Department of **Consumer and Employment Protection**
Government of **Western Australia**

Energy*Safety*

ELECTRICAL INCIDENT REPORT

INVESTIGATION OF WILDFIRE ON 2 DECEMBER 2004 AT LOCATION 1501 DALYUP ESPERANCE WESTERN AUSTRALIA

20 May 2005

2004-1366

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1 INTRODUCTION

A wildfire occurred at Location 1501, Dalyup about 40km west of Esperance on Thursday 2 December 2004. It was reported by the Fire Emergency Services (FESA) that the cause of the fire might have electrical origins.

As a result an investigation was carried out by Energy Safety, the technical and safety regulator for the electricity industry in WA. This report summarises the findings.

The cooperation and assistance of officers of FESA, Western Power Corporation (WPC) and Police Arson Unit is acknowledged.

1.1 Location of Incident

Location 1501, Dalyup about 42km west of Esperance.

1.2 Time and Date of Occurrence

Approximately 1400 hrs on Thursday 2 December 2004.

1.3 Notification of Incident

An Officer of FESA notified the Energy Safety Division of the incident on the afternoon of Thursday 2 December 2004.

1.4 Investigating Inspector

The investigation was carried out by Mr Gary Scott, Senior Electrical Inspector, Energy Safety Division designated Inspector (Electricity).

Mr Scott visited the site on 4, 7, 8 and 17 December 2004.

2 SUMMARY

Energy Safety investigated the cause of the fire at Location 1501, Dalyup about 40km west of Esperance and concluded that:

- A 19.1 kV phase conductor became detached from a pole mounted insulator at pole D250/16/5 and clashed with the underslung running earth conductor, approx 200m east towards pole D250/16/6. This resulted in a flashover that released hot metal particles, which ignited dry harvested stubble, initiating the wildfire.
- During the fire both the phase and running earth conductors broke. Pole D250/16/5 then failed whilst under the stress from the strong wind (northerly) and the attached earth conductor. The property owner witnessed this event whilst he was fighting the fire [Photographs, Appendix A].
- The clashing of conductors and subsequent breaking of the conductors did not result in the associated 33 kV Dalyup Feeder protection (D38) or the associated high voltage drop out fuse operating.
- Pole D250/16/5 failed because the structural strength of the pole had deteriorated to a level where the pole was no longer able to perform its normal duties.
- Pole D250/16/5 should have withstood the expected load.
- WPC removed the insulator and conductor tie (it is assumed the conductor was tied to the insulator prior to the incident) at pole D250/16/5 from the scene of the fire and could not provide this equipment for inspection. Therefore, the reason for the failure of the conductor tie at the insulator could not be determined.

3 ORIGIN OF THE WILDFIRE

No witnesses who claim to have seen the actual start of the wildfire have come forward. The first person to notice the fire was the property owner who advised that whilst he was watching another fire to the east, he noticed the early stages a fire on the boundary of his and a neighbouring property. The property owner advised that a power line conductor was hanging very low (approximately 1 metre above the fence), at the location of pole D250/16/5. He also advised that whilst attempting to access the neighbouring property to fight the fire both conductors fell towards the ground and contacted the dividing fence. The pole then fell to the ground.

The origin of the fire was approximately 200 metres from the failed pole (D250/16/5) towards the next pole east, which is consistent with the 19.1 kV aerial phase and earth conductors clashing.

The property owner estimates that an area of approximately 468 hectares had been burnt. It was evident that the fire was driven by wind in a southerly direction away from the clashing conductor point and the fallen WPC pole. This is consistent with the fire being driven away from the suspected point of ignition, by wind coming from a northerly direction, as was the case at the time of the fire.

In summary, it was concluded that the fire was ignited when the 19.1 kV phase conductor clashed with the underslung running earth conductor after dislodging from the insulator at WPC wood pole D250/16/5. The pole later failed and fell over in a southerly direction.

4 INVESTIGATION

The property owner stated that the fire started at approximately 1400 hrs on Thursday 2 December 2004.

4.1 WPC's Equipment

The WPC powerline was constructed as follows:

- Single phase 19.1 kV arrangement utilising a single active phase conductor (1 x 3/2.75 scgz) with an underslung galvanised steel earth conductor (1 x 3/2.75 scgz);
- The spans either side of pole D250/16/5 were, 270m to the east (pole D250/16/6) and 270m to the west (pole D250/16/4);
- The feeder supplying this system is called the Dalyup Feeder, which is electrically protected by a circuit breaker (D38) with auto reclose facility;
- The height of the pole was 9.47m from ground level; and
- The measurement from the active phase conductor to the underslung earth conductor was 1.5m.

4.2 Examination and Findings

The following facts were determined from information provided by the property owner, WPC Esperance depot staff and on site inspection:

- On arrival of the WPC repair crew on the afternoon of Friday 3 December 2004, the WPC pole (D250/16/5) was lying on the ground pointing in a south-westerly direction with the base being held off the ground by the boundary fence. The phase and earth conductors were both unattached to the insulators at pole D250/16/5. An electric arc burn mark was also noticed on the earth conductor at the point where it broke.
- WPC Distribution Systems Officer stated at the interview that pole D250/16/5 was last inspected on the 24 April 2004 by a WPC wood pole inspection contractor. WPC records indicate that pole D250/16/5 was installed on 1 January 1970.
- The associated WPC wood pole contractor has since advised Energy Safety that the inspector identified on the inspection record may not have been the actual inspector who carried out the inspection. This was due to delays in WPC issuing new inspector authorisation identification (ID) numbers (2-3 months delay) following inspector training. Therefore, a new inspector would utilise another inspectors ID for this period, as WPC's records could not be updated without an inspectors ID. Therefore, there has to be some doubt about the accuracy of WPC's records.
- The next pole west of the replaced (failed) pole (D250/16/5) appeared to be in a poor condition (where it enters the ground).
- Pole D250/16/5 and surrounding poles were not reinforced (i.e. no RSJ columns/stubs fitted).
- The Dalyup Feeder Circuit Breaker (D38) did not record a fault (operation) and the associated high voltage drop out fuse did not operate on Thursday 2 December 2004.
- Visual inspection of the conductor's insulator ties at the two poles either side of the failed pole (D250/16/5) found that the ties were corroded but in a reasonable condition.

4.3 Weather Conditions

The Bureau of Meteorology provided the following weather information for 2 December 2004 regarding the Esperance region:

> "*The region was subject to a strong wind warning, NE/N'ly winds 40/60 kmph ahead of a 40/60 kmph southerly change. Squalls to 80kmh with change".*

The Bureau of Meteorology provided the following weather information from the Cheadunup weather station (near Munglinup), for 14.00 hours on Thursday 2 December 2004:

Northerly wind at 34.3 kmph
Wind gusts of up to 65 kmph
Relative Humidity at 11%
Maximum air temperature of 34ºC

The Bureau of Meteorology provided the following weather information from the Esperance weather station, for 14.00 hours on Thursday 2 December 2004:

Northerly wind at 40.7 kmph
Wind gusts of up to 61.1 kmph
Relative Humidity at 9.6%
Maximum air temperature of 32.2ºC

4.4 Other Recent Pole failures

Information received on other pole failures in the western Esperance region that were related to the high winds on the 2 December 2004 were as follows:

- Four (4) other poles on the Dalyup Feeder, west of Esperance failed (i.e. snapped and fell over) on 2 December 2004 during or following the strong winds. A wildfire was the result of these pole failures. The pole No's were: D577/4 east, D318/35/10/8, D99/12/6 & D595/8 south. The poles were not steel reinforced. These pole failures are subject to separate investigation and report.

- WPC's Distribution Systems Officer stated at interview that three (3) other poles, west of Esperance failed (i.e. snapped and fell over) on 2 December 2004. These pole failures did not result in a fire. The area at the time was subject to strong wind conditions. The pole No's were: GS499/179/97 (Lort River), D888/98/8 (Melaleuca Rd, Munglinup) & D667 (South Coast Highway, Coomalbidgup).

4.5 Independent Scientific Inspection Results

Scientific inspection of the pole butt (above and below ground samples adjacent to the break) by the Forest Products Commission found:

4.5.1 Pole (D250/16/5) Stump (below ground sample)

This was a larger pole section, which included some splintering fracture of the outer heartwood but generally brittle fracture. The white plastic plug was removed and probed, which again indicated that the wood was sound although marginally softer that the surrounding. This is attributed to higher moisture content due to contact with the preservative rods.

4.5.2 Pole (D250/16/5) End (above ground sample)

This section above ground had internal splitting with obviously weathered wood. However, this would have little effect on the strength properties of the pole because there was no associated rot.

Remnants of decaying sapwood were just above the ground line, but standard engineering practice has been to ignore the non-durable sapwood in design unless it has been preservative-treated. The narrow sapwood band of jarrah (typically 12 to 15mm width) means that this species has a very low volume of sapwood in the cross-section compared with many others.

Overall it was considered that the cause of the pole failure was the increasing brittleness of the wood with increasing age and years in service. Jarrah is rated in Australian Standard AS5604-2003 'Timber – Natural durability ratings' as CSIRO Durability Class 2, i.e. the outer heartwood should give 15 to 25 years service in ground.

4.6 Analysis

It is prudent to assume that WPC's overhead powerlines would have been designed to ESAA C(b)1 "Guidelines for the design and maintenance of overhead distribution and transmission lines" {referred to as "ESAA C(b)1"} or equivalent or higher standard, considering that ESAA C(b)1 has been the accepted standard for overhead powerline design in the Electricity Supply Industry for many years.

The guidelines specified design factors of safety (FOS) for supports such as poles, considering wind loads and other types of loads. It can be expected that with the deterioration of a pole with age, the FOS would gradually reduce. However, it is expected that WPC's pole inspection and maintenance system would identify and initiate action when the FOS of a pole is less than 2.0. This is because poles with a FOS of less than 1.5 are considered to be unsafe and must be replaced or reinforced such that the FOS becomes greater than 2.0.

The reported wind speeds on the afternoon of 2 December 2004 – northerly winds at 40km/h with gusts to 72km/h – are substantially less than the design wind speeds specified in the ESAA C(b)1. The wind loads specified in the different versions of ESAA C(b)1 1964 to 1991 to be accommodated in the wood pole design have not changed substantially over the past 35 years and these have been calculated based on a maximum wind speed of 146km/hr. Consequently the poles should not have failed under the wind conditions that prevailed at the time.

5 CONCLUSIONS

There are a number of factors that occurred on the day of the wildfire that need to be considered. These are summarised below:

- No witnesses, who claim to have seen the actual start of the wildfire, have come forward. However, the property owner reported the fire claims to have arrived at the scene shortly after the fire started at approx 1400 hrs on Thursday 2 December 2004.
- Gusty winds is believed to have attributed to the dislodging of the 19.1 kV phase conductor insulator at pole D250/16/5 and clashing with the underslung earth conductor resulting in a flashover that released hot metal particles, which ignited dry harvested stubble, commencing the wildfire.
- Gusty winds from the north also caused the wildfire to spread over an area of approximately 468 hectares over numerous properties until FESA volunteers brought it under control.
- None of the poles in the immediate area of WPC pole D250/16/5 were reinforced at ground level (i.e. no RSJ columns – steels fitted).
- WPC's pole inspection records cannot be relied upon to identify the WPC inspector who inspected the poles and hence the data in the pole inspection report cannot be verified with that inspector and therefore has to be questionable.
- Scientific testing of the pole sample stump and pole end by the Forest Products Commission indicated that the samples showed signs of brittleness due to age.
- Pole (D250/16/5) failed because the structural strength of the pole had deteriorated to a level where the pole was no longer able to perform its normal duties.
- Pole (D250/16/5) should have withstood the expected wind load.
- The reason for the failure of the conductor tie at the insulator on pole D250/16/5 could not be determined.
- The clashing of the high voltage conductors should have resulted in the associated 33 kV Dalyup Feeder protection (D38) or the associated high voltage drop out fuse operating.

6 RECOMMENDATIONS

This investigation has identified that the WPC wood pole (D250/16/5) failed along with a number of other WPC wood poles in the area around the same period. As the mode of failure is similar in all cases (although the detail of the other cases is not covered in this report), it raises real concern about the structural adequacy of wood poles erected on or before 1985 in WPC's rural power system in the area west of Esperance.

Energy Safety is currently conducting a compliance audit of WPC's wood pole management system to assess compliance with the *Electricity (Supply Standards and System Safety) Regulations 2001*. A copy of this report will be provided to the compliance auditors.

It is recommended that Western Power Corporation:

1. Inspects the over current and earth fault protection settings on the 33 kV Dalyup Feeder (D38) and associated high voltage drop out fuse rating (for the single phase spur) to ensure that the protection systems are operational and will therefore provide protection for the overhead powerline and associated equipment;

2. Changes its wood pole inspection practices and procedures to ensure that the inspector who conducted the pole inspection can be clearly and positively identified;

3. Changes its practices to ensure that any evidence which is removed from the scene of a fire, where WPCs equipment may have caused the fire, is marked, retained and secured;

4. Inspects all the poles in the rural area to the west of Esperance that were erected in 1985 or earlier to determine the remaining structural strength and factor of safety (FOS) of those poles;

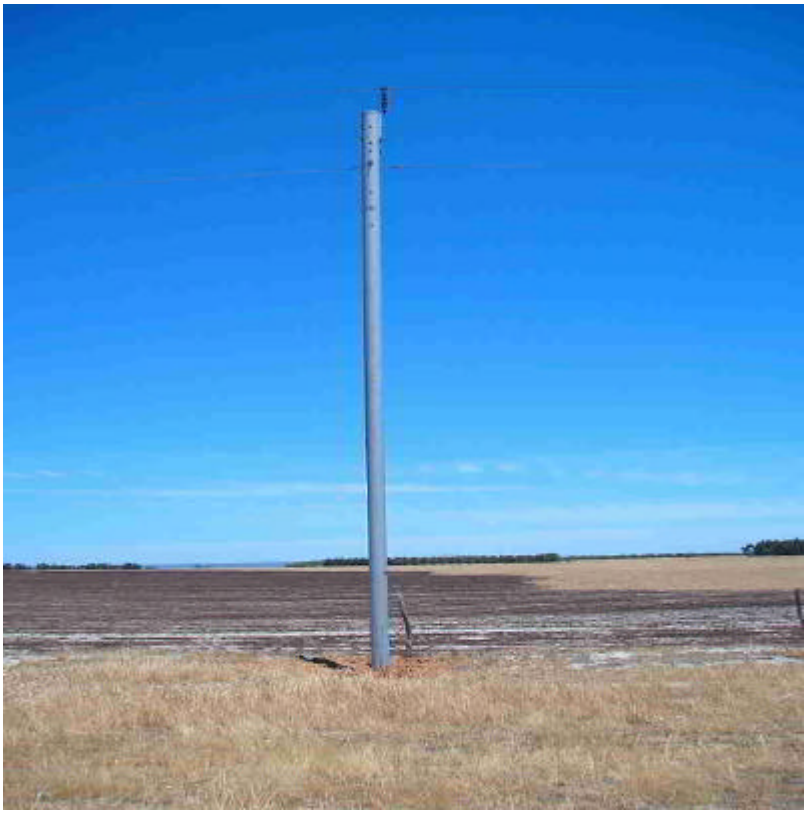
5. Reinforces or replaces all poles that do not have a residual FOS of 2.0 in respect of the loads specified in ESAA C(b)1; and

6. Prepares a plan and program to manage this work.

Energy Safety will be reviewing Western Powers actions and will ultimately decide whether or not it is necessary to issue an Order to ensure this work is completed to appropriate Standards and timeframe.

APPENDIX A - PHOTOGRAPHS

Photograph of Fire Scene Showing the New Replacement Steel Pole (D250/16/5)



Photograph of Aerial Pole D250/16/6 Insulator and Conductor Tie

Photograph of WPC Pole (D250/16/5) Stump End and Pole End Samples