



Pinewood Corporate Centre  
43-45 Centreway Place  
Mt Waverley VIC 3149

P O Box 449  
Mt Waverley VIC 3149

Telephone (03) 8846 9900  
Facsimile (03) 8846 9999

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Our Reference: UE.ED.07.02

Mr David Chan  
Director  
Australian Energy Regulator  
Level 35, The Tower,  
360 Elizabeth St,  
MELBOURNE VIC 3000  
GPO Box 520  
MELBOURNE VIC 3001

**BY EMAIL TO: David.Chan@aer.gov.au**

Dear Mr Chan,

**SUPPLEMENTARY SUBMISSIONS ON THE F-FACTOR DRAFT DETERMINATION BY UNITED ENERGY**

United Energy (UE) responded to the draft determination by the AER on the f-factor scheme in correspondence which was dated 18<sup>th</sup> November 2011<sup>1</sup>. The purpose of the current letter is to provide an update to the AER on information and reports which have recently become available.

Until recently, United Energy had been unaware of the extent of the under-reporting of fire starts in the firm's historical data. However, discussions with SKM, and the process of responding to queries about individual fault records, led the business to believe that a statistical analysis would ultimately be needed to derive an accurate historical record of past fire events (comprised of fires and fire starts)<sup>2</sup>.

The AER has recognised that there are unrecorded fires in the historical data and has attempted to apply a method to compensate for past under-reporting, so as to develop an appropriate f-factor benchmark for United Energy<sup>3</sup>. However, as has been discussed

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<sup>1</sup> Response to the f-factor draft determination, letter from United Energy to David Chan, Australian Energy Regulator: Previously unrecorded fires that are now covered by the order, 18<sup>th</sup> November 2011.

<sup>2</sup> UE responded to the questions posed by SKM in email correspondence dated 2<sup>nd</sup> September 2011, and in a subsequent letter to the AER: Further information pertaining to United Energy's response to the F-factor Regulatory Information Notice (RIN): The determination of uplift coefficients, a letter to David Chan, Australian Energy Regulator, from United Energy, 20<sup>th</sup> September 2011.

<sup>3</sup> AER, Draft determinations and Explanatory statement for the draft determinations, F-factor scheme determinations 2012-15 for Victorian electricity distribution network service providers, Australian Energy Regulator, 5th October 2011; see section 3.5.1.2, page 18.



previously, the method used by the AER to compensate for past under-reporting completely lacks any form of empirical justification<sup>4</sup>. Consequently, the target number of fire starts which has been calculated for UE by the AER is unreasonably low.

United Energy is implementing improved mechanisms for the reporting of fire starts under the auspices of Energy Safe Victoria. A new fire ignition reporting template has been developed and is being provided to field staff<sup>5</sup>. Additional resources have been committed to the re-training of linesmen. If the target number of fires for the f-factor scheme is set at an unreasonably low level, then there is a risk that the business will be penalised for the effort that it is making to enhance the standard of reporting for fire starts. Conversely, if the target number of fire starts is set at an appropriate level, following adjustments to the historical data, then the AER will be able to fulfil or maintain the objectives of the f-factor scheme without exposing United Energy to an unacceptable degree of financial risk.

UE disagrees with the contention by the AER that the recording system that has traditionally been used by the business to identify fire starts is robust<sup>6</sup>. UE notes that SKM expressed an opinion that the processes [employed by DNSPs] to collect data related to fire starts were robust and well controlled<sup>7</sup>. However, SKM did not state that the quality of the data showing fire starts that is held by UE in its distribution management system is of a high standard. Therefore, SKM fell short of saying that the actual unit records of fire starts are robust.

An examination of the records in the distribution management system shows that evidence of fires and fire starts was reported in an *ad hoc* fashion. Inconsistent terminology has been used, spelling is inaccurate, and the descriptions in the text field are sometimes incomplete. The questions posed by SKM in relation to specific records in the UE Distribution Management System (DMS) are indicative of some of the problems with the historic recording of information pertaining to fire starts<sup>8</sup>. The statisticians that have been engaged by UE to investigate under-reporting do not believe that the historical information on fire starts in the UE database is of especially high quality<sup>9</sup>.

Furthermore, Energy Transfer Solutions (ETS), the consultants engaged by UE, questioned the

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<sup>4</sup> Response to the f-factor draft determination, letter from United Energy to David Chan, Australian Energy Regulator: Previously unrecorded fires that are now covered by the order, 18<sup>th</sup> November 2011; see page 1.

<sup>5</sup> The template will be made available to the AER.

<sup>6</sup> AER, Op. Cit. The AER expressed this view in section 3.5.1.2 of the draft determination on the f-factor; see page 18.

<sup>7</sup> SKM, F-factor Incentive Scheme, Review of Submissions from Distribution Network Service Providers - Addendum, Sinclair Knight Merz, 22nd September 2011; section 6, conclusions, page 17. The emphasis has been added here.

<sup>8</sup> See AER – Guide to Questions – F-Factor Data Verification, questions posed by Terry Krieg, Sinclair Knight Merz, 2<sup>nd</sup> September 2011.

<sup>9</sup> Diamond, N. (2011b), A Review of “Using capture-mark-recapture methods to estimate fire starts in the United Energy distribution area” by Rho Environmetrics Pty Ltd together with John Field Consulting Pty Ltd. A report for United Energy prepared by Dr Neil Diamond, 7<sup>th</sup> December 2011; see section 2.2.2, page 5.



reliance by the AER and by its consultant, Sinclair Knight Merz, on the accuracy of the fire start data available from existing data capture systems operated by distribution businesses. ETS emphasised that the ability of these systems to record fire starts accurately was compromised because distribution outage reporting mechanisms were primarily geared towards the measurement of network reliability<sup>10</sup>.

**Report by Rho Environmetrics Pty Ltd together with John Field Consulting Pty Ltd: Using capture-mark-recapture methods to estimate fire starts in the United Energy distribution area**

The report by Rho Environmetrics Pty Ltd and John Field Consulting Pty Ltd is a core part of the overall submission by United Energy to the draft determination by the AER on the f-factor scheme<sup>11</sup>.

Correll and Field (2011) were given all of the relevant information on fire starts currently in the possession of United Energy. The material supplied included selected correspondence between UE and the AER, such as a letter to the AER which was prepared by UE in response to the questions posed by Sinclair Knight Merz<sup>12</sup>.

The statisticians applied the methodology of capture, mark, release and recapture to the number of fire starts in the UE distribution region. The United Energy area is served by two different fire agencies, the Country Fire Authority (CFA), and the Metropolitan Fire and Emergency Services Board (MFB). The authors estimated the number of fires in each area separately, and then combined the estimates.

For the UE/CFA area, there were two sources of data on fire starts: The databases held by the CFA and UE. By regarding one sample (UE) as the first sample, and the other sample (CFA) as the second sample, and observing the number of fires which are common to both databases (the 'marked' or 'tagged' fires), capture, mark and recapture methods were used to estimate the total number of fires in the UE/CFA area. Adopting a similar approach, Correll and Field (2011) also estimated the number of fires in the UE/MFB area.

The authors obtained several estimates of the number of fires in the UE distribution area using capture, mark and recapture (C-M-R) methods. The particular types of estimator applied included the common Lincoln-Petersen estimator, and a bias corrected version of Lincoln-Petersen, namely the Schnabel estimator. Various forms of the Schnabel estimator were trialled. Correll and Field (2011) found that the proportion of fires recorded in the United Energy database varied by season, but that incorporating this heterogeneity into the estimates of fire numbers did not produce large changes in the overall estimates. There was some evidence in the MFB database that larger fires have a greater probability of being reported, however, the data on which this finding was based showed some inconsistency over time. The

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<sup>10</sup> ETS (2011), Review of the F-factor draft determination by the Australian Energy Regulator as applied to United Energy, Energy Transfer Solutions; expert report by Lance Hancock; page 4.

<sup>11</sup> Correll, R., and J. Field (2011), Using capture-mark-recapture methods to estimate fire starts in the United Energy distribution area, prepared for Jeremy Rothfield, United Energy, 2<sup>nd</sup> December 2011, Rho Environmetrics Pty Ltd and John Field Consulting Pty Ltd.

<sup>12</sup> Further information pertaining to United Energy's response to the F-factor Regulatory Information Notice (RIN): The determination of uplift coefficients, a letter to David Chan, Australian Energy Regulator, from United Energy, 20<sup>th</sup> September 2011.



incorporation of information on the size of fires (which was measured in relation to the damage caused) proved to be less useful than the incorporation of seasonality into the Schnabel estimator.

Correll and Field (2011) concluded that their best estimate of the number of fires per year in the United Energy distribution area was 1,453 fires, with 95% confidence limits of 1,036 to 1,870.

#### **Peer review report prepared by Dr Neil Diamond**

United Energy engaged Dr Neil Diamond to undertake a comprehensive review of the work performed by Correll and Field (2011). Neil Diamond was provided with a broad terms of reference, which included being given access to all of the data used by Correll and Field (2011)<sup>13</sup>. Neil Diamond has published his findings separately in a review report<sup>14</sup>.

Neil Diamond evaluated the results of the data matching which had been performed by Correll and Field (2011). He examined the distinct or unique records in the three databases (CFA, MFB and UE) and found that the number of fire starts over the five-year period, from 2006 to 2010, could not be less than 1,253<sup>15</sup>. This number is considerably higher than the number of fire starts (561) which have actually been recorded as such in the historical data held by United Energy. Neil therefore confirmed the results which are reported in Table 1 of Field and Carroll (2011). The table shows that the number of fires recorded in the UE/CFA area was 567, while the number in the UE/MFB area was 686. The sum total of these values gives 1,253.

Neil Diamond endorsed the methods that had been applied by Correll and Field (2011), and found that he was able to replicate their results by using the R Capture package in R-software. He concluded that the estimate of 1,453 fires per annum, with a 95% confidence interval of 1,036 to 1,870, based on the Schnabel estimator, was the most reliable estimate found to-date<sup>16</sup>.

Neil Diamond then expounded further on the issue of heterogeneity, which is the phenomenon whereby larger, or more severe fires, are associated with a higher probability of being reported. Correll and Field (2011) mentioned that the consistency of the estimated numbers of fires from the overall and seasonal Schnabel estimators gave credibility to the estimators, and meant that the effects of heterogeneity did not appear so great as to make the estimates unusable<sup>17</sup>. Neil Diamond explained, with reference to the relevant literature, that heterogeneity is likely to lead to underestimation<sup>18</sup>.

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<sup>13</sup> The terms of reference, and expert witness guidelines, are appended to the review report prepared by Dr Neil Diamond.

<sup>14</sup> Diamond, N. (2011b), A Review of "Using capture-mark-recapture methods to estimate fire starts in the United Energy distribution area" by Rho Environmetrics Pty Ltd together with John Field Consulting Pty Ltd. A report for United Energy prepared by Dr Neil Diamond, 7<sup>th</sup> December 2011.

<sup>15</sup> Ibid., page 2.

<sup>16</sup> Ibid., page 15.

<sup>17</sup> Correll, R., and J. Field (2011), Op. Cit., page 14.

<sup>18</sup> Diamond, N. (2011b), Op. Cit., page 15.



### **A comparison of the results obtained from capture, mark, release and re-capture methods and from the application of a probabilistic approach**

In his review report, Dr Neil Diamond has provided guidance on the interpretation of estimates of under-reporting obtained using different statistical techniques. In an earlier study, Diamond (2011a)<sup>19</sup>, Neil Diamond applied a probabilistic model developed by Neubauer et al. (2011)<sup>20</sup>. The model assumes that the number of fire starts per month that are reported follows a binomial distribution with a constant probability of a fire start being reported,  $\pi$ , but with a poisson distributed number of fire starts occurring where the mean of the poisson distribution is allowed to vary from month to month.

In his review paper, Diamond (2011b), Neil Diamond has stated that<sup>21</sup>:

*When more than one list is available, there is less of a requirement to use probabilistic methods, although probability models still have some merit. Capture-recapture methods are preferred when there are two or more lists. In the present case, the results from the application of the Neubauer et al. (2011) method can be seen to be conservative since we now have a direct measure of the number of observed, distinct fire starts using the UE, CFA, and MFB databases.*

Neil Diamond also concluded that<sup>22</sup>:

- *Based on a direct examination of the records in the UE, CFA, and MFB databases, the number of fire starts over the five-year period must be greater than 1,253, i.e. greater than 250.6 fire starts per year.*
- *Probability Methods based on the generalised Poisson distribution, but using only the UE records, give results that are conservative.*
- *Capture-recapture methods based on the separate lists give more reliable results.*
- *The estimate of 1,453 fires per year with a 95% confidence interval of 1,036 – 1,870 based on the Schnabel estimator is the most reliable estimate found to date.*

### **United Energy conclusion about the appropriate benchmark for the target number of fire starts**

In its previous response to the f-factor determination, United Energy submitted that the fire factor benchmark to be applied by the AER should be based on the result obtained by Dr Neil

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<sup>19</sup> Diamond (2011a). Under-reporting of Fire Starts, A Report for United Energy, prepared by Dr Neil Diamond, Department of Econometrics and Business Statistics, Monash University, 20<sup>th</sup> November 2011.

<sup>20</sup> Neubauer, G., Djuras, G., and Fiedl, H. (2011), "Models for underreporting: A bernoulli sampling approach for reported counts," *Austrian Journal of Statistics*, **40**, 85-92.

<sup>21</sup> Diamond, N. (2011b), Op. Cit., page 13.

<sup>22</sup> Diamond, N. (2011b), Op. Cit., page 15.



Diamond [in Diamond (2011a)]<sup>23</sup>. The particular result was 940 fires over a five-year period, from 2006 to 2010, which translates into an annual f-factor scheme target of 188 fire starts. United Energy noted carefully at the time that, in the opinion of Neil Diamond, the estimate of 940 fire starts was most likely conservative (in other words, low)<sup>24</sup>.

The latest available evidence demonstrates that:

- A direct count of the unit records in the UE, CFA and MFB databases, taking into account overlapping records, implies that the number of fire starts over the five-year period must be no less than 1,253. This amounts to 250.6 fire starts per annum.
- The empirically determined estimate that is considered to be most reliable by three experts (Dr Ray Carroll, Dr John Field, and Dr Neil Diamond) is 1,453 fire starts per annum.

In the Regulatory Information Notice (RIN) template which was completed and provided to the AER, United Energy recorded 7,011 fault events which potentially gave rise to a fire over the period from 1<sup>st</sup> January 2006 to 31<sup>st</sup> December 2010. Details of the 7,011 fault incidents were incorporated into Table 6<sup>25</sup>. To this value should be added the individual fire starts (561 of them) in Table 5, bringing the total number of events to 7,572. On an annualised basis, the number of events would be 1,514. This value is not dissimilar to the best estimate of the number of fire starts per annum, calculated using the C-M-R methods and the Schnabel estimator.

UE firmly believes that the AER should use an empirically determined benchmark when setting an f-factor target for the business. The Australian Competition Tribunal (ACT) affirmed the principle of using an empirically determined result when it decided upon a particular value of gamma in the matter of the appeal by Energex, Ergon Energy and ETSA Utilities<sup>26</sup>. The ACT relied upon the state-of-the art dividend drop-off study to infer a value for theta, and it drew upon an estimate of the payout ratio which was obtained from investigations of tax statistics. We understand that the ACT decision on gamma was made in a different context from that in which the AER is currently operating when it makes an F-factor determination. However, the ACT has affirmed the proposition that reliable econometric and/or statistical evidence should be used as the best available evidence.

Evidence from econometric and/or statistical studies should be preferred over values that are obtained through regulatory inertia or as a result of arbitrary, unsubstantiated analysis. Accordingly, for the 2012 to 2015 period, the AER should apply an f-factor target of 1,453 fire starts per annum.

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<sup>23</sup> Response to the f-factor draft determination, letter from United Energy to David Chan, Australian Energy Regulator: Previously unrecorded fires that are now covered by the order, 18<sup>th</sup> November 2011; page 5.

<sup>24</sup> Response to the f-factor draft determination, letter from United Energy to David Chan, Australian Energy Regulator: Previously unrecorded fires that are now covered by the order, 18<sup>th</sup> November 2011; page 4.

<sup>25</sup> Contained within spread sheet workbook, <F-Factor Final Resubmit 200911.xls>.

<sup>26</sup> Application by Energex Limited (Gamma) (No 5) [2011] ACompT9, 12th May 2011.



The estimates of the number of fire starts which have been obtained from capture, mark, release and re-capture studies are consistent with a fairly broad definition of a fire start, and this definition is in harmony with the fire start definition that is set out in the f-factor Order in Council<sup>27</sup>. The unit records of the CFA and MFB databases appear to reflect a moderately expansive, but common sense definition of a fire or fire start. The analysis undertaken by Correll and Field (2011) and by Neil Diamond (2011a and 2011b) concentrated on fire starts which were reported as having been caused by electricity distribution equipment and/or infrastructure<sup>28</sup>.

The estimate of the number of fire starts, (940), which was obtained by an application of the bernouilli sampling approach, and which is reported in Diamond (2011a), is potentially based on a narrower interpretation of a fire start. The probabilistic method made use of the 561 fire starts recorded by UE in respect of the 2006 to 2010 period, but did not rely upon any other sources of fire data. Irrespective of the definition in the data, the probabilistic method was also inherently conservative, as evidenced by the inability of the model to fully predict the large number of fires which occurred in December 2006 and January 2007<sup>29</sup>.

### **Definition of a fire**

As previously stated, United Energy is implementing an improved process for capture of fire starts. As part of this endeavour, United Energy would like to provide further clarification of what does, and does not, constitute a fire. The f-factor Order in Council defines a 'fire start', but is otherwise silent on the definition of a fire.

The AER, in its Regulatory Information Notice, and Sinclair Knight Merz (SKM), in its final Review of Submissions from Distribution Network Service Providers, quoted the Cambridge Dictionary definition of fire as "heat, light and flames that are made when something burns".

The SKM document also quotes a Wikipedia definition (on 13<sup>th</sup> September 2011) as "the rapid oxidation of a material in the chemical process of combustion, releasing heat, light and various reaction products"<sup>30</sup>. Wikipedia further expands on the definition, adding that "...flame is the visible portion of the fire..."

It follows from the above two definitions, that the three characteristics, heat, light and flames must all be present, or have been present, if the event is to be classified as a fire. United Energy submits that acceptance of this definition will closely align with the common use of the word 'fire'.

United Energy has sought to conform to the Cambridge Dictionary definition by excluding, from its principal list of fire starts, events which do not appear to exhibit all of the characteristics. Examples of the exempted events can be described as follows:

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<sup>27</sup> National Electricity (Victoria) Act 2005, F-FACTOR SCHEME ORDER 2011, Order in Council, 21<sup>st</sup> June 2011, clause 4.

<sup>28</sup> Correll, R., and J. Field (2011), Op. Cit., section 2.1, page 5.

<sup>29</sup> Diamond (2011a), Op. Cit., page 5.

<sup>30</sup> SKM, F-factor Incentive Scheme, Review of Submissions from Distribution Network Service Providers - Final, Sinclair Knight Merz, 19<sup>th</sup> September 2011; page 3.



- **Normal arcing and sparking**

- Arcing and sparking are commonly observed as a result of faults, or may be symptomatic of the normal functioning of the distribution network. Arcing or sparking does not give rise to flame, unless the heat ignites combustible material, in which case a fire will be reported.

- **Melting**

- Most of the materials used in the construction of the electrical elements of the network do not sustain fire, but may melt if subjected to heat. The heat may result from high electrical load, or local overloading. Flames will not normally be evident unless other combustible material is ignited, in which case a fire will be reported.

- **Smoking**

- Smoke may be emitted due to local heating caused by a range of factors, in circumstances in which the temperature is not raised sufficiently to produce flame. The existence of smoke without flame may result in singeing or charring, but the incident will not generally be classified as a 'fire'.

- **Local charring or blackening**

- Local charring or blackening is frequently observed during routine maintenance. At times, the charring may not be sufficiently widespread as to be symptomatic of the past occurrence of heat, light and flames. Charring which is limited in scale will generally not qualify for recording as a particular fire event. Consequently, charring that is highly localised is not a characteristic of the incidents which feature in the principal list of 561 fire starts.

Following a process of consultation with SKM, United Energy submitted a revised RIN response to the AER on 21<sup>st</sup> September 2011<sup>31</sup>. The more definitive list of fire starts, which was presented as Table 5 of the RIN, contained the unit records of incidents which appeared to have been associated, at some stage in the past, with the three main attributes of fire. Events which did not appear to have given rise to heat, light and flames, at some stage, were expunged from the main list of incidents prior to submission, leaving 561 records. UE believes that for the purpose of future reporting, a list of exempted events which is similar to that presented above should apply.

### **One fault is reported as one fire**

United Energy has identified the possible scenarios under which a single fault could cause more than one fire. These scenarios can be described as follows:

- A fault occurs at a particular location, giving rise to fire, but then also causes a fire at a remote location. A pertinent example, in this context, would be the movement of conductors in response to the passage of a fault current. The movement of the conductors may cause clashing at one location, followed by clashing somewhere else, with fires occurring in sequence.

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<sup>31</sup> The data was inside the spread sheet workbook, <F-Factor Final Resubmit 200911.xls>.



- A conductor, which operates at high voltage, makes contact with another conductor which is rated at a lower voltage. Fires may eventuate at a number of locations. A good example would be when a 66kV conductor touches a 22kV conductor, causing the failure of a number of components, including fuses and surge diverters. Each failure could potentially give rise to a fire under certain conditions. Alternatively, a 22kV conductor might make contact with another conductor operating at a lower voltage, and the result may be multiple fires taking place in different sections of the low voltage network.
- A conductor which falls to the ground may also make contact at a number of different points along its length. A fire may result at each of these points, depending upon the ambient weather conditions.

The scenarios described in the bullet points above are entirely plausible. If each individual fire were counted as a separate incident, then there would be significant compounding of the aggregate number of reported fire events. There would be a potential distortion of the f-factor scheme, and United Energy would face the possibility of being liable for disproportionately high penalties. UE advocates the position that a single fault which results in a fire should be enumerated once, even if multiple fires result from that fault.

In the event that the AER does not accept the principle of “one fault, one fire”, then UE believes that the AER should adopt an expansive definition of a fire start, with the definition still capable of being accommodated within the terminology of clause 4 of the f-factor Order in Council.

**If you have any further questions on this submission, please do not hesitate to contact Jeremy Rothfield, Network Regulation and Compliance Manager, on (03) 8846 9854.**

Yours sincerely,

Jeremy Rothfield  
*Network Regulation and Compliance Manager*