Government of **Western Australia**
Department of **Commerce**
Energy*Safety*

Consultation Paper

Private Power Lines and Poles in Western Australia

Issued: May 2015

Private power lines and poles
In Western Australia

Background

In July 2014, the Government approved a public awareness campaign to inform property owners with private power poles and overhead lines of their legal responsibilities.

The campaign was launched in October 2014 and spanned a period of four weeks. A key element of the campaign was the distribution of Energy*Safety*'s revised information brochure[1] to all electricity customers across WA.

The brochure and (existing) guidelines for electrical contractors[2] reflected the policy position at the time and recommended that:

1. All new or replacement private power lines should be:
    - Underground cables (preferred); or
    - If overhead, restricted to the use of steel poles and insulated conductors.
2. Any hardwood poles older than 25 years and any poles made from sawn timber should be replaced immediately.

Purpose of this paper

Before proceeding to mandate these requirements, Energy*Safety* decided to conduct some further research to ensure the effectiveness of the new policy and consider its impact on electricity customers and industry. In particular, the likely performance of steel poles over time and in different environmental conditions was further investigated.

This paper sets out the safest practical options and limiting factors in the use of both steel poles and wood poles for private power lines in different areas of the State.

The paper is intended to serve as a basis for consultation with all stakeholders to develop the most cost effective option(s) for private power lines and poles across the State.

Following this consultation, new detailed guidelines will be prepared for the use and safe management of private power poles, leading ultimately to prescribing in regulations.

What are private power poles and lines?

Power lines on private property which transport electricity from the main switchboard and meter to the home or other buildings and facilities are "private power lines".

Poles on private property which support the network operator's overhead service cable and poles supporting private power lines are "private power poles".

Further details and practical examples of private poles and lines are illustrated in the Energy*Safety* brochure[1] "Private power poles and lines".

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[1] http://www.commerce.wa.gov.au/sites/default/files/atoms/files/private_power_poles_and_lines-brochure.pdf

[2] http://www.commerce.wa.gov.au/sites/default/files/atoms/files/guide_for_electrical_contractors_private_power_lines.pdf

Applicable technical requirements

Private overhead power lines and poles form part of a customer's electrical installation and therefore must comply with requirements set out in Australian Standard AS/NZS 3000 (Wiring Rules).

Those private poles that support the network operator's aerial service cable and/or meter must also comply with network operator requirements.

Recap on reasons for mandating steel poles in October 2014

The main reasons for this policy were the perceived superior performance of steel poles (over wood) in terms of:

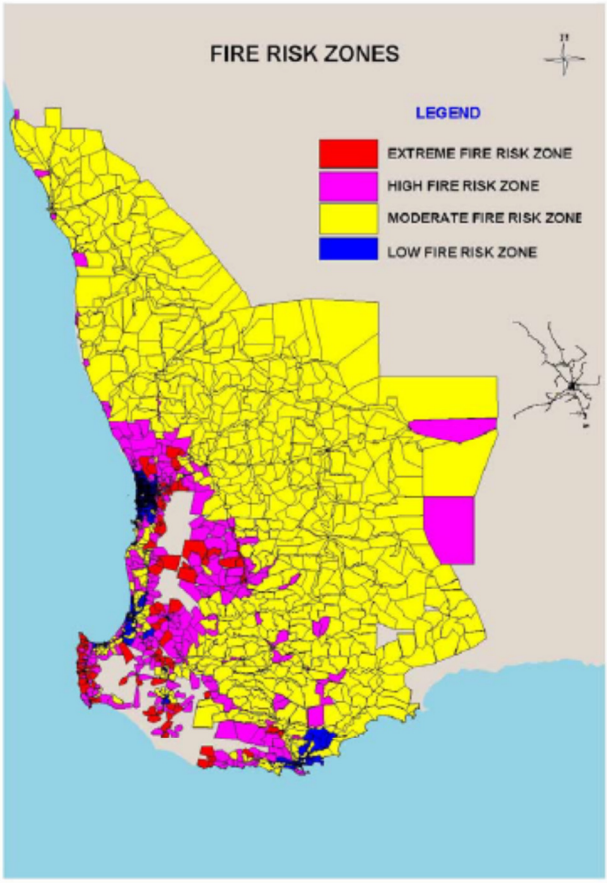
- relative ease of condition monitoring and maintenance (by customers and/or contractors) and therefore a reduced risk of unpredicted structural failure and consequential fire;
- no susceptibility to combustion initiated by wind-borne bushfire embers;
- ability to withstand the effects of intense fires; and
- a longer service life, depending on soil conditions and other environmental factors.

Question

1. Did the publicity campaign in October 2014:
   - create a noticeable increase in customer requests for work on private power lines?
   - stimulate a noticeable shift from overhead to underground for new or refurbished lines?

Assessment of fire risk

The most recent fire risk information available for the south west of the State is shown in the following map[3]:



The fire risk rating in the rest of the State is classified as low risk.

A new state-wide fire risk assessment is currently in progress and a new map is due for publication by the Office of Bushfire Risk Management[4] later this year.

Advice received from Curtin University

In November 2014, Energy*Safety* sought expert advice from Curtin University on the use steel poles in all areas of the State, with respect to corrosion processes relevant to buried galvanised steel and options for extending effective service life.

The findings were:

- The primary influences on in-ground corrosion rates are salinity and acid soils;
- Ground conditions can be highly variable within small distances, both in terms of lateral separation and depth; and
- Effective measures for reducing the rate of corrosion and extending service life are:
  - Increasing the thickness of galvanising;
  - Encasing the buried pole section in a high quality concrete footing; and

[3] Source: Western Power Bushfire Management Plan DM# 8293574

[4] OBRM@dfes.wa.gov.au

- Applying an additional protective chemical coating over the galvanised surface of the in-ground section of the pole.

In summary, Curtin's key recommendations are as follows:

1. All steel poles should be galvanised to HDG 600 (85 micron zinc coating) standard per AS/NZS 4680.
2. For saline and/or wet ground conditions, poles are treated with an additional protective coating of two-pack epoxy paint applied to the buried section up to ~200 mm above the ground line.
3. A specification for private pole footings is required, reflecting worthwhile improvements to current industry practice:
    - Increasing the concrete cover to ~100 mm minimum
    - Hand tamping of the concrete periodically during the course of pouring
    - Mounding the top of the concrete ~100 mm above ground level (per AS3000).

In Curtin's view, implementing these recommendations should extend the service life of a galvanised steel pole by approximately 20 years.

Advice received from Department of Agriculture and Food (DAF)

Energy*Safety* also sought advice from DAF about the predominant soil characteristics across the State which could guide the selection of suitable power poles to suit different environment conditions.

The DAF publishes very detailed information about soil types across the State. In particular, the publication, "Report card on sustainable natural resource use in agriculture" (Report Card), conveniently maps predominant soil characteristics throughout the south west in 11 different soil zones.

DAF confirmed that the soil characteristics most relevant to corrosion of steel poles are acidity (low pH), salinity and moisture. The soil data demonstrates that:

- Generally, the lowest soil pH encountered in practice is within the acceptable range stated by Curtin to represent only a moderate risk in terms of accelerating corrosion.
- Conversely, soil salinity is a major determinant of corrosion, particularly with moisture present.
- Soil conditions (including pH and salinity) are extremely variable within small distances, both laterally and with depth. However, the categorisation of predominant soil types in the Report Card provides the best available data for Energy*Safety*'s assessment.

Network operator experience

<u>Horizon Power</u>

Horizon Power has experienced a wide range of steel pole corrosion problems in different parts of the State in recent years. Horizon Power investigates and retains evidence about such occurrences.

Of particular relevance, numerous premature failures of streetlight poles have occurred in Broome due to rapid below ground corrosion, predominantly in watered urban verges. The specific cause of the accelerated corrosion is scientifically uncertain but is considered attributable to a combination of sustained moisture levels, fertiliser and canine urine.

Nevertheless, Horizon Power has decided to cease using timber poles anywhere in its networks, opting instead for exclusive use of galvanised steel poles for new works. This

decision was based on a life cycle cost study of different pole types. The steel pole specification requires an extra epoxy coating on the buried section.

Western Power

Western Power retains failed or corroded steel poles for investigation and evaluation. While most such poles are streetlight poles, the evidence of below ground corrosion is directly relevant to any galvanised steel pole.

Inspection of these recovered poles provided the following key observations:

1. The most severe corrosion occurs at the ground line and to a depth of ~200mm, consistent with experience elsewhere;
2. In most cases, significant corrosion occurs over the entire buried length; and
3. The inside surfaces of the corroded bases (i.e. not in direct contact with soil) were still relatively sound visually.

The following photos show a classic example of below ground corrosion on a tubular pole, with advanced degradation at the ground-line leading to ultimate failure.

Experience of electrical contractors

Electrical contractors' experience indicates that while there are occasional early failures of steel poles (typically in low lying areas), there is no evidence of a systemic corrosion issue warranting a major intervention in the current technical standard and installation practices for galvanised steel poles on private property.

Questions

2. Is your experience with below ground corrosion of steel poles generally consistent with the observations of Western Power's reclaimed poles?
3. If not, what different observations have you made and what are your views on the underlying causes of these different corrosion outcomes?

What others do

A number of Australian utilities publish technical information about their steel pole practices and several examples are provided below.

Main Roads (WA)

The Main Roads (WA) technical specification for its galvanised steel traffic signal masts requires the use of a properly engineered reinforced concrete foundation and additional corrosion protection at the ground line of the mast.

Queensland electricity distributors

Both Energex and Ergon specify a corrosion resistant coating on direct buried streetlight poles, extending 200mm above and approximately 400mm below the ground line.

Victoria

Powercor/Citipower specify a "high film protective coating" for the buried portion of streetlight poles to 250mm above the ground line. Specific products are named for this purpose.

Notably, the poles are direct buried in soil without any concrete.

VicRoads have a similar specification for their lighting columns but allow three coating options:

- Powder coating;
- Epoxy coating; or
- Heatshrink sleeve.

AusGrid (formerly Energy Australia)

AusGrid's specification for direct buried streetlight columns requires an additional below-ground protective coating from the bottom end to 300mm above ground line.

NZ Transport Agency

NZTA's specification for direct buried streetlight columns also requires an additional below-ground protective coating to 100 mm above finished surface level (ground or concrete).

Cost implications

To gauge the viability of options considered, Energy*Safety* has sought and received information from different parties about the cost of supply and installation of various pole types in urban and rural areas. These costs are taken as indicative only, recognising that actual costs may vary significantly depending on the location and specific nature of the work.

The preliminary conclusions that were drawn are:

- The additional cost of an epoxy coating over the buried portion of a steel pole is likely to be in the order of $100 to $150;
- Based on other cost assumptions, the additional cost of the epoxy coating is economically justified if it extends the life of the pole by approximately 25% or more; and
- The total installed cost of a coated steel pole and a wood pole is reasonably comparable.

Wood poles – relevant characteristics, benefits & limitations

Historically, wood poles used in WA have been mainly native hardwoods (both natural timber and preservative treated). In some cases, landowners sourced their own private poles from local vegetation.

More recently, CCA treated pine poles have become established as an accepted product and are widely used by electricity utilities, including Western Power.

Advantages of CCA treated pine poles

- Service life of 50+ years in most ground conditions, including saline soils
- Insulating material and therefore there is no electric shock risk
- Readily reinforceable structurally to further extend service life
- Can be coated with fire resistant material to withstand low intensity ground fires
- Direct burial in soil, no concrete required
- Local, renewable timber resource

Disadvantages

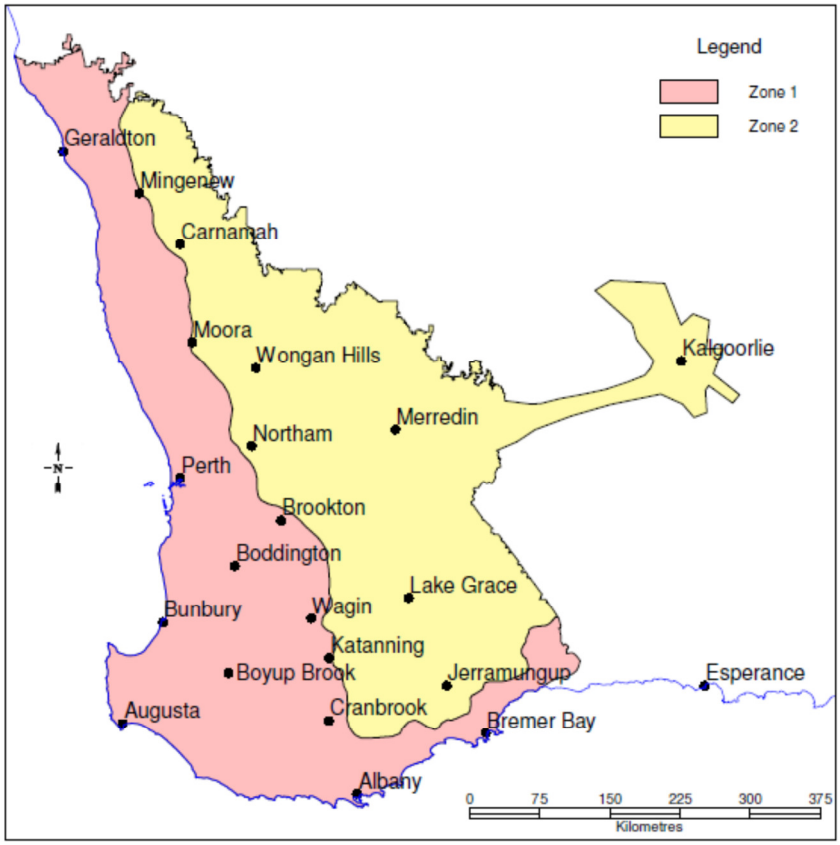
- Highly combustible and subject to severe damage/destruction in intense fires (even with fire resistant coating)
- Susceptible to fire ignition by wind-borne embers
- Subject to splitting as timber dries & ages – reduces effectiveness of fire resistant coating
- Difficult to determine structural integrity with current available inspection techniques
- Requires heavy equipment to install, reinforce and replace and therefore likely to have higher installation costs
- Ultimately, safe disposal of CCA treated timber is required in special landfill sites.

Wood poles are therefore well suited in areas of low fire risk and ground conditions that are highly corrosive to steel.

This area is described as Zone 2 in the following diagram where:

- Zone 1 is characterised by predominantly benign soils[5] and includes almost all geographic areas designated as high fire risk.
- Zone 2 incorporates the high salinity areas of the eastern wheatbelt, most of which are designated as low fire risk.

[5] However, it is noted that Zone 1 does have localised low lying areas, with permanent water or being prone to seasonal flooding, that are potentially highly corrosive to buried steel.



Question

4. Does your experience support the proposition that wood poles are a practical alternative in areas of saline soil such as the Wheatbelt?

Current industry practice

Galvanising standards

Currently, the Western Australian Distribution Connections Manual (WADCM)[6] requires consumer poles to be "galvanised to AS/NZS 4680". Under this standard, the required thickness of the zinc coating is related to the steel member thickness, giving the following particular outcomes:

- For consumer poles installed in Western Power's licence area, the wall thickness is 4.5mm and the required average zinc thickness is 70 microns or 500 grams/sq. metre (equivalent to HDG500 in Table 6.2 of AS/NZS 2312.2);
- For consumer poles installed in Horizon Power's licence area, the wall thickness is 6.4mm and the required average zinc thickness is 85 microns or 600 grams/sq. metre (equivalent to HDG600 in Table 6.2 of AS/NZS 2312.2).

Thicker zinc coatings were considered. However, given typical zinc corrosion rates in aggressive soils of ~10microns per year, it is considered that other ground line coatings would be more effective in terms of life extension. Therefore thicker zinc coatings have not been explored with suppliers at this stage.

[6] Published jointly by Horizon Power and Western Power

Installation of steel poles

Importantly, there is no comprehensive technical specification for consumer pole footings in relevant standards, codes and guidelines.

Feedback from industry suggests that installation practice varies considerably, but with typical methods as follows:

- The hole is dug using a post hole borer or by hand, to a diameter generally providing approximately 50-100 mm concrete cover.
- Use of good quality ready-mix concrete is only used according to availability and where time permits for curing.
- Rapid set concrete is frequently used, typically in rural areas or when power restoration time is important. Methods of mixing and/or placement are variable.
- The quality of water used for site mixed concrete is variable but most contractors supply their own potable water.
- Compaction of concrete is token, at best.
- Historically, the top of the concrete has generally not been extended above ground but this practice is becoming more common.
- Work may often be completed within one site visit/day, meaning that poles are likely to be loaded mechanically before the concrete is fully cured.

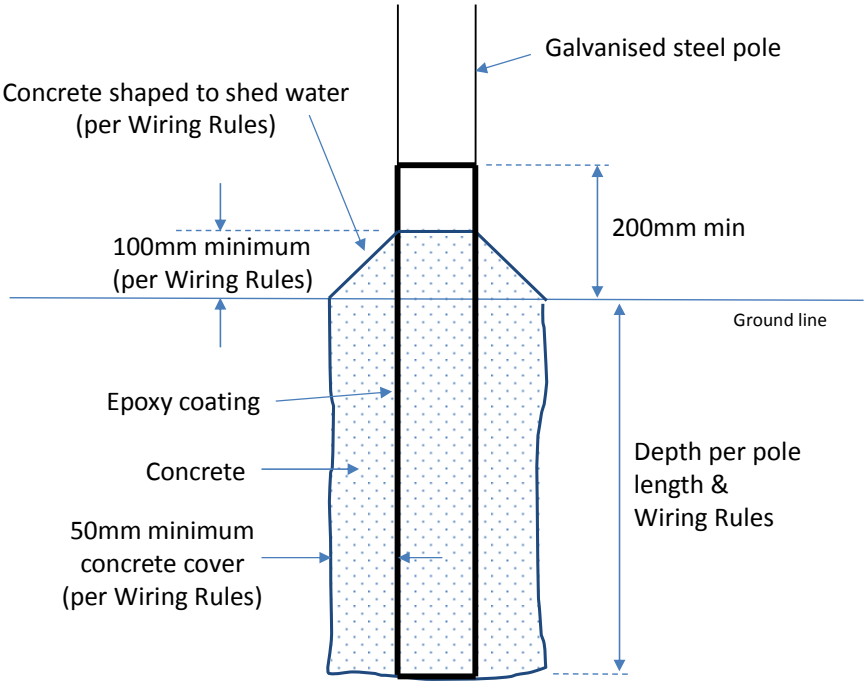
Curtin University has advised that these current installation practices mean that the concrete is likely to provide little effective corrosion protection of the galvanised steel.

Proposed new standards for steel poles (consumer poles and other private poles)

Concrete footing details

Based on consideration of all the factors identified above, an improved concrete footing standard for steel poles is proposed, as depicted below:

POLE FOOTING DETAILS



Question

5. Does any aspect of the proposed concrete footing present any practical installation issues or significantly increase costs for customers? If so, please explain.

Additional protective coating

The Curtin report suggests that an appropriate generic specification for the additional below-ground coating is simply "a two-pack epoxy painting system that meets the requirements of AS/NZS 4680:2006 and AS/NZS 2312.2:2014".

It is proposed that the additional protective coating is:

- A 2 pack epoxy paint system, factory applied;
- Equivalent to "System 4D" in Table 7.1 of AS/NZS 2312.2:2014, as a minimum standard; and
- Applied from the bottom end of the pole to 200mm above the nominal ground line.

Question

6. Does the use of an epoxy coating on the base of a pole present any practical installation issues or significantly increase costs for customers (other than the incremental cost of the pole)? If so, please explain.

Conclusions

The key conclusions from the information above are:

- While rapid corrosion of galvanised steel poles has been experienced in some locations and circumstances, there is no apparent systemic problem in the south west of the state that warrants major change. However, it is considered worthwhile making a number of improvements to current practice to extend the expected service life of steel poles.
- The exclusive use of steel poles in high fire risk areas should be maintained.
- The primary characteristic of WA soils relevant to corrosion of buried steel is salinity.
- CCA treated pine poles are likely to have longer service lives (than steel) in saline soils.
- There is close correlation of high fire risk/low salinity and low fire risk/high salinity areas.
- The existing galvanising standard for consumer poles is adequate.
- Cost benefit analysis demonstrates that coating the in-ground portion of steel poles with epoxy to extend the service life is economically justified.
- A number of small refinements to current installation practices for steel pole footings should improve the level of corrosion protection provided by the concrete.
- The incremental costs of an epoxy coating and modified footing specification represent modest increases in initial costs to customers.
- Given the wide range of environmental conditions across the State, it is appropriate to provide standard steel, coated steel and timber pole options for industry. [It is noted that Horizon Power has already committed to using only steel poles in its licence areas in future.]

Proposed Actions

1. Three geographic zones (see map below) are used as a basis for differentiating between private power pole practices, namely:

   Zone 1

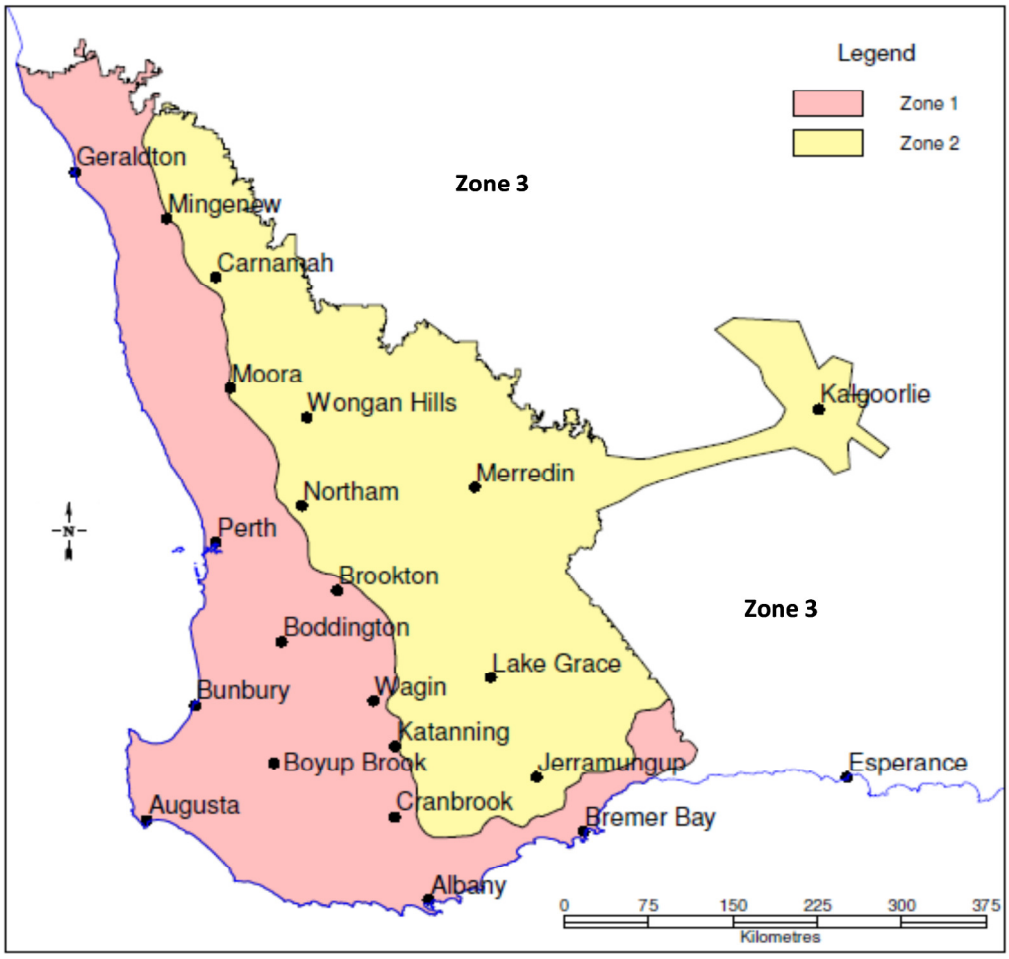
   - Characterised by predominantly benign soil conditions, incorporating all the high fire risk areas – essentially the broad coastal strip, approximately 50-200 km wide
   - Pole options - galvanised steel poles only, either standard or with an additional protective coating where aggressive soil conditions are encountered locally

   Zone 2

   - Characterised by predominantly saline soils and low fire risk
   - Pole options - either galvanised steel poles with an additional protective coating or CCA treated pine poles

   Zone 3

   - This zone covers the entire Horizon Power electricity licence area
   - Pole options - all poles to be galvanised steel with an additional protective coating.



2. The specification for consumer poles in the WADCM is enhanced to include:

   - The option of a below ground protective coating and technical details; and
   - Details of the concrete footing.

3. Related modifications are made by Energy*Safety* to the WAER and current publications for private power lines (customer brochure and contractor guidelines).

Questions

7. Do you support the proposed pole options and application zones in terms of expected technical performance and service life? If not, please explain why.
8. Do the proposed pole options and application zones present any logistical or cost issues for industry that need to be addressed? If so, please describe the issue and suggest the appropriate remedy.

Question

9. Are there any other aspects of the proposals in this paper that you would like to comment on?

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