Aurora Power Poles Weibull Analysis

Nicholas Hastings
Albany Interactive Pty Ltd
Email: naj.hastings@bigpond.com

1. Summary

A Weibull statistical analysis has been carried out on the life of power poles from data provided by Aurora Energy.

The results show that the poles have a projected mean life of 55.47 years, and a wear out pattern with Weibull Beta value of 4.50.

These results are based on data where, so far, approximately 10% of the installed poles have failed, so it is possible that the failure pattern could change as more poles age.

2. Data

The data provided by Aurora Energy is shown in Appendix A. Some moderation of the data was undertaken after correspondence (email) with Jarad Hughes.

The total number of poles is more than 196,000 and it is to be expected that a small percentage of anomalies will occur in a data set of this magnitude.

Some poles appear in the data with failures at negative ages. The numbers in this category are less than 0.5% of the total. This data was ignored.

Some failures are reported at age zero. This was approximately 2% of the total. This may be due poles being found unsuitable at the time of installation. These poles would not affect the subsequent life distribution and are also ignored.

Pole inspections are undertaken from age 10. A small number of failures (less than 0.2%) was shown for poles in the 1 – 9 year age range. These have been ignored in the analysis.

The results relate to the failures of poles age 10 years plus and suspensions (i.e. surviving poles) for all ages. This represents over 97% of the presented data and excludes the anomalies just discussed.

3. Weibull Analysis

Weibull Analysis (Reference 1) is a statistical technique used by reliability engineers to assess failure patterns, including burn-in, random and wearout patterns, and to assess life distribution parameters, such as mean life and failure rate. The failure pattern is diagnosed by calculating a "Beta" value. Values greater than 1 represent a wearout pattern. The Aurora power poles have a Beta value of 4.50 which indicates a clear wearout pattern.

4. Results

a. Weibull Scales Plot

Weibull analysis is carried out by fitting a Weibull distribution to the data. This may be done by plotting the data on special probability paper with "Weibull scales". These are of a logarithmic nature. Figure 1 shows this plot for the Power Poles data.

The analysis gives parameters of the fitted Weibull distribution. The results are shown in the panel at bottom left in Figure 1. The results are:

C
o
n
fi
d
e
n
ti
a
l

b. Reliability Plot

The remaining graphs shown in the report are portrayals of the data and fitted Weibull distribution as obtained from the Webull plot analysis.

Confidential

c. Failure Probability Density Function

Figure 3 shows the failure probability density function for the life of the poles. In this case the distribution is similar in shape to the Normal distribution. This is in contrast to an item with random failures which would have a negative exponential life distribution.

Figure3. Probability Density Function for Life of Poles

d. Failure Rate

Figure 4 shows the Hazard Function for the poles. This shows how the failure rate of surviving poles varies with age. The vertical scale shows the failure rate per 10 pole

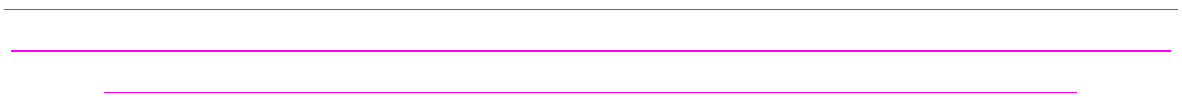

Figure 4. Hazard Function (Failure Rate)

e. Cumulative Probability of Failure

Figure 5 shows the cumulative probability of failure with age. This is the opposite of the Reliability Graph.Confidential

Figure 5. Cumulative Probability of Failure.

Confidential

f. Conclusion

A Weibull statistical analysis has been carried out on the life of power poles from data provided by Aurora Energy.

The data was reviewed and after email communication with Jarad Hughes a small number of anomalies in the data (less than 3% of total entries) were identified. Analysis then continued with the remaining data.

Confidential

These results are based on data where, so far, approximately 10% of the installed poles have failed, so it is possible that the failure pattern could change as more poles age.

Reference 1. R.F. Stapelberg. Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design. Springer 2009.

Appendix A. Aurora Pole Data