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**Appointed examiner's audit of Exceptional Event Claim -
UK Power Networks (London)
11kV incident – Bengeworth Road
11 December 2015**



Document Properties


Title: UK Power Networks (London) – Audit of Exceptional Event Claim – UKPN (LPN) – 11kV incident - Bengeworth Road – 11 December 2015

Reference: ep/Ofgem/LPN/11 Dec '15

Issue: Final report v1.0

Date: 20 October 2016

Authorisation

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History

Issue	Date	Originator	Checker	Description
1.0	20 October 2016	Geoff Stott	Glen Chapman	Final version following receipt of the manufacturer's post-incident investigation report and no further comments
0.2	26 September 2016	Geoff Stott	Glen Chapman	Updated draft incorporating UKPN comments
0.1	02 August 2016	Geoff Stott	Glen Chapman	Interim draft report sent to Ofgem and to UKPN for comment
0.0	13 June 2016	Geoff Stott	-	Pre-draft report created from energypeople template

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Glossary

Abbreviation	Meaning
AE	Appointed Examiner
CB	Circuit-breaker
CI	Customer Interruptions per 100 connected customers
CML	Customer Minutes Lost per connected customer
DNO	Distribution Network Operator
ENA	Energy Networks Association
ep	energypeople (Ofgem's Appointed Examiner)
ESQCR	Electricity, Safety, Quality and Continuity Regulations
QoS	Quality of Service
LPN	UKPN's London Power Network licensed area
NEDeRS®	The ENA's National Equipment Defect Reporting Scheme
RIGs	Regulatory Instructions & Guidance
OOEE	One-Off Exceptional Event claim
PD	Partial Discharge
SCADA	Supervisory Control and Data Acquisition
SI	Short Interruption
SLD	Single Line Diagram
SoF	Statement of Facts
ToR	Terms of Reference
UKPN	UK Power Networks

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:

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

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

It is calculated as:

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

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

1. Ofgem has commissioned energypeople as its Appointed Examiner (AE) to audit the submission made by UK Power Networks (UKPN) under the "one off" exceptional event mechanism that an incident which affected its 11kV switchboard at its Bengeworth Road Primary Substation at 13:17 on Friday 11 December 2015 adversely affected the reported performance for its London Power Networks (LPN) licensed area for the reporting year 2015/16.
2. The AE has visited LPN 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 CI but not CML.
3. The AE concludes that the event falls within the category of an "other event" as defined in paragraph 2D.34 of Special Licence Condition CRC 2D, including meeting the exceptionality requirements set out in Appendix 3 thereof.
4. The AE therefore proceeded to part 2 of the "one-off" exceptional event process, assessing LPN's performance in mitigating the impact of the event upon its customers.
5. The AE concludes that LPN's inspection and maintenance programme is consistent with good practice and was up to date at the time of the incident.
6. The AE also concludes that UKPN had no reason to doubt the integrity of its 11kV switchboard at its Bengeworth Road Primary Substation.
7. The AE commends LPN's control engineers for analysing the alarms generated by the incident and for restoring all supplies as quickly as possible.
8. The AE concludes that LPN had met the criteria of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D and that the incident therefore is deemed to be eligible for adjustment in the DNO's reported performance.
9. The AE recommends that an adjustment to LPN's 2015/16 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	1.35	0.25	0.25
CML	0.27	0	0



1 Audit part 1

1.1 Summary of the main facts

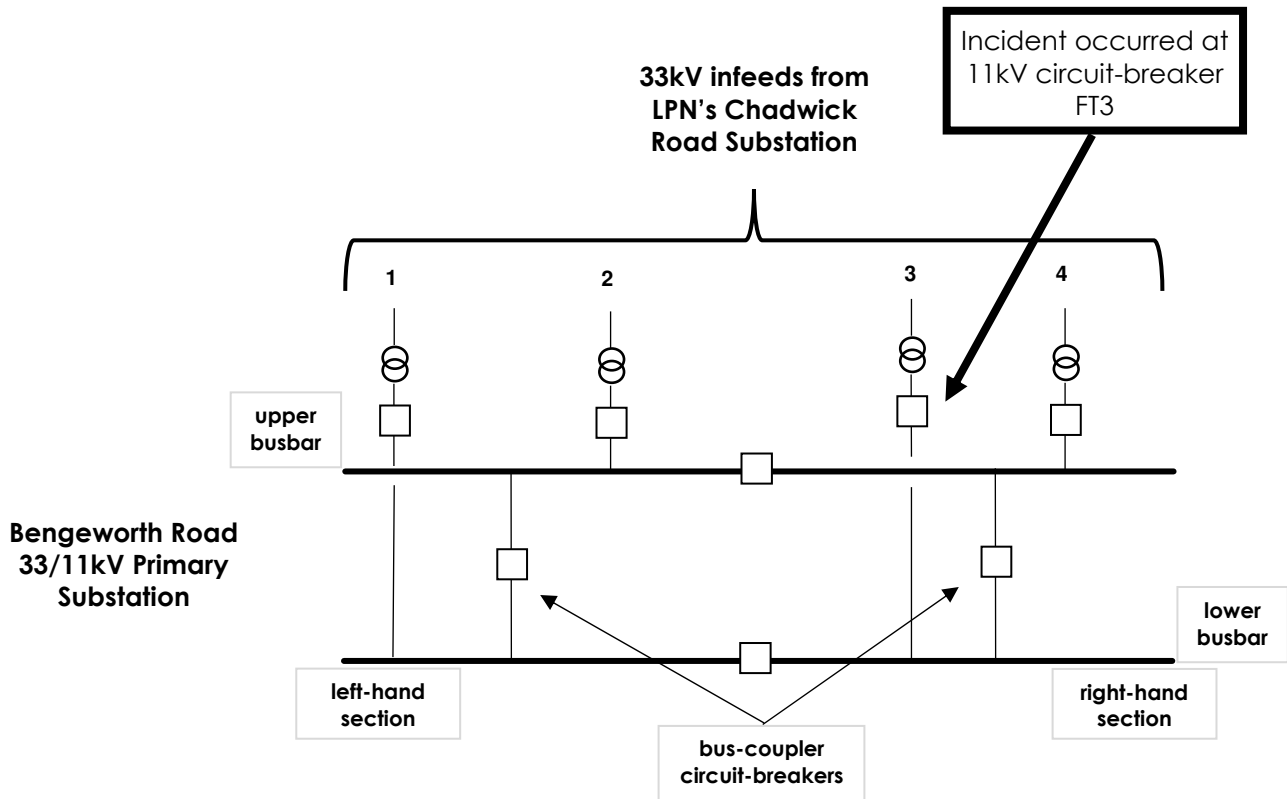
10. The AE's headline information log for this event is set out in Table A-1 at Appendix A. In addition, the following paragraphs summarise the main facts of the event.
11. The affected section of LPN's distribution system is an 11kV indoor, metal-clad, switchboard with double-busbars and horizontally withdrawable circuit-breakers.
12. Under normal running conditions, the non-automatic bus-section circuit-breaker in each busbar is closed.
13. LPN's terminology identifies the four sections of busbar as 'upper' and 'lower'; 'left' and 'right'.
14. A normally open bus-coupler circuit-breaker interconnects the upper and lower busbars in each of the left and right-hand sections of the switchboard.
15. There are four 33/11kV transformers, each of which is connected to one section of the busbars.
16. There are sixteen outgoing 11kV feeders.
17. In the event of the loss of an infeed, an auto-close scheme operates to close any of the bus-coupler or bus section circuit-breakers; the actual operation being dependent upon how the auto switching relay has been programmed for the loss of an infeed. At the time of incident, the auto switching relay was programmed to close both bus-couplers for the loss of an infeed.
18. In line with its refurbishment programme, UKPN has retained the fixed portions of the 11kV switchboard and replaced the former, oil-filled circuit-breakers with modern, purpose-designed vacuum types.
19. UKPN has 259 retro-fit circuit-breaker of an earlier type of vacuum circuit-breaker in service.
20. As this earlier type of vacuum circuit-breaker is no longer manufactured, the installation at LPN's Bengeworth Road Primary Substation is of a newer design and the first of this type to be purchased by UKPN.
21. LPN's 33/11kV system at its Bengeworth Road Primary Substation was running normally at the time of the incident.
22. At 13:17 on 11 December 2015 a fault developed which affected the 11kV circuit-breaker (FT3) of with the number three 33/11kV transformer and the associated fixed portion of the switchboard.
23. At the time of the incident the FT3 circuit-breaker was connected to the lower busbar within the right-hand section of the switchboard.
24. LPN's auto-close scheme operated to attempt to restore supplies but the nature of the fault had affected both the upper and lower sections of busbars.
25. Consequently, LPN's protection operated correctly to de-energise the whole of the 11kV switchboard at its Bengeworth Road Primary Substation, resulting in the loss of supplies to 31,468 of LPN's customers.
26. LPN's sequence switching restored supplies to 200 of these customers within three minutes.
27. LPN's control engineers used tele-controlled switching to restore the other 31,268 customers' supplies.



28. Smoke was reported to be coming from the 11kV switchroom. The London Fire Brigade attended site but its services were not needed.
29. Following an initial on-site inspection, LPN was able to restore the left-hand sections of both the upper and lower busbars and the infeeds from numbers one, two and four 33/11kV transformers.
30. After a further inspection, LPN was able to restore the lower busbar of the right-hand section of the switchboard; leaving the upper busbar in this section of the switchboard de-energised until permanent repairs could be effected.
31. The 11kV FT3 vacuum circuit-breaker at LPN's Bengeworth Road Primary Substation was commissioned on 02 July 2013 and, prior to this incident occurring, has been trouble-free since that time.
32. At the time of the audit visit the manufacturer of the damaged circuit-breaker was still investigating the root cause of the incident.
33. The manufacturer was due to return to Bengeworth Road Primary Substation to carry-out permanent repairs during late May / early June 2016, submitting its final report to UKPN by the end of June 2016.
34. Subsequently, having completed the investigations, the report from the manufacturer of the equipment clearly shows that the root cause of the incident was an undetected void within the fixed portion of the switchboard.
35. A simplified view of the section of LPN's 132/33kV network affected by this incident is shown in Figure 1.



Figure 1 – Simplified Network Diagram of LPN's 33/11kV distribution system affected by the incident



Notes:

1. Only the salient items of switchgear are shown;
2. LPN's network was running normally at the time of the incident with the auto-close scheme being programmed to close both bus-coupler circuit-breakers in the event of the loss of an infeed, Thus:
 - a. the bus-section circuit-breakers were closed; and
 - b. the bus-coupler circuit-breakers were open;
3. Both bus-coupler circuit-breakers auto-closed during the incident; and
4. LPN's control engineers used tele-controlled switching to restore supplies.

2 Exceptionality requirements

2.1 Does the event qualify for exclusion

36. The AE considers that the event falls within the category of an “other event” as defined in paragraph 2D.34 of Special Licence Condition CRC 2D, and meets the exceptionality requirements set out in Appendix 3 thereof.
37. The AE therefore considers that, subject to satisfying the requirements of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D, the event qualifies for possible exclusion under the “one-off” exceptional events process.

2.2 Exceptionality test results

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

Table 1 – The number of incidents attributed to the event

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

39. 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 2.

Table 2 – Summary of exceptionality test results

Test	Threshold	Number in SoF	Audited number	Pass / Fail	Amount above threshold
CI exceptionality	1.10	1.35	1.35	Pass	0.25
CML exceptionality	0.88	0.27	0.27	Fail	0

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 the threshold(s) is/are carried forward into the Audit part 2 assessment of DNO performance; and
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 2015/16 to 2018/19



3 LPN's views of its performance

3.1 Dealing with the incident

40. The 11kV switchboard at LPN's Bengeworth Road Primary Substation is supplied via four 33/11kV transformers fed via 33kV underground cables from LPN's Chadwick Road Substation.
41. LPN's distribution system affected by this incident was running normally at the time.
42. At 13:17 on 11 December 2015, the circuit-breakers controlling the infeeds to the 11kV switchboard tripped as follows:
 - a. At Chadwick Road Substation, the 33kV circuit-breaker controlling the number three feeder to Bengeworth Road Primary Substation; and
 - b. At Bengeworth Road Primary Substation, the 11kV circuit-breakers associated with 33/11kV transformer numbers one, two and four.
43. LPN considers its protection operated correctly to clear the incident from its system.
44. 200 of LPN's customers experienced a short-interruption to their supplies.
45. The supplies to the other 31,268 of LPN's customers affected by this incident were restored by LPN's control engineers using tele-controlled switching.
46. LPN considers that its duty control engineers reacted well in assessing the alarms generated by the event and restoring supplies via tele-controlled switching on the 11kV network.
47. LPN considers that its personnel acted correctly in identifying that the left-hand section of its 11kV switchboard at its Bengeworth Road Primary Substation could be safely re-energised, thus restoring resilience to this section of LPN's distribution network.
48. LPN also considers that its personnel subsequently acted correctly in declaring the lower busbar of the right-hand fixed portion safe to re-energise.
49. The cause of the incident was confirmed to be due to a flashover on the panel to which the 11kV circuit-breaker associated with the number three 33/11kV transformer was connected.
50. At the time of writing the interim report, the manufacturer of the retro-fit 11kV vacuum circuit-breaker was still investigating the root cause of the incident.
51. The manufacturer has now completed these investigations, the result of which clearly shows the root cause of the incident to be an undetected void within the fixed portion of the switchboard.

3.2 LPN's answers to questions on its performance

52. Within the last three years, the AE has reviewed LPN's design standards, construction methods and maintenance procedures during previous visits to audit exceptional event claims and found them fit for purpose.
53. The AE confirms that LPN's emergency procedures provide for the type of event being examined here.
54. To aid understanding of the background to LPN's Statement of Facts (SoF), the AE prepared a list of initial questions regarding this incident. These questions were used as the basis for the examination of UKPN's claim.



55. The initial questions were discussed during the AE's visit to UKPN's Control Centre on 24 May 2016, when the records of LPN's SCADA system, the incident report and other information were made available.
56. LPN 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 LPN's answers being printed in normal font.
- Q1. What, if any, changes has UKPN made to its emergency plans and procedures since the Appointed Examiner (AE) last visited to audit the one-off exceptional event (OOEE) claim concerning the incident affecting UKPN's 132kV infeeds to its Fleethall Grid Substation that occurred on 11 October 2014?**
- A1. UK Power Networks has reviewed its emergency plans and procedures in line with its natural review cycle; however, there have been no significant changes.
- Q2. At UKPN's Bengeworth Road Substation What type of protection scheme is fitted to:**
- (a) the 11kV busbars?**
- A2(a). Overcurrent and Earth Fault on the transformer breakers and
- (b) the 11kV bus-section circuit-breakers?**
- A2(b). The bus-section circuit-breakers are covered by the busbar protection scheme. There is also an auto change-over scheme in place which operates in the event of the loss of a transformer infeed.
- Q3. When was the protection equipment last tested at UKPN's Bengeworth Road 11kV Substation?**
- A3. UKPN's Asset Register shows that the protection was maintained in April 2006.
- Q4. UKPN's Statement of Facts (SoF) indicates that supplies were lost to all four sections of the 11kV busbars although bus-section and bus-coupler circuit-breakers are clearly visible on UKPN's SLD. Why were all four sections affected for an incident on a circuit-breaker connected to one of them?**
- A4. The sequence of events that resulted in the loss of both the upper and lower busbar at Bengeworth Road Substation was 'replayed' to the AE during the audit visit. *[AE's note: the replay, together with the photographic evidence seen during the audit visit, confirms that UKPN's protection operated correctly to de-energise all sections of the 11kV busbars].*
- Q5. What type of circuit-breaker is the one that failed?**
- A5. The failed circuit-breaker is a Siemens "C-Sion" retrofitted into a Reyrolle C6T housing / fixed portion of the 11kV switchboard.
- Q6. When was the faulted circuit-breaker commissioned?**
- A6. The circuit-breaker was commissioned on 02 July 2013.
- Q7. What is UKPN's policy for the routine inspection and maintenance for this type of circuit-breaker and, specifically, when are isolating contacts inspected / maintained on withdrawable switchgear?**
- A7. Circuit-breakers are inspected every 6 months, operated every year and subject to a full maintenance every 12 years. Isolating contacts are



inspected at the same time as the full circuit-breaker maintenance is carried-out.

Q8. When was the circuit-breaker that failed last inspected and last maintained?

A8. The inspections of the 11kV switchboard at Bengeworth Road Substation carried out in 2015 and before the incident were as follows:

- 07/01/2015 – Diagnostic inspection – no issues recorded
- o 15/04/2015 – Mini inspection – no issues recorded
- o 30/07/2015 – Minor inspection – no issues recorded
- o 30/10/2015 – Mini inspection – no issues recorded

The circuit-breaker was too new to have required a full maintenance.

Q9. What were the reports resulting from those activities?

A9. As can be seen in the response to Q8 above, a full set of inspections was completed in 2015; from mini inspection through to diagnostic inspection which includes routine test for partial discharge. No defects were identified from these inspections.

Q10. What is UKPN's experience of the reliability of this type of circuit-breaker?

A10. This is the first type of this installation in UK Power Networks and the first failure experienced.

Q11. What is the UK's reported experience of the reliability of this type of circuit-breaker as reported via the ENA's National Equipment Defect Reporting Scheme (NEDeRS®)?

A11. At the time of the audit visit, we understand that the fault was initiated on the Reyrolle 'C' fixed portion rather than C-Sion retrofit breaker. Reyrolle 'C' is generally very reliable – spreadsheet available showing all C gear incidents reported via NEDeRS®. This was the first installation of C-Sion and so it is too early to comment on reliability.

Q12. The AE infers from UKPN's photographs that the failed vacuum circuit-breaker was a 'retro-fit' to replace an oil-filled circuit-breaker. What is UKPN's policy for this type of conversion?

A12. UKPN's policy is that where the fixed portion of a reliable 11kV switchboard is deemed to have 20 years plus of serviceable life left and an economic retro-fit circuit-breaker is available this will be considered. The AE has been provided with the decision document for Bengeworth Road retro-fit breakers. *[AE's note: UKPN's documentation confirms that the decision to retain the fixed portion of the 11kV switchboard at Bengeworth Road Primary Substation and to retro-fit vacuum circuit-breakers was sound].*



Q13. What is UKPN's policy for testing. UKPN's SoF indicates that the failed circuit-breaker has been returned to the manufacturers for forensic examination. What has been the outcome of that examination?

A13. This is still ongoing with the manufactures. At the time of the audit visit they were due to return to site in the last week in May to the beginning of June to complete their investigation and to carry-out repairs to the fixed portion of the switchboard. UK Power Networks can now confirm that the work on site has been completed and both the fixed and moving portions are away undergoing further investigation.

[AE's note: the investigations were subsequently completed as noted elsewhere in this report].

Q14. In carrying-out these conversions, what tests does UKPN apply to the fixed portions of the switchboard, including the isolating contacts, are the fixed isolating contacts replaced? [AE's note: the AE infers from the photographs provided, and the significant presence of smoke that the "catastrophic failure" was not of the circuit breaker itself, but started at the isolating contact area and involved busbar / spout insulation].

A14. The retro-fit installation was carried out for UKPN by Siemens. Prior to installation, spot PD tests were carried out (which proved negative) and a visual inspection carried out to check for compound leaks and signs of overheating. These also showed the switchboard was in a healthy condition. The fixed contacts were not replaced.

Q15. What were the results of those tests in relation to the 11kV switchboard at Bengeworth Road Substation?

A15. The AE was shown the investment case for the project to replace the breaker which included details of its condition. *[AE's note: as noted at A12 above, UKPN has provided a copy of its decision-making documentation. It confirms the tests on the fixed portion of the 11kV switchboard at Bengeworth Road Primary Substation revealed no signs of defects].*

Q16. The AE understands that this type of switchgear has been produced with air-insulated, compound-insulated and oil-insulated busbars.

(a) Which type is installed at Bengeworth Road Substation?

A16(a). Compound filled.

and

(b) How many others of the same design are installed on UKPN's networks?

A16(b). Bengeworth Rd is the only C-Sion installation. This type of circuit-breaker replaced the earlier 'Retvac' type of retro-fit circuit-breaker, which is no longer available. Within UK Power Networks there are 259 Retvac 11kV circuit-breakers in service on Reyrolle C fixed portions. Some of these installations have been in service since 1996 and have been trouble-free.

Q17. How many other retro-fit installations of this type does UKPN have on its distribution network?

A17. As noted above, this is the only site with this type of retrofit in UKPN.



Q18. What has UKPN done to assure itself that the other installations of this type are free from similar failure?

A18. As noted above, this is the only installation with this type of circuit-breaker. The results of the Siemens' investigation show that the root cause of the incident was not in the retro-fitted circuit-breaker.

Q19. What learning points has UKPN incorporated into its procedures as a result of this incident?

A19. Despite having carried-out partial discharge testing of the fixed portion of the switchboard prior to retro-fitting, the final report from Siemens shows the root cause of the incident to be an undetected void within it. UKPN therefore concludes that there are no specific learning points to be gleaned from this incident.

Q20. What further learning points should be considered as a result of the application of the current one-off exceptional event claims process?

A20. As stated following previous audits, the closer to the event the audit can be completed the better, as it makes the retrieval of data and information easier.

57. During the discussion of this claim it was concluded that a visit to the site of the incident would be unnecessary; the AE was satisfied with LPN's date-stamped audit trail.

58. LPN also provided further information both during and subsequent to the audit visit. This includes:

- A discussion on the investigation carried-out by the manufactures of the retro-fit circuit-breaker;
- A copy of the manufacture's post-incident investigation report showing the cause of the failure to be an undetected void in the busbar chamber of the fixed portion of the switchboard;
- Information to show that the affected section of LPN's network is P2/6 compliant – 56.7 MVA firm (winter);
- Information to show that, prior to the current incident, LPN's retro-fitted vacuum circuit-breakers have provided trouble-free service;
- LPN's switching log that covers the commissioning of the circuit-breaker involved in this incident;
- LPN's control room log for this incident;
- LPN's incident report from which it calculated the CI and CML attributed to this incident;
- The details of LPN's SCADA alarms received during this incident;
- A representation of the incident on LPN's SCADA system; and
- Copies of LPN's protection schemes and associated relay settings for its 33/11kV network affected by this event.



4 Audit part 2

4.1 LPN's performance in preventing the event

59. In reviewing LPN's performance in preventing this incident, the AE has considered what more LPN could have reasonably been expected to have done to ensure that its 11kV switchboard at its Bengeworth Road Primary Substation was free from any known defects.
60. LPN had carried-out tests to prove the integrity of the fixed portion of the switchboard before deciding to replace the oil-filled circuit-breakers with the up-to-date type of vacuum circuit-breaker.
61. The retro-fitted vacuum circuit-breaker had been designed by, made by, and purchased from, a well-known and respected manufacturer of this kind of equipment.
62. Following a series of commissioning tests, LPN's 11kV circuit-breaker FT3 at its Bengeworth Road Primary Substation entered service on 02 July 2013.
63. Photographs 1 and 2, copied from UKPN's SoF, show the damaged fixed portion of the 11kV switchboard and the front of the damaged 11kV vacuum circuit-breaker respectively.
64. Photograph 3, specifically requested by the AE during the audit visit, shows the rear of the circuit-breaker. The un-damaged contacts where the circuit-breaker 'plugs-into' the lower busbar of the fixed portion of the switchboard are clearly seen.
65. Photograph 4, also specifically requested by the AE during the audit visit, shows a close-up of the damage caused to the upper areas of the circuit-breaker by the electrical arcing created during the flow of fault current.
66. LPN's inspection and maintenance regime was up to date at the time of the incident and LPN had no reason to think that its 11kV switchboard at its Bengeworth Road Primary Substation contained any defects.
67. LPN's measurement systems clearly show the tripping of the circuit-breakers to de-energise the incident at 13:17 on Friday 11 December 2015.
68. LPN's measurement systems confirm the restoration of supplies lost from its Bengeworth Road Primary Substation via tele-controlled switching from alternative 11kV sources.
69. An examination of UKPN's measurement systems and a SCADA representation of its distribution network confirm that LPN did all it could to restore supplies as expeditiously as possible.
70. The AE concludes that, prior to this incident occurring, LPN had done all it could reasonably have been expected to do in considering that its 11kV switchboard at its Bengeworth Road Primary Substation was free from any known defects.

4.2 LPN's performance in mitigating the effects of the event

71. The report from site confirmed that the incident affecting the FT3 11kV circuit-breaker had caused damage to the right-hand section of the switchboard and to 11kV vacuum circuit-breaker FT3.
72. Hence, when LPN's auto-close scheme operated, the fault was 'seen' by the protection systems fitted to the other three 33/11kV transformers. These operated to de-energise the entire 11kV switchboard.



73. The AE has studied the running arrangements of LPN's 33/11kV distribution networks affected by this incident and concludes that LPN's protection systems worked correctly to clear it from LPN's distribution system.
74. The AE commends LPN's control engineers for analysing the situation, and for restoring supplies as rapidly as possible, thereby minimising the duration of the interruption.

4.3 Recommended performance adjustments

75. The AE's recommendations to Ofgem are shown in Table 3.

Table 3 – Recommended performance adjustments

	Amount above threshold	Audit part 2 recommendation
CI	0.25	0.25
CML	0	0

4.4 Detailed justification

76. In reaching a judgement on a recommendation, the AE has firstly considered whether or not LPN could have reasonably taken any different course of action that would have prevented the incident that affected its 11kV switchboard at its Bengeworth Road Primary Substation.
77. In viewing LPN's performance in preventing this event, the AE has taken into account his personal knowledge of the United Kingdom's distribution system practice and that of his colleagues who have considerable operational experience of incidents due to many causes.
78. The AE notes that LPN has other installations of retro-fitted vacuum circuit-breakers designed by, made by, and purchased from, the same reputable manufacturer as the unit affected by this incident.
79. The AE also notes that LPN has no previous records of incidents of this type affecting any of its other such installations.
80. The AE also notes that LPN's routine inspection and maintenance regimes were up to date at the time of the incident and the company had no reason to think that the 11kV switchboard at its Bengeworth Road Primary Substation was faulty.
81. The AE further notes that, despite UKPN having carried-out partial discharge testing prior to the retro-fitting work, the investigations by the manufacturer clearly show that the root cause of the incident was an undetected void in the busbar chamber of the fixed portion of the switchboard.
82. The AE therefore concludes that LPN had no cause to consider any additional measures other than those consistent with good UK practice.
83. In considering LPN's restoration strategy, the AE is conscious that UKPN's duty control engineers acted with commendable skill and speed in analysing the SCADA alarms and indications generated by this incident; and, using tele-controlled switching, restored supplies as rapidly as possible.



84. The AE is satisfied that LPN's distribution network affected by this incident complies with the requirements of Security of Supply Standard P2/6 (56.7 MVA at 11kV firm on a winter peak of 37.7 MVA).
85. The Appointed Examiner therefore concludes that UKPN's claim is justified and recommends to Ofgem that the amount of CI above the threshold value should be excluded from LPN's performance for regulatory reporting year 2015/16.

Appendix A - Record of Audit part 1

Table A-1: Appointed Examiner's Information Log

"One-Off" Exceptional Event	Reporting Year 2015/16
Licensed Area	UKPN(LPN)
Date of event	11 December 2015
Cause	11kV incident at Bengeworth Road Primary Substation
Notification to Ofgem	23 December 2015
SoF received by Ofgem	12 February 2016
SoF information	<ul style="list-style-type: none"> • LPN's 33/11kV distribution system was running normally at the time of the incident; • At 13:17 on Friday 11 December 2015 the 33kV circuit-breaker controlling the infeed to the number three 33/11kV transformer at Bengeworth Road tripped at Chadwick Road; • Virtually simultaneously, the 11kV circuit-breakers of numbers one, two and four 33/11kV transformers at Bengeworth Road tripped; • Sequence automation restored 200 customers in under 3 mins; • Supplies lost from Bengeworth Road 33/11kV Primary Substation were restored via 11kV alternatives using tele-controlled switching (31,268 customers > 3 mins); • The right-hand section of the switchboard was isolated and the left-hand section was re-energised, restoring security of supply to LPN's customers; • Subsequently the lower busbar of the right-hand section was re-energised; and • The root cause of the incident is being investigated by the equipment manufactures.
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 LPN's responses, is contained in paragraph 56 of the report.
Location of audit visit	UKPN's Control Centre
Date of audit visit	24 May 2016
Visiting Auditor	Geoff Stott (ep)
UKPN's Representatives	Bill d'Albertanson and Steve Johnson.
Information provided during and subsequent to the audit visit	<p>Comprehensive documentation / information including:</p> <ul style="list-style-type: none"> • A discussion of LPN's decision-making process and evaluation of retro-fitting vacuum circuit-breakers to its indoor metal-clad switchboards in place of the oil-filled circuit-breakers at its Bengeworth Road Primary Substation; • A discussion regarding the history of any similar previous incidents; • A discussion regarding the post-incident learning and notifications under (NEDeRS®);

- A discussion of the protection arrangements on the 33/11kV network affected by this incident;
- The settings applied to the above protection schemes;
- A copy of LPN's switching programme for the incident which shows the tripping of the 33kV and the 11kV circuit-breakers controlling the infeeds to the switchboard at Bengeworth Road at 13:17 on 11 December 2015;
- Sight of LPN's switching programmes showing:
 - the restoration of supplies to LPN's customers off supply for more than three minutes via tele-controlled 11kV alternative sources; and
 - the commissioning of the FT3 11kV vacuum circuit-breaker at Bengeworth Road on 02 July 2013.
- A discussion regarding the investigations by the manufacturers of the retro-fit circuit-breaker;
- Copies of the relevant 33/11kV SLDs;
- Sight of the printout from LPN's SCADA system that shows the alarms generated by the event;
- A copy of UKPN's incident report that shows:
 - the number of customers affected by the incident for longer than 3 minutes to be 31,268; and
 - the customer minutes lost due to the incident to be 635,085;
- The AE confirms that these figures agree with those quoted in UKPN's SoF;
- Using LPN's total connected customers at 30 September 2015 of 2,311,906 the number of customers affected equates to a CI of 1.35 $[31,268 \times 100 / 2,311,906]$
- Similarly, the customer minutes lost for this event equate to a CML of 0.27 $[635,085 / 2,311,906]$;
- No need to visit the site of the incident to clarify anything;
- Discussed post-fault learning points, including anything to affect LPN's future programme of retro-fitting vacuum circuit-breakers to metal-clad switchboards;
- Confirmed P2/6 compliant (56.7 MVA at 11kV firm in winter);
- LPN provided answers to the initial questions plus additional information both during and subsequent to the audit visit; and
- Okay regarding compliance with Appendix 4 of paragraph 2D.35 of CRC 2D.

Table A-2: Impact on CI and CML

	CI		CML	
Voltage + DNO's incident references	Claimed	Audited	Claimed	Audited
132kV	0	0	0	0
EHV	0	0	0	0
HV (INCD-128807-J)	1.35	1.35	0.27	0.27
LV	0	0	0	0
Total	1.35	1.35	0.27	0.27
UKPN (LPN) Threshold (total)	1.10		0.88	
Part 1 Exceptionality Test	Pass		Fail	
Part 1 Precondition of eligibility (meets App 3 to paragraph 2D.34 of CRC 2D)	Pass			

NOTE: LPN'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 2015/16.

Appendix B – Photographs

Photograph 1 - the fixed portion of the 11kV switchboard



Photograph 2 - the front of the damaged vacuum circuit-breaker



Photograph 3 - the rear of the damaged vacuum circuit-breaker



Photograph 4- the electrical arc damage to the vacuum circuit-breaker

