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**Appointed examiner's audit of Exceptional Event Claim -  
Northern Powergrid (Northeast)  
132kV Incident at Chirton Grange Grid Substation  
17 September 2015**

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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
CPU	NPG's Operational Critical Property Units process
DNO	Distribution Network Operator
EHV	Extra High Voltage – all voltages above 20kV up to but excluding 132kV
ep	energypeople
ESQCR	Electricity, Safety, Quality and Continuity Regulations
HV	High Voltage – all voltages above 1kV up to and including 20kV
IIS	Ofgem's Information Incentives Scheme
MIMP	NPGs Major Incident Management Plan
OMS	NPG's Outage Management System
QoS	Quality of Service
RIGs	Regulatory Instructions & Guidance
SCADA	Supervisory Control and Data Acquisition
NPG	Northern Powergrid
NPG(NE)	Northern Powergrid (Northeast)
RIIO-ED1	Ofgem's Revenue = Incentives + Innovation + Outputs model for the DNOs' current price control
SLD	Single Line Diagram
SoF	Statement of Facts
TMS	NPG's Trouble Management system
ToR	Terms of Reference

### Notes:

Within this document:

1. The term "higher voltage" is used to indicate all voltages greater than 1kV.
2. The calculations of CI and CML within this document are adapted from the annual calculations contained in the RIGs to reflect the CI and CML generated by the actual incidents being audited. They are as follows:

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

It is calculated as:

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

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 Northern Powergrid (NPG) under the "one off" exceptional event mechanism that an incident which occurred at its Chirton Grange Grid Substation at 19:17 on Thursday 17 September 2015 adversely affected the reported performance for its Northeast (NPG(NE)) licensed area for the reporting year 2015/16.
2. The AE has visited NPG 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 NPG's performance in mitigating the impact of the event upon its customers.
5. The AE concludes that NPG did all it could to ensure that its number 1 132kV circuit from its Tynemouth Grid Substation to Chirton Grange Grid Substation was as free from defects as possible before the outage began on the number 2 circuit.
6. The AE also concludes that NPG acted appropriately in contacting the personnel involved with the outage of the number 1 132kV circuit and in requesting its engineer at its Tynemouth Grid Substation go to its nearby Chirton Grange Grid Substation to investigate.
7. The AE considers that NPG's protection operated correctly to clear the incident from its distribution system.
8. The AE commends NPG for its learning points resulting from this incident and the discussions regarding incidents in other UK DNOs whereby NPG has added to its existing pro-active approach regarding exposed arcing horns on its higher-voltage equipment in order to further mitigate against the risk of a similar incident in the future.
9. The AE also commends NPG's control engineers for analysing the alarms generated by the incident and for restoring all supplies as quickly as possible.
10. The AE concludes that NPG had met the criteria of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D and that therefore the incident is deemed to be eligible for adjustment in the DNO's reported performance.
11. The AE therefore recommends that an adjustment to NPG(NE)'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	2.69	2.69	1.11
CML	0.38	0	0

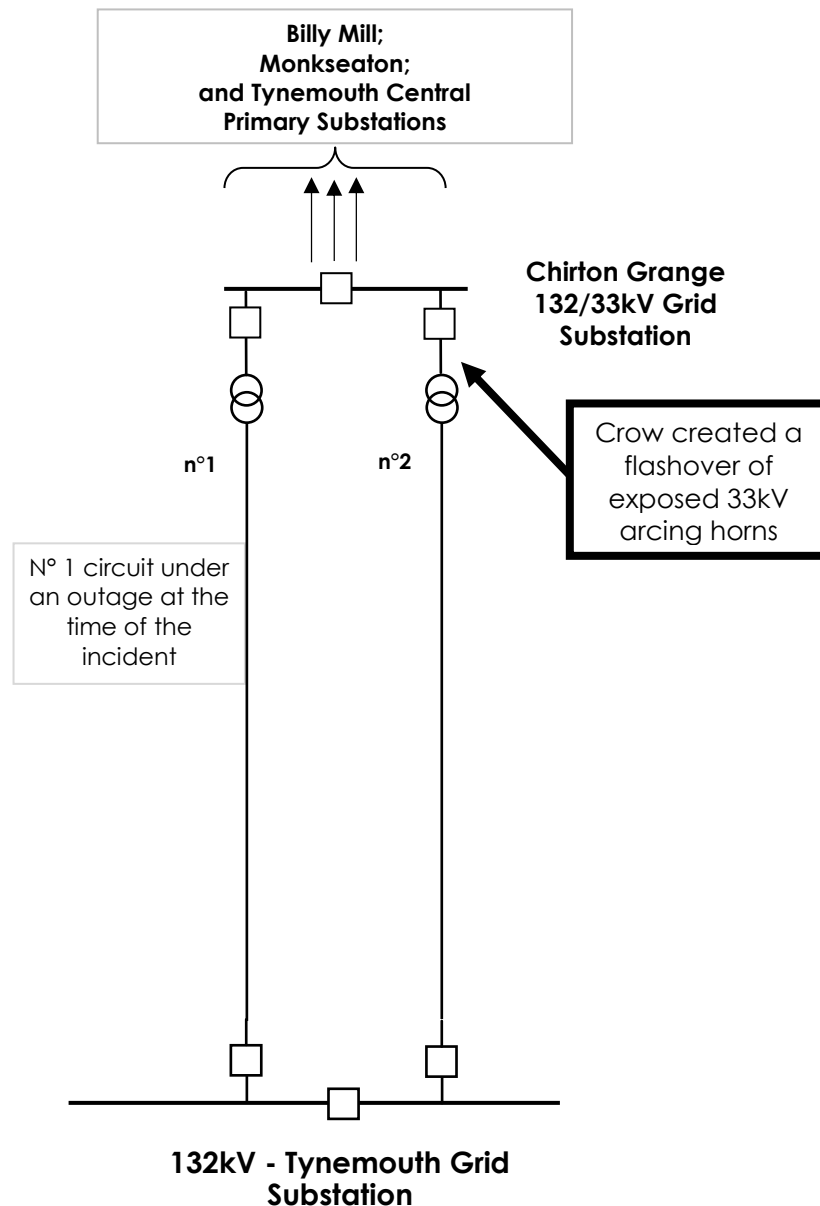


## 1. Audit part 1

### 1.1 Summary of the main facts

12. 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.
13. NPG has provided photographic evidence to support its claim that a crow precipitated a flashover of the 33kV exposed arcing horns of the auxiliary earthing transformer associated with the number two 132/33kV Grid Transformer at its Chirton Grange Grid Substation.
14. The flashover, which caused no irreparable damage, resulted in the loss of 33kV infeeds to three of NPG's Primary Substations, interrupting supplies to 42,962 of NPG's customers fed from them.
15. NPG's protection operated correctly to clear the incident from its distribution network, tripping the 132kV circuit-breaker at its Tynemouth Grid Substation to de-energise the circuit.
16. NPG's 132kV distribution system was running abnormally at the time of the incident due to the number one 132kV circuit from Tynemouth Grid Substation to Chirton Grange Grid Substation being under a two-day outage for routine maintenance and protection testing.
17. Due to the above outage, NPG's Chirton Grange Grid Substation was running with a single 132kV infeed at the time of the incident.
18. Prior to the outage of the number one 132kV circuit, NPG had surveyed the number two 132kV circuit in accordance with its documented procedure. This includes a review of fault history, a risk assessment of a second circuit outage and contingency plans should the single, remaining, circuit fail.
19. Work on the number one 132kV circuit had been completed and, following the rectification of a tele-control malfunction, the number one 132kV circuit had been re-energised from Tynemouth Grid Substation when the number two 132kV circuit tripped.
20. Being approximately 1 mile apart; NPG's engineer in charge of the outage on the number one 132kV circuit went from Tynemouth Grid Substation to Chirton Grange Grid Substation.
21. He reported the cause of the incident to be a crow bridging the arcing horns of the auxiliary earthing transformer associated with the number two 132/33kV transformer.
22. NPG's control engineer used tele-control to close the 33kV circuit-breaker associated with the number one 132/33kV transformer, thus restoring the infeeds to Chirton Grange Grid Substation and the three Primary Substations fed from it.
23. All supplies were thus restored in a single switching operation.
24. 42,962 of NPG's customers experienced a supply interruption of fourteen minutes' duration.
25. The following day, NPG confirmed there was no permanent damage to its equipment at Chirton Grange Grid Substation. The affected porcelain insulator was cleaned and the number two 132kV infeed was restored to its Chirton Grange Grid Substation.
26. A simplified view of the section of NPG's 132/33kV networks affected by this event is shown in Figure 1.

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



#### Notes:

1. Only the salient items of equipment are shown;
2. The outgoing 33kV feeders from Chirton Grange Grid Substation are shown schematically;
3. NPG's network was running abnormally at the time of the incident, the number one 132kV infeed to Chirton Grange Grid Substation was about to be restored following the completion of a two-day outage; and
4. Following confirmation of the cause of the incident, the number one 132kV circuit was returned to service by tele-controlled switching.

## 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 2D.34 of Special Licence Condition CRC 2D, 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
<b>Total</b>	<b>1</b>	<b>1</b>

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	1.58	2.69	2.69	Pass	1.11
CML exceptionality	1.26	0.38	0.38	Fail	0

**Notes:**

1. Ofgem's CI and CML exceptionality criteria are set out in the AE's ToR<sup>1</sup>;
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.

<sup>1</sup> Audits of Electricity Distribution Network Operators' one-off Exceptional Events Claims for 2015/16 to 2018/19





### **3. NPG's views of its performance**

#### **3.1 Dealing with the incident**

31. NPG's 132/33kV Chirton Grange Grid Substation is normally supplied via dual 132kV underground cables from its Tynemouth Grid Substation.
32. In turn, NPG's Chirton Grange Grid Substation supplies three of NPG's Primary Substations.
33. Each 132/33kV Grid Transformer at Chirton Grange Grid Substation is equipped with an auxiliary earthing transformer, the connections to which are via exposed overhead conductors.
34. The porcelain bushings on the auxiliary earthing transformers are protected by arcing-horns in line with conventional UK engineering practice.
35. At the time of the incident, the number one 132kV circuit was being restored following a two-day outage for maintenance and protection testing.
36. Prior to this outage, under its in-house procedures, NPG had carried-out a detailed survey of the number two 132kV circuit, including a review of any fault history, a risk assessment and contingency plans in the event that the single circuit failed.
37. NPG therefore considers that it did all it could to ensure that the number two circuit was free from defects during the outage on the number one circuit.
38. At 19:17 on 17 September 2015, the circuit-breaker controlling the number two 132kV circuit tripped, resulting in the loss of infeeds to Chirton Grange Grid Substation and its three satellite Primary Substations.
39. Having just re-energised the number one 132kV circuit from Tynemouth Grid Substation, the engineer in charge of the outage went to the nearby Chirton Grange Grid Substation.
40. He reported that the cause of the incident was a crow having caused a flashover across the exposed 33kV arcing horns of the auxiliary earthing transformer associated with the number two 132/33kV Grid Transformer.
41. NPG's control engineer immediately used tele-control to close the 33kV circuit-breaker associated with the number one 132/33kV transformer, thus restoring infeeds to Chirton Grange Grid Substation and its three satellite primary Substations.
42. NPG considers that its protection operated correctly to clear the incident from the system.
43. NPG's Chirton Grange Grid Substation is located in a semi-rural area and NPG has no record of previous incidents of this nature having occurred.
44. NPG considers that its duty control engineer reacted well in assessing the alarms generated by the event, contacting the engineer in charge of the outage on the number one 132kV circuit and requesting he attend Chirton Grange Grid Substation.
45. NPG also considers that its control engineer did well in re-energising the number one 132kV infeed to Chirton Grange Grid Substation, thereby restoring all supplies fourteen minutes after the start of the incident.

#### **3.2 NPG's answers to questions on its performance**

46. Within the last three years, the AE has reviewed NPG's design standards, construction methods and maintenance procedures during previous visits to audit exceptional event claims and found them fit for purpose.



47. The AE confirms that NPG's emergency procedures provide for the type of event being examined here.
48. To aid understanding of the background to NPG'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 NPG's claim.
49. The initial questions were discussed during the AE's visit to NPG's Penshaw Control Centre on 27 May 2016, when the records of NPG's SCADA system, the incident report and other information were made available.
50. NPG 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 NPG's answers being printed in normal font.

**Q1. What, if any, changes has NPG made to its emergency plans and procedures since the Appointed Examiner (AE) last visited to audit the one-off exceptional event (OOEE) for the incident at NPG's Scarborough Grid Substation that occurred on 11 April 2013?**

- A1. Northern Powergrid undertakes reviews following each major incident and any learning is used to update our major incident management plan (MIMP) where required. In addition, an annual review of the plan is carried out to which there were no significant updates.

Northern Powergrid invites attendees to our emergency planning seminars and tests, depending upon the content. Northern Powergrid's event on 2 May 2014 covered various subjects around severe weather events including DECC, customer service and communications. Mark Prouse, Head of Security and Resilience for DECC, spoke at this event to provide an overview of the ministerial review into the industry performance during the 2013 Festive Period storms.

Two further events took place in the period. The first, on 23 September 2014 covered a severe weather overview and a test of new Strategic Management Committee arrangements. On 11 November 2015 an event took place that covered national electricity emergencies, black start, and emergency and planned demand reduction.

The latter two events did not lend themselves to external invitees, however, we have been actively involved in the multi-agency reviews into Storm Eva, particularly in North and West Yorkshire.

Northern Powergrid also provides ongoing support for local, regional and national multi-agency exercises through various emergency planning fora it is part of. A forthcoming example is a regional event planned for July 2016 for Yorkshire and Humber that Northern Powergrid is co-sponsoring so that organisations can consider their response to a nationwide loss of electricity supplies or black start. The Emergency Planning team normally coordinates or attend these exercises and provides direct feedback into our emergency plans.

- Q2. Paragraph 32 of NPG's SoF states that shrouding of arcing horns is not possible. The AE is aware that another UK DNO shrouds the arcing horns on its distribution equipment and, where a risk assessment determines it is viable, removes them altogether. Why has NPG chosen not to learn from this example (as required by Ofgem) and undertaken a similar exercise? [AE's note: in particular, see photograph 3 of the AE's report into the OOEE claim for WPD's Ernesettle Grid Substation that occurred on 16 June 2006].**



- A2. Northern Powergrid endeavours to learn from both its own experiences and those of other DNOs.

However, in the case of learning from the AE's report into the OOOE claim for WPD's Ennesettle Grid Substation incident (16 June 2006) this was not possible as Northern Powergrid was not aware of this report until the AE advised of its existence. Also, Northern Powergrid is not aware of this report being made available by Ofgem for all DNOs to review and identify learning opportunities from. In this respect it is recommended that all of the one-off incident reports should be made available to the DNOs.

With regard to its own incidents, Northern Powergrid continuously considers the potential risk of interruptions with significant IIS impact. For example, with regard to, incidents of birds bridging the pathway between EHV arcing horns on transformers, we have had a previous incident that we did learn from.

In the 9-year period from April 2004 to March 2013 in the Northeast there were two incidents, neither of these having any IIS impact. In the next three years there were three incidents, one having no IIS impact and two (Scarborough Grid in April 2013 and Chirton Grange in September 2015) with significant IIS impact.

In the case of the Scarborough Grid incident, Northern Powergrid quickly took remedial action after the incident and applied insulation to the busbars that were bridged by a seagull immediately post-event due to increased risk of an incident at this site due to an adjacent fish processing plant attracting seagulls and the location of the site taking longer to reach than typical, potentially delaying restoration switching.

Also, Northern Powergrid has previously removed arcing horns from overhead line circuits both following bird-related events and to ensure the correct operation of surge arresters on a case-by-case basis.

Further, Northern Powergrid has carried-out a cost-benefit analysis to review its policy (this was made available to the AE during the audit) for mitigating against events where birds bridge arcing horns / busbars on all of its EHV transformers in the Northeast region and determined that the payback period for such events is considerable with non-positive NPV.

Given this, and the low frequency of such events, no immediate work programme to insulate all arcing horns / bus bars is planned. However, Northern Powergrid will continue, as it has done in the past, to continuously learn from both past incidents and consider the potential risk of incidents at substations (and on circuits) where there is increased risk of interruptions with substantial IIS impact due to bird interference.

Where a risk assessment determines it is viable to take precautionary action (e.g. shrouding or removing arcing horns) this work may be implemented during planned outages for other work to minimise the number of occasions when an EHV substation is on single circuit security. It is our belief that the application of a risk assessment process to identify where shrouding should be installed would not have led to their installation at Chirton Grange due to the low probability of wildlife at that site. Hence it is important to consider cost-benefit of shrouding and this is why the cost-benefit analysis for widespread application was done.



Additionally, Photograph 3 of the AE's report into the OOE claim for WPD's Ernesettle Grid Substation shows that the arcing horns were partially shrouded, leaving an arcing path via the open end of the shrouding around the arcing horn tips.

Despite this precaution, in this case, the partial shrouding did not prevent a flashover and subsequent asset damage as the seagull bridged the pathway between the expose tips of the arcing horns. It is therefore noted that shrouding arcing horns may reduce the risk of bridging by birds but it does not guarantee that bridging will not occur. **[AE's notes:** NPG is correct in stating that the shrouded arcing horns at WPD's Ernesettle Grid Substation did not prevent the incident occurring. That said, however, as recorded in the AE's report, "WPD had taken all reasonably practicable steps to safeguard its 33kV switchgear from flashovers caused by birds at its Ernesettle Substation, Plymouth". In other words; WPD had demonstrated that it had identified a potential risk and taken active steps to mitigate against it. Mitigation is a requirement placed on all UK DNO's under their licence obligations and a test for which forms part of the AE's remit and investigations. The AE is pleased to note that NPG is already pro-active in its risk assessment and removal of unshrouded arcing horns. As mentioned during the audit visit, the AE is obliged to record that any future incidents due to this cause in NPG would have to be considered alongside NPG's progress and its knowledge of WPD's approach].

**Q3. The AE infers from the aerial plan in appendix 1 of NPG's SoF that its Chirton Grange Grid Substation adjoins farmland. How does NPG assess the risk associated with its exposed live conductors in such locations?**

A3. In accordance with our ESQCR obligations, exposed live conductors are assessed as part of the substation risk assessment process. This process uses the substation inspection data.

A further layer of risk assessment carried-out by Northern Powergrid is to assess the risk to its bulk supply and primary substations using the Operational Critical Property Units (CPU) process. This carries out a risk assessment against the following nine key hazards:

- Security;
- Fire;
- Flood;
- Lightning;
- Environment;
- Asset condition;
- Loss of supply;
- Asbestos; and
- Cyber security.

A risk assessment (negligible, low, medium or high) is calculated for each of the above categories as shown below for Chirton Grange.

- Security - Negligible;
- Fire - Low;
- Flood - Medium;
- Lightning - Negligible;
- Environment - Negligible;

- Asset condition - Medium;
- Loss of supply - Negligible;
- Asbestos - Negligible;
- Cyber security - Negligible.

Note that Northern Powergrid's System Risk Category for the Chirton Grange substation is 2, indicating that the substation demand can be picked up by remote control and manual switching within 3 hours at any time of the year (refer to the Emergency Return to Service Plan in Appendix 5 of the Statement of Facts).

**Q4. What type of perimeter fence is installed at NPG's Chirton Grange Grid Substation?**

A4. The substation is enclosed by a 2.8m electric security fencing affixed to a 2.4m metal palisade fencing. *[AE's note: NPG's photographs clearly show the high level of security arrangements in place at its Chirton Grange Grid Substation. This is consistent with the company's policy of protecting its installations as far as reasonably practicable and has been observed at other NPG Substations].*

**Q5. What is NPG's policy for the routine inspection of its Grid Substations?**

A5. Routine inspections are carried out every month with 3 levels of inspection:

- EHV site inspection – 1-month;
- EHV site inspection – 3-month;
- EHV site inspection – 12-month.

NPG's check-list contains 79 specific items that are required for a 1-month inspection. A 3-month inspection has 161 checks and a 12-month inspection 225 checks. Details of the additional checks carried out for 3-month and 12-month inspection have been provided to the AE. *[AE's note: the AE confirms that NPG's inspection reporting requirements are most comprehensive].*

**Q6. When was the last routine inspection carried-out at NPG's Chirton Grange Grid Substation?**

A6. The last inspection was a 1-month inspection carried out on 6th April 2016.

**Q7. What was the outcome of that inspection?**

A7. The AE has been given a copy of the inspection report. In summary, the result of the inspection was:

- Security fencing, gates, doors, locking mechanisms all in good condition.
- No evidence of unauthorised access or attempted unauthorised access.

Items requiring remedial action noted during this inspection were that some of the electric fence warning signs were missing and that some of the electric fence insulators were defective. *[AE's note: the AE confirms that NPG's inspection report shows no cause for concern].*

**Q8. Paragraph 31 of the SoF states that there is no history of birds interfering with its distribution equipment at its Chirton Grange Grid Substation. Over what period of time does this refer?**



A8. Incident reports in Northern Powergrid's Outage Management System (OMS) and its Trouble Management System (TMS) dating back to April 2000 have been examined and no incidents were found at Tynemouth/Chirton Grid caused by birds. **[AE's note: the AE confirms that NPG's records show no previous incidents of this nature affecting its Chirton Grange Grid Substation].**

**Q9. Other than those contained in section 2.5 of NPG's SoF, what learning points has NPG gained from this incident?**

A9. As noted in Q2 above, Northern Powergrid will continue to monitor the frequency of bird-related events of this type, given the increase in frequency in the last two years.

It is clear that the widespread application of shrouding is not economic, however Northern Powergrid will develop a formal risk assessment process as part of our CPU assessment to evaluate the impact of wildlife upon our major substation assets. **[AE's note: as at A2 above, the AE is again pleased to note that NPG is being pro-active in furthering its risk assessments associated with unshrouded arcing horns attached to its higher-voltage equipment].**

**Q10. What further learning points should be considered as a result of the application of the current one-off Exceptional Event Claims process?**

A10. The use of this process, including the preparation of a statement of facts and the subsequent independent audit, encourages systematic analysis of the exceptional event and the consideration of learning points. Continued use of this methodology, where appropriate, is therefore recommended provided the event is audited in a timely manner.

It would also be beneficial to have a regular forum for sharing learning from these events between the DNOs. Rather than create a new forum for this, regular meetings of the Ofgem QoS Working Group would suffice, although no meetings have taken place since the start of RIIO-ED1.

51. During the discussion of this claim it was concluded that a visit to NPG's Chirton Grange Grid Substation would be unnecessary; the AE was satisfied with NPG's date-stamped audit trail and NPG's photographic evidence. Also, "Bing Maps" provided sufficient site information to enable the AE to make a judgement on the location and layout of NPG's Chirton Grange Grid Substation.

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

- Information to show that the affected section of NPG's network is P2/6 compliant – NPG records show that its Chirton Grange Grid Substation has a maximum demand of 52.55MVA. It is therefore categorised as a Class C supply under P2/6. All customers' supplies were restored in 14 minutes which is compliant with P2/6 as there is no requirement in P2/6 for minimum demand to be met after a second circuit outage;
- Information to show that, prior to the current incident, NPG's Chirton Grange Grid Substation has been free from incidents due to this cause;



- NPG's photographs of the dead crow and the general layout of its Chirton Grange Grid Substation;
- NPG's control room log for this incident;
- NPG's incident report from which it calculated the CI and CML attributed to this incident;
- The details of NPG's SCADA alarms received during this incident;
- A representation of the incident on NPG's SCADA system;
- Copies of NPG's protection schemes and associated relay settings for its 132kV and 33kV feeders affected by this event; and
- A discussion of NPG's learning points following this incident, including its on-going risk assessments and considerations associated with its exposed arcing horns and any reasonable preventative measures it can apply.



## 4. Audit part 2

### 4.1 NPG's performance in preventing the event

53. In reviewing NPG's performance in preventing this Incident, the AE has considered what more NPG could have reasonably been expected to have done to ensure that its 132kV equipment at its Chirton Grange Grid Substation was safeguarded from the effects of third party interference and such things as the larger sizes of birds and windborne materials.
54. This is particularly relevant as NPG has no records of a similar incident having occurred previously.
55. The AE has discussed NPG's policy on its preventative measures and considers that those applied at the time of the incident were in accordance with conventional UK engineering practice.
56. Whilst NPG was already pro-active in regard to measures it takes regarding unshrouded arcing horns; subsequent to the incident, NPG has added additional steps to its risk assessment process in regard to the measures it takes to safeguard its installations from incidents of this nature.
57. Photograph 1, specifically requested by the AE during the audit visit, shows the perimeter fence at NPG's Chirton Grange Grid Substation to be surrounded by an 'unclimbable' palisade fence in accordance with accepted UK practice for this type of substation. The fence is in good condition and carries statutory warning notices. Also shown in the photograph is the electrified fence backing-up the palisade fencing on the perimeter of the site.
58. Photograph 2, also specifically requested by the AE during the audit visit, shows the additional 'safety' notices regarding the request to report any sightings of any trespassers seen on the site. NPG had no record of any such reports of trespassing for this site prior to this incident occurring.
59. However, examination of NPG's current records shows that a third party tunnelled underneath the boundary fencing to steal earthing from the site on 01 December 2015.
60. NPG's photograph 3, copied from the SoF, shows the dead crow below the 33kV exposed conductors of the auxiliary earthing transformer associated with the number two 132/33kV Grid Transformer at its Chirton Grange Grid Substation.
61. NPG's photograph 4, also copied from the SoF, is a close-up of the porcelain bushing and its arcing horns across which the crow created the flashover. The marks from the electrical arc can be seen on the lower arcing horn as can the remnants of the crow on the porcelain bushing.
62. Photograph 5, included for completeness, is a screen-shot taken from "Bing maps" which shows the location of NPG's Chirton Grange Grid Substation on the edge of farmland.
63. NPG's measurement systems clearly show the tripping of the number two 132kV Chirton Grange Grid Substation circuit-breaker at its Tynemouth Grid Substation at 19:17 on 17 September 2015.
64. NPG's measurement systems also show the restoration of infeeds to Chirton Grange Grid substation and its three satellite Primary Substations fourteen minutes later.



65. An examination of NPG's measurement systems and a SCADA representation of its distribution network confirm that NPG did all it could to restore supplies as expeditiously as possible.
66. The AE concludes that, prior to this incident occurring, NPG had done all it could reasonably have been expected to do in considering that its outdoor 132kV equipment at its 132/33kV Chirton Grange Grid Substation was protected from the effects of third party interference, windborne material and large birds in accordance with accepted conventional practice within the UK electricity supply industry.

#### 4.2 NPG's performance in mitigating the effects of the event

67. The dead crow found below the exposed 132kV conductors is consistent with an electric arc having occurred and with the operation of the system protection that detected a flashover of the arcing horns within the protection zone of the 132/33kV Grid Transformer at NPG's Chirton Grange Grid Substation.
68. This is also consistent with NPG's protection scheme operating to trip the 33kV transformer circuit-breaker at Chirton Grange Grid Substation and to inter-trip the incoming 132kV circuit via the 132kV controlling circuit-breaker at its Tynemouth Grid Substation.
69. The AE has studied the running arrangements of NPG's 132/33kV distribution network affected by this incident and concludes that NPG's protection systems worked correctly to clear the incident from NPG's distribution system.
70. The AE commends NPG's control engineers for analysing the situation, contacting NPG's person in charge of the outage on the number one circuit and for immediately restoring supplies once he had reported from site as to the cause of the incident. NPG thereby minimised the duration of the interruption.

#### 4.3 Recommended performance adjustments

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

**Table 3 – Recommended performance adjustments**

	Amount above threshold	Audit part 2 recommendation
CI	1.11	1.11
CML	0	0

#### 4.4 Detailed justification

72. In reaching a judgement on a recommendation, the AE has firstly considered whether or not NPG could have reasonably taken any different course of action that would have prevented the crow from precipitating a 33kV flashover at NPG's Chirton Grange Grid Substation.
73. In viewing NPG'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.



74. In commending NPG for applying additional mitigating measures since the incident at its Scarborough Grid Substation that occurred on 11 April 2013, the AE notes that NPG has added further steps to its on-going process regarding the risk associated with unshrouded arcing horns fitted to its higher-voltage equipment.
75. The AE also notes that NPG has no previous records of incidents of this type at its Chirton Grange Grid Substation and that it therefore had no cause to consider any additional preventative measures other than those consistent with conventional UK practice.
76. The AE considers that the preventative measures employed by NPG on its 132/33kV outdoor equipment at its Chirton Grange Grid Substation at the time of the incident were in accordance with the industry standard in preventing damage due to third party interference, larger birds and windborne objects.
77. In line with NPG's approach to the security of its installations, the AE also notes that NPG had installed an electric fence behind and above its 'unclimbable' outer perimeter, thus further safeguarding its site from trespass.
78. The AE is satisfied that NPG took all reasonable steps to ensure its number two 132kV circuit between Tynemouth and Chirton Grange Grid Substations was as free from defects as possible before the outage began on the number one circuit.
79. In considering NPG's restoration strategy, the AE is conscious that NPG's duty control engineer acted swiftly in analysing the SCADA alarms and indications generated by this incident, contacting NPG's personnel on site and restoring supplies immediately the cause of the incident was known.
80. The AE is satisfied that NPG's distribution network at Chirton Grange Grid Substation complies with the requirements of Security of Supply Standard P2/6 (52.55 MVA firm demand).
81. The AE therefore concludes that NPG's claim is justified and recommends to Ofgem that the amount of CI above the threshold values should be excluded from NPG's performance for reporting year 2015/16.
82. In the light of the conversation at the audit visit regarding question 2 above, the AE has discussed NPG's learning from this incident and is pleased that NPG is actively considering the best approach to applying additional, non-conventional measures to mitigate against a recurrence of incidents of this type.
83. However, the AE is obliged to record that, should a subsequent incident arise where a flashover occurs across exposed arcing horns, NPG's on-going deliberations and conclusions would have to be considered in any recommendation made for an adjustment in the company's annual IIS / QoS performance.

## 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	NPG(Northeast)
Date of event	17 September 2015
Cause	Flashover of exposed 33kV arcing horns
Notification to Ofgem	25 September 2015
SoF received	06 November 2015
SoF information	<ul style="list-style-type: none"> <li>The number one 132kV circuit from Tynemouth Grid to Chirton Grange Grid was under a two-day outage for routine maintenance and protection testing;</li> <li>Prior to this outage the number two circuit had been surveyed in accordance with NPG's pre-outage procedure;</li> <li>Thus at the time of the incident Chirton Grange Grid, was on a single 132kV circuit infeed;</li> <li>Chirton Grange has three satellite Primary Substations;</li> <li>The outage on the number one 132kV circuit was being restored when the number two circuit tripped at 19:17 on Thursday 17 September 2015;</li> <li>Supplies to 42,962 customers were interrupted;</li> <li>The number one 132kV circuit-breaker was closed at Tynemouth Grid;</li> <li>The engineer in charge of the outage went to Chirton Grange and found a dead crow below the auxiliary earthing transformer of the number two 132/33kV transformer;</li> <li>The 33kV circuit-breaker of the number one 132/33kV transformer was closed, thus restoring all supplies at 19:31 – an interruption of 14 minutes' duration; and</li> <li>The network was restored to normal running the next day once the affected bushing had been inspected and cleaned-up.</li> </ul>
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 NPG's responses, is contained in paragraph 50 of the report.
Location of audit visit	NPG's Penshaw Control Centre
Date of audit visit	27 May 2016
Visiting Auditor	Geoff Stott (ep)
NPG's Representatives	Neil Dunn-Birch, Matthew Preston and Ian Punshon
Information provided during and subsequent to the audit visit	<p>Comprehensive documentation / information including:</p> <ul style="list-style-type: none"> <li>A discussion regarding the experiences of other UK DNOs and their approaches to the removal or shrouding of exposed arcing horns;</li> <li>A discussion of the protection arrangements on NPG's</li> </ul>

Tynemouth Grid to Chirton Grange Grid 132kV circuits;

- A discussion on the settings applied to the above protection schemes;
- Sight of NPG's pre-outage checks carried-out on the number two circuit prior to the outage commencing on the number one circuit;
- Sight of NPG's switching programme for the incident which shows the loss of supplies from NPG's Chirton Grange Grid at 19:17 on 17 September 2015 and their restoration at 19:31 that day;
- Copies of the relevant 132kV and 33kV SLDs;
- Sight of the printout from NPG's SCADA system that shows the alarms generated by the event;
- Sight of NPG's incident report that shows:
  - the number of customers affected by the incident to be 42,962; and
  - the customer minutes lost due to the incident to be 601,468;
- The AE confirms that these figures agree with those quoted in NPG's SoF;
- Using NPG's total connected customers at 30 September 2015 of 1,596,374 the number of customers affected equates to a CI of 2.69  $[42,962 \times 100 / 1,596,374]$ ;
- Similarly, the customer minutes lost for this event equate to a CML of 0.38  $[601,468 / 1,596,374]$ ;
- NPG's photographs of the area of the 33kV compound at the point where the incident occurred, together with "Google Maps" views showing Chirton Grange Grid Substation's surrounding compound fence;
- No need to visit Chirton Grange Grid Substation to clarify anything;
- Discussed post-fault learning points, including anything to affect the NPG's future policy on shrouding arcing horns fitted to outdoor bushings – NPG's learning points include:
  - The consideration of non-conventional measures for arcing horns on higher-voltage equipment;
  - NPG's cost-benefit analysis which shows the NPV if a special programme was carried-out to shut-down all 132kV and 33kV equipment fitted with arcing horns to either remove them or to shroud them; and
  - Considerations of carrying-out the above work over a period of time in conjunction with NPG's routine maintenance outage programme;
- Confirmed P2/6 compliant (52.55 MVA firm);
- NPG 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 reference)	Claimed	Audited	Claimed	Audited
132kV (INCD-311760-h)	2.69	2.69	0.38	0.38
EHV	0	0	0	0
HV	0	0	0	0
LV	0	0	0	0
Total	2.69	2.69	0.38	0.38
NPG(NE) Threshold (total)	1.58		1.26	
Part 1 Exceptionality Test	pass		fail	
Part 1 Precondition of eligibility (meets App 3 to paragraph 2D.34 of CRC 2D)	pass			

**NOTE:** NPG'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 security fencing surrounding NPG's Chirton Grange Grid Substation



Photograph 2 – the additional 'trespass' notices affixed to the perimeter fencing





Photograph 3 – the dead crow in relation to the number two 33kV auxiliary earthing transformer







Photograph 4 – a close-up of the 33kV bushing and exposed arcing horns





Photograph 5 – the location of NPG's Chirton Grange Grid Substation

