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**Appointed examiner's audit of One-Off Exceptional Event Claim
Western Power Distribution (South West)
33kV incident at Churchill Grid Substation
02 July 2015**

Document Properties


Title: Western Power Distribution (South West) – Audit of One-Off Exceptional Event Claim – 33kV incident at Churchill Grid Substation - 02 July 2015

Reference: ep/Ofgem/WPD(SW)/02 Jul '15

Issue: Final report v1.0

Date: 09 June 2016

Authorisation

Name	Position	Signed	Date
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History

Issue	Date	Originator	Checker	Description
1.0	09 June 2016	Geoff Stott	Bill Slegg	Final report incorporating comments from Ofgem and from WPD
0.1	25 May 2016	Geoff Stott	Bill Slegg	Draft report sent to Ofgem and to WPD for comment
0.0	23 May 2016	Geoff Stott	-	Pre-draft report created from energypeople template

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Glossary

Abbreviation	Meaning
AE	Appointed Examiner
CB	Circuit-breaker
CI	Customer Interruptions per 100 connected customers
CML	Customer Minutes Lost per connected customer
DNO	Distribution Network Operator
ENA	Energy Networks Association
ep	energypeople
NEDeRS®	The UK's National Equipment Defect Reporting Scheme
OLTC	On Load Tap Changer
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(SW)	Western Power Distribution's South West 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 33kV busbars at its Churchill Grid Substation at 09:54 on Thursday 02 July 2015 adversely affected the reported performance for its South West WPD(SW) licensed area for the regulatory reporting year 2015/16.
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 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 WPD's performance in mitigating the impact of the event upon its customers.
5. The AE concludes that WPD's routine inspection and maintenance programme for its grid substations 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 33kV equipment at its Churchill Grid Substation were free from defects.
7. The AE commends WPD's control engineers for restoring customers' supplies as quickly as possible.
8. The AE therefore concludes that WPD has met the criteria of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D and that the incident is therefore deemed to be eligible for adjustment in the DNO's reported performance.
9. The AE recommends that an adjustment to WPD(SW)'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	2.88	1.28	1.28
CML	0.63	0	0

Note: these figures and the associated calculations in this report are based upon WPD(SW)'s customer numbers as at 30 September 2015.



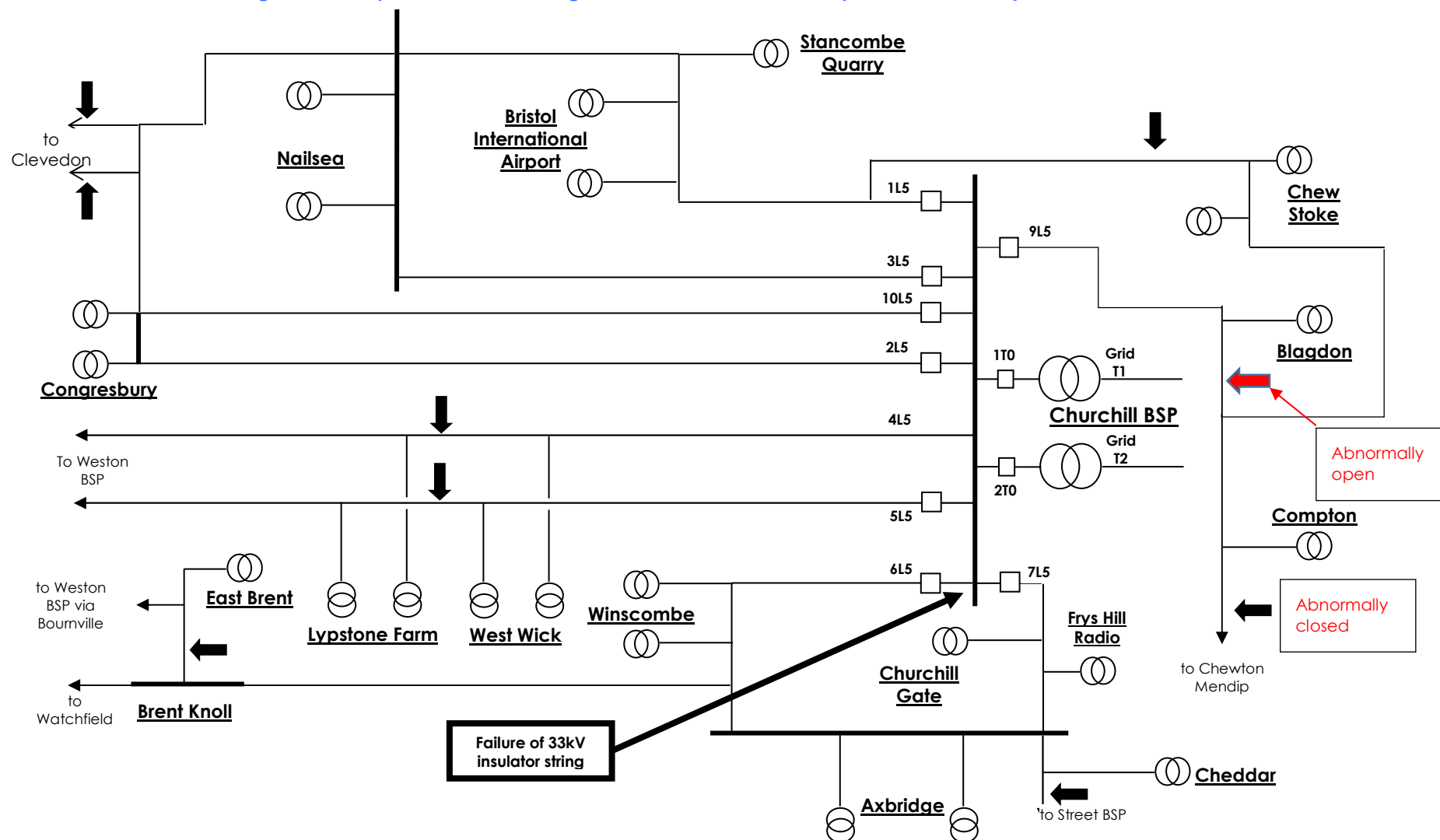
1. Audit part 1

1.1 Summary of the main facts

10. The AE's headline information log for this event is set out in Table A-1 at Appendix A. In addition, the following paragraphs summarise the main facts of the event.
11. The two 132/33kV transformers at WPD's Churchill Grid Substation feed the outdoor 33kV switchgear.
12. WPD's Churchill Grid Substation is configured as a 33kV double busbar arrangement with a bus-coupler and nine outgoing feeders, each controlled by a 33kV circuit-breaker.
13. Currently, there is no 33kV bus-section circuit-breaker and no busbar protection at WPD's Churchill Grid Substation.
14. WPD has provided evidence to support its claim that the failure of a 33kV tension insulator string at its Churchill Grid Substation caused the associated bare conductor to fall onto the under-running reserve busbar, thereby precipitating a double busbar fault.
15. At 09:54 on Thursday, 02 July 2015 WPD's protection operated correctly to de-energise the 33kV busbars at its Churchill Grid Substation, thus losing all 33kV outfeeds from the site.
16. WPD commenced the restoration of supplies using tele-controlled switching.
17. A report from site indicated the cause of the incident and confirmed that both the reserve busbar and failed over-running conductor could not be re-energised until repairs had been effected.
18. The remaining customer supplies were restored following manual isolation of the damaged reserve busbar and over-running connection and the subsequent manual selection of the outgoing feeders to the undamaged main busbar.
19. WPD replaced the failed overhead conductor, its tension insulator strings and two sections of the reserve busbar, restoring the system to normal at 02:24 on 03 July 2015.
20. A simplified view of the section of WPD's distribution system affected by this event is shown in Figure 1.



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



Notes to Figure 1:

1. Only the salient items of switchgear are shown.
2. The solid black arrows indicate 'normal open point'.
3. As shown, due to on-going work elsewhere, WPD's network was running slightly abnormally at the time of the incident and WPD's customers fed from Chew Stoke Primary Substation were not affected by the incident.

2. Exceptionality requirements

2.1 Does the event qualify for exclusion?

21. 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.
22. The AE therefore considers that, subject to satisfying the requirements of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D, the event qualifies for possible exclusion under the "one-off" exceptional events process.

2.2 Exceptionality test results

23. 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

24. 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	1.60	2.88	2.88	pass	1.28
CML exceptionality	1.28	0.63	0.63	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 the DNO's 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.

3. WPD's views of its performance

3.1 Dealing with the incident

25. The 33kV outdoor double busbars at WPD's Churchill Grid Substation are fed from the two 132/33kV transformers, GT1 and GT2.
26. There are nine outgoing 33kV feeders and a 33kV bus-coupling circuit-breaker.
27. At the time of the incident all outgoing 33kV feeder circuit-breakers were selected to the reserve busbar.
28. Hence, when the insulator string failed and its associated over-running 33kV connection fell onto the reserve busbar, WPD's protection operated to de-energise the 33kV busbars, thus interrupting supplies to 45,822 of WPD's customers.
29. WPD considers that its protection operated correctly to clear the incident from its distribution network.
30. WPD considers that its duty control engineers reacted well in assessing the alarms generated by the event and despatching its personnel to site as a matter of urgency.
31. WPD also considers that its control engineers acted correctly in beginning to restore supplies using tele-controlled switching before its personnel reached site and reported back on their findings.
32. Furthermore, WPD commends all those involved in the removal of the damaged equipment, its replacement with new items and the restoration of its system to normal operation within seventeen hours of the incident occurring.

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

33. Following the incident, WPD carried-out a detailed examination of the failed insulator string, contacted other DNOs who are members of the national overhead line forum of the Electricity Networks Association and the National Equipment Defect Reporting Scheme (NEDeRS®).
34. No other instances of this mode of failure were found, leading WPD to conclude that this failure is a 'one-off', which, due to its nature, appears to be the result of a manufacturing defect.

3.2 WPD's answers to questions on its performance

35. Within the last two 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.
36. The AE confirms that WPD's emergency procedures provide for the type of event being examined here.
37. 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.
38. The initial questions were discussed during the AE's visit to WPD's control centre on 17 May 2016, when the records of WPD's SCADA system, the incident report and other information were made available.
39. 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 one-off exceptional event (OOEE) claim concerning the incident affecting WPD's 66kV system in the Evesham area that occurred on 16 July 2014?

- A1. WPD has made several changes since the AE's last visit. For clarity, these are grouped under three headings as follows:

Control

Implementation of OMS (Outage Management System) throughout all of Western Power. A new system has now gone live which enables all engineers to view all of the outages in their area and quickly identify risks and any potential outage clashes before they are even at the request stage.

Primary Contingency Full Reviews of all primary substations which identify any potential shortfalls

Sequence switching scheme reviews - Including all 11kV Transformers and Delayed Auto Reclose schemes, in order to achieve quicker customer restoration and network security

Sequence Switching (SQC) Scheme Implementations using the PowerOn Network Control System. Intelligent software driven replacements of old hardwired site schemes that give greater flexibility and are able to restore customers under different scenarios.

Emergency Planning

WPD has recently carried out emergency services briefings. These briefings were designed to address a number of topics.

Clarification of what WPD's equipment is out on the network. A typical example of this would be BT poles versus WPD poles for electrical distribution.

Discussions took place regarding potential inconsistencies amongst the emergency services across WPD's licence areas. This included the ability to get adequate information from the emergency services regarding the site location and the equipment involved when they are reporting an incident.

Included in the discussions were also:

- Lines low / down;
- Proximity working / safety clearances; and
- Safe access to WPD's sites.

WPD is now working with the emergency services to create a bespoke training package which WPD will deliver to the local category 1 responders (Blue lights). To support this WPD is also updating its own emergency services guidance documents.

Following this, WPD is creating a new direct number to enable the emergency services to contact WPD's Dispatch directly (change of process). This will enable the call to be flagged as a high priority and handled accordingly by a team leader.

As a category 2 responder under the civil contingences act (2004), WPD continues to actively engage with the Local Resilience Fora.

A large part of this work includes the promotion of the Priority Services Register (PSR) for all of our vulnerable customers. One of the outputs will provide an accurate and up to date list of all priority customers who are supplied from any given WPD asset. This will include grid references for all properties to aid the mapping that is used by local authorities and emergency responders.

Q2. WPD's Statement of Facts (SoF) for this current OOE claim indicates that there is no bus-bar protection and no bus-section circuit-breaker at its Churchill BSP. The AE is aware that WPD has installed such equipment at some of its other Grid Sites and questions WPD's current considerations for its Churchill BSP. This is considered particularly pertinent as this is not the first time that all supplies have been lost from this site due to an incident within it, a fact referred to in WPD's SoF. [AE's notes: the catastrophic failure of a 33kV circuit-breaker on 19 June 2007 resulted in all supplies being lost from WPD's Churchill BSP. See also WPD's answer to question 11 in the AE's report into the OOE incident that occurred at WPD's Ennesettle BSP on 16 June 2006].

A2. The busbars at Churchill 33kV S/S are currently protected by the standby earth fault and by LV overcurrent protection installed on each Grid transformer.

In accordance with WPD Policy POL:TP3/2, all new substations with 33kV busbars controlled by local circuit breakers shall have full scheme busbar protection fitted (e.g. high impedance instantaneous protection).

The implementation plan for POL:TP3/2 states:

"With the following exceptions, there is no retrospective action required on the existing distribution system as a result of this policy. It will be fully implemented on issue for new or substantially modified systems.

The retrospective fitting of partial busbar protection, utilising cross connected CTs, operating an IDMT relay, should be considered on the basis of cost, ease of implementation and improvements in system security."

At Churchill that assessment has identified a number of issues with the fitting of a full busbar protection. These are due to the lack of a bus section and a bus coupler that is not rated for the increased network demands placed on the site if running across two bars.

In addition, there is a lack of auxiliary contacts on the isolators and the lack of matched CT's of the correct class to create a stable and effective protection system.

The solution being sought for Churchill is in three stages:

- Short term – install two new 2000A bus coupler Isolators, thus enabling the substation to run across the two busbars. The benefit of this change will be to speed up the restoration time following a busbar fault. Specifically, half the busbar without a fault will be able to be restored immediately with the opening of the bus coupler and the restoration of the associated GT. This work is planned to be completed by the end of 2016.
- Medium term – develop a partial differential busbar scheme. To be completed as part of the larger ongoing works on site. The benefit of this is restricted loss of supplies to customers on the healthy busbar. Designs are completed for this and await a prioritised date for the work, estimated 2017.
- Long term – due to the significant works required to fit a full busbar protection scheme in line with POL:TP3/2, it is anticipated this would be completed only when replacing the currently installed major assets, circuit breakers and isolators.

These assets have a life expectancy of 40 years and were installed in 1993 - just over half their nominal asset life. Therefore, any more significant works may not be for some time as WPD has a duty to replace assets in priority order.

The strategy for Churchill has been constrained due to the planning associated with Hinckley Point C.

Plans have variously included; (a) the removal of the 33kV site to facilitate a new 440kV S/S; and (b) no works required.

With investment decisions still awaiting ratification; WPD, working with Ofgem, has triggered works at Churchill ahead of need.

The benefit to Churchill 132kV s/s will be the introduction of a third 132kV circuit into the site. This provides a more reliable system to cover faults on the OHL feeding into Churchill, further opens the South West to more distributed generation connections and maintains P2/6 compliance for the site as the loadings on the connected network increase.

It should be noted the replacement strategy for each site is considered on its merits but most recently that assessment has resulted in the 33kV outdoor substation at Tiverton being replaced with an indoor 33kV switchboard with full busbar protection and works to complete the same at Ernesettle 33kV S/S commencing in 2015.

Q3. WPD's SoF also states that "all the circuits are selected to the reserve busbar". A review of the AE's report into the situation in June 2007 indicates that all circuits were selected to the main busbar, the reserve busbar being kept alive via a bus-coupling circuit-breaker.

(a) If this is correct, what are the reasons behind WPD's changed mode of operation? [AE's note: see paragraph 1.21 of the AE's report into the OOOE incident that occurred at WPD's Churchill BSP on 19 June 2007].

A3(a). Information received indicates the substation was always running on the reserve bar and the statement of facts for the previous incident were incorrect.

(b) In each case why were all circuits selected to the same bar, is this normal or how long had they been running that way?

A3(b). This has been the setup for some time.

Q4. In addition to its own in-house considerations, what learning points has WPD taken from the retrospective installation of busbar protection within SSEPD as reported in various OOOE reports posted by Ofgem on its website? [AE's note: for example, see paragraphs 5 and 6 of the AE's report into the OOOE incident at SSEPD's Chippenham Grid Substation that occurred on 14 January 2013 and SSEPD's answer to question 5 in the AE's report into the OOOE incident at SSEPD's Burghfield Grid Substation that occurred on 07 September 2008].

A4. At present WPD is unable to view any outputs from OOOE reports in other DNOs. In addition, there is currently no official forum for learning from others' experiences.

Q5. What protection operated to clear the incident from WPD's distribution system?

A5. Standby earth fault operated on both grid transformer 33kV breakers, tripping 1T0 and 2T0, thereby disconnecting the fault from our network.

Q6. When was the failed insulator string commissioned?

A6. The broken insulator is marked as being manufactured in 1961. WPD assumes it was commissioned shortly afterwards by the then Central Electricity Generating Board, whose site this was at that time.

It should be noted that the affected 33kV switch-bay was upgraded in 1993, when 6L5, 6L4 & 6L6 were replaced.

Q7. What is WPD's policy for the inspection and maintenance of this type of equipment?

A7. Every 3 months a visual inspection is carried-out in accordance with WPD ST: SP2A.

In addition, WPD's policy requires an annually infra-red survey at BSP & 132kV switching station outdoor plant and connections, although this would not have identified the mode of failure experienced at Churchill.

Q8. Was WPD's inspection and maintenance programme up-to-date at the time of the incident?

A8. Yes – a visual Inspection was completed on 16/6/2015 and in infra-red survey late 2014 (recorded in asset data base as 01/01/2015).

WPD considers it worth noting that at the same time as the infra-red survey, a check for partial discharge was also completed. Predominately this was to highlight issues with internal discharge within switchgear but may have been successful in identifying a potential failure of an insulator string.

Q9. When was the failed insulator string last inspected?

A9. Please see A8 above.

Q.10. What was the result of that inspection?

A10. The Inspection report identified no issues associated with the busbars. No formal report for the infra-red survey or partial discharge checks was available.

Speaking to the Technician a report would only be completed if suspect areas were identified. **[AE's note: the AE can confirm having had sight of WPD's inspection report which shows no abnormalities found].**

Q11. What is WPD's policy for the replacement of equipment such as this insulator string at its Grid Substations?

A11. There are three methods where an insulator string may be replaced, due to age or condition:

- When completing an asset change of the associated major assets. The replacement policy for CB's and isolators is currently 40 years. Where these asset types are replaced then an assessment as to the health of the associated plant is undertaken;
- Where a routine visual inspection spotted an area of concern; or
- If information was available about repeat failures of that type of asset.

In the case of Churchill, the CB and isolators were replaced in 1993 when the insulator string had been installed 32 years. A condition assessment would have been undertaken, the result of which was the original string was left in situ.

WPD's examination of the failed string identified a split pin that was of recent vintage thus indicating work had been completed to that string since its date of installation. This supports the concept that no issues were identified at that time.

WPD's examination of the condition of the other two insulator strings associated with the failed string did not give rise to concern following this incident and are assessed to be suitable for service.

In addition, and with no formal information regarding failures of this type noted, an informal question was asked of members of the ENA OHL forum without positive response. From this WPD believe this to be a one-off event. Consequently, WPD has raised a defect notification for issue.

Q12. Under the above policy, when was the failed insulator due to be replaced?

A12. The two 132kV transformers on site are of 2004 and 2014 vintage and the three 132kV circuit breakers were all changed as part of the DPCR5 programme in 2014 and 2015.

As part of these 132kV improvements, the overhead busbars running from the 33kV side of the grid transformer to the 33kV s/s were replaced.

This leaves the 33kV CB's and isolators as the oldest major assets with an installed date of 1993.

Consequently, therefore, no assets at Churchill have been identified to be changed for asset condition reasons in RIIO-ED1.

Q13. WPD's SoF states that "investigations are ongoing but it is believed that the failure was due to a manufacturing error which resulted in the cement bond being inadequate". What has been the outcome of those investigations?

A13. Due to the physical evidence this was deemed a manufacturing defect. In addition, there was no adverse weather that day and the site is not a particularly 'windy' site.

As discussions with other DNOs did not identify any similar issues and the asset was not in its early stage of life, focus was turned to site improvements as noted in WPD's responses above.

Q14. What studies has WPD undertaken to determine the feasibility of carrying-out inspections / tests on similarly aged insulators from this or other substations in an attempt to determine whether this is a one off or a potential batch problem?

A14. WPD purchases equipment that has had type testing regimes applied and for insulator strings of this type, this would include tension testing. This test would have been a destructive test and therefore would have been applied to a percentage of units manufactured.

It is deemed that this level of testing would still be considered satisfactory and therefore it is felt, with its one-off mode of failure, the current inspection policy is sufficient.

Q15. What is the UK's reported experience of the reliability of this type of insulator as reported via the ENA's National Equipment Defect Reporting Scheme (NEDeRS®)?

A15. As stated above, WPD can find no reference to a similar failure having been reported by another DNO.

Q16. What has WPD done to assure itself that no other insulator strings on its distribution system are likely to exhibit the same failure mode?

A16. Please see WPD's response to Q14 above.

Q17. What learning points has WPD incorporated into its procedures as a result of this incident?

A17. Please see WPD's response to Q2 above.

Q18. What further learning points should be considered as a result of the application of the current one-off Exceptional Event Claims process?

A16. This OOE claim is being assessed nearly 12 months after the events at Churchill.

This means any information flow or recommendations that the AE may wish to propose or any additional information on similar national incidents useful to WPD are delayed by that length of time.

In this case, whilst the work on site has not slowed or stopped, the retirement of WPD's manager responsible for the matters here being examined has resulted in some of the background, undocumented information, being lost.

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

- Up-to-date information regarding WPD's programme for the retrospective installation of busbar protection / bus-section circuit-breakers where none currently exist:

As indicated above, WPD reviews these on a site-by-site basis, based on need for major asset change at that site. WPD's current policy is to have busbar protection installed at this time and for this reason the business case is often to replace outdoor equipment with indoor switchgear thus removing the risk of failures such as the subject of the present OOE claim for Churchill Grid Substation;

- A discussion regarding the learning taken from OOE reports that have occurred in other Distribution companies: At A4 above, WPD has indicated its lack of direct knowledge of the experiences of other UK DNOs;



- Sight of WPD's policy for the routine inspection and maintenance of the type of insulator string that failed: The AE had sight of an extract from WPD's Policy SP2/8 relating to the routine inspection and maintenance of its distribution system substations, plant and protection systems and its standard technique: SP2A/3 relating to routine substation inspection;
- Examination of the failed insulator, string: as shown in the photograph, this clearly shows the lack of a bond between the metal cap of the insulator and the cement filling;
- Information to show that the affected section of WPD's network is P2/6 compliant: Churchill BSP has a maximum loading of 68.3MVA which, under P2/6, requires full group demand to be immediately restored following a first circuit outage. The two 60/90MVA grid transformers cater for this requirement. There is no second circuit outage requirement for this group size;
- Sight of WPD's SCADA alarms showing the sequence of circuit-breaker operations during the incident;
- WPD's incident report from which it calculated the CI and CML attributed to this incident; and
- A representation of the incident on WPD's SCADA system.

4. Audit part 2

4.1 WPD's performance in preventing the event

41. 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 the insulators in the tension strings fitted to its 33kV outdoor equipment at its Churchill Grid Substation was inspected and maintained to ensure it is free from any known defects.
42. Photograph 1, specifically requested by the AE during the audit visit, shows a close-up of the metal cap of the failed insulator, devoid of any of the cement which should bond it to the insulator pin.
43. Photograph 2, also specifically requested by the AE during the audit visit, shows the date of manufacture of the failed insulator.
44. Photograph 3, copied from WPD's SoF, shows the damage to one phase of the reserve busbar at Churchill Grid Substation.
45. Photograph 4 is also copied from WPD's SoF and shows the damage to the over-running 33kV connection as it lies on the ground below Isolator 6L6.
46. WPD's measurement systems clearly show the incident unfolding at its Churchill Grid Substation and the sequence of events concerning the subsequent restoration of supplies via a combination of tele-controlled and manual switching.
47. 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.
48. 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 equipment affected by the incident was free from defects and showed no signs of abnormality.
49. The AE also concludes that WPD's distribution system affected by this incident was configured so as to minimise any disruption to customers' supplies in the event of an incident occurring as required by the criteria of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D.
50. WPD's routine inspection and maintenance policy for the equipment affected by this incident is thorough and was up to date prior to the incident occurring.

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

51. In the AE's experience, the failure of an insulator string such as that which occurred at WPD's Churchill Grid Substation is very rare and of a type that would lie undetected until the failure occurred.
52. The AE has examined WPD's routine inspection and maintenance procedures and found them fit for purpose and consistent with good practice.
53. Thus, with reference to criteria of Appendix 4 to paragraph 2D.35 of Special Licence Condition CRC 2D, the AE concludes that WPD had done all it could be reasonably expected to do to minimise any interruption to its customers' supplies from this particular incident.

54. The AE has studied the running arrangements of the affected sections of WPD's network systems and concludes that WPD's protection systems worked correctly to clear the incident from its distribution system.
55. 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

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

Table 3 – Recommended performance adjustments

	Amount above threshold	Audit part 2 recommendation
CI	1.28	1.28
CML	0	0

4.4 Detailed justification

57. 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 failure of the insulator string at its Churchill Grid Substation.
58. 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.
59. The AE notes that WPD has undertaken an investigation into the mode of failure, including contacting other UK DNOs and has concluded that it was due to a manufacturing defect.
60. The AE also notes that WPD's routine inspection and maintenance procedures are thorough and were up to date at the time of the incident.
61. The AE therefore concludes that WPD had no cause to consider any additional measures other than those consistent with good UK practice.
62. The AE can confirm that the failure mode of the insulator string is the first such occurrence he has personally seen during his work in the national and international electricity sectors.
63. The AE also confirms that no inspection tests currently deployed would detect the incipient fault within the failed insulator.
64. To comply with the equipment specification, all such equipment is type-tested to destruction by the manufactures and WPD therefore had no reason to consider the failed insulator was unsound.
65. 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 a combination of tele-controlled and manual switching, restored supplies as rapidly as possible.
66. The AE is satisfied that WPD is pursuing the installation of improved protection arrangements to further improve the security of supplies to its customers.



67. The AE is satisfied that this section of WPD's distribution system complies with the requirements of the security of supply standard P2/6.
68. The AE is satisfied that the reasons given by WPD as to the apparent lack of progress with the installation of busbar protection are valid and notes the forthcoming work to install a simplified arrangement during the current regulatory reporting year.
69. The AE 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 WPD South West's performance for reporting year 2015/16.

Appendix A - Record of Audit part 1

Table A-1: Appointed Examiner's Information Log

"One-Off" Exceptional Event	Reporting Year 2015/16
Licensed Area	WPD(SW)
Date of event	02 July 2015
Cause	33kV incident at Churchill Grid Substation
Notification to Ofgem	10 July 2015
SoF received	24 July 2015
SoF information	<ul style="list-style-type: none"> WPD's distribution system affected by this incident was running abnormally at the time of the incident (Chew Stoke on the alternative supply from Radstock); At 09:54 on Thursday 02 July 2015 all supplies were lost from Churchill Grid Substation; WPD's control engineers began to restore supplies using tele-controlled switching; Personnel sent to site reported a broken insulator string and the associated overhead connection falling across the reserve busbar; The reserve busbar was isolated and remaining supplies restored by manually selecting outgoing feeders to the main busbar after it was re-energised; WPD has no history of previous failures problems of this type of insulator failure; No history of failure from other UK DNOs; No records of problems in the NEDeRS system either; and WPD's deliberations for the site affected by Hinkley Point PS but WPD is working towards a form of busbar protection by the year end
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 39 of the report.
Location of audit visit	WPD's control centre
Date of audit visit	17 May 2016
Visiting Auditor	Geoff Stott (ep)
WPD's Representatives	Lloyd Bridges, Carolyn Hinchey, Richard Horlington and Pete Williams
Information provided during and subsequent to the audit visit	<p>Comprehensive documentation / information including:</p> <ul style="list-style-type: none"> A discussion on the findings from the most recent inspection and maintenance reports; A discussion on the situation regarding this section of WPD's distribution system being P2/6 compliant; A discussion regarding the examination of the failed insulator; A discussion regarding the restoration of supplies; The details of what protection operated to clear the incident from WPD's network;



- A discussion of WPD's investigations into the root cause of the failure of the insulator;
- A copy of WPD's switching programme for the incident which shows the timings and events as outlined elsewhere in this report;
- A copy of WPD's switching programme showing the restoration of supplies to WPD's customers affected by the incident via a combination of tele-controlled and manual switching;
- A copy 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:
 - the total number of customers affected by the incident to be 45,822; and
 - the total customer minutes lost due to the incident to be 1,004,807;
- The AE confirms that these figures agree with those quoted in WPD's SoF;
- Using WPD(SW)'s total connected customers at 30 September 2015 of 1,590,050 the number of customers affected equates to a CI of 2.88 $[45,822 \times 100 / 1,590,050]$;
- Similarly, the customer minutes lost for this event equate to a CML of 0.63 $[1,004,807 / 1,590,050]$;
- Nothing to be gained from the AE visiting site;
- 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 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	0	0	0	0
EHV (INCD-3197-B)	2.88	2.88	0.63	0.63
HV	0	0	0	0
LV	0	0	0	0
Total	2.88	2.88	0.63	0.63
WPD(SW) Threshold (total)	1.60		1.28	
Part 1 Exceptionality Test	pass		fail	
Part 1 Precondition of eligibility (meets App 3 to paragraph 2D.34 of CRC 2D)	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 2015/16.



Appendix B - Photographs

Photograph 1 - a close-up of the empty metal cap of the failed insulator



Photograph 2 - the year of manufacture of the failed insulator





Photograph 3 - damage to the reserve busbar



Photograph 4 - the damaged over-running 33kV connection

