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30th October 2009

Our Reference: UE-SU-01

Mr Chris Pattas
General Manager
Network Regulation South
Australian Energy Regulator
GPO Box 520
Melbourne VICTORIA 3000

BY EMAIL TO: aerinquiry@aer.gov.au

Dear Chris

Re: Explanatory statement. Proposed amendment, Service target performance incentive scheme. Electricity distribution network service providers, September 2009.

United Energy Distribution (UED) is pleased to have this opportunity to respond to the proposed amendments to the Service Target Performance Incentive Scheme (STPIS) which were released on 21st September 2009.

UED wholeheartedly supports the Regulator's objectives in making the amendments, which are aimed at:

- Improving the clarity, effectiveness and operation of the scheme.
- Providing greater flexibility with respect to the statistical approach that can be used when determining if an event can be excluded from the scheme.
- Addressing a timing issue associated with the operation of the scheme in Victoria.

Proposed amendments to the approach to determining the major event boundary

United Energy understands that ETSA Utilities has sought a variation to the scheme so as to facilitate the use of the Box-Cox transformation method when determining and applying a SAIDI based exclusion regime.

ETSA Utilities analysed its daily SAIDI data and found that it did not transform, using the natural logarithm, into a normal distribution. The 2.5 Beta method for identifying major event days explicitly assumes that the daily SAIDI data is log-normally distributed, in other words that the natural logarithms of the daily observations are normally distributed. The 2.5 Beta method has been sanctioned by the US Institute of Electrical and Electronics Engineers (IEEE) and has

been published as the IEEE standard 1366-2003. The assumption of normality is conveyed via the description of a Gaussian or normal probability distribution in section B.4.2 of the 1366-2003 reliability standard[1].

ETSA Utilities considered that the assumption of log-normality was inappropriate, and, instead, explored a number of possible transformations of its data which would give rise to a normally distributed series. A statistician, Dr John Field, was engaged to analyse the data and to assess the potential options. Field considered two alternative approaches to transformation:

- Taking the natural logarithm of SAIDI for two consecutive days; or
- Undertaking a Box-Cox transformation.

The AER had previously signalled, via its Framework and Approach Paper for ETSA Utilities, that it would consider the Box-Cox transformation for determining the major event day threshold.

Field conducted a number of statistical tests and also calculated the skewness and kurtosis for the log-normal data series and the Box-Cox transformed data. He found that, whereas the distribution of the logarithm of the daily SAIDI data was significantly different from normality, the data transformed using the Box-Cox technique exhibited characteristics which were broadly consistent with a normal distribution. Field recommended the application of the Box-Cox method for determining the major event day threshold. ETSA Utilities is currently proposing to implement the recommendation.

United Energy examined the regulatory proposal which was submitted by ETSA Utilities to the AER in July 2009. ETSA also provided UED with copies of the two reports authored by John Field[2]. UED reviewed the reports and then engaged John Field to undertake an analysis of the United Energy reliability data.

Results of the empirical investigation of United Energy's SAIDI data

UED has an extended time series of data available through its data management system covering variables such as:

- The sum of customer minutes off-supply.
- The number of customers affected.
- The aggregate customer base.

UED initially provided John Field with daily unplanned SAIDI data across the entire UED network, covering the period from 01st January 2004 to 31st August 2009. The data series supplied excluded the contributions to SAIDI from 'upstream' events such as load shedding, and problems affecting the shared transmission network.

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1 IEEE Standard 1366-2003. IEEE Guide for Electric Power Distribution Reliability Indices. IEEE Power Engineering Society. Sponsored by the Transmission and Distribution Committee.

2 *Defining Major Event Days. A Report produced for ETSA Utilities,* 05th August 2008; and

Memorandum to Grant Cox, ETSA Utilities, 04th March 2009. Distribution of SAIDI values.

Prepared by John Field Consulting Pty. Ltd.

John Field undertook concurrent investigations of the data on a calendar year basis, from 2004 to 2008, and on a financial year basis, from 2004-05 to 2008-09. An important finding is that there was little difference between the results from calendar years and financial years.

The five years of log (SAIDI) values were clearly not normally distributed. The distribution was shown to have a small positive skewness (i.e. the upper tail is longer than the lower tail), and to be rather more 'flattened' than a normal distribution, with more bulk in the centre and less in the tails than might reasonably be expected if normality prevailed.

A caveat on these results is that the tests assumed independence of the observations, and this is not strictly so with reliability data, because there is a small but significant serial correlation between values, driven largely by weather. Low values of SAIDI tend to be followed by further low values, whilst large values tend to be followed by further large ones.

Field reported that the most useful assessment of normality could be made from normal probability plots. The confidence limits shown on the plots were close together because of the large number of data points. However, systematic discrepancies were evident, suggesting either a light-tailed distribution and/or a mixture of normal distributions.

Field considered the effect of the Box-Cox transformation on the UED reliability data, and again undertook the analysis separately for calendar years (from 2004 to 2008) and financial years (from 2004-05 to 2008-09). Essentially, this simply meant drawing different data samples. Field reported that while the Box-Cox transformation made a minor improvement to the distributions in reducing the skewness of the data, the transformed series were still clearly non-normal. The 'flatness' of the distributions was still apparent. The formal tests of normality gave extremely low P values, which can be interpreted as demonstrating that it was extremely unlikely that the Box-Cox transformed data could be said to have been drawn from a normal distribution.

The Box-Cox transformation did not normalise the data, and Field suggested working with log (SAIDI) because this would be simpler, and would provide almost identical results.

Field experimented with a range of other distributional transformations, including two or three parameter versions of the following: Log-normal, exponential, weibull, extreme value, gamma, logistic, and log-logistic. He reported that none of these transformations fitted the data particularly well.

Field also examined the seasonal variation in the data, and found that the medians of the log (SAIDI) distributions for summer, winter and spring were approximately stable, while the median for autumn had increased steadily over the period under investigation. Field also noted that individual seasons in individual years had SAIDI values which were close to being log-normally distributed.

Field concluded that the mixture of data from seasons and years was resulting in a SAIDI distribution which is not log-normally distributed, even though data from the one season and year can be regarded as approximately log-normally distributed.

There is a resemblance here to the results reported for ETSA Utilities. Field noted, in the context of his supplementary report for ETSA (dated 04th March 2009), that log (SAIDI) was in fact distributed normally in 2007-08, but not in the other two years (page 7).

The full report of the work performed by John Field is provided as an attachment to this submission. Please find enclosed: "*Distribution of SAIDI data*, a report produced for United Energy, version II, 26th October 2009".

Supplementary empirical investigation of a longer time series of reliability data

As part of an effort to find a statistical transformation which would produce a normally distributed series, UED provided John Field with an additional reliability data pertaining to the period from January 1999 to December 2003.

Field analysed the daily values from January 1999 until December 2008, and again deduced that neither log (SAIDI) nor the Box-Cox transformed data could be regarded as normally distributed. He reported that there was a consistent pattern of non-normal behaviour when the data was investigated over the entire time period, and when the data was analysed in rolling five-year periods.

The United Energy network is divided into rural and urban segments. Classification of the two separate parts is generally undertaken at the end of a regulatory year, with retrospective application for the previous year. The categorisation is carried out on the basis of feeder types. The distinction between a short-rural and an urban feeder depends upon load density, which is measured in MVA per kilometre.

Field analysed the rural and urban daily SAIDI data separately for calendar years 2004 and 2005. He found that there were distinct differences between the rural and urban distributions: The urban distribution was more symmetric than the rural distribution, and the rural distribution appeared to have a longer upper tail. There was little difference between the results, in terms of normal probability plots, for the two years examined. There was greater similarity between the rural and urban distributions in the lower tails, than in the middle regions or the upper tail.

Field found that the separately categorised rural and urban SAIDI data was not normally distributed. He reported that the Box-Cox transformation provided no improvement over the log transformation for the urban SAIDI values, and only marginal improvement for the rural SAIDI values. Hence, a consideration of this sub-division of the data did not appear to offer a route to normality.

The full results of the supplementary empirical work performed by John Field are provided as a report attached to this submission. Please find enclosed: "*Distribution of SAIDI data, Part II.* A report produced for United Energy, version 2, 26th October 2009".

Implications of the empirical analysis

In its explanatory statement prepared for this consultation (September 2009), the AER has acknowledged that the STPIS is currently underpinned by an assumption that all SAIDI data collected under the scheme exhibits a log-normal distribution.

The empirical work undertaken separately by ETSA Utilities and United Energy has demonstrated that this assumption is untenable. Accordingly, UED proposes that the AER should modify its approach to the definition and identification of the major event day boundary, as currently presented in Appendix D of the STPIS paper (version .01.2, draft). UED proposes that the following paragraphs should be inserted:

The use of a mathematical probability distribution such as the normal or log-normal distribution to describe the actual distribution of some variable is a convenience to enable us to perform probability calculations about the variable. It is not some innate property of the variable, and is at best an approximation to the actual distribution.

The IEEE standard recognises that SAIDI values experienced by a utility will be subject to variation because of geography (and consequently weather), system design, data classification issues and other factors[3]. These variations will have subtle influences on the actual distribution of the values, and it cannot be guaranteed that actual SAIDI values for all utilities will have the same distribution.

Further suggested changes to Appendix D of the STPIS are as presented in the text below. UED believes that the set of instructions outlined on page 35 of the STPIS paper should be substituted for the content presented in this submission.

To replace the set of procedures explained at the bottom of page 35 of the STPIS paper:

Apply a commonly accepted statistical test for normality to the data set, and, irrespective of whether the data is or isn't normally distributed:

4. Find α (alpha), the average of the logarithms of the data set.

5. Find β (beta), the standard deviation of the logarithms of the data set.

6. The boundary for an extreme event or major event day (TMED) is then calculated as follows:

a. $T = e(\alpha + 2.5\beta)$ MED

(where the value of 2.5B is adjusted to reflect any alternative amount permitted to be used in accordance with this scheme).

7. Any day in the new reporting period where the total unplanned SAIDI exceeds this value of TMED is classified as a major event day.

Where application of the statistical test to the data set referred to in step 3 above indicates the data set is not normally distributed:

1. Propose an alternative data transformation method which results in a more normally distributed data set in accordance with clause 2.2 of this scheme.

2. If no satisfactory alternative method can be found, then continue to use the log-normal approach, as per the IEEE standard.

3. Apply the proposed alternative data transformation to calculate each daily unplanned SAIDI value in the data set.

…etc.

Timing of performance measurement

UED does not support the Regulator's proposed amendment to the timing of performance measurement, which would result in the recording of reliability results for Victorian distributors, on a calendar year rather than financial year basis. UED propounds that performance be measured according to financial years, consistent with the intent of version 01.1 of the STPIS paper.

The use of a financial year results period has advantages, in terms of achieving a closer alignment between the recording of performance outcomes, and the payment of a penalty or

[3] IEEE Std. 1366-2003, section 6.2, page 17.

earning of a reward. UED considers that the financial year approach has merit because it would result in only a six-month delay from the year in which performance was measured to when the S-factor is then applied. Consequently, the objectives of the scheme, as set out in section 1.5 of the STPIS paper, would be better served. In particular, there would be greater fulfilment of the need to ensure that the incentives available under the scheme are sufficient to offset any financial imperatives which a service provider may have to reduce costs at the expense of service levels. The incentive properties of the STPIS would be strengthened.

To-date, UED has been reporting reliability performance on a calendar year basis, in the context of the existing service target incentive scheme, developed by the Essential Services Commission, Victoria (ESCV). UED acknowledges that transitional issues would arise, as a result of a transition from calendar years to financial years, however the firm is confident that these issues can be addressed satisfactorily.

It is conceivable, for instance, that the STPIS reward or penalty which is to apply to calendar year 2012, the first year of operation of the new scheme, could be calculated from the out-turn values of the reliability and customer service performance measures recorded for the first half of calendar 2011. Targets for this period could be generated, based on the average performance from the first six months of 2004-05 to 2008-09, subject to modifications put forward in a distributor's regulatory proposal. This suggestion is consistent with an earlier proposal advanced by SP-Ausnet, in its submission to the Victorian Framework and Approach paper[4].

Follow-up to this submission

Should you or your staff have any queries in relation to this submission, please do not hesitate to contact Jeremy Rothfield, Regulatory Economist, on (03) 8540 7808.

Yours sincerely

Andrew Schille
Regulatory Manager

[4] SP Ausnet, Electricity Distribution Price Review, 2011 to 2015 (EDPR). SP Ausnet Response to Framework and Approach Position Paper, 06th March 2009; pages 15-16.