



Government of **Western Australia**
Department of **Commerce**

EnergySafety WA

ELECTRICAL INCIDENT REPORT

POWER POLE FAILURE AND BUSH FIRE BALINGUP WESTERN AUSTRALIA 14 FEBRUARY 2009

April 2009

Report prepared by:

EnergySafety WA

EIS 2009-578

Balingup Fire Report

TABLE OF CONTENTS

1	INTRODUCTION	3
1.1	Time and Date of Occurrence	3
1.2	Notification of Incident	3
1.3	Investigating Inspectors	3
2	SUMMARY	4
3	ORIGIN OF THE BUSH FIRE	5
4	INVESTIGATION ANALYSIS	6
4.1	Examination of the Incident Scene	6
4.2	Line Design and Construction	6
4.3	Pole Base Reinforcement	7
4.4	Pole and Power Line Inspection	7
4.5	Termite Treatment	8
4.6	Weather Conditions and Topography	8
5	CONCLUSIONS	9
	APPENDIX A: SATELLITE LOCATION IMAGE	1
	APPENDIX B: PHOTOGRAPHS	11
	Photograph No 1: Fallen Pole Number K360/36/3 as Found by DEC	11
	Photograph No 2: Fire Origin and Conductors on the Ground.	12
	Photograph No 3: Termite Infestation on Pole Number K360/36/3	13
	Photograph No 4: Termite Infestation and Damage to Pole Number K360/36/3.....	14
	Photograph No 5: Fallen Pole Number K360/36/3 on the Ground	15
	Photograph No 6: Bent Steel Reinforcement Attached to Pole Number K360/36/3.....	16
	Photograph No 7: Termite Treatment Notice on Pole Number K360/36/5	17
	Photograph No. 8: Ground-line rot in failed pole	18

1 INTRODUCTION

A bush fire occurred adjacent to the Balingup-Nannup Road near Balingup on 14 February 2009. The Department of Environment and Conservation (DEC) informed EnergySafety the next day that the bush fire appeared to have originated where a Western Power (WP) 12.7kV distribution pole had fallen to the ground. The fire burnt out approximately 1800 hectares of pine plantation and bush.

The investigation was carried out and completed with the cooperation and assistance of DEC, Police and Western Power (WP) under established protocols.

1.1 Time and Date of Occurrence

Approximately 1344 hours on Saturday 14 February 2009.

1.2 Notification of Incident

EnergySafety was notified of the incident by Mr John Tillman, DEC's Regional Fire Coordinator, at 0915 hours on Sunday 15 February 2009. Mr Peter Wright, EnergySafety's Manager Electrical Inspection (Supply), arranged for an investigation the same day with the DEC and WP at the fire scene.

1.3 Investigating Inspectors

EnergySafety Senior Electrical Inspector (Regional), Mr Ross Reid carried out the onsite investigation commencing on 15 February 2009 with DEC's Fire Investigator, Mr Raymond Flanagan.

Further Inspections of the incident site were carried out by Inspector Reid and Mr John Collins, Electrical Engineer, EnergySafety, on 27 February 2009.

2 SUMMARY

The pole that failed is Western Power pole number K360/36/3. This pole is part of the K360/36 single phase power line (spur) from the 22,000 volt (22 kV) three phase line originating at Bridgetown substation (BTN 511.0) and extending to the Kirup region [Appendix A, Satellite Location Image].

The K360/36 single-phase 12,700 volt (12.7kV) spur line consists of an active 12,700 volt conductor and an underslung running earth conductor at earth potential. At 1344 hours on 14 February 2009, pole number K360/36/3 fell over with the live 12,700 volt active and running earth conductors still attached. Electrical arcing occurred when the live active conductor contacted the ground, which ignited the dry vegetation in that vicinity [Appendix B, Photographs Numbers 1 and 2].

Pole number K360/36/3 was reinforced with a single "H" section steel column driven into the ground and secured to the pole by two steel banding straps [Appendix B, Photograph Number 6]. This reinforcing stake did not support the pole as intended when the pole broke and fell over on the 14 February 2009.

Pole number K360/36/3 was inspected by WP for ground line rot, remaining strength and serviceability on 8 January 2009 (37 days before it fell over) and was found to be serviceable. The pole was previously inspected on 30 May 2003, when it was found to have less good wood than when inspected subsequently on 8 January 2009.

Inspection of the pole after it fell over found:

- Live termite activity extending up the pole, but no evidence that the pole had been treated for termites [Appendix B, Photograph Numbers 3 and 4].
- Advanced rot with little or no pole strength remaining.

The K360/36/3 pole was an in-line strain pole with two stays installed on either side in line with the power line.

The spans either side of this pole are unusually long (580 metres and 530 metres).

The wind speed when the pole failed on 14 February 2009 was approximately 27kph from an East/South East direction. This wind speed is substantially less than the wind speeds corresponding to the design wind pressures for overhead power lines.

The K360/36 spur line runs through an area of recently replanted pine forest. The previous pine trees were cut about two years ago, which removed the shielding from prevailing winds that the mature trees had previously provided the power line.

EnergySafety will continue its investigations, with Western Power's assistance, to identify all the causes contributing to the pole failure, including line and pole design, construction, inspection/maintenance and base reinforcement installed.

3 ORIGIN OF THE BUSH FIRE

DEC's Fire Investigator advised that the bush fire's point of ignition was on the ground in dry vegetation next to where the live high voltage conductors on Western Power's pole number K360/36/3 fell to the ground [Appendix B, Photographs numbers 1 and 2].

An inspection of the ignition point indicated that an area of grass and bush had burnt out adjacent to the Western Power 12.7 kV overhead power line. The bush fire had continued in a West /North West direction. This is consistent with the bush fire being driven forward from the point of ignition by wind from the East/South East.

4 INVESTIGATION ANALYSIS

4.1 Examination of the Incident Scene

The Western Power K360/36 spur line adjacent to the Balingup to Nannup Road consists of:

- 12.7 kV active conductor material (x1): Steel
- Running earth conductor material (x1): Steel
- Pole material: Wood (jarrah untreated)
- Pole length (#360/36/3): 12.5 Metres (approx)
- Span length (#360/36/2 to #360/36/3): 580 Metres
- Span length (#360/36/3 to #360/36/4): 530 Metres
- Direction of power line: North East-South West

Note: The pole that fell over on 14 February and the pole immediately to the east of it were found to be designated with the same pole number (#360/36/3). References in this report to pole number K360/36/3 mean the pole that fell over on 14 February 2009, which was the sixth along the spur line from the T-off pole designated K360/36. The pole to the east of this pole is being re-designated K360/60/2A.

Investigation found that pole number K360/36/3 failed just below the ground line and fell at 90° to the power line. The steel reinforcing was still attached to the pole and was bent at the place of pole failure [Appendix B, Photograph Number 6].

There were no visible burn marks on the active and running earth conductors indicating they had clashed, prior to (or during) the pole falling. The active and running earth conductors were found lying separated on the ground.

When EnergySafety's Senior Electrical Inspector, Mr Ross Reid, visited the scene on Sunday 15 February 2009, a replacement pole had already been installed. The fallen pole was still lying on the ground and had been cut above the failure point [Appendix B, Photograph Number 5]. WP later removed and transported part of the pole butt and pole immediately below and above the ground line to Perth for examination under the established evidence process.

Western Power took the remainder of the pole above the ground to their Bridgetown Depot following a later request by EnergySafety. An inspection of the pole on 27 February 2009 by EnergySafety found that a section of the pole (approximately 3 metres) was missing and could not be provided for inspection.

The spur line was protected by a recloser that had operated four times as result of the fault and then locked out, de-energising that section of the power line.

Other sources of the fire ignition were considered and eliminated such as lightning, power line fuse operation, vehicle movements in the area and arson.

4.2 Line Design and Construction

Pole number K360/36/3 was an in-line type strain pole supported by two stays installed on each side of the pole in-line with the power line. There were no stays transverse to the power line supporting the pole and conductors against the wind forces at 90 degrees to the power line.

The power line spans either side of K360/36/3 pole were 580 metres and 530 metres. These spans, reflecting the undulating terrain, are much longer than Western Power's typical rural spans, which are generally less than 300 metres.

The K360/60/2A pole at the other end of the longer span (580 metres) to the east of the failed pole was supported by a back-stay. The K360/36/4 pole at the other end of the shorter adjacent span (530 metres) was not supported by any stays. There were no stays supporting any of the straight line poles in this spur other than those on the K360/36/3 pole, or any stays supporting the in-line poles against transverse wind loads (i.e. 90° to the power line). This raises questions about the power line design and construction, taking into consideration the lengths of the bays either side of K360/36/3 pole.

Western Power has installed two transverse stays and two in-line stays on the new pole replacing pole number K360/36/3.

Further investigation is required into the pole and line design and the staying arrangements on the K360/36/3 pole, and the other poles supporting long spans in this spur line.

4.3 Pole Base Reinforcement

Pole number K360/36/3 was fitted with a single "H" section steel reinforcing stake driven into the ground alongside the pole. This stake is secured to the pole above ground by two large banding straps. The "H" section steel stake bent at the ground line, allowing the pole to fall over, but remained secured to the pole by the banding straps above the ground. The banding straps stretched, but did not break.

Western Power uses these reinforcing stakes to guard against pole failures caused by ground-line rot and to extend the safe service life of its wood poles. The reinforcing stake on pole number K360/36/3 did not support the pole when it broke.

Further investigation is required into the adequacy of the pole-base reinforcing installed on K360/36/3 pole and along the K360/36 spur line.

4.4 Pole and Power Line Inspection

WP inspected pole number K360/36/3 on 8 January 2009. This inspection found the pole to be serviceable with 160 mm of good wood in each of the three inspection holes tested. The field inspection results were not updated in WP's records until after the pole had fallen over on 14 February 2009.

Inspection of the pole butt after its failure found advanced wood rot below the ground line, which casts doubt on the effectiveness of the below ground pole inspection carried out on 8 January 2009.

WP previously inspected pole number K360/36/3 pole on 30 May 2003. This inspection found substantially less good wood, and hence pole strength, than was reported from the January 2009 pole inspection. These pole inspection results are inconsistent. The pole inspection results and monitoring activities warrant further investigation.

On 27 February 2009 pole number K360/36/8, on the same spur line, was found to be leaning more than good construction practice would allow and was possibly broken and unsafe. WP was informed and the pole was replaced on 28 February 2009.

On 10 March 2009, a concerned property owner living near the K360/36 spur line advised EnergySafety of another pole (K360/36/14) that was leaning over and looked unsafe. WP was informed of the condition of the pole and replaced it on 2 April 2009.

The condition and serviceability of the other poles in this spur line, including the poles WP have or intend to replace, also require further investigation.

4.5 Termite Treatment

Pole number K360/36/3 was found to be infested with an active termite colony. There was no label on the pole indicating the termite activity had been identified and/or treated. Also other poles in the spur line have a yellow termite treatment notice identifying when the termite treatment was administered. Pole number K360/36/5 is one such pole fitted with a termite treatment notice [Appendix B, Photograph Number 7].

A number of other poles in this spur line are also infested with termites. Most appear to have been treated.

Examination of sections cut through the pole by WP showed clear evidence of active termites, both at and above the ground line. While the termite galleries were present, the wood rot at the ground line contributed more to the loss of strength and pole failure than the termite activity.

The absence of WP's approved termite treatment of pole number K360/36/3 and the management of termite treatment on this spur line require further investigation.

4.6 Weather Conditions and Topography

The weather conditions recorded at the Styles Fire observation tower (approximately 11 km South/South West of the fallen pole) for 14 February 2009 as follows:

1300 hours

East/South East wind at 27 kph

Relative humidity 28%

Ambient air temperature was approximately 28°C

The wind speed recorded at Bridgetown at 1321 hours was 26 kph and gusting to 54 kph.

The wind speed recorded at Donnybrook at 1500 hours was 37kph.

The sky was clear and there was no evidence of lightning in the area.

The wind speeds corresponding to the design wind pressures specified in the *Guidelines for the design and maintenance of distribution and transmission overhead power lines–1999* range from 120 to 160 kph. The wind speeds prevailing when the pole fell over should not have been a significant factor in its failure.

5 CONCLUSIONS

Taking all available evidence at the time into account, it is reasonable to conclude that:

- There were no suspicious circumstances concerning the origin of the bush fire.
- There were no other potential sources of ignition of the fire such as lightning, power line fuse operation, vehicle movements through the area or arson.
- The bush fire originated at the fallen WP pole number K360/36/3.
- The pole failed at the ground line and fell to the ground. Contact between the live high voltage conductor and dry vegetation on the ground ignited the grass fire that spread to the plantation and surrounding area.
- The wind speeds when the pole fell over were well within the design limit. They were not high enough to explain pole number K360/36/3 falling over.
- Because of undulating terrain, the spans either side of pole number K360/36/3 were substantially longer than normal rural power line spans. These long spans may be a significant factor in the pole falling over. This requires further investigation.
- Considerable rot in the pole in the safety-critical zone at and below the ground line was a significant factor in the pole falling over.
- The WP inspection on the 8 January 2009 failed to identify the real condition and strength of the pole in the safety critical-zone at and below the ground line. Delays in reporting the inspection results means the pole would still have fallen falling over, even if the January 2009 inspection had properly identified the condition and strength of the pole.
- The pole base reinforcing stake failed to support the rotted pole as was intended. This was a contributing factor to the pole falling over and the fire starting.
- Termites were active in the pole at and above the ground line. While the termite galleries would have reduced the pole's strength and serviceability to some degree, this was considered to be of lesser significance in the pole falling over than the ground line rot, which was advanced.
- Two other poles in the spur line near to pole number K360/36/3 were found to be leaning and possibly unsafe. Western Power has replaced one and intends to replace the other. While these poles did not contribute to pole number K360/36/3 falling over and the bush fire on the 14 February 2009, they raise questions about the effectiveness and timeliness of Western Power's inspections.

Further investigation is required by Western Power and EnergySafety to identify the contributing causes of pole number K360/36/3 falling over including:

1. Line design and construction.
2. Pole inspection.
3. Line inspection.
4. Pole base reinforcement.
5. Line and pole maintenance, including termite treatment.

APPENDIX A: SATELLITE LOCATION IMAGE

Showing the Origin of the Bush Fire. Image taken prior to the bush fire



APPENDIX B: PHOTOGRAPHS

Photograph No 1: Fallen Pole Number K360/36/3 as Found by DEC

Photograph taken at 1546 hours on Saturday 14 February 2009 by the Department of Environment and Conservation.



Photograph No 2: Fire Origin and Conductors on the Ground.

The active conductor is shown in the centre of the picture.

Photograph taken on 15 February 2009 by Senior Electrical Inspector Ross Reid, Energy Safety.



Photograph No 3: Termite Infestation on Pole Number K360/36/3

Photograph taken on 15 February 2009 by Senior Electrical Inspector Ross Reid, Energy Safety.



Photograph No 4: Termite Infestation and Damage to Pole Number K360/36/3

Photograph taken on 15 February 2009 by Senior Electrical Inspector Ross Reid, Energy Safety.



Photograph No 5: Fallen Pole Number K360/36/3 on the Ground

Photograph taken on 15 February 2009 by Senior Electrical Inspector Ross Reid, Energy Safety.



Photograph No 6: Bent Steel Reinforcement Attached to Pole Number K360/36/3

Photograph taken on Sunday 15 February 2009 by DEC Fire Investigator Mr Raymond Flanagan



Photograph No 7: Termite Treatment Notice on Pole Number K360/36/5

Photograph taken on 15 February 2009 by Senior Electrical Inspector Ross Reid, Energy Safety.



Photograph No. 8: Pole Number K360/36/3 showing ground-line rot.

Photograph taken by EnergySafety engineer Andrew Martin at Western Power's head office, 363 Wellington Street, Perth.

