Fire Risk Modelling

Assessment of the risk due to fires within Endeavour Energy's Electricity Network

Report prepared for Endeavour Energy

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This report incorporates the use of data and mathematical and empirical models developed using and including third party data and models. Any and all data, results and other information contained within this report ("Results") are subject to certain inherent limitations including potential errors in the models/ data, shortcomings in the experiment designs, the conjectural quality of the forcing scenarios used to drive the models and statistical uncertainty of model results. While this report has been prepared in good faith, the Results are inherently uncertain (particularly with respect to forward looking matters) and it is not possible within the context and scope of this report to verify the accuracy and completeness of the Results. Accordingly, this report is provided on an "as is" basis. To the maximum extent permitted by law, Risk Frontiers excludes all express or implied representations or warranties related to this report, including, but not limited to, warranties of accuracy, completeness, reliability, merchantability and fitness for a particular purpose. The reliance that the user places on this report, and the Results, is a matter for its own judgment.

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Executive Summary

This project for Endeavour Energy is a comprehensive modelling exercise to quantify Endeavour Energy's exposure to potential bushfire liability due to fires started by or attributable to Endeavour Energy's electricity assets. The deliverables for this project are intended to support decision making in relation to risk and insurance as a result of fires that may be caused by Endeavour Energy's electricity assets in New South Wales, Australia. Endeavour Energy's insurance requirements are a multi-year commitment and a material programme within an insurance market that has experienced a number of losses, both locally and internationally, over the past two decades.

To undertake this project, we utilise our detailed bush and grass fire catastrophe loss model – FireAUS. This enables us to estimate the financial losses arising out of damage to property and business interruption from fires originating within Endeavour Energy' electricity distribution network under present day climate condition. Potential additional cost factors including the loss of lives and disablement, legal fees and other factors that have contributed to previously awarded bushfire claims are also analysed. The ignition set is further refined to account for simulated fire starts that are both physically close to Endeavour Energy's electrical assets as well as likely caused by at least one such asset (e.g., through fault or contact). If Endeavour Energy is deemed liable for a bushfire loss, we also account for Contributory Negligence where other third parties may be required to contribute to any potential payout. We use the learnings from the Ash Wednesday fires in Victoria where SP AusNet was liable for approximately 77% of the pay-out[1] in the Kilmore-East class action. However, it should be stressed that the worst-case scenario where Endeavour Energy is found 100% liable for the damages and injuries remains a possibility.

The modelling results are presented in terms of Occurrence Exceedance Probability (OEP) curves providing estimations of the recurrence of tail (extreme event) losses. For the simulated fires ignitions that are most likely to be caused by Endeavour Energy's electrical assets, the **AUD** ▮▮▮▮▮ loss has an Average Recurrence Interval (ARI) of around ▮▮ years. **Assuming a uniform 77% contribution across the OEP curve, the ARI of that same loss amount becomes** ▮▮ **years which is equivalent to an occurrence exceedance probability of** ▮▮▮▮. **In contrast, a limit of AUD** ▮▮ **million can be exceeded with an occurrence exceedance probability of** ▮▮**% under the same Contributory Negligence assumption.**

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[1] https://www.ausnetservices.com.au/-/media/Files/AusNet/Investor-Centre/ASX-Releases/2014/KilmoreEastClassAction.ashx

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Results Summary

The following table shows the occurrence exceedance probabilities indicating the likelihood of exceeding a range of policy limits, namely, ██████████████████████████████████. The Policy Limit column shows the simulated occurrence losses due to events for which Endeavour Energy is likely liable for with 77% Contributory Negligence.

Table 1. Occurrence Exceedance Probability Table for Selected Return Intervals.

Average Return Interval (Years)	Exceedance Probability	Policy Limit (AUD million)
███████████	███████████	███████████

The Occurrence Exceedance Probability (OEP) curves are shown in Figure 1 which provides estimations of the recurrence of tail losses (larger ARIs / less frequent but more severe events). Since FireAUS is a probabilistic model, multiple executions of the model over property loss and casualty sampling resulted in a total 605 model samples. The figure shows all these samples as single mean curves with the 90% uncertainty bounds around the orange curve, associated with ignitions that Endeavour Energy is likely liable for and assuming 100% Contributory Negligence.
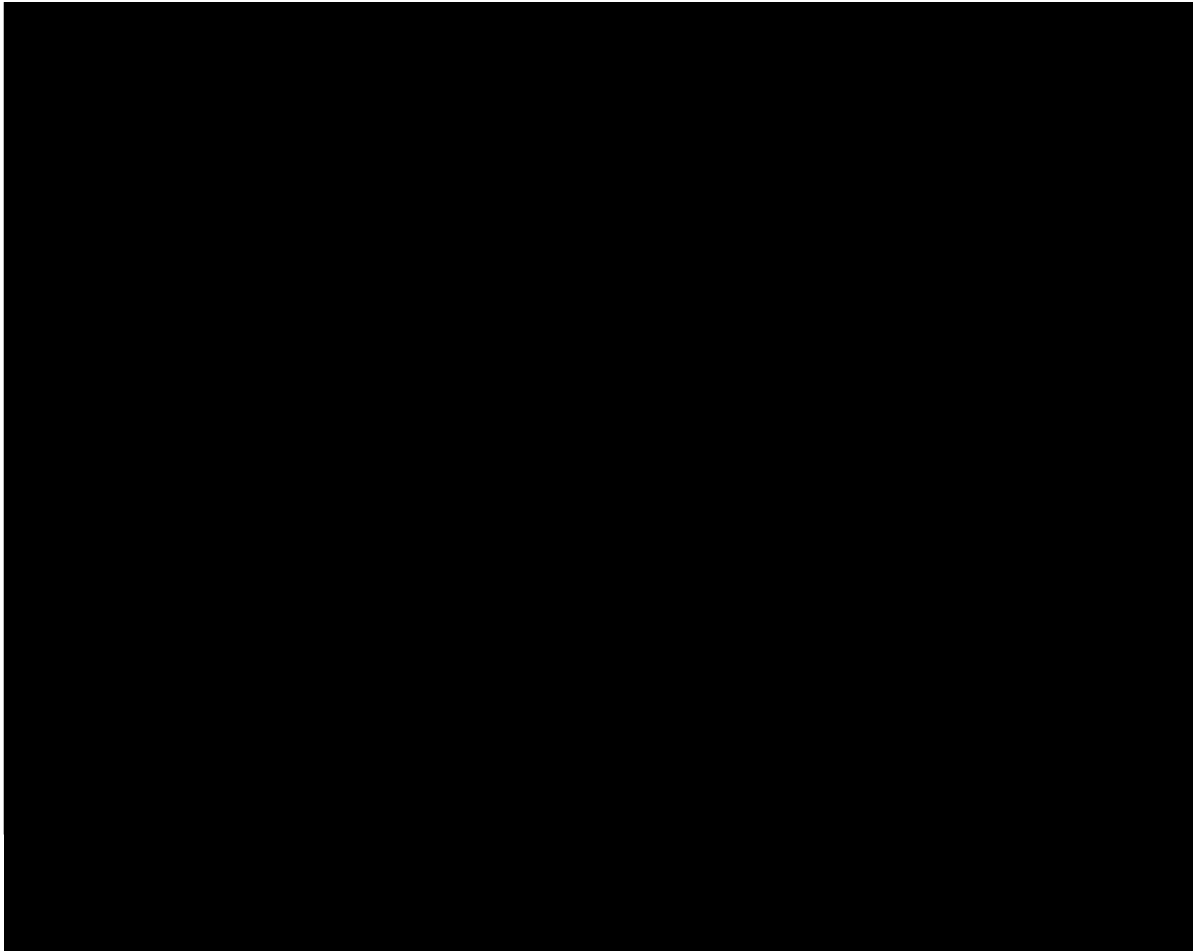
The dashed green curve represents the mean of the OEP curves when all fires igniting within Endeavour Energy's franchise area are considered. The intersection of the curve and the horizontal red line shows an ARI of around ██ years for a loss of AUD ███ million. The name ELPD&PI means that the curve includes both Economic Loss and Property Damage as well as losses due to fatalities and injuries (PI).

By analysing fires that are most likely to start from Endeavour Energy's assets, we obtain the orange curve of Figure 1 and a potential loss of AUD ███ million loss has an ARI of approximately ████ years. The uncertainty around the blue ELPD&PI E-Ig curve illustrates that, even though ████ is the most likely ARI for that loss, the confidence in such an assessment can range from ███████ years, approximately. The blue curve represents the impact of a uniform 77% contribution across the ELPD&PI E-Ig OEP curve which estimates the return interval of an AUD ███ million loss to be around ██ years or having an occurrence probability of ███% of being exceed.

Table 2 gives the losses for selected ARIs where we have emphasised the ███████████████ ███████████████ million hypothetical limits for all three assumptions (represented by the loss columns).

About Risk Frontiers

Risk Frontiers specialises in the assessment and management of risk across the Asia-Pacific region. We help organisations ranging from the global insurance industry and infrastructure operators to government departments and emergency services understand and price natural hazard risk.

Our research and expertise cover major hazards affecting the region including floods, tropical cyclones, storms, bushfires, heatwaves, drought, coastal erosion, and earthquakes. We also work with communities to understand the human dimension of risk and policy implications.

In particular, Risk Frontiers has extensive experience in the assessment and modelling of bushfire and natural hazard risks over the course of the last 27 years including developing the first-ever Australian Bushfire loss model - FireAUS. Risk Frontiers draws on its unparalleled experience to regularly deliver assessments to residential, commercial and industrial businesses, local government agencies as well as communities in bushfire-prone areas across the country. Risk Frontiers' FireAUS model has been widely used by insurance, reinsurance, and reinsurance broking companies in Australia and internationally.

Risk Frontiers also has experience in processing remotely sensed data for bushfire risk modelling. Postfire hazard and risk assessment have been conducted by analysing high-resolution aerial photos/satellite images for major fire events. Landsat images have been used with machine learning models to delineate bushland boundaries. Recently, latest MODIS burnt area products have been used to update our bushfire loss model.

Rigorous, independent, and data-driven, Risk Frontiers is one of Asia-Pacific's leading providers of risk management and catastrophe modelling solutions.

Climate science engagement

Risk Frontiers is a Partner Organisation of the Australian Research Council Centre of Excellence for Climate Extremes, making us well positioned to deliver the latest in climate change solutions to enhance our clients' decision making. We also were a member of the Scientific Committee of the Climate Measurement Standards Initiative (CMSI), an industry-led collaboration between insurers, banks, scientists, reporting standards professionals, service providers and supporting parties to support TCFD reporting. The first phase of the CMSI was recently completed with reports published in September 2020.

Risk Frontiers sits on the Australian Government's Expert Panel for Climate Change in the Pacific. This panel is convened by DFAT (Department of Foreign Affairs and Trade) within the Australian Pacific Climate Partnership.

Contact

Risk Frontiers Group Pty Ltd
Level 8, 33 Chandos St
St Leonards NSW, 2065
Australia

T: +61 (2) 8459 9770
info@riskfrontiers.com