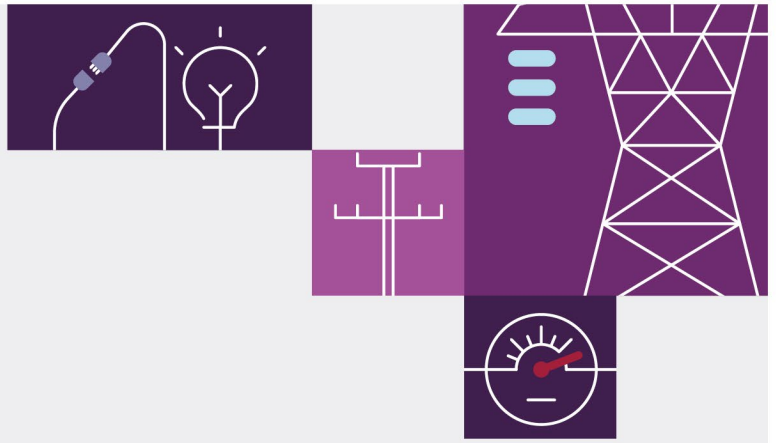


Final Report: Tasmania market suspension on 1 March 2022

August 2023

A market event report for the
National Electricity Market





Important notice

Purpose

AEMO has prepared this final market event report in accordance with clauses 3.14.3(c)-(d) and 3.14.4(f)-(g) of the National Electricity Rules, using information available as at the date of publication unless otherwise specified.

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Abbreviations

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
AGC	Automatic Generation Control
DBYD	Dial Before You Dig
EMMS	Electricity Market Management System
FCAS	Frequency Control Ancillary Service
FOS	Frequency Operating Standard
ICCP	Inter-Control Centre Communications Protocol
MN	Market Notice
MSPS	Market Suspension Pricing Schedule
NEMDE	National Electricity Market Dispatch Engine
NER	National Electricity Rules
NOCS	Network Operations and Control System
PFR	Primary Frequency Response
SCADA	Supervisory Control and Data Acquisition
RPSS	Residual Power System Security
SPS	System Protection Schemes
TI	Trading Interval
TNSP	Transmission Network Service Provider



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1 Overview

This is the final report relating to AEMO's suspension of the spot market in Tasmania on 1 March 2022. It consolidates and updates AEMO's preliminary report on the market suspension published in March 2022¹ and is based on information available to AEMO on 31 July 2023.

At approximately 1200 hrs² on 1 March 2022, following two separate, unrelated incidents causing damage to both Telstra fibre cables linking Tasmania to the Australian mainland, the Inter-Control Centre Communications Protocol (ICCP) link between AEMO and TasNetworks was severed³. As a result, AEMO lost all Supervisory Control and Data Acquisition (SCADA) visibility in Tasmania and subsequently suspended the spot market in Tasmania from 1235 hrs to 1915 hrs. The power system remained in a secure operating state throughout the market suspension, and no generation or load was lost because of the incident. During the suspension period, Tasmanian prices were set using market suspension schedule pricing.

As required by National Electricity Rules (NER) 3.14.3(c) and 3.14.4(f), AEMO has conducted a review of the market suspension. This final report includes the matters required by NER 3.14.3(c) and (d) and 3.14.4(g), namely:

- The reason for the suspension and its effect on the operation of the spot market, which is unchanged from the preliminary report and is covered in Section 2. Information and analysis of system responses and actions is substantially unchanged from the preliminary report and is also summarised in Section 2.
- AEMO's assessment of the adequacy of the provision and response of facilities and services, and actions taken to maintain power system security, which is in Section 3.
- Details of the payments and compensation made to each Market Suspension Compensation Claimant and the share of compensation costs recovered from each Market Customer in Tasmania⁴. These details were not available at the time of the preliminary report and are provided in Section 4.

This report also includes, in Section 5, an update on the progress of actions or recommendations set out in the preliminary report.

2 Event summary

Table 1 below outlines the timeline of key events which formed part of this market suspension. The information in Table 1 is based on AEMO's operational logs.

This sequence of events does not differ from the timeline of events set out in the preliminary report.

¹ AEMO, Preliminary report: Tasmania market suspension on 1 March 2022. Available at https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/preliminary-report-tas-market-suspension.pdf?la=en.

² National Electricity Market time (Australian Eastern Standard Time [AEST]) is used in this report.

³ TasNetworks is the transmission network service provider (TNSP) in Tasmania.

⁴ There were no compensation payments for this market suspension and therefore there was no compensation cost recovery.

Table 1 Sequence of key events on 1 March 2022


Time	Event
1204 hrs	AEMO became aware of total loss of SCADA in the Tasmanian region due to the failure of the Tasmania region's ICCP links and commenced investigations.
1222 hrs	TasNetworks confirmed to AEMO that it had full visibility and full SCADA control of all transmission assets in the Tasmanian region.
1224 hrs	Hydro Tasmania confirmed that it had full SCADA visibility and was able to receive and follow market targets. AEMO requested that TasNetworks monitor power system security until AEMO could re-establish an ICCP link.
1239 hrs	AEMO declared the spot market suspended in Tasmania from 1235 hrs with Market Suspension Schedule Pricing (refer National Electricity Rules [NER] clause 3.14.5(b)) from Trading Interval (TI) 1240 hrs on 1 March 2022 until further notice. AEMO issued Market Notice 94979 noting the reason for the suspension was a failure of SCADA systems.
1240 hrs	AEMO issued Market Notice 94978 advising that AEMO was experiencing a SCADA service interruption to Tasmanian networks.
1242 hrs	AEMO requested that TasNetworks assume Residual Power System Security (RPSS) for the Tasmanian region in accordance with Regional Power System Operating Procedure Section 13.
1357 hrs	Prices for TI 1240 hrs, the first interval of the suspension, were adjusted to the market suspension pricing schedule (MSPS). Market Notice 94981 issued.
1625 hrs	AEMO confirmed with TasNetworks and Hydro Tasmania that there was sufficient local Frequency Control Ancillary Services (FCAS) in Tasmania to manage the loss of Basslink. TasNetworks confirmed that both Basslink System Protection Schemes (SPS) were operational. Hydro Tasmania advised that there was 300 MW of lower 6-second and 294 MW raise 6-second FCAS available.
1836 hrs	AEMO confirmed with Telstra that service on the first fibre link to the Tasmania region had been restored and operated in a stable condition.
1843 hrs	AEMO issued Market Notice 94993 declaring that the suspension of the spot market in Tasmania would end at 1915 hrs on 1 March 2022.
1845 hrs	AEMO and Hydro Tasmania confirmed Tasmanian generation outputs against the latest National Electricity Market Dispatch Engine (NEMDE) dispatch in preparation for the cancellation of the Market Suspension.
1856 hrs	AEMO requested that TasNetworks restore ICCP links to AEMO.
1859 hrs	AEMO requested TasNetworks to end RPSS for the Tasmania region in accordance with Regional Power System Operating Procedures.

2.1 Fibre cable routes between mainland Australia and Tasmania

Three separate fibre cables join the mainland and Tasmania across Bass Strait. Two of the cables, Bass Strait 1 and 2, are owned and operated by Telstra. The third cable is operated by Basslink and is co-located with the Basslink interconnector. AEMO owns the ICCP pathway connecting to TasNetworks, and leases capacity on the Bass Strait 1 and 2 cables.

2.2 ICCP failure and loss of AEMO SCADA visibility

Based on AEMO's initial investigation and information provided by Telstra, AEMO understands that at approximately 1017 hrs on 1 March 2022, one of the Bass Strait fibre cables was cut during civil works in Victoria. At 1200 hrs on 1 March 2022, prior to connection being restored on the first severed cable, the second Bass Strait fibre cable was severed during separate, unrelated civil works in Tasmania. Telstra was not involved in or aware of either of these civil works activities. The loss of the second fibre link resulted in AEMO losing all Supervisory Control and Data Acquisition (SCADA) services for the Tasmania region. Telstra has some leased capacity (at approximately 10 GB/s maximum speed) on the Basslink fibre cable that is used to provide emergency and priority services to Tasmania in case of failure of the two primary services. Priority traffic was automatically



transitioned to the capacity Telstra retains on the Basslink fibre link. At 1628 hrs on 1 March 2022, Telstra rerouted additional selected services to the Basslink fibre link to alleviate network congestion. However, this leased capacity was insufficient for AEMO SCADA to be restored. TasNetworks' SCADA system is only reliant on local communication infrastructure, so its SCADA visibility and control was not impacted by the outage of Bass Strait 1 and 2 fibres. TasNetworks confirmed to AEMO that it still had full SCADA visibility and control of the Tasmanian network. Hydro Tasmania leases capacity on the Basslink fibre cable, meaning that Hydro Tasmania was able to send and receive signals to/from AEMO via the EMMS (Electricity Market Management System). Hydro Tasmania confirmed to AEMO that it could still bid and follow energy dispatch targets from the National Electricity Market Dispatch Engine (NEMDE) during the AEMO SCADA outage.

2.3 Declaration of market suspension

The market suspension was triggered by a loss of Tasmanian SCADA visibility at AEMO due to both Bass Strait fibres being severed. AEMO became aware of the SCADA failure at 1204 hrs on 1 March 2022 due to the failure of the Tasmania region ICCP links. AEMO assessed that the ongoing lack of SCADA meant it was no longer possible to operate the spot market in accordance with National Electricity Rules (NER) 3.8 and 3.9.

AEMO issued Market Notice (MN) 94979 at 1239 hrs on 1 March 2022, declaring that:

- The spot market in Tasmania was suspended from Trading Interval (TI) 1240 1 March 2022 until further notice;
- Prices in Tasmania would be set using market suspension schedule pricing; and
- The cause of the suspension was a failure of SCADA systems.

MN 94979 complied with NER 3.14.4(a).

The time between first detecting the loss of SCADA visibility in Tasmania and suspension of the spot market in that region was approximately 40 minutes. This aligns with the recommended timing in Market Suspension and Systems Failure Procedures 3706⁵. Procedures 3706 contains guidelines on the steps that should be taken if the spot market needs to be suspended. The guidelines state that if a large number of SCADA points have failed, AEMO will consider suspending the spot market if:

- 30 minutes have elapsed since AEMO became aware of the SCADA failure; and
- The SCADA system is not expected to be restored within a further 10 minutes.


2.4 Pricing during the market suspension

During a spot market suspension, prices may be determined in accordance with NER 3.9, or in accordance with the Market Suspension Pricing Schedule (MSPS) published under NER 3.14.5(e).

As outlined in MN 94979, market suspension schedule pricing was used to set the Tasmanian market prices during the market suspension. In accordance with AEMO's published Market Suspension Pricing Methodology⁶,

⁵ See Section 8.2 of https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3706%20Failure-of-Market-or-Market-Systems.pdf.

⁶ See <https://aemo.com.au/-/media/files/electricity/nem/data/mms/estimated-price-methodology-suspension-ner-3-14-5.pdf?la=en>.



this MSPS is based on a four-week rolling average of historic regional prices, separated into business and non-business days, with a half-hourly resolution⁷.

2.5 Power system operation during the market suspension

Following the market suspension being declared, in accordance with Section 13 of the Regional Power System Operating Procedures, AEMO requested that TasNetworks assume Residual Power System Security (RPSS) control.

Initial analysis from TasNetworks indicates that the Tasmanian power system remained in a secure operating state and the Frequency Operating Standard⁸ (FOS) was met throughout the market suspension. No generation or load was shed or disconnected and there were no unplanned outages of transmission equipment during the Tasmania SCADA failure. TasNetworks also confirmed that system voltages remained within acceptable limits and all Special Protection Schemes (SPS) and Voltage Control Schemes remained operational. Additionally, TasNetworks confirmed that total system inertia and the three-phase short-circuit fault levels at the region's system strength nodes remained above secure operating levels for the duration of the market suspension.

AEMO's Participant Infoserver remained available throughout the incident. Consequently, participants in Tasmania with access to the Basslink fibre cable were able to rebid generation and receive dispatch instructions. The NEMDE remained operational, and generators in Tasmania with access to the Basslink fibre cable continued to follow their dispatch targets through the EMMS.

However, the failed ICCP links meant that Hydro Tasmania was unable to receive Automatic Generation Control (AGC) signals from AEMO via TasNetworks. Additionally, generators in Tasmania without leased capacity on the Basslink fibre cable were not able to access the AEMO Participant Infoserver, and therefore could not bid generation or receive and follow dispatch targets.


At 1340 hrs on 1 March 2022, TasNetworks' Network Operational Control System (NOCS) failed for 2 minutes. Subsequent investigation by TasNetworks found the cause to be an intermittent hardware fault, with no discernible link to the fibre optic cable outages. Analysis indicates that there was no adverse impact on system security during the NOCS failure.

When RPSS was invoked, AEMO requested that TasNetworks enable its AGC. However, after observing issues with its performance, TasNetworks disabled its AGC and, at 1345 hrs, requested that Hydro Tasmania attempt to operate with its own AGC. Hydro Tasmania made two attempts to operate with its own AGC but found that it caused minor fluctuations in the Tasmania frequency and hence disabled it within the same dispatch interval. For the remainder of the market suspension, both AGC systems were disabled. However, local enablement of regulation Frequency Control Ancillary Services (FCAS) was not required because the Basslink dispatch allowed for the transfer of frequency regulation from the mainland.

The Primary Frequency Response (PFR) of generator governors in Tasmania helped maintain the FOS in the absence of AGC action. Additionally, Hydro Tasmania altered its bidding behaviour to ensure that Basslink was maintained at a mid-range import level into Tasmania to allow for the Basslink frequency controller to provide maximum frequency regulation.

⁷ See https://www.nemweb.com.au/REPORTS/CURRENT/MKTSUSP_PRICING/.

⁸ See <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF>.



To maintain system security for the loss of Basslink during the market suspension, TasNetworks, Hydro Tasmania and AEMO ensured that there were sufficient local FCAS enabled in Tasmania. TasNetworks confirmed that both of the Basslink SPS were operational, and Hydro Tasmania confirmed that 300 MW of lower 6-second FCAS and 294 MW of raise 6-second FCAS were available locally. Initial analysis indicates that these measures helped enable maintenance of power system security throughout the Tasmanian SCADA outage.

Generator reserve requirements were determined manually through collaboration between TasNetworks, Hydro Tasmania and AEMO, and units were dispatched accordingly by Hydro Tasmania.

2.6 Market operation during the market suspension

Generators in Tasmania were unable to send SCADA to AEMO via TasNetworks due to the broken AEMO ICCP links. In accordance with Market Suspension and Systems Failure Procedures 3706, when NEMDE does not receive a SCADA value for the output of a generating unit at the start of a TI, it uses the dispatch target from the previous interval as the initial MW value for the current interval, thereby assuming all generators are perfectly following their dispatch targets. Therefore, during the market suspension, generators with access to the Basslink fibre cable were still able to receive and follow the resulting dispatch instructions using AEMO's EMMS.

During the AEMO SCADA outage, Hydro Tasmania was unable to receive AGC signals for regulation FCAS from AEMO via TasNetworks. Consequently, no regulation FCAS could be enabled in Tasmania while SCADA was unavailable.

Hydro Tasmania rebid generation to ensure consistent southward flows over Basslink during the market suspension. This prevented a reversal of Basslink flow, which could in turn have led to a lack of regulation FCAS in Tasmania⁹.


2.7 Pricing during the market suspension

AEMO is also required to manually review prices for the first one (or possibly two) intervals during a market suspension that uses market suspension schedule pricing in the suspended region. This is because a declaration of market suspension happens partway through a TI but applies from the start of that TI (when the prices for the TI were published). If market suspension schedule pricing is used, the prices published at the start of the TI need to be overwritten. AEMO's central dispatch system does not allow this retrospective action to be performed automatically. The prices must therefore be reviewed by AEMO manually¹⁰.

Manual review also includes checking whether the prices in any other regions require scaling under NER 3.14.5(f). NER 3.14.5(f) applies only to suspended regions connected by one or more regulated interconnectors to a neighbouring region. Because the only interconnector between Tasmania and Victoria is Basslink, which is a Market Network Service Provider, NER 3.14.5(f) does not apply in this instance.

⁹ Basslink has a +/- 50 MW 'no-go' zone, which means that it cannot transfer FCAS while it is in the process of changing the direction of its power flow. The amount of FCAS that Basslink can transfer is also dependent on its power transfer level.

¹⁰ If the declaration of market suspension happens sufficiently far through a TI that the pricing run for the next TI has been triggered, the prices for the second TI also require manual review. This did not happen during this event.



AEMO updated the revised Tasmania prices for TI 1240 during the market suspension, using the MSPS published on 12 February 2022 and applying to the week beginning 28 February 2022, meeting the NER requirements. This triggered MN 94981 at 1357 hrs on 1 March 2022, advising the market of the revised prices in Tasmania.

2.8 Restoration of Tasmanian SCADA visibility

Telstra located the fault on the first fibre cable in Victoria and began repair works at approximately 1700 hrs on 1 March 2022. The splicing works were completed at approximately 1748 hrs, and by 1821 hrs the majority of communications were confirmed as being operational. At 1836 hrs, AEMO confirmed that one of the fibre links had been restored and that the market could be resumed. AEMO then requested that TasNetworks restore all ICCP links to AEMO to prepare for the market resumption. Once the ICCP links were restored, AEMO had full SCADA visibility of the Tasmania region.

Concurrently, Telstra was undertaking works to repair the second damaged fibre cable in Tasmania. These works were completed, and full redundancy was restored, at 2332 hrs on 1 March 2022.

2.9 Resumption of the spot market

At 1836 hrs on 1 March 2022, AEMO confirmed with Telstra that ICCP connectivity had been restored. In response, AEMO issued MN 94993 at 1843 hrs on 1 March 2022 declaring that the spot market in Tasmania would resume from 1915 hrs 1 March 2022. MN 94993 complied with NER 3.14.4(d).

The time between declaring the resumption of the spot market in Tasmania and the spot market resuming was about 30 minutes. This aligns with the recommended timing in Section 10.2(b)(ii) of Procedures 3706.

The spot market in Tasmania was suspended for a total of six hours and 40 minutes.

3 Adequacy of actions taken

Under NER 3.14.3(c), AEMO has reviewed the adequacy of the provision and response of facilities and services during the market suspension, and the appropriateness of actions taken to restore or maintain power system security, and has concluded all responses and actions were adequate in the circumstances.

4 Payments and compensation

4.1 Market suspension pricing schedule payments and compensation payments

Table 2 shows the MSPS energy and FCAS payments and compensation payments for energy and FCAS made to each Market Suspension Compensation Claimant, as required by NER 3.14.3(d)(1)(i) and (ii). For this market suspension event no compensation payments arose under NER 3.14.5A (applying AEMO's published schedule of benchmark values) and no additional compensation claims were made under NER 3.14.5B or 3.15.7B. During the

market suspension period there were two Market Suspension Compensation Claimants, being the scheduled generators and ancillary service providers who supplied energy or provided FCAS in an affected region.

Table 2 MSPS payments and compensation payments

Participant name	MSPS payment (energy)	MSPS payment (FCAS)	Compensation payment (energy and FCAS)
Hydro-Electric Corporation	\$298,859	\$31,053	\$0
Firmus Grid Pty Ltd ¹¹	\$0	\$4529	\$0
Total	\$298,859	\$35,582	\$0

4.2 Compensation costs payable

Given there were no compensation payments or additional compensation claims for this market suspension, there were no compensation costs payable by Market Customers, therefore nothing to report under NER 3.14.3(d)(1)(iii).

5 Actions taken since preliminary report

This section provides an update on progress of the actions or recommendations identified in the Next Steps section (Section 5) of the preliminary report.

5.1 TasNetworks review of its Residual Power System Security procedure

5.1.1 Preliminary report

While the Residual RPSS procedures worked effectively in this event, TasNetworks has commenced a review of its own RPSS procedures and systems, including its AGC system, to ensure that they operate effectively in the event of a SCADA outage.

5.1.2 Final report

A strategy to perform energy dispatch manually, hold contingency and regulation reserve on island during RPSS is in an advanced stage of investigation by TasNetworks. The extent to which AGC is used will be determined during a later phase of this review.

¹¹ Firmus Grid Pty Ltd was suspended from all trading in the NEM in its registration category of Market Customer on 9 August 2022. See <https://aemo.com.au/en/newsroom/news-updates/suspension-of-firmus-grid>

5.2 AEMO review of the Residual Power System Security procedure

5.2.1 Preliminary report

AEMO will review the RPSS procedure within the Regional Power System Operating Procedures in consultation with TasNetworks.

5.2.2 Final report

The RPSS procedure will be reviewed and potentially updated in collaboration with TasNetworks at a suitable point.

5.3 TasNetworks investigation of NOCS failure

5.3.1 Preliminary report

TasNetworks is currently investigating the cause of the 2-minute failure of its NOCS during this event.

5.3.2 Final report

An intermittent hardware fault lasting for about 2 minutes caused a core SCADA node failover to be initiated. During the failover, the hardware fault resolved itself resulting in the original SCADA node coming back online. After the 2 minute fault, the original SCADA node remained operational and did not cause further disruptions. The TasNetworks NOCS failure and the fibre optic cable outages that led to the market suspension were separate events with no discernible link between them.

TasNetworks has made two changes to make a similar event less likely to occur in the future:

- The online SCADA server was moved to a new physical host after the failover initiation and has remained on this new host since.
- The hardware fault was investigated with its vendor, resulting in the detection of the hardware issue and replacement of the faulty board.

5.4 AEMO review of ICCP redundancy

5.4.1 Preliminary report

AEMO is currently reviewing the redundancy of its ICCP pathway connecting to TasNetworks.

5.4.2 Final report

After consulting with its current provider, Telstra, AEMO has confirmed that the redundancy of the current ICCP pathway connecting to TasNetworks cannot be further improved by adding or reserving more capacity on the Basslink fibre. This is because it is not possible to dedicate sufficient capacity to AEMO within Telstra's already leased capacity on the Basslink fibre cable that is used to provide emergency and priority services to Tasmania in case of failure of the two primary services.

5.5 Actions of participants that lost access to the Participant Infoserver

5.5.1 Preliminary report

AEMO will confirm the actions of participants in the Tasmania region that lost access to AEMO's Participant Infoserver during the event.

5.5.2 Final report

Loss of internet at Musselroe, Wild Cattle Hill and Granville Harbour wind farms

Musselroe, Wild Cattle Hill and Granville Harbour wind farms lost internet connection and lost connection to AEMO's dispatch system, consistent with the communication loss between Tasmania and mainland Australia. Given the failed primary communications system, each participant utilised secondary SCADA communications with TasNetworks, which remained operational over the course of the event.

Due to the loss of connection between the Transmission Network Service Provider (TNSP) and AEMO's dispatch system, no targets were received via the primary link, but no semi dispatch cap was applied via the secondary SCADA link over the course of the event to any of these participants.

In addition, each participant generated up to the maximum wind availability and maintained communication with critical staff to manage operation if required throughout the event. Each wind farm had staff available in mainland Australia that were capable of rebidding the output of each windfarm into AEMO's central dispatch.

Separate connectivity issues at Studland Bay and Bluff Point wind farms

At Studland Bay and Bluff Point wind farms, a third party severed SCADA and internet cables on 28 February 2022, resulting in disruption to the normal operation of both farms until 3 March 2022, covering the entire period of the Tasmanian SCADA outage and subsequent market suspension.

Over this period, both wind farms generated no energy, had no internet access and no connection to AEMO's dispatch system. The site issue at these farms was unrelated to the incidents that damaged two Telstra fibre cables connecting Tasmania to mainland Australia on 1 March 2022.

5.6 Understanding the Dial Before You Dig tool

5.6.1 Preliminary report

Telstra is a member of Dial Before You Dig (DBYD)¹², and is currently in discussions with both organisations that were undertaking the civil works that caused the fibre outages to understand how they use the DBYD tool to help ensure similar incidents do not reoccur.

5.6.2 Final report

Telstra informed AEMO that fibre breaks are the most common cause of mass outages impacting Telstra customers. In this case, both breaks were caused by organisations who actively used Dial Before You Dig or a

¹² Dial Before You Dig (DBYD) is an Australia-wide, free referral service that links individuals or organisations that are undertaking excavation work with utilities such as Telstra that may have infrastructure buried underground.



locator service. Following the incident, Telstra informed these organisations of the importance of proper usage of the Dial Before You Dig website.

Although the simultaneous loss of two links linking Victoria and Tasmania across the Bass Strait is a rare event, Telstra conducted a post incident review that concentrated on network resilience, and as a result, additional routing capacity (the ability to circumvent a single fibre break within Victoria) was implemented in June 2022.