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Appointed examiner's audit of One-Off Exceptional Event Claim
Western Power Distribution (West Midlands)
66kV incident - Evesham to Broadway
16 July 2014

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Authorisation

Name	Position	Signed	Date
Geoff Stott	Ofgem's Appointed Examiner		15 September 2015

History

Issue	Date	Originator	Checker	Description
1.0	15 September 2015	Geoff Stott	Mel Brown	Final version following 'no further comments' from Ofgem and from WPD
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0.0	21 June 2015	Geoff Stott	-	Pre-draft report created from energypeople template

Contents

Tables

Figure

Photographs

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
EHV	Extra High Voltage – all voltages above 20kV up to but excluding 66kV
ep	energypeople
QoS	Quality of Service
RIGs	Regulatory Instructions & Guidance
SCADA	Supervisory Control and Data Acquisition
SLD	Single Line Diagram
SoF	Statement of Facts
ToR	Terms of Reference
WPD	Western Power Distribution
WPD(WM)	Western Power Distribution's West Midlands licensed area

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 Western Power Distribution (WPD) under the "one off" exceptional event mechanism that an incident which affected its 66kV single circuit overhead line between its Evesham and Broadway Substations at 20:32 on Wednesday 16 July 2014 adversely affected the reported performance for its West Midlands Networks (WPDWM) licensed area for the regulatory reporting year 2014/15.
2. The AE has visited WPD 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 8.57 of Special Licence Condition CRC 8, 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 WPD's performance in mitigating the impact of the event upon its customers.
5. The AE concludes that WPD's overhead line 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, prior to this incident, WPD had done all it could to ensure its 66kV overhead line circuit was free from defects.
7. The AE commends WPD for replacing the shattered glass insulators with high impact-resistant porcelain type on both the affected overhead line structure and structure number 77QEVE34.
8. The AE particularly commends WPD's control engineers for analysing the alarms generated by the incident and for restoring all supplies as quickly as possible from what had become an n-3 depleted network.
9. The AE concludes that WPD had met the criteria of Appendix 4 to paragraph 8.58 of Special Licence Condition CRC 8 and that the incident is therefore deemed to be eligible for adjustment in the DNO's reported performance.
10. The AE therefore recommends that an adjustment to WPD(WM)'s 2013/14 reported distribution system performance is made, in line with the part 1 audited CI figures as shown in the following table:

	Audited number	Number above the threshold	Recommended adjustment
CI	1.49	0.49	0.49
CML	0.65	0	0

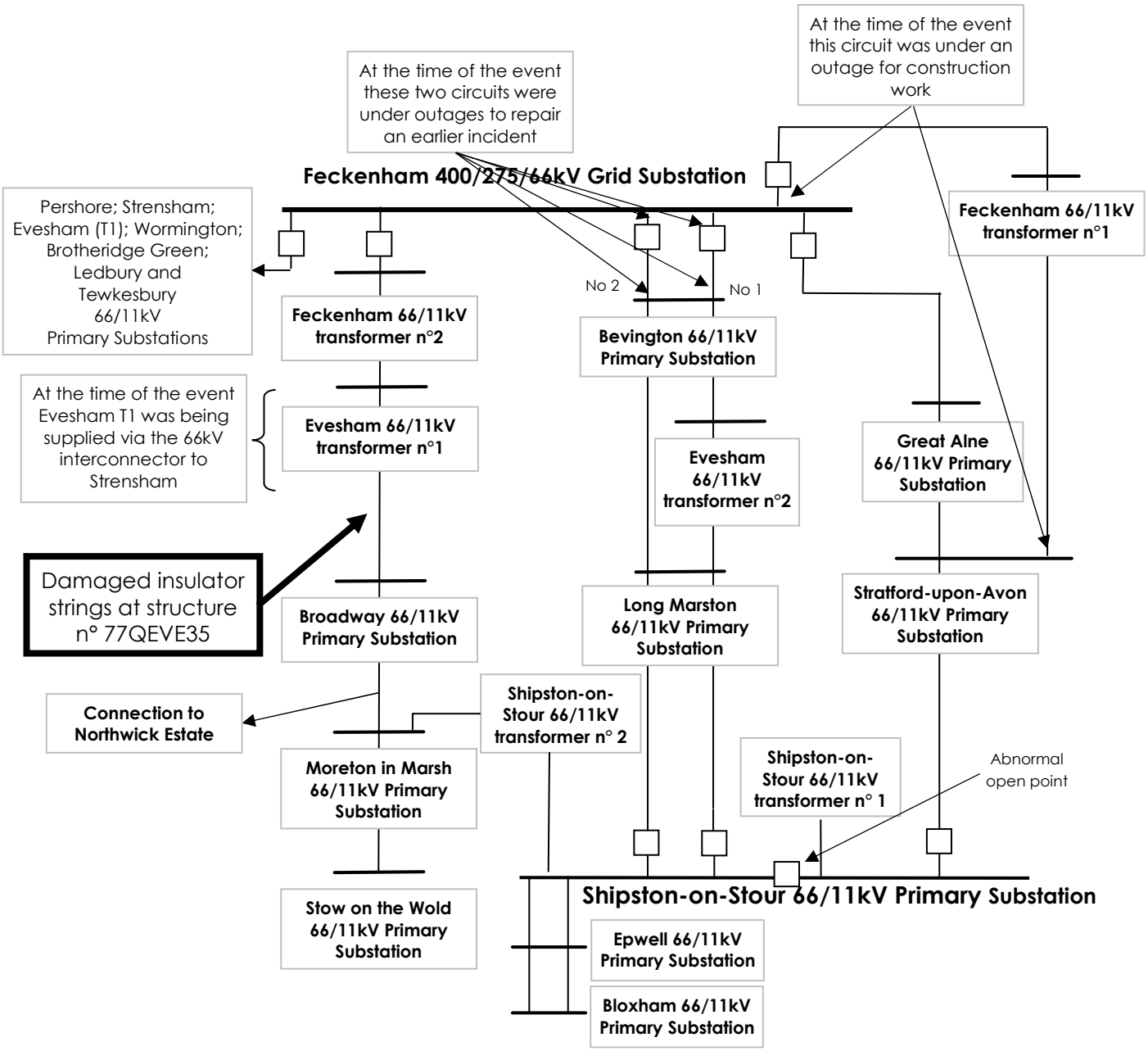
1. Audit part 1

1.1 Summary of the main facts

11. 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.
12. WPD has provided photographic evidence to support its claim that, in the village of Badsey, Worcestershire, the glass insulator strings supporting the 66kV overhead line conductors at structure number 77QEVE35 between WPD's Evesham and Broadway 66/11kV Primary Substations had been irreparably damaged by an unknown third-party.
13. Consequently, during a period of heavy rain, a short-circuit was created between two of the phase conductors via the metal cross-arm on structure number 77QEVE35, causing the controlling circuit-breaker at Feckenham 400/275/66kV Grid Substation to trip, resulting in the loss of supplies to 41,405 of WPD's customers, 36,615 of whom were off supply for longer than three minutes.
14. One of the affected 66kV conductors dropped from the damaged suspension insulator string and came into contact with an under-running 11kV overhead line.
15. This 11kV overhead line is supplied from WPD's Broadway Primary Substation and was therefore affected by the incident on the 66kV overhead line. However, the restoration of the customers affected by this 11kV incident could not take place until the 66kV conductor had been re-hung on the replacement insulators at structure number 77QEVE35.
16. WPD has properly accounted for the different restoration times in its incident reports, i.e. there is no double-counting.
17. At the time of the incident affecting structure number 77QEVE35, this interconnected section of WPD's 66kV network was already at an 'n-2' situation due to an incident affecting the number 2 66kV circuit between Feckenham 400/275/66kV Grid Substation and WPD's 66/11kV Bevington Primary Substation plus the need to de-energise the number 1 66kV circuit to provide safety clearance for repairs.
18. The earlier incident occurred at 12:09 on 16 July 2014 and was found to be due to a broken jumper on the double-circuit terminal tower close to Feckenham 400/275/66kV Grid Substation. Following reports of abnormal volts, the circuit was de-energised at 12:17 that day.
19. The number 1 circuit was de-energised at 20:13 to provide the above-mentioned safety clearance.
20. Whilst this interconnected part of WPD's 66kV network is subject to several derogations from security of supply standard P2/6 and WPD is currently working to remedy this situation, the provisions of P2/6 would not have mitigated against the sequence of events that resulted in the 'n-3' situation which is the situation that WPD faced and is the subject of the present OOEE claim.
21. The combination of the earlier incident, the outage on safety grounds and the incident affecting structure number 77QEVE35, resulted in the loss of infeeds to seven of WPD's 66/11kV Primary Substation, part of two other 66/11kV Primary Substations and the 66kV connection to Northwick Estate.

22. WPD's protection operated correctly to clear the incident from its distribution network, tripping the 66kV circuit-breaker controlling the single-circuit overhead line.
23. WPD's 66kV distribution system was running abnormally at the time of the incident affecting structure number 77QEVE35 due to the above-mentioned incident affecting the 66kV circuits between Feckenham 400/275/66kV Grid Substation and Bevington 66/11kV Primary Substation plus construction work at Feckenham 400/275/66kV Grid Substation affecting the circuit to Stratford-upon-Avon Primary Substation teed T1 at Feckenham Primary Substation. This construction work is in conjunction with WPD replacing the 11kV switchboard at its Stratford-upon-Avon Primary Substation.
24. WPD's control engineer used tele-controlled switching to begin to restore supplies from alternative 66kV and 11kV sources.
25. WPD's control engineer also requested that the work to repair the broken jumper on the number 2 66kV circuit between Feckenham 400/275/66kV Grid Substation and WPD's Bevington Primary Substation be suspended so that the number 1 circuit could be restored.
26. The number 1 circuit was re-energised via tele-controlled switching at 21:21 on 16 July 2014 thus enabling the restoration of supplies to the remainder of WPD's affected customers except those directly affected by the 66kV conductor falling onto the 11kV overhead line at structure number 77QEVE35.
27. The final customers' supplies were restored at 05:36 on 17 July 2014 following repairs to the damaged 11kV overhead line.
28. WPD carried-out an investigation into the incident that affected structure number 77QEVE35, which concludes that third-party damage to the glass insulators had resulted in a short-circuit through the metal cross-arm during heavy rain, causing the controlling circuit-breaker to trip.
29. As a result of this incident and to prevent a re-occurrence, WPD has fitted high-impact resistant porcelain insulators to both structure number 77QEVE35 and the next structure along the line; 77QEVE34.
30. Coincidentally, the section of 11kV overhead line over which the 66kV overhead line crossed was due to be undergrounded at the request of the local farmer. One of the newly erected poles for this purpose is visible in Photograph 4 - the top of this pole is wrapped in red insulating material.
31. A simplified view of the sections of WPD's 66/11kV network affected by this event is shown in Figure 1.

Figure 1 – Simplified Network Diagram of WPD's 66/11kV distribution system affected by the incident



Notes:

1. Only the salient items of switchgear are shown.
2. WPD's network was running abnormally at the time of the incident.
3. Seven 66/11kV Primary Substations and two other 66/11kV Primary Substation lost partial supply for longer than three minutes.
4. Supplies to the 4,790 customers supplied from Bloxham 66/11kV Primary Substation were restored within three minutes via WPD's auto-sequence switching.
5. The connection to Northwick Estate was also interrupted.
6. WPD's control engineer used tele-controlled switching to restore supplies via alternative 11kV sources before the Feckenham to Bevington number 1 66kV circuit was brought back into service.
7. The final restoration of supplies was at 11kV following the repairs to the 66kV and 11kV overhead lines were they crossed at structure number 77QEVE35.

2. Exceptionality requirements

2.1 Does the event qualify for exclusion

32. 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.
33. 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.

2.2 Exceptionality test results

34. 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	1	1
HV	0	0
LV	0	0
Total	**1**	**1**

35. 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	Claimed number	Audited number	Pass / Fail	Amount above threshold
CI exceptionality	1.0	1.49	1.49	pass	0.49
CML exceptionality	0.8	0.65	0.65	fail	0

Notes:

1. Ofgem's CI and CML exceptionality criteria are set out in the AE's ToR[1].
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.
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 2012/13 to 2014/15

3. WPD's views of its performance

3.1 Dealing with the incident

36. WPD's interconnected 66kV system in the area affected by this event is supplied from Feckenham 400/275/66kV Grid Substation.
37. Six 66kV circuits radiate from Feckenham 400/275/66kV Grid Substation.
38. One of these circuits normally supplies WPD's Pershore, Strensham, Brotheridge Green, Tewskbury, part of Ledbury and part of Evesham (66/11kV transformer number 1) Primary Substations. At the time of the incident WPD's 66kV system was running abnormally and this circuit was carrying all of the Evesham load. This circuit was unaffected by the event in question and consequently enabled the speedy restoration of some supplies via alternative 11 kV sources.
39. Another of these 66kV circuits is the one to Stratford-upon-Avon Primary Substation via Great Alne Primary Substation. It was also unaffected by the event in question. The section of this 66kV circuit between Stratford-upon-Avon and Shipston-on-Stour Primary Substations also enabled some supplies to be restored quickly.
40. A third circuit is the normal infeed to Stratford-upon-Avon Primary Substation teed to 66/11kV transformer number 1 at Feckenham Primary Substation. This circuit was under a planned outage prior to the event in question event occurring.
41. A further two of the 66kV circuits from Feckenham 400/275/66kV Grid Substation are the numbers 1 and 2 to Shipston-on-Stour teed Evesham teed Long Marston teed Bevington Primary Substations.
42. Earlier, on the day the event at structure number 77QEVE35 occurred, both these circuits were de-energised as already mentioned due to a broken jumper on the double-circuit terminal tower near Feckenham 400/275/66kV Grid Substation.
43. The sixth 66kV circuit from Feckenham 400/275/66kV Grid Substation normally supplies Broadway, Moreton in Marsh, Stow on the Wold, part of Evesham (66/11kV transformer number 2) and part of Shipston-on-Stour Primary Substations. This is the 66kV circuit of which structure number 77QEVE35 is part.
44. As noted above, WPD's contingency switching had previously moved all the Evesham T1 load to the Strensham 66kV circuit and hence only the number 2 66/11kV transformer at Evesham Primary Substation was affected by the incident at structure number 77QEVE35.
45. Thus, at 20:32 on Wednesday 16 July 2014, when the circuit-breaker controlling the 66kV circuit containing structure number 77QEVE35 tripped, WPD's 66kV system was already severely depleted by the then existing incident affecting both the 66kV circuits to Bevington Primary Substation from Feckenham 40/275/66kV Grid Substation.
46. WPD considers that its protection operated correctly to clear the incident from its distribution network.
47. WPD considers that its duty control engineers reacted well in assessing the alarms generated by the event and beginning to restore supplies from alternative 11kV sources and the spare capacity of the 66kV circuit from Feckenham 40/275/66kV Grid to Shipston-on-Stour teed Stratford teed Great Alne Primary Substations.

48. WPD also considers that its control engineers acted correctly in halting the repairs to the number 2 66kV circuit from Feckenham 40/275/66kV Grid Substation to Bevington 66/11kV Primary Substation so that the number 1 circuit could be brought back into use to enable the restoration of the remaining customer supplies.
49. WPD also considers that its personnel did well in identifying the cause of the incident and replacing the damaged insulators with a minimum of delay, enabling the restoration of the 66kV circuit from Feckenham 400/275/66kV Grid Substation to Evesham 66/11kV Primary Substation at 04:58 on 17 July 2015, thus maximising the security of supply for its customers.
50. Following the incident, WPD carried-out an investigation into its cause and concluded that the damage was due to third-party interference.

3.2 WPD's answers to questions on its performance

51. Within the last three years, the AE has reviewed WPD's design standards, construction methods and maintenance procedures during previous visits to audit exceptional event claims and found them fit for purpose.
52. The AE confirms that WPD's emergency procedures provide for the type of event being examined here.
53. To aid understanding of the background to WPD'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 WPD's claim.
54. The initial questions were discussed during the AE's visit to WPD's operational depot at Worcester on 08 June 2015, when the records of WPD's SCADA system, the incident report and other information were made available.
55. WPD 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 WPD's answers being printed in normal font.

Q1. What, if any, changes has WPD made to its emergency plans and procedures since the Appointed Examiner (AE) last visited to audit the exceptional event claim concerning the loss of supplies from Winster BSP on 12 October 2011 which affected WPD's customers in its East Midlands licensed area?

A1. Following the incident at Winster, WPD has purchased a portable 33kV switchboard which would be deployed should another incident of that nature occur in the future.

Q2. What is the location of structure number 77QEVE35 – i.e. rural, semi-urban or urban?

A2. Structure 77QEVE35 is a located in a rural setting. *[**AE's note:** this was confirmed during a site visit]*.

Q3. What history does WPD have of any vandalism occurring to any of its overhead line equipment in the vicinity of pole number 77QEVE35?

A3. WPD has no history of vandalism affecting its overhead lines (both 66kV and 11kV) in the vicinity of structure 77QEVE35.

Q4. What is WPD's risk assessment for its overhead lines in the vicinity of pole number 77QEVE35? What affect has this incident had on WPD's risk assessment?

A4. WPD carries-out risk assessment as an integral part of its overhead line patrols. As a direct result of this event WPD's local manager had regular inspections carried out for a period of 6 months following the incident and no further damage was found.

Q5. When was the 66kV overhead line between Evesham and Broadway commissioned?

A5. The overhead line was commissioned in 1959.

Q6. What is WPD's policy for the routine maintenance of its 66kV overhead lines?

A6. WPD carries-out overhead line maintenance when the need is identified by one of its overhead line patrols.

Q7. Prior to the incident, when was the last routine maintenance carried-out on this overhead line?

A7. Please see A6 above: as a consequence of the 'no-action needed' content of the reports from its regular patrols, WPD has no reason to suspect the integrity of its overhead line infrastructure in the area.

Q8. Prior to the incident, was WPD's routine maintenance policy being applied to the 66kV overhead line between Evesham and Broadway? The AE will require sight of the last maintenance records for this section of WPD's 66kV overhead line network.

A8. Yes, WPD's policy was being applied to the overhead lines in the locality.

Q9. What is WPD's policy for the line patrolling of its 66kV overhead lines?

A9. WPD carries-out a foot patrol every two years with a helicopter patrol in the intervening years. WPD also carries-out a full risk assessment inspection every seven years.

Q.10. Prior to the incident, was WPD's policy being applied to the line patrolling of the 66kV overhead line between Evesham and Broadway?

A10. Yes, WPD's line patrols were up to date: as mentioned in the SoF, a foot patrol was carried-out on 10 December 2013; and a helicopter patrol was carried-out on 03 May 2014.

Q11. WPD's Statement of Facts (SoF) indicates that the overhead line was last patrolled in December 2013. The AE will require sight of the report from this line patrol.

A11. The reports from the above two overhead line patrols will be made available during the AE's audit visit. *[**AE's note:** the overhead line reports show no damage to WPD's 66kV infrastructure].*

Q12. The positioning of circuit-breakers shown on the 66kV SLD incorporated in WPD's SoF suggests that, for an incident affecting the overhead line between Evesham and Broadway, only two 66/11kV transformers would lose their infeeds:

one of the two transformers at Feckenham 400/275/66kV BSP; and

one of the two transformers at Broadway 66/11kV Substation.

At both these locations, the second transformer would be expected to maintain supplies – the AE will need to understand why any customers' supplies were interrupted by the tripping of circuit-breaker 2L5 at Feckenham BSP.

A12. With the system running normally that would be a correct situation. However, at the time of the incident, WPD's 66kV system was running abnormally: Both 66kV circuits between Feckenham and Bevington were de-energised due to a fault on the number 2 circuit and the need to switch out the number 1 circuit for safety clearances to repair the broken jumper on the number 2 circuit.

Prior to de-energising the number 1 circuit WPD had carried-out contingency switching as follows:

At Bevington the Feckenham 66kV line isolators on the number 1 and number 2 66kV circuits were open;

At Shipston-on-Stour the Stratford-upon-Avon 66kV circuit-breaker was open; and

At Evesham, the load on the number 2 66/11kV transformer was transferred to the number 1 66/11kV transformer and the 66kV bus-section circuit-breaker was open.

Thus the Feckenham / Evesham / Broadway 66kV circuit was feeding Feckenham T2, Broadway, Moreton-in-Marsh, Stow-on-the-Wold, Northwick Generation, Shipston-on-Stour T2, Epwell, Bloxham, Long Marston and Bevington. When 2L5 Tripped at Feckenham then all Supplies would have been lost to these sites.

Q13. What protection schemes are installed on this interconnected part of WPD's 66kV network?

A13. The details of WPD's protection schemes will be made available to the AE. *[**AE's note**: WPD has provided details of its protection schemes applied to the affected circuit]*.

Q14. What settings are applied to these protection schemes?

A14. The settings applied to the above protection schemes will be made available to the AE. *[**AE's note**: WPD has provided details of these settings]*.

Q15. What protection operated on WPD's 66kV network to clear the incident from the system?

A15. The protection operations will be made available to the AE. *[**AE's note**: WPD has provided details of the protection operations]*.

Q16. WPD's SoF also indicates that the detached 66kV conductor at structure number 77QEVE35 came into contact with an under-running 11kV overhead line circuit, causing its protection to operate and de-energise the circuit, what protection operated to clear this incident from WPD's 11kV overhead line.

A16. WPD's pole-mounted auto-reclosing circuit-breaker locked-out to isolate the section of 11kV overhead line affected by the fallen 66kV conductor.

Q17. What is the minimum vertical clearance between the 11kV overhead line and the over-running 66kV overhead line? How does this distance compare with WPD's standards for overhead line crossings of this type?

A17. A minimum of 2.3 metres is required. The 66kV structure is 14 metres high and the 11kV overhead line pole is 10 metres. There is thus adequate clearance between the two overhead lines.

Q18. What protection schemes are fitted to the under-running 11kV overhead line?

A18. The pole-mounted circuit-breaker noted at A16 above is a Whipp and Bourne type GVR recloser.

Q19. What protection operated to clear the incident from WPD's 11kV network?

A19. Please see A16 above.

Q20. The AE will need to understand the running arrangements of this 11kV circuit. As noted below, a copy of the associated SLD will be needed for the AE's report.

A20. A representation of WPDs 11kV network will be shown to the AE during the audit visit. *[**AE's note**: the section of 11kV network affected by the falling 66kV conductor is a spur, protected by a pole-mounted auto-reclosing circuit-breaker. WPD sectionalised the 11kV overhead spur and thus restored supplies to as many customers as possible before inspecting the affected section of overhead line before subsequently restoring all supplies}.*

Q21. What learning points has WPD incorporated into its procedures as a result of this incident?

A21. In its 'business as usual' approach, WPD has reviewed this incident. WPD has concluded that its processes worked well in restoring its customers' supplies in what had become a severely depleted 66kV network. WPD was already working to eliminate the lack of compliance with P2/6 at the time of the incident and is on course to complete the required work within the agreed timescale of the derogations.

WPD is also introducing a new approach to the risk assessment of outage planning and risk management which is intended to further enhance its already robust policy.

In addition, WPD has up-dated its outage planning process, including the introduction of pre-outage site contingency plans and the production of contingency switching schedules by its control room personnel.

Q22. What further learning points should be considered as a result of the application of the current one-off Exceptional Event Claims process?

A22. WPD considers that all exceptional event claims should be subject to timely audit by a person experienced in the Industry.

56. Whilst the AE was satisfied with WPD's date-stamped audit trail and WPD's photographic evidence; during the discussion of this claim it was concluded that the AE would visit the site to gain a better appreciation of location of this incident. *[**AE's note:** it is confirmed that structure number 77QEVE35 is located in a rural setting, near to some farm outbuildings where caravans are parked}.*

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

- The damaged insulator strings as removed from structure number 77QEVE35;
- Information for the affected section of WPD's interconnected 66kV system regarding the requirements of P2/6;
- Information to show that, prior to the current incident, the affected 66kV overhead line has been free from incidents due to this cause;

- Sight of the weather report for 16 July 2014;WPD's photographs of the damaged insulator strings, the location of structure number 77QEVE35 and the construction details of the terminal tower close to Feckenham 400/245/66kV Grid Substation showing the need for safety clearance to the number 1 circuit to effect repairs to the broken jumper on the number 2 circuit
- WPD's control room log for this incident;
- WPD's incident report from which it calculated the CI and CML attributed to this incident;
- The details of WPD's SCADA alarms received during this incident;
- A representation of the incident on WPD's SCADA system; and
- Copies of WPD's protection schemes and associated settings for its 66kV and 11kV circuits affected by this event.

4. Audit part 2

4.1 WPD's performance in preventing the event

58. In viewing WPD's performance in preventing this incident, the AE has considered what more WPD could have reasonably been expected to have done to ensure that its 66kV single-circuit overhead line was safeguarded from incidents of this nature.
59. The AE has discussed WPD's inspection and maintenance regime and notes that the inspections were both thorough and up to date; the most recent helicopter patrol being carried-out on 03 May 2014 when nothing untoward was reported at structure 77QEVE35.
60. Photograph 1, copied from WPD's investigation report, shows the severely damaged insulator strings in relation to their original location on structure number 77QEVE35.
61. Given the above-mentioned helicopter patrol, WPD concludes that the damage must have happened between 03 May 2014 and 16 July 2014, the day the incident occurred.
62. Photograph 2 shows a new glass disc insulator. For each phase conductor, five of these made up each insulator string on structure number 77QEVE35.
63. Photograph 3 is taken from "Google Earth". It shows the rural setting where this incident occurred.
64. Photograph 4 shows a closer view of WPD's 66kV and 11kV overhead lines plus the farm outbuildings and caravans mentioned as being seen during the AE's site visit.
65. WPD's measurement systems clearly show the incident concerning the broken jumper on the number 2 66kV Feckenham 44/275/66kV Grid Substation to Bevington Primary Substation and the consequential need to de-energise the number 1 circuit to provide for safe working clearance in order to repair the broken damage.
66. WPD's measurement systems also clearly show the tripping of the Feckenham to Evesham 66kV circuit due to the incident at structure number 77QEVE35.
67. WPD's measurement systems confirm the restoration of supplies via tele-controlled switching from the spare capacity of its 66kV circuit from Feckenham 40/275/66kV Grid Substation to Shipston-on-Stour via Stratford-upon-Avon.
68. WPD's measurement systems confirm the restoration of some supplies via 11kV alternative sources.
69. WPD's measurement systems also confirm the postponement of the repair to the broken jumper on the number 2 66kV Feckenham 44/275/66kV Grid Substation to Bevington 66/11kV Primary Substation so that the number 1 circuit could be re-energised to enable the restoration of the majority of the remaining customer supplies via WPD's 66kV network.
70. The remaining customer supplies were connected to the 11kV overhead line onto which the 66kV conductor had fallen at structure number 77QEVE35.
71. These supplies were restored following the re-erecting of the 66kV conductor at structure number 77QEVE35 and repairs to WPD's 11kV overhead infrastructure; including a pole-mounted transformer.

72. An examination of WPD's measurement systems and a SCADA representation of its distribution network confirm that WPD did all it could to restore supplies as expeditiously as possible, particularly as the section of 66kV network was at an 'n-2' condition before the incident at structure number 77QEVE35 occurred.
73. The AE concludes that, prior to this incident occurring, WPD had done all it could reasonably have been expected to do in considering that its 66kV overhead line at structure number 77QEVE35 was free from defects and showed no signs of third-party interference.
74. WPD's overhead line inspection policy is thorough and was up to date prior to the incident occurring.

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

75. In the AE's experience, damage such as that which occurred to the glass insulators at structure number 77QEVE35 could only be caused by third-party interference.
76. Furthermore, the AE is of the opinion that the damage is consistent with the insulators having been systematically targeted and shattered by either rifle fire or shotgun pellets.
77. The AE has studied the running arrangements of this section of WPD's 66kV network and concludes that WPD's protection systems worked correctly to clear the incident from its distribution system.
78. Given the incident concerning the broken jumper and the arrangement of the equipment on the associated terminal tower, the AE concludes that WPD had no choice but to go to an n-2 situation in order to effect repairs.
79. Following the incident at structure 77QEVE35 and its reducing WPD's 66kV system to an n-3 condition, the AE also concludes that WPD acted correctly in postponing the repair to the broken jumper and re-energising the number 1 circuit to restore supply.
80. The AE commends WPD's control engineers for analysing the whole situation, and for their actions in restoring supplies as rapidly as possible, thereby minimising the duration of the interruption to WPD's customers.

4.3 Recommended performance adjustments

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

Table 3 – Recommended performance adjustments

	Amount above threshold	Audit part 2 recommendation
CI	0.49	0.49
CML	0	0

4.4 Detailed justification

82. In reaching a judgement on a recommendation, the AE has firstly considered whether or not WPD could have reasonably taken any different course of action that would have prevented the damage to the insulators at structure number 77QEVE35.
83. In viewing WPD'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.
84. The AE notes that WPD has no previous records of incidents of this type affecting either this 66kV overhead line or the 11kV overhead lines in the area.
85. The AE also notes that WPD's overhead line patrols were up to date with a helicopter patrol having been carried-out just over two months before the incident occurred. This helicopter patrol confirmed the report from the previous ground patrol in that there was no damage at structure number 77QEVE35.
86. The AE therefore concludes that WPD had no cause to consider any additional measures other than those consistent with good UK practice.
87. In considering WPD's restoration strategy, the AE is conscious that WPD'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.
88. The AE is satisfied that this section of WPD's 66kV network is being updated in line with its current derogations from P2/6. That said, WPD's restoration strategy ensured that its customers' supplies in the n-3 situation were restored in less time than required under an n-2 situation.
89. The Appointed Examiner therefore concludes that WPD's claim is justified and recommends to Ofgem that the amount of CI above the threshold value should be excluded from WPDWM's performance for reporting year 2013/14.

Appendix A - Record of Audit part 1

Table A-1: Appointed Examiner's Information Log

"One-Off" Exceptional Event	Reporting Year 2013/14
Licensed Area	WPD(WM)
Date of event	16 July 2014
Cause	Third party damage to 66kV insulator strings
Notification to Ofgem	22 July 2014
SoF received	20 August 2014
SoF information	• WPD's 66kV distribution system was running abnormally at the time of the incident: o the 66kV circuit from Feckenham 400/275/66kV Grid Substation to Stratford-upon-Avon 66/11kV Primary Substation teed T1 Feckenham 66/11kV Primary Substation was under a shutdown for construction work; o both 66kV circuits from Feckenham 400/275/66kV Grid Substation to Shipston-on-Stour teed Bevington teed Evesham teed Long Marston 66/11kV Primary Substations were under outages for a broken jumper on the n° 2 circuit and associated safety clearance on the n° 1 circuit; and o The 66kV SLD shows this to be an n-2 condition for a considerable section of this interconnected network. • At 20:32 on Wednesday 16 July 2014 the Evesham teed Feckenham T2 teed Broadway teed Moreton in Marsh teed Northwick Estate 66kV circuit-breaker at Feckenham 400/275/66kV Grid Substation tripped; • Supplies to 8 of WPD's 66/11kV Primary Substations were interrupted, together with part of a ninth Primary substation and the 66kV connection to Northwick Estate; • A total of 41,405 customers lost supply with 4,790 being restored within 3 minutes via WPD's sequence switching scheme; • Of the 36,615 (41,405-4,790) who were off supply for more than three minutes, all but 337 were restored within the hour by a combination of tele-controlled switching on WPD's 66kV and 11kV networks plus manual operation of an 11kV overhead line isolator; • The 337 customers' supplies were affected by a 66kV conductor having fallen onto an under-running 11kV overhead line; • These customer's supplies were restored once the 66kV and 11kV overhead lines were repaired; • WPD found all three sets of 66kV suspension insulators shattered at structure number 77QEVE35; • The incident occurred during a period of heavy rainfall; • WPD has no history of lightning strikes in the vicinity that would cause the damage; and • WPD's post-incident investigation report demonstrates the flow of fault current and concludes that the incident was caused by previous third-party damage to the 66kV

	insulator strings at structure 77QEVE35.
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 WPD's responses, is contained in paragraph 55 of the report.
Location of audit visit	WPD's operational depot at Worcester
Date of audit visit	08 June 2015
Visiting Auditor	Geoff Stott (ep)
WPD's Representatives	Dave Park-Davis, Richard Ellam, Carolyn Hinchey, Richard Skyte and David Waring
Information provided during and subsequent to the audit visit	Comprehensive documentation / information including: • The three severely damaged insulator strings as removed from structure number 77QEVE35; • A discussion of WPD's inspection and maintenance policy regarding its 66kV overhead circuits – both foot and helicopter patrols were up to date; • A discussion on the findings from the above two most recent overhead line patrols – both showed no damage at structure number 77QEVE35; • A discussion on the situation regarding this section of WPD's 66kV system having four current derogations from P2/6 and the actions that WPD is taking to rectify these; • A discussion regarding the absence of any known vandalism previously affecting any of WPD's overhead lines in the locality; • A discussion regarding the pre- and post-incident risk assessments for the locality – no further damage since this incident; • A discussion regarding the learning and the replacement of the shattered glass insulators with high impact-resistant porcelain types on both structure 77QEVE35 and structure number 77QEVE34; • A discussion regarding the n-2 situation due to the broken jumper on the Feckenham to Bevington 66kV n° 2 circuit and the need to de-energise the n° 1 circuit to safely effect repairs; • A discussion of the protection arrangements on the 66/11kV networks affected by this incident; • The settings applied to the above protection schemes; • The details of what protection operated to clear the incident from WPD's network; • A copy of WPD's switching programme for the incident which shows the tripping of the 66kV circuit-breaker controlling the single-circuit overhead line at 20:32 on 16 July 2014; • Sight of WPD's switching programmes showing the restoration of the supplies to the affected Primary Substations via tele-controlled switching on the 66kV and 11kV networks;

	• Sight of WPD's switching programme showing the restoration of the final customers who are supplied via the 11kV under-running overhead; • Copies of the relevant 66kV and 11kV SLDs; • Sight of the printout from WPD's SCADA system that shows the alarms generated by the event; • A copy of WPD's incident report that shows: o the number of customers affected by the incident to be 36,615; and o the customer minutes lost due to the incident to be 1,604,175; • The AE confirms that these figures agree with those quoted in WPD's SoF; • Using WPDWM's total connected customers at 30 September 2014 of 2,455,914 the number of customers affected equates to a CI of 1.49 [36,615*100/2,455,914] • Similarly, the customer minutes lost for this event equate to a CML of 0.65[1,604,175/2,455,914]; • The AE to visit the site on his way back to East Anglia; • WPD 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 8.58 of CRC 8.

Table A-2: Impact on CI and CML

	CI		CML	
Voltage (DNO's incident reference)	Claimed	Audited	Claimed	Audited
132kV	0	0	0	0
EHV (INCD-145089-E)	1.49	1.49	0.65	0.65
HV	0	0	0	0
LV	0	0	0	0
Total	1.49	1.49	0.65	0.65
WPDWM Threshold (total)	1.0		0.8	
Part 1 Exceptionality Test	pass		fail	
Part 1 Precondition of eligibility (meets App 3 to paragraph 8.57 of CRC 8)	pass			

NOTE: WPD'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 2014/15.

Appendix B - Photographs

Photograph 1 – The severely damaged insulator strings in relation to structure 77QEVE35

This photo-montage is taken from WPD's report following the company's investigation into the cause of the incident.

The damaged insulator strings are depicted above their original locations on structure 77QEVE35.

Structure 77QEVE35 is shown with the replacement insulator strings which are made from high-impact porcelain to legislate against similar third-party damage in the future.

Photograph 2 – A new glass disc insulator

Five glass disc insulators like this made up each suspension string on WPD's 66kV structure 77QEVE35.

The metal pin shown projecting towards the top left of the photograph engages in the socket of the metal cap on which this disc insulator rests. A spring clip prevents the pin coming free from the socket but does not prevent the joint moving in windy conditions.

The glass section of the item provides the actual electrical insulation. The underside 'ribs' of the insulator provide a long tracking-path which prevents a flash-over occurring between the two metal components.

Thus, in the absence of the glass section due to, say, third-party damage, the electrical path between the two metal pieces is very short and, with pollution and rain, a flashover is likely to occur.

Photograph 3 – A view of structure 77QEVE35 taken from "Google Maps"

The rural setting is apparent from this photograph

Photograph 4 – Structure 77QEVE35 in relation to the farm outbuildings and WPD's under-running 11kV overhead line

This photograph was taken after the incident. In addition to the 66kV and 11kV overhead lines it shows the farm outbuildings and a newly erected terminal pole for the undergrounding of two spans of the 11kV overhead line at the request of the farmer. The pole with red-coloured insulation wrapping will be a new terminal pole for this undergrounding job.