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Creating a safer state with electricity and gas

500 kV Tower Incident (Cressy) 31January 2020

Incident report

VICTORIA State Government

Preface

This technical investigation report has been prepared by Energy Safe Victoria (ESV) pursuant to the objectives, powers and functions conferred on it by The Electricity Safety Act 1998 (Act). Specifically, these include, amongst other things, to investigate events or incidents, which have implications for electricity safety and to regulate, monitor and enforce the prevention and mitigation of bushfires that arise out of incidents involving electric lines or electrical installations and to monitor and enforce compliance with this Act and the regulations.

Contents

Summary

On 31 January 2020, at approximately 14:46 AEDT, ESV received a report of an incident in the Cressy area. The report indicated that AusNet Services Transmission's double circuit 500 kV overhead electric line between the Moorabool Terminal Station to Tarrone Terminal Station, and Moorabool Terminal Station to Mortlake Power Station had sustained damage during a high wind event between towers 137 and 144, with towers 138 to 143 (six towers) having failed.

Powercor also reported that their distribution poles and conductors in the same area had sustained damage during the high wind event.

As a result of the tower collapse, supply to the Portland Alcoa aluminium smelter was interrupted and the Heywood interconnector between Victoria and South Australia was impacted. No injuries, damage to property or fire starts were reported as a result of the incident.

AusNet Services reported to ESV that they had dispatched personnel to conduct physical examination of the collapsed towers and determine why the towers collapsed. A helicopter aerial survey was also carried out to acquire topographical imagery and point cloud data using LiDAR technology in the affected section of the transmission line.

ESV enforcement officers investigated the incident, examined evidence and obtained information regarding the cause of the original towers collapsing. ESV also requested detailed information, calculations and demonstration from AusNet Services that the new replacement tower design will meet all required standards.

Towers 137 and 144 sustained damage but did not collapse in this event. AusNet Services assessed the structural integrity and, as an outcome of the assessment, AusNet Services decided, as a precautionary measure, to replace tower 137. Tower 144 was found to be structurally sound and could remain in service as the deflection of this tower was minimal and within allowable deflection limits.

A review of the wind speed recordings available from the Bureau of Meteorology (BOM) coupled with site and local area evidence, confirmed that severe convective downbursts near the electricity transmission infrastructure caused the collapse of the towers. The wind speed at the time of the incident was determined, based on the tower damage and damage to trees and other structures in the vicinity, to be in excess of 125 km/h.

ESV investigation of the structural integrity of the collapsed towers found no defects or issues that may have led to the collapse. ESV reviewed the last asset inspection and maintenance records and was satisfied that the maintenance was in accordance with the maintenance procedures outlined in AusNet Services accepted Electrical Safety Management Scheme (ESMS) and Bushfire Mitigation (BFM) plan.

ESV investigated the design requirements for the replacement towers and AusNet Services demonstrated to ESV that the replacement towers are being designed to a wind speed that meets the requirements detailed in the latest version of AS/NZ 7000 '*Overhead line design*'. The latest version of the standard requires designs to consider convective downdraft wind gusts, sometimes referred to as high intensity winds, which are generated by severe thunderstorms. The original towers were designed to older standards by the State Electricity Commission of Victoria (SECV) between1978 and 1980 which did not consider convective downdraft wind gusts at this time. The SECV constructed the towers between1980 and 1983.

By March 2020, AusNet Services restored the transmission lines using emergency structures which are designed for short term use. Replacement towers are being installed and will take several months to complete.

ESV is monitoring the progress of the replacement of the towers via fortnightly reporting requested from AusNet Services.

ESV concludes that the cause of the incident was a severe weather event in the area (severe convective downburst), and that the existing towers had been inspected and maintained in accordance with AusNet Services Transmission's Electrical Safety Management Scheme (ESMS); a standard that ESV had accepted as meeting the requirements of the regulations. All actions undertaken by AusNet Services (Transmission) subsequent to this event were appropriate, and other than monitoring the installation of the replacement towers, no further action will be taken by ESV on this matter.

Introduction

Purpose of this report

This report summarises ESV's findings of the technical investigation undertaken by Energy Safe Victoria (ESV) into AusNet Services' management of the 500 kV tower line at Cressy, and actions taken to address the tower failure incident that occurred on 31 January 2020.

The objectives were twofold:

1. To ascertain whether AusNet Services was in compliance with its practices for managing the line according to ESV accepted Electrical Safety Management Scheme (ESMS), and
2. To ensure the replaced structures were being constructed to the appropriate standard to minimise the risk of reoccurrence '*as far as practicable*' as defined in the Electricity Safety Act.

Regulatory framework

Regulatory bodies

The Energy Safe Victoria Act establishes Energy Safe Victoria to enable it to perform its functions and exercise powers in such a manner as it considers best to achieve the objectives of Energy Safe Victoria specified in the Electricity Safety Act 1998 and the Gas Safety Act 1997 and any other Act. Energy Safe Victoria (ESV) is the independent technical regulator responsible for electricity, gas and pipelines in Victoria.

ESV regulates networks, and parts thereof, once they are set to be commissioned and put into service to ensure they can safely operate. ESV does not have direct involvement in the economic regulation of the networks; this is undertaken by the Australian Energy Regulator (AER).

The Australian Energy Market Operator (AEMO) is also responsible for overseeing the market and operation, including the planning and system design of the transmission network across Australia.

How electricity network safety is regulated

The safety of the Victorian electricity networks is governed by the Electricity Safety Act 1998 (the Act) and relevant regulations, under which the electricity network businesses must adhere to the following:

- Electricity Safety (Management) Regulations 2019, referencing the Australian standard (AS 5577) for an Electricity Safety Management Scheme (ESMS) which set out the requirements for an ESMS that is required to be submitted by all Major Electricity Companies (MECs) for acceptance and audit by ESV
- Electricity Safety (Bushfire Mitigation) Regulations 2013, which set out the requirements for a BMP that is required to be submitted in a Bushfire Mitigation Plan (BMP) by all MECs for acceptance and audit by ESV
- Electricity Safety (Electric Lines Clearance) Regulations 2020, which set out the requirements for an Electric Line Clearance Management Plan (ELCMP) that is required to be submitted for approval and audit by ESV.
- Electricity Safety (General) Regulations 2020, which specify the safety requirements relating to electrical installations and electrical work and certain requirements for electricity suppliers.

The electricity infrastructure safety regime (inclusive of ESMS) utilises principle, performance and outcome based regulatory approaches. The primary reason is that the safety risks are complex,

geographically diverse, have significant consequences (regardless of frequency), and often require tailored solutions. It also describes how MECs will meet the general duties of the Act, and comply with regulations and prescribed standards, in order to minimise safety risk.

How is this responsibility discharged?

The obligations on MECs require them to proactively eliminate, where practicable, the risk of an incident before it occurs, or otherwise to minimise the risk of failure to the extent that the cost of doing so is not grossly disproportionate to the risk reduction achieved. This is the effect of legislative and regulatory requirements that oblige MEC's to maintain a safe workplace, safe systems of work, a safe supply and the safety of staff and the public[1]. This goes beyond an obligation to mitigate the risks when a safety incident, despite precautions, actually occurs.

The required practice is to demonstrate what is reasonably practicable by implementing all controls unless the implementation of that control is technically not feasible, and demonstrate that the cost of implementation far outweighs the risk reduction benefit (e.g. costs are grossly disproportionate to risk), or that implementation of the control creates other unacceptable risks.

In general, what is considered to be acceptable costs will depend on the societal benefits gained from that expenditure, versus the willingness of the community to bear the costs of implementing the control. As part of its role as the economic regulator, the Australian Energy Regulator (AER) reviews the costs to be borne by the electricity users and determines, at a high level, whether any extra expenditure is warranted to reduce risk whilst maintaining increasing costs within a reasonable accepted range. Where required, Governments may also mandate expenditure on controls to reduce risk that are above and beyond what the AER has determined reasonable.

ESV is not a planning referral authority, and does not have direct involvement in planning decisions. ESV holds MECs to account by monitoring and enforcing the safety of the design, construction, operation, maintenance and decommissioning of their networks; and monitors compliance with the obligations under the Act to minimise risk, as far as practicable, as articulated in an ESV accepted ESMS and BMP, and approved ELCMP.

[1] For example: Occupational Health and Safety Act 2004 (Vic); National Electricity Objective, National Electricity Rules, Electricity Safety Act 1998 (Vic).

Technical Investigation

Scope

This report details the investigation conducted by Energy Safe Victoria (ESV) in relation to the event that occurred at Cressy, Victoria on 31 January 2020.

The investigation aim is to ascertain whether AusNet Services' was in compliance with its practices for managing the line according to its accepted Electrical Safety Management Scheme (ESMS), and to ensure the replaced structures were being constructed to the appropriate standard to minimise the risk of reoccurrence.

Background

On 31 January 2020 at approximately 14:46 AEDT, an event report was received and recorded in ESV's incident management system (OSIRIS) in relation to the collapse of 500 kV towers near Cressy, Victoria.

Due to the nature of the incident involving a critical infrastructure, 500 kV transmission lines, ESV assigned two officers to conduct a technical analysis and investigation to determine causes and corrective actions.

Information requested and received

The ESV investigation included requesting and reviewing data, records and reports from AusNet Services Transmission. On 6 February 2020, ESV requested AusNet Services to provide information, documentation and to demonstrate that AusNet Services had minimised risk *as far as practicable* in regard to existing and the replacement towers to be constructed. The response included information regarding:

- the age of the line,
- original design parameters,
- causal analysis,
- maintenance records,
- site investigation outcomes,
- steps taken to make the site safe, and
- the detailed plan to restore the line to the latest standards.

ESV initiated requests for more information after a review of preliminary information gathered in February and throughout the course of the investigation. ESV has received information from AusNet Services since March 2020 on a fortnightly basis, and continues to receive fortnightly progress reports, of construction works to replace the towers.

On 10 June 2020 AusNet Services organised a teleconference meeting (due to COVID restrictions) with ESV to present a detailed technical analysis about the incident and respond to any remaining questions.

The ESV investigation confirmed the cause of the incident to be an extreme wind event from the storm that passed through the area.

Technical Assessment

Prevailing Weather

Weather data collected from the Bureau of Meteorology for 31 January 2020 at the nearest weather station, Colac (Mt. Gellibrand), which is approximately 29 km from Cressy, is shown in Figure 1 below.

The data recorded for the 31 January 2020 indicates that the maximum recorded wind speed at the Colac weather station at the time of the incident was 118.4 km/h. At the Fawkner Beacon weather station, approximately 112 km from Cressy, the maximum recorded wind speed at the station was 146 km/h at around 15:06.

The towers collapsed at approximately 14:46 and the Fawkner Beacon recording was in the path of the storm from west to east, indicating an increasing storm front.

From the evidence of damage at the site and in the local area, it appears that a severe convective downburst occurred in the local area, and the wind speed at the site when the towers collapsed was determined to have been in excess of 125 km/h.

Figure 1 – Weather recordings from the BOM

Mount Gellibrand

Station ID: 090035
Lat: -38.23 Lon: 143.79
Height: 261.0m above sea level

Time (AEDT)	T °C	Td °C	RH %	Wind Spd km/h	Wind Dir degrees	Wind Gust km/h	Rainfall since 9am mm
0900	31.3	6.4	21	20.5	10	29.5	0
0930	33.7	6.9	19	29.5	10	35.3	0
1000	37.3	6.3	15	33.5	360	46.4	0
1003	37.6	4.5	13	35.3	360	59.4	0
1017	37.4	4.4	13	57.2	360	64.8	0
1030	37.4	5.4	14	55.4	360	70.2	0
1054	37.8	10.2	19	50	360	70.2	0
1100	37.9	10.3	19	59.4	360	81.4	0
1130	36.7	10.8	21	59.4	360	85.3	0
1145	36	8.7	19	38.9	20	42.5	0
1200	35.8	7.8	18	31.3	10	37.1	0
1230	37.6	9.2	18	40.7	360	51.8	0
1300	39	10.4	18	42.5	350	57.2	0
1330	41.2	11.3	17	42.5	330	55.4	0
1345	40.8	12.6	19	51.8	310	70.2	0
1400	40.6	12.5	19	48.2	320	70.2	0
1430	39.5	12.4	20	46.4	310	64.8	0
1438	36.6	9.2	19	37.1	250	44.3	0
1441	36.8	9.4	19	29.5	280	37.1	0
1442	36.3	10.5	21	29.5	300	50	0
1443	35.8	13.9	27	38.9	330	50	0
1444	33	16.8	38	48.2	330	92.5	0
1445	31.4	17.7	44	83.2	330	114.8	0
1448	22.6	20.9	90	90.7	340	118.4	0.6
1451	22.9	22.9	100	85.3	340	118.4	1.8
1453	23.9	23.9	100	27.7	350	50	2.4

Figure 2 – Damage to trees near the tower line

Figure 3 – Close up photo of damage to trees

Figure 4 – One of the collapsed towers

Inspection and Maintenance

The towers were designed and installed by the SECV in 1980 to 1983 and have been maintained in accordance with SECV and AusNet Services' inspection and maintenance standards and practices.

Maintenance and inspection processes are described in the AusNet Services' ESMS and BMP as accepted and regularly audited by ESV. In accordance with their accepted practices AusNet Services perform annual line and easement inspection by qualified, trained and experienced personnel to assure the safe and reliable operation of the assets. AusNet Services also perform targeted, detailed inspections and varying condition monitoring activities such as thermal vision and corona checks on the conductors, fittings and support structures. The program also includes repairs of defects identified from the inspections by risk priorities.

In addition to the annual line and easement inspection program, a range of other condition monitoring activities are conducted on either cyclic or ad hoc basis which include:

- Tower climbs at varying intervals
- Smart Aerial Inspection and Processing (SAIP)
- Corona and thermal survey
- Tower footing corrosion protection systems review
- Tower footing condition assessment (sample based).

Monitoring of tower corrosion issues focusses on all metallic components of the tower, e.g. lattice members and bolts, including the tower legs at ground line. The monitoring program undertakes corrosion assessment and grading in accordance with assessment criteria with results recorded in the asset management system for planning and scheduling of maintenance and replacement activities.

The general asset inspection and maintenance program includes the cyclic inspection and condition assessment of tower lines. Condition assessment data, together with asset performance data such as in-service failures, combine to identify the need for targeted replacement programs to cost effectively mitigate the risk of asset failure.

ESV requested the latest inspection records and the records indicate that all required maintenance had been carried out, including repair of conductors, replacement of signs, and addition of corrosion inhibitors in accordance with AusNet Services' asset management systems.

Tower damage assessment

Towers 137 and 144 did not collapse during the storm and they were inspected by AusNet Services structural engineers after the incident. AusNet Services found that both towers had sustained some deflection.

The deflection in tower 137 was visible. The assessment an analysis deemed the tower to be unsafe to remain in service and for this reason AusNet Services decided to replace the tower with a new suspension tower.

Tower 144 had no visible signs of deflection and the measured deflection was considered within tolerable limits. The engineering assessment undertaken by AusNet Services determined that the tower did not require replacement and this tower will remain in service.

Replacement tower design

The replacement towers are required to be designed and constructed to meet the latest requirements of Australian Standards. The ESMS specifies that AusNet Services design towers to the latest version of AS/NZS 7000 Overhead Line Design.

ESV required AusNet Services to demonstrate that the line design process used meets or exceeds the requirements of AS/NZS 7000 and to show the inputs and outputs of the line design process.

To achieve this, AusNet Services structural engineers met with ESV engineers (via teleconference due to COVID restrictions) and presented the detailed failure report which includes detailed design analysis of the new towers. This report includes the following aspects:

- Cause of failure
- Analysis of storm damage at the site
- Basis of original SECV design
- Design parameters used in new tower design
- Outputs from PLS CADD of old design and new tower design
- Maintenance and inspection of towers.

AusNet Services demonstrated that the new design interactively using the PLS CADD software. Aspects of design that ESV confirmed included:

- New design utilises parameters from AS/NZS 7000 correctly
- Design process is undertaken by qualified engineers
- Design considers higher safety factors compared to SECV design (security level and return period consideration)
- Wind speed considers latest knowledge, including downdraft wind (in accordance with the latest AS 1170.2 Structural Design Loads – Wind actions)
- Design outputs show member stress in critical support areas are within accepted range for worst case scenarios (via PLS CADD)
- Design considers extra safety measures including use of stronger material, support plates, and extra steel in supports.

ESV also questioned the limitations on existing towers that remain and how these may be affected. AusNet Services demonstrated that the tower 144 that is to remain in service will meet the requirement of the original SECV design based on inspection outcome and design analysis.

From the report and interactive demonstration, ESV confirmed that AusNet Services had adequately considered all aspects relating to the new tower design and demonstrated that the requirements of the latest AS/NZS 7000 were met.

Conclusion

ESV's investigation of the Cressy incident including of technical information provided by AusNet Services Transmission in relation to the incident concluded that the incident was caused by a severe weather event and beyond the design specification of the towers.

ESV is also satisfied that the replacement towers are being constructed in compliance with the relevant standard AS/NZS 7000, and will continue to monitor the replacement program to ensure the new structures are fit for purpose.

The ESV investigation is considered closed and no further action warranted.