grid Substation operated correctly to clear the incident from its distribution system.
- 1.37 SEPD has determined the cause of the mal-operation of the intertrip signal and has put in place a cure to prevent a re-occurrence.
- 1.38 During the event, SEPD's personnel kept in constant touch with its affected customers, including broadcasts by local radio, asking its customers to restrain their usage of electricity whilst restoration work was being carried out.
- 1.39 SEPD also considers that its engineering team did well in bringing to site a 33kV ring main unit and subsequently jointing it in to improve the security of supply to its customers.

SEPD's answers to questions on its performance

- 1.40 Within the last three years, the AE has reviewed SEPD's design standards, construction methods and maintenance procedures during previous visits to audit exceptional event claims and found them fit for purpose.
- 1.41 SEPD's SoF indicates that it has examined the engineering implications of this incident. As part of the audit of this claim, the AE therefore included a discussion on how far SEPD had progressed in its deliberations.
- 1.42 Whilst some of SEPD's post-event activity is commercially confidential, the details of its conclusions regarding the root cause of the incident have been passed to the Energy Networks Association (ENA) for circulation amongst the other UK DNOs. [AE's note: amongst other things, the ENA collates information regarding equipment failures and defects and circulates it to all DNOs to alert them to potential problems under the National Equipment Defect Reporting Scheme (NEDeRS)].
- 1.43 The AE confirms that SEPD's emergency procedures provide for the type of event being examined here.
- 1.44 To aid understanding of the background to SEPD's SoF, the AE prepared a list of initial questions regarding this incident. These questions were used as the basis for the examination of SEPD's claim.
- 1.45 The initial questions were discussed during the AE's visit to SEPD's Portsmouth Control Centre on 27 June 2011, when the records of SEPD's SCADA system, the incident report and other information were made available.
- 1.46 Given the information and photographic evidence provided by SEPD, the fact that the 33kV switchboard has been changed and the AE's personal knowledge of installations of this type, it was considered to be unnecessary to visit Portsmouth Grid Substation.
- 1.47 SEPD has provided answers to the AE's initial list of questions. For ease of reference, the AE's questions are printed in bold font with SEPD's answers being printed in normal font.

Q1. What, if any, changes has SEPD made to its emergency plans and procedures since BPI last visited to audit the exceptional event claim concerning the incident that occurred at Burghfield Grid on 07 September 2008?

- A1 We continue to review and update our emergency plans, for example our storm response plans were updated and reissued in June 2009. Although we do not have specific plans for one-off events, the Burghfield incident illustrated the value of photographic evidence and our internal report includes a selection of photographs of the fire damage at Portsmouth.
- Q2 At the time of submitting its Statement of Fact (SoF), SEPD was still investigating the incident; what has SEPD since determined to be the cause of the incident?
- A2. The incident was caused by a failure in the CT/cable termination chamber of a 33kV circuit-breaker. The damage to the equipment was too extensive and severe to determine the exact cause/mechanism of failure. [*AE's note: it is extremely*]

unlikely that the precise, i.e. root cause, of this incident will ever be known due to the extent of the damage caused to the equipment concerned. SEPD has passed what information it has to the ENA under NEDeRS]

- Q3. When were the 33kV busbars and switchgear commissioned at SEPD's Portsmouth Grid Substation?
- A3. Most of the 33kV switchboard was manufactured in 1986 and installed in 1987/88 with four circuit-breakers having been installed in later years.
- Q4. What type of switchgear was installed at Portsmouth 132 / 33 kV substation at the time of the incident?
- A4. The equipment was Reyrolle SMS circuit-breakers air-insulated busbars etc with horizontal withdrawable circuit-breakers operating in SF₆.

Q5. What is SEPD's operational experience of this type of switchgear?

A5. Please see SEPD's internal report which will be available during the audit visit.

Q6. What are the as-found details of the switchgear fault?

A6. Although much of the evidence was destroyed in the fire it appears that the initial fault was a failure of the CT's within C1T0, beginning as a phase-to-earth fault and developing into a phase-to-phase fault between red and yellow connections within the compartment. The fault and the subsequent fire damaged the circuit-breaker which lost its insulating SF₆ gas and led to an electrical breakdown across the circuit-breaker contacts which then re-energised the transformer cables from the 33kV busbars.

Q7. SEPD's SoF suggests that the switchgear affected by this incident is situated indoors. If this is the case, what fixed fire-fighting installations and / or fire segregation measures were deployed at Portsmouth 132 / 33 kV Substation?

- A7. Both the 11kV and 33kV switchboards at Portsmouth are SF₆ and consequently there is no need for CO₂ or similar fixed fire-extinguishing system. [*AE's note: it is usual practice to build fire segregation and install fixed CO*₂ equipment where switchgear is of the bulk-oil type. At the time of reading the SoF it was not clear that the equipment at Portsmouth Grid Substation was insulated with SF₆, where fixed fire-fighting provisions, etc are not considered necessary].
- Q8. What is SEPD's policy for the installation of fixed fire-fighting equipment and other measures for switchgear of this type situated indoors? Were these measures deployed at its Portsmouth 132 / 33 kV Substation?
- A8. Policy from 1980 was no walls and no fire fighting for SF₆ equipment. Policy now is walls but no fire fighting systems due to low fire risk. Policy for indoor 33kV oil boards was both CO₂ and fire walls. [AE's note: SEPD's revised policy is in line with UK practice for new build or switchgear replacements where switchboards and busbars can be designed to pass through segregating walls. For existing switchboards the cubicles are side by side and no physical separation exists through which to install segregating walls].
- Q9. SEPD's SoF mentions that supplies were interrupted to five Primary Substations. The 33 kV SLD in SEPD's SoF also shows the "DOCK" 33 kV busbar and the 33 kV circuit to "WYME N/O". Are these two locations included in SEPD's computation of CI and CML for this incident?
- A9. DOCK is the EHV supply to Portsmouth naval dockyard, which is a single customer and is included within our CI/CML calculations. The circuit to WYME N/O is an

interconnection to Wymering grid and was running open at Wymering so has no impact on the CI/CML calculation.

- Q10. SEPD's SoF also mentions that access was denied to its Portsmouth 132 / 33 kV Substation by the fire services 'until after 07:00 on 26th June'. How has the requisite clock-stopping period been incorporated within SEPD's claimed figure for the CML attributed to this incident as required under paragraph 4.70 of the guidance in RIGS version 1?
- A10. We have not included any clock-stopping in our incident report due to delays accessing the switchroom on the basis that, although the fire service formally denied access, the physical conditions in the switchroom, (heat, smoke, soot, etc) would not have allowed us to start repairs any earlier. During this period we restored large numbers of customers via alternative supplies and continued to maintain supply to as many of these as the network capacity would allow.
- Q11. At SEPD's Portsmouth 132 / 33 kV Substation, what protection schemes are installed on:

a. the 33kV busbars;

A11(a). 33kV busbars had busbar protection with check and discrimination zones.

b. the 33 kV sides of the three 132 / 33 kV transformers?

A11(b). The transformer 33kV windings and connections were fitted with balanced earthfault protection, (BEF), directional overcurrent, voltage-controlled overcurrent, undervoltage protection and standby earth-fault (two-stage).

c. the two 33kV bus section circuit-breakers?

A11(c). The 33kV bus section circuit-breakers were fitted with overcurrent and earth fault relays.

d. the circuit-breakers controlling the 132 kV sides of the three 132 / 33 kV transformers?

A11(d). The 132kV side of the grid transformers is protected by remote 132kV circuitbreakers and tripping is initiated by operation of the transformer differential protection, the HV or LV balanced earth fault protection, the HV overcurrent stage 1 and standby earth fault stage 2.

Q12. What settings are applied to the above protection schemes?

A12. Please see SEPD's relay settings schedules which will be available during the audit visit.

Q13. What protection operated when supply was lost?

- A13. At the first stage the main differential protection relay operated together with the 33kV balanced earth fault relay operating the main protection relay for A1MT. The backup IDMT overcurrent relay at Wymering also operated. At the second stage the standby earth fault relays operated on both A4MTA and A4MTB.
- Q14. What learning points have SEPD incorporated into its procedures as a result of this incident?
- A14. Please see the internal investigation report which will be available during the audit visit.
- Q15. What further learning points should be considered as a result of the application of the current one-off Exceptional Event Claims process?

- A15. It would be easier to carry out the audit within three months of the event occurring.
 - 1.48 SEPD also provided further information both during and subsequent to the audit visit. This includes:
 - photographs of the faulted equipment additional to those in SEPD's SoF;
 - sight of the most recent partial discharge test results and non-urgent recommendations for the now-replaced 33kV switchgear at Portsmouth Grid Substation;
 - sight of SEPD's control room log as included in the SCADA record of the incident;
 - sight of SEPD's SCADA alarms received during this incident;
 - a representation of the incident on SEPD's SCADA system;
 - discussion of the method used to capture the fire service message preventing access to the switchroom in SEPD's measurement systems;
 - copies of SEPD's protection schemes and associated relay settings for its 132kV and 33kV feeders affected by this event;
 - a simplified SLD of the relevant sections of SEPD's 33 kV network showing all the Primary Substations affected by the loss of supply during this incident; and
 - sight of SEPD's incident report from which it calculated the CI and CML attributed to the event.

2. Audit part 2

SEPD's performance in preventing the event

- 2.1 In viewing SEPD's performance in preventing this event, the AE has considered what more SEPD could have reasonably done to ensure that its 33kV switchgear at Portsmouth Grid Substation was free from latent defects.
- 2.2 The fire service's contemporaneous observations and SEPD's post-incident investigation pointed to a failure within the CT chamber of 33kV circuit-breaker C1T0. SEPD's photographs 1 and 2 show the severe damage to the CT chamber and surrounding components of the fixed portion of switchgear.
- 2.3 SEPD's photographs 3 and 4 show the extensive damage to the withdrawable portion of C1T0.
- 2.4 SEPD's photograph 5 shows another view of the extensive damage to the fixed portion and SEPD's photograph 6 shows an undamaged arrangement.
- 2.5 Prior to this incident, SEPD had experienced CT failures associated with this type of switchgear in 2001 and in 2009.
- 2.6 As a pro-active measure, SEPD commissioned the switchgear manufacturers to carry out partial discharge tests on all the CTs at Portsmouth Grid Substation. The work, which was carried out during December 2009 and January 2010, found no immediate cause for concern, (the CTs in C1T0's case, being recommended for a follow-up test 'within 12 months to establish the source of higher than normal discharge', which was suspected to be transmission through the transformer cables).
- 2.7 The AE has discussed SEPD's operational experience of this type of SF₆ insulated switchgear and is satisfied that, in commissioning partial discharge testing and taking heed of the associated recommendations, SEPD had taken all reasonable precautions regarding its reliability and fitness for service at Portsmouth Grid Substation.
- 2.8 SEPD's measurement systems clearly show the tripping of the number one grid transformer (A1MT) at 23:41 on 25 June 2010, followed by the tripping of the other two grid transformers (A4MTA and A4MTB) at 01:01 on 26 June 2010. [**AE's note:** *the incident start time is the time at which A4MTA and A4MTB tripped*].
- 2.9 SEPD's measurement systems also confirm the restoration of supplies via a combination of tele-controlled switching and extensive manual switching on the distribution network and mobile generation.
- 2.10 An examination of SEPD's measurement systems and an SCADA representation of its distribution network confirm that SEPD did all it could to restore supplies as expeditiously as possible, only resorting to re-interruptions when the loading became too great for some of the 11kV feeders.

2.11 The AE concludes that SEPD had been pro-active and done all it could reasonably have been expected to do in considering that its 33kV switchgear at Portsmouth Grid Substation had been tested free of latent defect and that it was fit for purpose.

SEPD's performance in mitigating the effects of the event

- 2.12 SEPD's internal investigation concludes that the root cause of the incident is most likely to have been within the CT chamber of the fixed portion of circuit-breaker C1T0.
- 2.13 Following a failure of a CT at Portsmouth Grid Substation in 2009, SEPD adopted a very pro-active approach and commissioned the CT manufacturers to carry out a partial discharge test of all CTs at the Substation. The tests found no cause for SEPD to take any immediate action. [*AE's note:* In addition to alerting other DNOs via the ENA and NEDeRS, SEPD has instituted on-going tests at the other locations where this type of switchgear is installed].
- 2.14 The AE is pleased to note that SEPD continues to learn from this incident and has reviewed its practices and already put in place measures to further enhance the testing of the relevant equipment on its distribution system.
- 2.15 The actions of SEPD's standby personnel, its control engineers and the additional switching staff resulted in the restoration of customers' supplies as swiftly as possible.
- 2.16 SEPD's control engineers' careful monitoring of the network loadings ensured that no network component was overloaded which could have resulted in further unplanned loss of supplies; any potential overloading was managed by reinterrupting supplies as necessary.
- 2.17 The AE has discussed the running arrangements and protection schemes associated with the affected sections of SEPD's distribution network with SEPD's engineering personnel.
- 2.18 The examination of the protection arrangements on the 132kV feeders into Portsmouth Grid Substation and those applied to the 3 Grid Transformers shows that SEPD's protection schemes are appropriate for this network arrangement.
- 2.19 The AE commends SEPD's control engineers, who with the limitations of the distribution network, analysed the serious situation, mobilised additional control room and operational personnel and alerted the company's senior management, who in turn invoked SEPD's emergency procedures.
- 2.20 The AE further commends SEPD's personnel and the company's contractors who worked in very difficult circumstances to strip, examine, clean, test and re-energise section numbers 1 and 3 of the 33kV busbars at Portsmouth Grid Substation.
- 2.21 The AE also commends SEPD's personnel who were involved in the sourcing and commissioning the temporary 33kV ring main unit so as to improve the security of supplies to part of the affected system.
- 2.22 The AE is also pleased to note that SEPD has replaced the whole of the affected 33kV switchboard to prevent a re-occurrence.

Recommended performance adjustment(s)

2.23 The AE's recommendations to Ofgem are shown in Table 2-1.

	Amount above threshold	Audit part 2 recommendation
CI	0.83	0.83
CML	4.24	4.24

Table 2-1: Audit part 2 recommended adjustment(s)

Detailed justification

- 2.24 In reaching a judgement on a recommendation, the AE has firstly considered whether or not SEPD could have reasonably taken any different course of action that would have prevented the catastrophic failure of section 2 of its 33kV busbars at Portsmouth Grid Substation.
- 2.25 In viewing SEPD's performance in preventing this event, the AE has taken into account the company's pro-active approach in commissioning partial discharge tests following the failure of a CT at the site in 2009.
- 2.26 The results of the testing, which were completed less than six months before this incident occurred, gave SEPD no cause for concern regarding the continuing use of the 33kV switchboard.
- 2.27 The AE commends SEPD for its demonstrably pro-active approach in arranging the partial discharge testing by the reputable manufacturer of the switchgear.
- 2.28 The AE has also discussed this incident with his colleagues who have considerable operational experience of incidents with many differing causes; they agree with the visiting auditor's conclusions and recommendations.
- 2.29 In considering SEPD's restoration strategy, the AE is conscious that SEPD's duty control engineers acted as a team and exhibited commendable skill in restoring supplies without overloading any of the switched alternatives.
- 2.30 The AE has personal knowledge of incidents of this type and the conditions under which the people engaged in the restoration of sections 1 and 3 of the switchboard had to work. The AE commends them for their fortitude in such difficult circumstances.
- 2.31 The AE is satisfied that the affected sections of SEPD's distribution network comply with the requirements of Security of Supply Standard P2/6.
- 2.32 The AE has discussed SEPD's learning from this incident, including the incorporation of enhanced protection maintenance measures it has put in place.

- 2.33 The AE commends SEPD for having replaced the entire 33kV switchboard.
- 2.34 The AE is satisfied that SEPD has met the criteria for preventative and mitigating actions set out in Appendix 4 to paragraph 8.58 of Special Licence Condition CRC 8.
- 2.35 The AE therefore concludes that SEPD's claim is justified and recommends to Ofgem that the amount of CI and CML above the threshold values should be excluded from its performance for reporting year 2010/11.

Appendix A Record of Audit part 1

"One-Off" Exceptional Event	Reporting Year 2010/11				
Licensed Area	SEPD				
Date of event	26 June 2010				
Cause	Catastrophic failure of 33kV switchgear				
Notification to Ofgem	28 June 2010				
SoF received	19 July 2010				
SoF information	• At Portsmouth Grid Substation 33kV and 132kV protection operated to de-energise 132/33kV T/F A1MT at 23:41 on Friday 26 June 2010.				
	• SEPD's standby engineer was asked to attend. He began his site inspection in the relay room, which is directly above the 33kV switchroom. Before he approached the 33kV switchroom the 33kV CB's associated with the other two 132/33kV T/Fs operated at 01:01 on Saturday 26 June 2010.				
	• Upon opening the door to the 33kV switchroom he was met with smoke and gasses emitted by the catastrophic failure of a section of the 33kV switchboard.				
	 Supplies to five of SEPD's 33/11kV Primary Substations and the 33kV supply to Portsmouth Dockyard were interrupted. 				
	SEPD's duty control engineers:				
	 (a) Requested the standby engineer to attend Portsmouth Grid; 				
	 (b) Began supply restoration by tele-controlled switching immediately supplies were lost; 				
	(c) Called out additional operational personnel;				
	(d) Alerted SSE's senior management of the situation;				
	(e) Systematically checked the loadings on SEPD's distribution system to ensure that no feeder became overloaded due to the loss of the 132kV infeeds to Portsmouth Grid; and				
	(f) Arranged for rota connections where necessary to ensure that no alternative supplies became compromised.				
	 Upon opening the door, SEPD's standby engineer attending site reported that smoke was coming from within and immediately called the fire service; 				
	• The fire service prevented access to inspect the damage until 07:00 when the switchroom had been fully vented and it was deemed safe to enter;				
	 SEPD mobilised additional personnel who, once set to work, stripped the numbers 1 and 3 sections of the switchgear (all covers off, all trucks removed, all spouts inspected), cleaned 				

Table A-1: Appointed Examiner's Information Log

	 off all the soot and smoke damage, tested the equipment for serviceability and restored these sections as swiftly as possible; Mobile generation was sourced and deployed to restore several distribution substations; and Temporary 33kV switchgear was deployed and subsequently jointed into the system to optimise security of supplies 				
Additional pre-visit information provided	Based on the SoF the AE drew up a list of initial questions. These were discussed during the audit visit. This initial list of questions, together with SEPD's response, is contained in paragraph 1.47 of the report.				
Location of audit visit	SEPD's Portsmouth Control Centre				
Date of audit visit	27 June 2011				
Visiting Auditor	Geoff Stott (BPI)				
SEPD's Representatives	John Blyth, Alan Broadbent and Adam O'Hara				
Information provided during and subsequent to the audit visit	 Comprehensive documentation / information including: a discussion of the protection arrangements for the three Grid T/Fs at Portsmouth Grid and their associated CBs copies of the relevant 132kV and 33kV SLDs; the fire service attended site and, after administering oxygen, insisted that the standby engineer immediately attend the local accident and emergency hospital to check for the effects of smoke inhalation. He was released after about 3 hours; sight of the report of SEPD's confidential internal investigation into the incident, including the learning points to be fed back into SEPD's policies and procedures; sight of the printout from SEPD's SCADA system that shows the alarms generated by the event; the control engineer's switching schedules covering the event; the switching log showing the loss of supplies from Portsmouth Grid commenced when the CBs associated with Grid T/Fs 4A and 4B tripped on standby earth fault at 01:01 on 26 June 2010; the normal network running arrangements were demonstrated; sight of SEPD's 'NaFIRS' incident report that shows: o the number of customers affected by the incident to be 50,661; and o the customer minutes lost to be 14,490,869. the AE confirms that these figures agree with those quoted in SEPD's soF; using SEPD's total connected customers at 30 September 2010 of 2,934,581 the number of customers affected equates to a CI of 1.73. [50661*100/2934581]; similarly, the customer minutes lost for this event equate to a CML of 4.94. [14490869/2934581]; discussion regarding SEPD's operational experience with this type of SF₆ switchgear; 				

 entire 33kV switchboard at Portsmouth Grid Substation; sight and discussion of the results and recommendations of the most recent partial discharge tests carried out on the 33kV switchgear at Portsmouth Grid Substation; discussion regarding the fire services having been content to let the fire burn out and therefore, the absence of either water or foam facilitating the return to service of the cleaned-up numbers 1 and 3 sections of the 33kV switchboard; and a commercially confidential discussion of SEPDs post-incident internal report, including photographs of the damaged switchgear.
No need to visit Portsmouth Grid Substation. Discussed the information from the National Equipment Defect Reporting Scheme (NEDeRS). Discussed the number of other units of this type in SEPD – very few. Discussed post-fault learning points, including partial discharge testing of the few other units on SEPD's network and SEPD's enhanced trip-testing regime. Confirmed P2/6 compliant (90 MVA firm). The whole of the old 33kV switchboard has been replaced with a new SF ₆ -insulated one in another room. The list of initial questions was discussed. SEPD provided answers to the initial questions plus additional information both during and subsequent to the audit visit. Ok re compliance with Appendix 4 of Paragraph 8.58 of CRC 8.

Table A-2: Impact on CI and CML

	CI		CML		
	Claimed	Audited	Claimed	Audited	
132kV	0	0	0	0	
EHV	1.73	1.73	4.94	4.94	
HV	0	0	0	0	
LV	0	0	0	0	
Total	1.73	1.73	4.94	4.94	
SEPD Threshold (total)	0.9		0.	0.7	
Part 1 Exceptionality Test	Pass		Pass		
Part 1 Precondition of eligibility (meets App 3 to paragraph 8.57 of CRC 8)	Pass				

SEPD's measurement systems are subject to QoS audits for accuracy of reporting and it is not within the AE's ToR to repeat that work as part of the examination of exceptional event claims, although any consequential adjustments to reporting accuracy will be reflected in Ofgem's final adjudication of reported performance for the regulatory reporting year 2010/11.



Appendix B SEPD's Photographs of the damaged equipment

Photograph 1 – Rear of cable box showing single-core cables and CTs at the rear



Photograph 2 – The CTs and connections to the circuit-breaker truck



Photograph 3 – View of withdrawn circuit-breaker truck C1T0



Photograph 4 – The irreparably damaged SF6 interrupters on C1T0



Photograph 5 – Irreparable damage to cable box and CTs



Photograph 6 – CT arrangement in an undamaged panel