

ORDER
ENERGY COORDINATION ACT 1994 S. 18B

TO: WESTERN POWER
363 WELLINGTON STREET
PERTH WA 6000

PRELIMINARY

This Order dated 29 September 2009 is issued to the Electricity Networks Corporation trading as Western Power by Inspector (Electricity), Mr Michael Bunko, under Section 18B of the *Energy Coordination Act 1994*. The background to the Order is set out below.

INVESTIGATION OF WESTERN POWER'S WOOD POLE MANAGEMENT

Western Power's wood pole management systems and activities were investigated in 2006 for compliance with the *Electricity Act 1945* and *Electricity (Supply Standards and System Safety) Regulations 2001* ("the Regulations"). This investigation presented in EnergySafety's *November 2006 Report of the Regulatory Compliance Assessment of Western Power's Wood Pole Management Systems* found that Western Power:

- Sustained pole failure rates two to four times higher than the Australian industry target and 20 times higher than those achieved by the leading Australian wood pole network operators;
- Was not effectively inspecting and assessing the strength of its poles in the safety critical zone below ground;
- Used the sound, dig and drill inspection method, with a 'good-wood' serviceability criterion that does not effectively assess the strength of its poles in the safety critical zone below ground, or at the top of any pole base reinforcement installed. The 'good-wood' criterion also does not consider the forces imposed by wind pressure on the poles, conductors and pole-top hardware;
- Had accumulated a backlog of poles to be inspected and was identifying few unserviceable poles because of the low pole inspection and condemnation rates;
- Had no pole replacement plan other than replacing the unsafe poles identified from its pole inspection activity;
- Had no management system to ensure that the unsafe poles identified were replaced;
- Was replacing less than 1700 poles in its network of more than 630,000 poles;
- Had a pattern of unassisted pole failures in its rural network with poles that:
 - Were untreated jarrah;
 - Were between 30 and 60 years old;
 - Did not meet the design standards when they were installed;

- Were not supported by stays or conductors transverse to the power lines that would support these poles against the forces from wind pressure on the poles, conductors and other pole top hardware;
- Had found no evidence of internal rot and loss of pole strength in these untreated jarrah rural poles, even though they were more than 30 years old; and
- Were in rural locations where the risk of ground fires, damage to property and life are high through the dry summer months.

Western Power's wood pole management systems were again investigated in 2008 with specific attention to the matters identified in the 2006 Regulatory Compliance Assessment. This investigation found that Western Power:

- Had reduced the number of unassisted pole failures by correcting its recent records;
- Had substantially increased the number of poles being inspected;
- Was reducing the backlog of poles to be inspected;
- Continued to use the sound, dig and drill inspection method and had not modified its 2006 pole inspection practice to inspect poles in the safety critical zone below ground;
- Was still using its 2006 good-wood serviceability criterion which, combined with its pole inspection practice, was not assessing the remaining strength of the poles inspected;
- Was still not assessing the forces on the poles from the wind pressure on poles, conductors and other pole top hardware;
- Had increased its pole replacement and reinforcement activities, but not to levels that would deliver the required wood pole safety;
- Had not established effective wood pole replacement and reinforcement;
- Had not established management systems that would ensure unsafe poles were replaced, or reinforced;
- Had not addressed the risk of unassisted rural pole failures identified in 2006;
- Does not effectively assess the condition of its poles in the safety critical zone below ground with its pole inspection practice;
- Does not assess the strength of its wood poles based on the real condition of the poles and strength of the wood;
- Does not assess the risks of pole failures based on the remaining pole strength and the forces on the poles with its current good wood serviceability criterion;
- Does not have management systems that ensure unsafe poles are replaced, or reinforced;
- Is not replacing and reinforcing its wood poles at rates that will provide the wood pole safety required;
- Has not recognised and addressed the particular risk of rural pole failures identified in 2006.

By reason of the above matters it is my opinion that Western Power:

1. Has not developed and implemented pole inspection practices and serviceability criteria that comply with Regulation 10(2)(b) in that they do not effectively identify unsafe poles that should be replaced or reinforced;
2. Has not developed and implemented plans to replace the wood poles in its distribution network to comply with Regulation 10(2)(b) and sufficient to:
 - a. Provide for the safety of persons, including employees and contractors to Western Power to comply with Regulation 10(1)(a); and
 - b. Avoid or minimise any damage to property, inconvenience or other detriment as a result of the prescribed pole replacement activity to comply with Regulation 10(1)(c);
3. Lacks a wood pole replacement plan and management systems to comply with Regulations 10(2)(b) and that the absence of such plans and systems results in pole failures that endanger employees, the public and property; and
4. Has not ensured that the design, engineering and operation of its network are regularly reviewed for safety and effectiveness to comply with Regulation 10(2)(e) and that the absence of this review for safety and effectiveness endangers employees, the public and property.

REASONS FOR THE OPINION

- Western Power's pole inspection practice is set down in its April 2003 Network Pole Inspection Manual and the June 2008 revision of this Manual. The 2008 revision did not address the below-ground inspection and serviceability criteria issues identified in the 2006 Audit Report.
- Western Power's sound, dig and drill practice for pole inspection is intended to identify the internal rot and remaining good wood from above and below ground inspection holes drilled into the pole for this purpose. The internal good wood measurements from these test holes are the basis of the serviceability criteria used to decide which poles should be replaced, reinforced, or remain in service for a further four years.

The 2006 field check of a sample of recently inspected poles at that time found none of these poles had been inspected below ground and the below ground good wood records in Western Power's maintenance records were not based on below ground good-wood readings from these poles. This check of recently inspected poles was repeated in 2008 and while some progress had been made with quality assurance to ensure below ground inspection were being done, many of the poles inspected in the last two years have not benefited from this improved quality assurance. There are also poles encased in brick and concrete paving that has not been disturbed and have not been inspected below ground.

- Western Power's inspection records still do not reflect the real condition and strength of the poles in the safety-critical zone below the ground where the loss of pole strength due to internal and external rot and the bending forces on the pole are greatest.

- Western Power's Network Pole Inspection Manual does not call for all poles to be excavated and inspected in the safety-critical zone below the ground line.
- The poles that are inspected below ground are not excavated around their circumference to identify the full extent of external rot and loss of pole strength. The loss of external wood is more critical to the pole strength and safety than the internal loss of good wood.
- An assessment of the loss of internal good wood based on just two test holes is unlikely to establish the condition and strength of the poles.
- For poles to be safe and remain in service their strength must exceed the stresses caused by the forces applied to them. The ratio between the pole strength and the stresses within the pole is the factor of safety. The design forces used in the pole and line designs, the allowable stress and the factors of safety are specified in the *HB C(b)1 Guidelines for the design and maintenance of overhead distribution and transmission lines*.
- Western Power's good wood serviceability criterion takes no account of the actual mechanical forces on the pole and power lines, the stresses caused by these forces, and the allowable design strengths based on a realistic assessment of the pole condition. This comparison of pole strength and stress is essential to assess the actual factor of safety and serviceability of each pole inspected.
- Unrealistic inspection records and strength assessments can result in unsafe poles remaining in service.
- Western Power's below-ground inspection practices and good-wood serviceability criterion permit unsafe poles to remain in service.
- Western Power does not have a management system that ensures unserviceable poles are replaced or reinforced.
- Western Power manages some 620,000 wood poles in its distribution network. Almost all of these poles were installed by the State Electricity Commission, the State Energy Commission of WA and most recently Western Power in the period since World War II. Some very old poles installed by local councils before World War II may still be in service in the distribution network.
- The November 2006 Report of the Regulatory Compliance Assessment of Western Power's Wood Pole Management Systems found pole replacements were less than 1700 in that year.
- The *2008 Distribution Wood Pole Audit Review* found pole replacements had increased to less than 5,000 poles per year.
- The 2008 investigation also found Western Power has plans, subject to financial approval, to replace approximately 11,300 poles per year over the next three years. This is more than the unsafe poles identified from its pole

inspection activities, but still less than is necessary to address the safety risks of the aging untreated jarrah poles in the distribution network.

- The wood poles in the distribution network are in almost equal parts untreated jarrah and treated species. An estimated 310,000 untreated jarrah poles were installed from the end of WWII until the late 1970s, when diminishing supplies of suitable poles prompted the use of more plentiful treated poles with smaller diameters.
- The untreated jarrah poles are all between 30 and 65 years old.
- The service life of untreated jarrah poles is specified in AS 1720.2 and AS 2209 to be 15 to 25 years in ground and 15 to 40 years above ground.
- All the untreated jarrah poles in Western Power's distribution network are older than the 15 to 25 years for jarrah poles in ground. Many are older than the 40 year service life for jarrah poles above ground, which is the prudent service life for reinforced untreated jarrah poles.
- The *November 2006 Report of the Regulatory Compliance Assessment of Western Power's Wood Pole Management Systems* found a pattern of untreated jarrah pole failures in Western Power's rural distribution network. A common factor was that all these poles had no lateral support from wires or stays transverse to the power line that would support them against transverse wind forces.
- The *November 2006 Report* also found from Western Power's investigations of these failures that none of these poles had the strength required to meet the design standards specified in the *HB C(b)1 Guidelines for the design and maintenance of overhead distribution and transmission lines* when installed.
- The *2008 Distribution Wood Pole Audit Review* found that 1 of 6 failed poles investigated did not have the strength to meet the required design standards when installed, but that 5 of 6 did not have the necessary strength to meet the more recent C(b)1 - 1991 and 1999 design standards.
- The allowable bending stress was reduced from approximately 100 MPa to 50 MPa over the 30 years from the 1960s to 1991. This reduction of the pole design strength recognises the reduced serviceability and safety of the untreated jarrah poles in Western Power's rural network based on industry experience with these poles.
- Tests results of clear samples from a 35 year old untreated jarrah pole that failed in 2008 showed the reduction in the allowable design bending strength to 50 MPa to be necessary and prudent. The unseasoned samples in the critical failures zone below ground all failed at approximately 57 MPa. Most of the seasoned samples from above ground failed at ~ 90 MPa, except for two samples that failed at less than 40 MPa. These results reflect the variability expected in the wood fibre strength in old poles and the need for caution when assessing the strength of such poles.

- The pattern of rural pole failures identified in 2006 had not been addressed in 2008. These failures may be the result of one or more of the following factors:
 - The inadequacy of Western Power's pole inspection practices to identify the condition and strength of its poles.
 - The inadequacy of Western Power's good wood serviceability criterion to identify undersized poles installed because of design errors.
 - Poles that may have met the older design requirements, but do not meet the current design requirements.
- Some 15,000 untreated jarrah poles were installed each year in the 20 year period from the 1950s to the late 1970s. Many of these were installed in Western Power's rural distribution network through the rural electrification Contributory Extension Scheme. Pole replacement rates in the order of 15,000 per year focussed on replacing the oldest untreated jarrah poles will not significantly reduce the risk of old jarrah pole failures. Significantly higher rates must be implemented immediately to achieve the safety outcomes required.

ACTIONS REQUIRED

Pursuant to Section 18B of the *Energy Coordination Act 1994*, I hereby order Western Power to:

1. POLE INSPECTION

- 1.1. By 31 December 2009 modify its sound, dig and drill pole inspection practice to inspect all wood poles around their full circumference in the safety-critical zone 100 mm to 200 mm below ground ("the Modified Inspection Practice").
- 1.2. By 31 December 2009 draft new and amend existing documents to incorporate the Modified Inspection Practice.
- 1.3. By 31 December 2009 prepare an implementation plan to put into effect the Modified Inspection Practice.
- 1.4. By 30 June 2010 implement the amended pole inspection practice.

2. POLE STRENGTH ASSESSMENT

- 2.1. By 31 December 2009 modify its wood pole strength assessment so as to assess the strength of in-service wood poles based on the following:
 - a) An accurate measure of the external good wood diameter of the pole in the safety-critical zone below the ground line;

- b) An accurate measure of the external good wood at the top of any pole-base reinforcement installed;
- c) The loss of internal good wood above and below the ground line, and at the top of any pole-base reinforcement installed; and

The allowable design stresses for the pole species specified in the HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines, or later editions of this Guideline. The allowable design strength may be reduced to the extent justified by information obtained from post-mortem investigations of all unassisted pole failures and the results of clear-sample tests of wood from these failed poles.

(Collectively "the Modified Wood Pole Strength Assessment Criteria")

- 2.2. By 31 December 2009 draft new and/or amend existing documents to incorporate the Modified Wood Pole Strength Assessment Criteria.
- 2.3. By 31 December 2009 prepare an implementation plan to put into effect the Modified Wood Pole Strength Assessment Criteria.
- 2.4. By 30 June 2010 implement the Modified Wood Pole Strength Assessment Criteria.

3. SERVICEABILITY CRITERIA

- 3.1. By 31 December 2009 adopt serviceability criteria for Western Power's in-service wood poles based on the following:
 - a) The safety factor for each pole derived from the pole strength determined under item 2.1 above and the forces on the power lines and pole specified in the 1999 and later editions of HB C(b)1 Guidelines for the design and maintenance of overhead distribution and transmission lines. Safety factors must be calculated for each pole in the safety critical zone below the ground line, and at the top of any pole-base reinforcing installed;
 - b) The effectiveness of pole-base reinforcement installed based on calculations of the structural strength, testing and field experience of the different pole base reinforcements on poles that fail;
 - c) The lateral support of the poles and power lines derived from the conductors and stays attached to the pole transverse to the power line;
 - d) Pole age compared with age-failure experience with the pole species; and
 - e) The life expectancy of poles specified in AS 1720.2 and AS 2209.

(Collectively "the Required Pole Serviceability Criteria")

- 3.2. By 31 December 2009 draft new and/or amend existing documents to incorporate the Required Pole Serviceability Criteria;
- 3.3. By 31 December 2009 prepare an implementation plan to achieve the Required Pole Serviceability Criteria.
- 3.4. By 30 June 2010 implement the Required Pole Serviceability Criteria.

4. WOOD POLE MANAGEMENT PLAN

- 4.1. By 31 January 2010 develop and document a Wood Pole Management Plan.
- 4.2. The Wood Pole Management Plan must:
 - a) Identify the regulatory and technical standards that must be met and the safety performance that is to be achieved;
 - b) Detail the annual budgeting and work program and the person(s) responsible to update the Wood Pole Management Plan;
 - c) Detail the:
 - i) Outcomes from the post-mortem investigations of all unassisted pole failures; and
 - ii) Tests and investigations of the strength of the wood pole timber and / or the reinforcing and changes to the wood pole management processes and plan that follow from these investigations and tests; and
 - iii) Analysis of the unassisted pole failures trends over the last five years;
 - d) Provide for changes to the wood pole management systems, serviceability criteria and pole inspection practice to reflect the investigation findings in 4.2 c) above;
 - e) Detail the management systems and processes that will be used to identify, reinforce and replace the poles that do not meet Western Power's serviceability criteria and comply with the *Electricity (Supply Standards and System Safety) Regulations 2001* and related technical standards;
 - f) Detail for the next year and each of the following years of the pole inspection cycle each of the following:

- i) The planned inspection activity;
 - ii) The anticipated pole condemnation rates;
 - iii) The forecast pole replacement and reinforcement activity; and
 - iv) The poles not reinforced or replaced at the end of each planning period to be carried forward into the next period;
- g) Forecast the three-year rolling average unassisted pole failure rates at the end of each year for the next four years;
 - h) Identify the wood pole asset records data used in developing the plan;
 - i) Detail the processes used to ensure the data are accurate and sufficient to ensure the plan will deliver the wood pole safety outcomes required;
 - j) Identify the persons who have prepared and authorised the Wood Pole Management Plan;
 - k) Identify the persons who will implement the Wood Pole Management Plan and achieve the safety outcomes required; and
 - l) Be updated by 31 July in each financial year.

4.3. By 1 February 2010 implement the Wood Pole Management Plan.

5. RURAL WOOD POLE TECHNICAL ENGINEERING REVIEW

5.1. By 31 December 2009 Conduct a **Technical Engineering Review** of the rural wood pole strengths based on the following:

- a) Current data of the external good wood diameter of the pole in the safety-critical zone below the ground line;
- b) Current data of the external good wood at the top of any pole-base reinforcement installed;
- c) Current data of internal good wood above and below the ground line, and at the top of any pole-base reinforcement installed; and
- d) The allowable design stresses for the pole species specified in the HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines, or later editions of this Guideline.

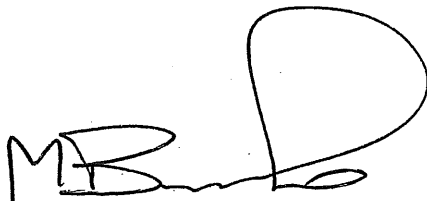
The allowable design strength may be reduced to the extent necessary to account for the reduction of the real strength of timber in these old untreated Jarrah poles derived from the investigation of all unassisted pole failures and tests of wood samples from these poles;

- 5.2. By 31 May 2010 validate the pole strengths identified through this Technical Engineering Review by testing in situ to failure of at least 50 poles with the lowest assessed safety factor and comparing the failure forces with those predicted from the Technical Engineering Review;
- 5.3. By 31 January 2010 conduct an Assessment of the Failure Risk of Rural Wood Poles based on the following:
 - a) The safety factor for each pole based on the pole strength derived from the Technical Engineering Review and the forces on the conductors and pole specified in the 1999 and later editions of HB C(b)1 Guidelines for the design and maintenance of overhead distribution and transmission lines. Safety factors shall be calculated for each pole in the safety critical zone below the ground line, and at the top of any pole-base reinforcing installed;
 - b) The effectiveness of pole-base reinforcement installed;
 - c) The lateral support for the poles and conductors derived from the conductors and stays attached to the pole transverse to the power line;
 - d) Pole age compared with age-failure experience with the pole species and treatment; and
 - e) The life expectancy of poles specified in AS 1720.2 and AS 2209.

6. RURAL WOOD POLE SAFETY IMPROVEMENT PLAN

- 6.1. By 31 January 2010 develop and implement a Rural Pole Safety Improvement Plan that will:
 - a) Identify and record:
 - i) The number and location of rural distribution poles; that is all poles not within a town or city boundary;
 - ii) The risk of failure of these poles and highlighting those in fire-risk farming and forest locations;
 - iii) The poles that must be replaced, or reinforced in each year of the plan; and

- iv) The poles reinforced or replaced in each period compared with the numbers required to comply with the Rural Pole Safety Improvement Plan;
 - b) By 30 June 2012 replace, or reinforce all unsupported rural poles that do not comply with HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines, and related technical and engineering standards using maximum wind pressures based on wind speeds with a five year recurrence interval;
 - c) By 30 June 2014 replace, or reinforce all unsupported rural poles that do not comply with HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines and related technical and engineering, using wind pressures based on maximum wind speeds with a ten year recurrence interval;
 - d) By 31 December 2015 replace, or reinforce all unsupported rural poles that do not comply with HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines and related technical and engineering, using maximum wind pressures specified in that Guideline;
 - e) Identify and secure the special and additional resources needed to develop, manage and effect the plan; and
 - f) Ensure that:
 - i) All the rural poles shall comply with the HB C(b)1- 1999 Guidelines for the design and maintenance of overhead distribution and transmission lines, and related technical standards current at that time; and
 - ii) By 31 December 2015 the Rural Pole Safety Improvement Plan as developed and implemented is to be completed.
- 6.2. By 30 June 2010 review and amend the Rural Pole Safety Improvement Plan to reflect proper consideration of the elements identified in items 5.1, 5.2 and 5.3 above; with specific attention to the untreated and unsupported Jarrah poles in forest and rural fire risk areas.



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