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**Appointed examiner's audit of Exceptional Event Claim -
UK Power Networks (Eastern)
132kV incident – Norwich Trowse
to Gorleston and Great Yarmouth Grid Substations
31 August 2014**

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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
EHV	Extra High Voltage – all voltages above 20kV up to but excluding 132kV
ep	energypeople
EPN	UKPN's Eastern Power Network licensed area
ESQCR	Electricity, Safety, Quality and Continuity Regulations
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
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 132kV dual circuit overhead line from Norwich Trowse Substation to Gorleston and Great Yarmouth at 14:24 on Sunday 31 August 2014 adversely affected the reported performance for its Eastern Power Networks (EPN) licensed area for the reporting year 2014/15.
2. The AE has visited EPN 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 EPN’s performance in mitigating the impact of the event upon its customers.
5. The AE concludes that EPN’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, prior to this incident, EPN had done all it could to safeguard its 132kV double-circuit tower line from third-party interference.
7. The AE commends EPN’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 EPN 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.
9. The AE therefore recommends that an adjustment to EPN’s 2014/15 reported distribution system performance is made, in line with the part 1 audited CI and CML figures as shown in the following table:

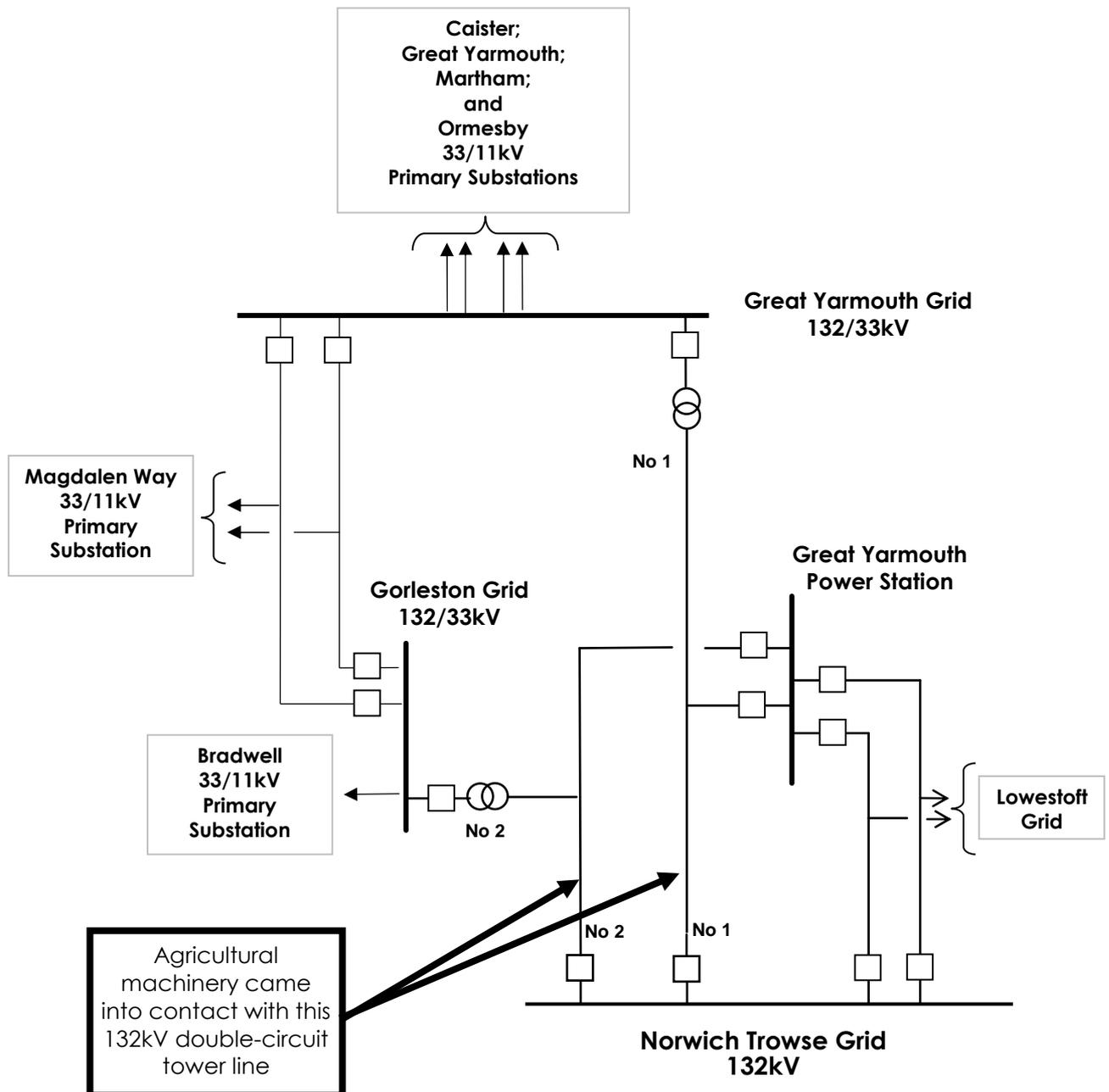
	Audited number	Number above the threshold	Recommended adjustment
CI	1.44	0.74	0.74
CML	0.14	0	0

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. EPN has provided evidence to support its claim that, in the Parish of Fritton and St Olaves, the boom of an agricultural spraying rig came into contact with its 132kV double-circuit tower line that connects Gorleston and Great Yarmouth with Norwich Trowse Grid,
12. The length of the boom was measured to be 20 metres.
13. EPN measured the ground clearance at the lowest part of the affected span to be 8.5 metres.
14. EPN's distance protection tripped the 132kV circuit-breakers at its Norwich Trowse Grid Substation, sending inter-trip signals to trip the circuit-breakers at the remote ends.
15. These were correct operations for this type of incident.
16. The incident affected both 132kV circuits and resulted in the loss of 132kV infeeds to both Gorleston Grid Substation and Great Yarmouth Grid Substation. Great Yarmouth Power Station has feed connections with each of these 132kV circuits.
17. In addition, Great Yarmouth Power Station has two other 132kV connections to Norwich Trowse 132kV Grid, both of which are feed to Lowestoft Grid Substation.
18. As a result of the loss of 132kV infeeds to Gorleston and Great Yarmouth 132/33kV Grid Substations, the 33kV infeeds to six of UKPN's 33/11kV Primary Substations were interrupted.
19. This resulted in the loss of supply to 51,400 of EPN's customers for longer than three minutes.
20. EPN's protection operated correctly to clear the incident from its distribution network, tripping the 132kV circuit-breakers controlling the 132kV double-circuit tower line.
21. EPN's 132kV distribution system was running normally at the time of the incident.
22. EPN's control engineer began to use tele-controlled switching to restore supplies from alternative 33kV and 11kV sources.
23. At 14:33 EPN's control engineer re-energised the number 1 132kV circuit to restore all supplies.
24. A report was received from the fire service indicating that agricultural machinery had contacted the 132kV overhead lines.
25. Following confirmation from site that no permanent damage was caused, the number 2 132kV circuit was re-energised at 15:30.
26. A simplified view of the sections of EPN's 132/33kV networks affected by this event is shown in Figure 1.

Figure 1 – Simplified Network Diagram of EPN’s 132/33kV distribution system affected by the incident



Notes:

1. Only the salient items of switchgear are shown.
2. EPN’s network was running normally at the time of the incident.
3. EPN’s control engineer used tele-controlled switching to restore supplies via alternative 33kV and 11kV sources.
4. The outgoing 33kV feeders from Gorleston and Great Yarmouth Grid Substations are shown schematically.

2. Exceptionality requirements

2.1 Does the event qualify for exclusion

27. 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.
28. 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

29. 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	1	1
EHV	0	0
HV	0	0
LV	0	0
Total	1	1

30. 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	0.7	1.44	1.44	Pass	0.74
CML exceptionality	0.6	0.14	0.14	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.
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. EPN's views of its performance

3.1 Dealing with the incident

31. EPN's Gorleston and Great Yarmouth 132/33kV Grid Substations are normally supplied via a double-circuit 132kV tower line from its Norwich Trowse Grid Substation.
32. Each of these 132kV circuits has a teed connection to Great Yarmouth Power Station.
33. At the time of the incident, the system was running normally with both 132kV circuits on load.
34. At 14:24 on 31 August 2014, the 132kV circuit-breakers controlling the circuits tripped, inter-tripping the remote ends.
35. EPN considers that its protection operated correctly to clear the incident from the system.
36. EPN considers that its duty control engineer reacted well in assessing the alarms generated by the event and beginning to restore supplies via tele-controlled switching on the 33kV and 11kV networks.
37. EPN considers that its duty control engineer acted correctly in re-energising the number 1 circuit at 14:33 to restore the remaining customer supplies.
38. The cause of the incident was confirmed to be third-party contact in the form of agricultural machinery, as reported to EPN via the fire service.
39. The number 2 132kV circuit was re-energised and EPN's distribution system was restored to normal running conditions.

3.2 EPN's answers to questions on its performance

40. Within the last three years, the AE has reviewed EPN's design standards, construction methods and maintenance procedures during previous visits to audit exceptional event claims and found them fit for purpose.
41. The AE confirms that EPN's emergency procedures provide for the type of event being examined here.
42. To aid understanding of the background to EPN'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.
43. The initial questions were discussed during the AE's visit to UKPN's Control Centre on 19 June 2015, when the records of EPN's SCADA system, the incident report and other information were made available.
44. EPN 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 EPN's answers being printed in normal font.

Q1. What, if any, changes has EPN made to its emergency plans and procedures since the Appointed Examiner (AE) last visited to audit the exceptional event claim concerning the incident that occurred 01 January 2014 which affected EPN's customers supplied from its Great Yarmouth Grid Substation?

- A1. UK Power Networks reviews its policies and procedures on a regular basis, however, no changes have been made following this incident.

- Q2. EPN's Statement of Facts (SoF) for the incident affecting its Gorleston and Great Yarmouth Grid Substations on 31 August 2014 indicates that the cause was attributed to farm machinery coming into contact with the 132kV overhead lines. What photographic evidence is available to support EPN's claim that this was the cause of this incident?**
- A2. The AE was shown a picture of the incident site during his visit; however, there are not any pictures from site of the farm machinery involved.
[AE's note: EPN's photograph shows the 132kV tower line and the location of the contact made by the farm machinery].
- Q3. EPN's Statement of Facts (SoF) also states that the incident occurred near to Decoy Public House. Is this the Decoy Tavern adjacent to the Fritton Lakes? it would be helpful if EPN can provide a location map of the site of the actual incident.**
- A3. "Yes", this is the vicinity of the incident. A view of the location on "Google maps" was shown to the AE during the audit visit.
[AE's note: EPN indicated the location of the incident using "Google Maps" which confirmed the rural nature of the location].
- Q4. What is the history of farm machinery affecting these overhead lines?**
- A4. There is no history of this type of incident affecting the overhead line in question.
- Q5. What damage was caused to the affected 132kV conductors and what repairs, if any, were needed?**
- A5. All supplies were restored without the need to repairs to overhead line.
- Q6. What is the statutory minimum height of the affected 132kV conductors at the point where the incident occurred? How does this compare to the actual height measured by EPN and mentioned in its SoF?**
- A6. The statutory minimum clearance is 6.7m, as referenced in ENA's ENATS 43-8 Overhead Line Clearances.
- Q7. What is EPN's policy for the routine inspection of its 132kV overhead lines?**
- A7. UK Power Networks inspection is every 2 years for 132kV tower lines.
- Q8. When was the last inspection carried-out of the 132kV lines affected by this incident between towers 93 and 94 of its PPA circuit?**
- A8. Last inspection date 18/06/2014.
- Q9. What was recorded in that report about the land use between towers 93 and 94 of EPN's PPA circuit?**
- A9. Land usage agricultural/farm land.
- Q.10. What differences, if any, did that report show compared to the previous inspection report? The AE will require sight of both inspection reports.**
- A10. No change in land usage was recorded.
- Q11. What learning points has EPN incorporated into its procedures as a result of this incident?**
- A11. UK Power Networks reviews its policies and procedures on a regular basis, however, no changes have been made following this incident.

Q12. What further learning points should be considered as a result of the application of the current one-off Exceptional Event Claims process?

- A12. UKPN considers it is always better to review claims as close to the event as possible as it makes it easier to retrieve any additional information requested by Ofgem's AE.
45. 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 EPN's date-stamped audit trail and EPN's demonstration of the incident location.
46. EPN also provided further information both during and subsequent to the audit visit. This includes:
- Information to show that the affected section of EPN's network is P2/6 compliant;
 - Information to show that, prior to the current incident, the affected 132kV double-circuit tower line has been free from incidents due to this cause;
 - EPN's demonstration of the site of the incident in relation to its 132kV double-circuit tower line;
 - EPN's control room log for this incident;
 - EPN's incident report from which it calculated the CI and CML attributed to this incident;
 - The details of EPN's SCADA alarms received during this incident;
 - A representation of the incident on EPN's SCADA system; and
 - Copies of EPN's protection schemes and associated relay settings for its 132kV and 33kV feeders affected by this event.

4. Audit part 2

4.1 EPN's performance in preventing the event

47. In viewing EPN's performance in preventing this incident, the AE has considered what more EPN could have reasonably been expected to have done to ensure that its 132kV double-circuit tower line was safeguarded from incidents of this nature.
48. The AE has discussed EPN's inspection and maintenance regime and notes that the inspections were up to date; the most recent patrol being carried-out on 18 June 2014 when nothing untoward was reported.
49. EPN used "Google Earth" to demonstrate the location where the farm machinery came into contact with the EPN's double-circuit 132kV overhead tower line.
50. EPN's measurement systems clearly show the loss of 132kV infeeds to its Gorleston and Great Yarmouth Grid Substations when the circuit-breakers controlling them tripped at 14:24 on 31 August 2014.
51. EPN's measurement systems confirm the restoration of some supplies via tele-controlled switching from 33kV and 11kV alternative sources.
52. EPN's measurement systems also confirm the restoration of the number 1 132kV circuit at 14:33 and the number 2 circuit at 15:30 – both on the day of the incident.
53. An examination of UKPN's measurement systems and a SCADA representation of its distribution network confirm that EPN did all it could to restore supplies as expeditiously as possible.
54. The AE concludes that, prior to this incident occurring, EPN had done all it could reasonably have been expected to do in considering that its 132kV double-circuit tower line from Norwich Trowse Grid Substation to Gorleston and Great Yarmouth was free from third-party interference of this kind.
55. EPN's overhead line inspection policy is thorough and was up to date prior to the incident occurring.

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

56. The fire service report confirmed that the incident was due to agricultural machinery coming into contact with EPN's 132kV double-circuit tower line.
57. The AE has studied the running arrangements of EPN's 132/33kV distribution network supplying its Gorleston and Great Yarmouth Grid Substations and concludes that EPN's protection systems worked correctly to clear the incident from EPN's distribution system.
58. The AE commends EPN'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

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

Table 3 – Recommended performance adjustments

	Amount above threshold	Audit part 2 recommendation
CI	0.74	0.74
CML	0	0

4.4 Detailed justification

60. In reaching a judgement on a recommendation, the AE has firstly considered whether or not EPN could have reasonably taken any different course of action that would have prevented the agricultural machinery from contacting its 132kV double-circuit overhead lines.
61. In viewing EPN'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.
62. The AE notes that EPN has no previous records of incidents of this type affecting this 132kV double-circuit tower line.
63. The AE also notes that EPN's overhead line inspection and maintenance policy was sound and the inspections were up to date at the time of the incident.
64. The AE is mindful that the statutory minimum height for 132kV overhead line conductors at the point of contact is 6.7 metres as defined in the Electricity, Safety, Quality and Continuity Regulations (ESQCR).
65. EPN has confirmed that, on the day following the incident, it measured the minimum height of its affected overhead line span as 8.5 metres; 1.8 metres greater than the statutory minimum.
66. The AE therefore concludes that EPN had no cause to consider any additional measures other than those consistent with good UK practice.
67. In considering EPN's restoration strategy, the AE is conscious that UKPN's duty control engineer 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.
68. The AE is satisfied that EPN's distribution network supplying its Gorleston and Great Yarmouth Grid Substations complies with the requirements of Security of Supply Standard P2/6 (117.3 MVA firm).
69. 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 EPN's performance for reporting year 2014/15.

Appendix A - Record of Audit part 1

Table A-1: Appointed Examiner's Information Log

"One-Off" Exceptional Event	Reporting Year 2014/15
Licensed Area	UKPN (EPN)
Date of event	31 August 2014
Cause	Agricultural machinery contacting a 132kV double-circuit tower line
Notification to Ofgem	01 September 2014
SoF received	24 October 2014
SoF information	<ul style="list-style-type: none"> • EPN's 132kV distribution system was running normally at the time of the incident with both 132kV circuits being on load; • At 14:24 on Sunday 31 August 2014 the 132kV circuit-breakers controlling the 132kV double-circuit tower line tripped, thus losing all supplies from Gorleston and Great Yarmouth Grids; and • Supplies to 6 of EPN's 33/11kV Primary Substations were interrupted (51,400 customers).
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 EPN's responses, is contained in paragraph 44 of the report.
Location of audit visit	UKPN's Control Centre
Date of audit visit	19 June 2015
Visiting Auditor	Geoff Stott (ep)
UKPN's Representatives	Bill D'Albertanson and Stuart Plant.
Information provided during and subsequent to the audit visit	<p>Comprehensive documentation / information including:</p> <ul style="list-style-type: none"> • A discussion of EPN's overhead line ground clearance policy regarding its 132kV overhead circuits in relation to the requirements of the ESQCR; • A discussion on the ground clearance at the site of the incident; • A discussion regarding EPN's inspection and maintenance policy for its 132kV overhead lines and its latest reports for the section of overhead lines affected by this incident; • A discussion regarding the history of any similar previous incidents; • A view of the area via "Google Maps" which clearly shows the cut swathe at the site of the incident; • A copy of EPN's switching programme for the incident which shows the tripping of the 132kV circuit-breakers controlling the double-circuit tower line at 14:24 on 31 August 2014;

- Sight of EPN's switching programmes showing the initial restoration of the supplies to the affected Primary Substations via tele-controlled switching on the 33kV and 11kV networks;
- A copy of the damage report received from the fire service;
- Sight of the restoration of the 132kV circuits and thereby the restoration of supplies to the remaining affected customers;
- Copies of the relevant 132kV and 33kV SLDs;
- Sight of the printout from EPN'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 to be 51,400; and
 - the customer minutes lost due to the incident to be 481,777;
- The AE confirms that these figures agree with those quoted in UKPN's SoF;
- Using EPN's total connected customers at 30 September 2014 of 3,581,606 the number of customers affected equates to a CI of 1.44 [$51,400 \times 100 / 3,581,606$];
- Similarly, the customer minutes lost for this event equate to a CML of 0.14 [$481,777 / 3,581,606$];
- UKPN's demonstration of the agricultural spraying rig in relation to the 132kV double-circuit tower line;
- No need to visit the site of the incident to clarify anything;
- Discussed post-fault learning points, including anything to affect the UKPN's future overhead line inspection and maintenance policy;
- Confirmed P2/6 compliant (117.3 MVA firm (winter));
- EPN 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

Voltage (DNO's incident reference)	CI		CML	
	Claimed	Audited	Claimed	Audited
132kV (FREP-734926-H)	1.44	1.44	0.14	0.14
EHV	0	0	0	0
HV	0	0	0	0
LV	0	0	0	0
Total	1.44	1.44	0.14	0.14
UKPN (EPN) Threshold (total)	0.7		0.6	
Part 1 Exceptionality Test	Pass		Fail	
Part 1 Precondition of eligibility (meets App 3 to paragraph 8.57 of CRC 8)	Pass			

NOTE: EPN'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.