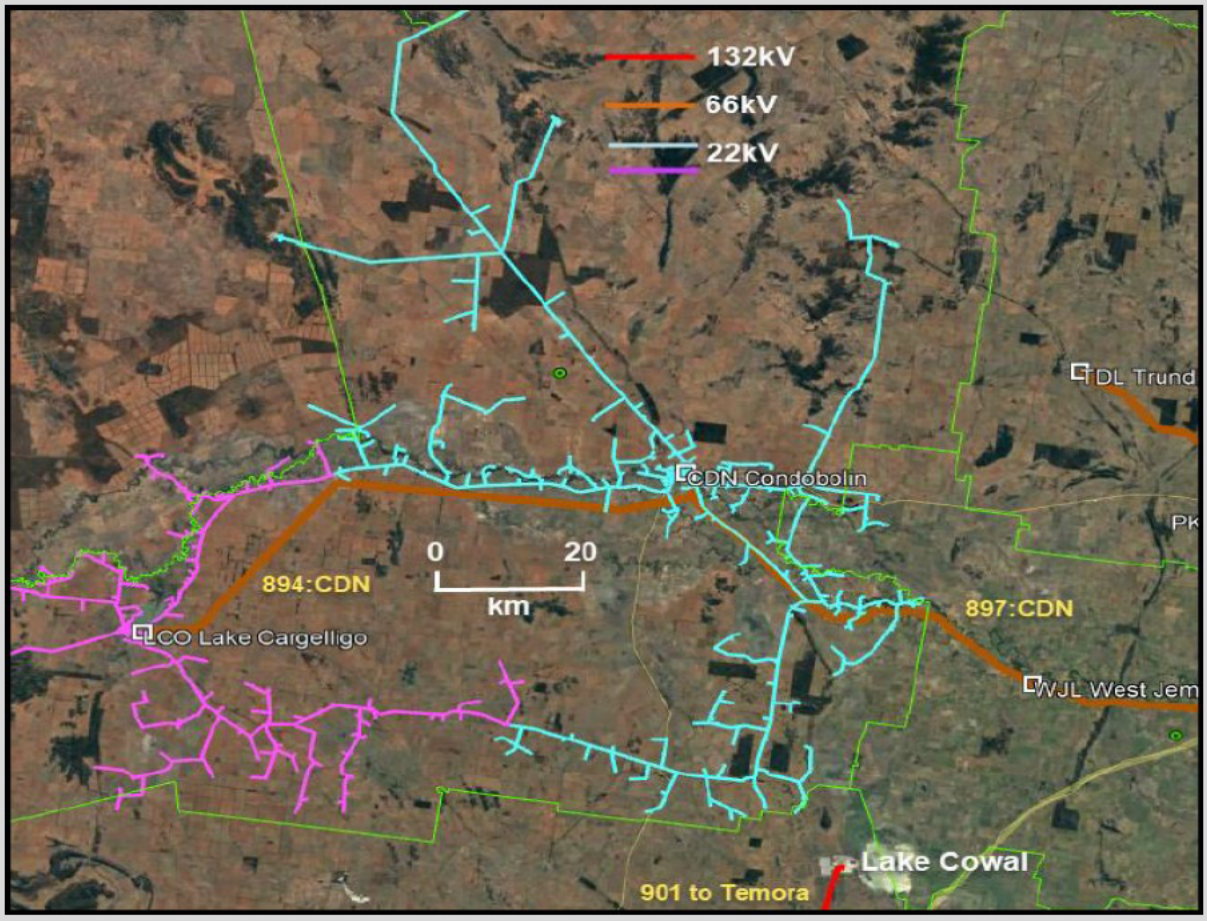
Essential Energy

10.06.10 Resilience Lake Cargelligo Network Investment Case



November 2022

Network Resilience Project

Project:	10.06.10 Resilience Lake Cargelligo Network Investment Case
Date:	Nov 2022
Authors:	[redacted]
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Approvals

	Name	Division	Title & Function	Date
1.	[redacted]	Asset and Operations	Manager Network Planning	14/12/22

Revisions

Issue Number	Section	Details of Changes in this Revision
1.	All	Initial Issue
2.		
3.		
4.		
5.		

Table of Contents

1. Executive Summary

Major Project	10.06.10 Resilience Lake Cargelligo Network Investment Case
Description	Establish back up supply to Lake Cargelligo ZS
Drivers for Investment	Resilience: To improve the resilience of the network for customer on the Lake Cargelligo ZS as historical reliability performance is unacceptable. Poor reliability performance is primarily caused by lightning and wind. Climate change analysis is forecasting an increase in wind risk in this area. Following extreme weather events there has been extended periods of power outages, including: 05/01/22: 25 hours 30/09/2021: 16 hours 18/12/21: 11 hours Reliability: To improve reliability for customers on the Lake Cargelligo ZS. This will also maintain the safety, quality, and security of supply of the network as per NER 6.5.7 capital objectives. Strong customer support for proactive resilience projects including microgrids (refer 4.02 How engagement informed our Proposal).
Investment Options	Options considered to improve customer reliabilty included: > Diesel Generation > Network solution > Battery backup > Market Non-network solution > Lightning protection (excessive capital costs, excluded from further analysis) Due to the scale of this project an Expression of Interest (EOI) for non-network solutions will be advertised prior to project initiation to enable the private sector to submit non-network options for evaluation. The following option was investigated in detail and evaluated using Net Present Value of cost and benefit: > Diesel Generation (NPV $10.5M)
Estimated Expenditure FY24$	

2024/25	2025/26	2026/27	2027/28	2028/29
[redacted]	[redacted]	$0	$0	$0

Note: All values are in middle of the year 2023-24 real dollar terms

2. Network

The Lake Cargelligo ZS is supplied from West Jemalong ZS via Condobolin ZS, as shown in figure 1 below. A 66kV line (894:CDN 89km) from Condobolin ZS provides radial supply to Lake Cargelligo ZS and Condobolin ZS is radially supplied by a 66kV line (897:CDN 64km) that emanates from West Jemalong ZS. The total 153km 66kV radial line affects the reliability of Lake Cargelligo ZS. The 897:CDN conductor is 6/4.75+7/1.60 ACSR/GZ Cherry no OHEW and 894:CDN conductor is 6/1/3.75 ACSR/GZ conductor with OHEW only near to the ZS. The forecasted load for Lake Cargelligo ZS is 3.8MVA and serves 1525 customers.

Both 894:CDN 89km and 897:CDN 64km form the radial backbone out of West Jemalong to Lake Cargelligo. Any outage on this 153km radial line impacts negatively on the reliability of the Lake Cargelligo ZS. The main components that resulted in the highest Customer Minutes Lost (CML) is due to weather impact

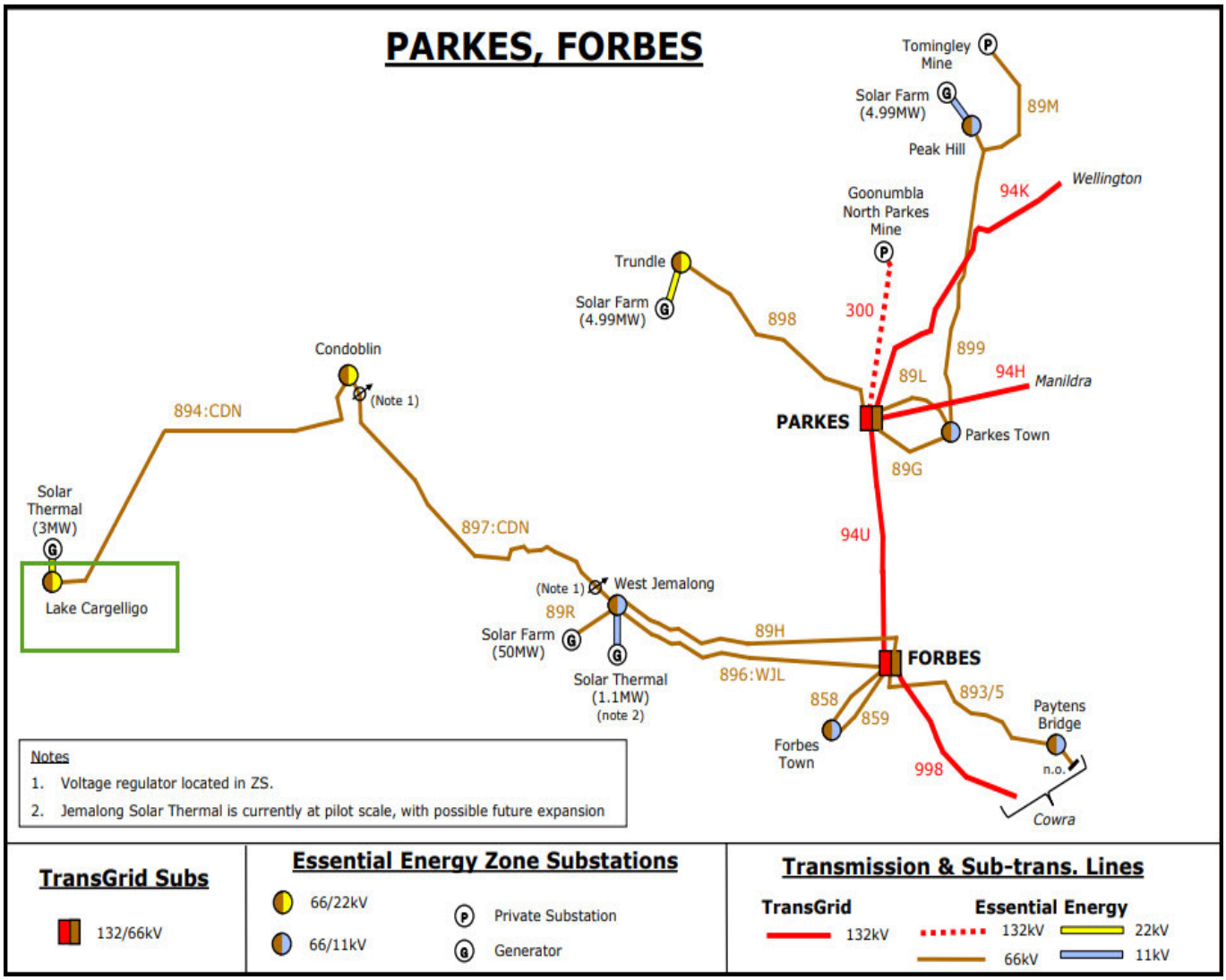

Figure 1 - Simplified Subtransmission Network

Asset inspection cycles include a ground inspection every five years and aerial photo inspections (drone), also every five years. To minimise customer outages, the feeders are mostly maintained live line. The 66kV feeder in this distribution network are susceptible to lightning strikes, being unshielded, with no overhead earthwire for the entire length, other than 1km sections at zone substation entry and exit points.

3. Reliability

Reliability of the 66kV subtransmission network is mostly affected by weather. Storm activity and lightning, impact the unshielded feeders causing the network to trip the radial 66kV from West Jemalong ZS via Condobolin ZS. Further historical reliability data for this feeder can be found in Appendix A.

For faults on this feeder, resources patrol the feeder visually via adjacent roads and other access. Depending on weather and night/daytime, patrols may take several hours. Once the fault is found, emergency repairs are usually completed straight away. Typical storm/lightning faults are usually with the pole top; crossarm or insulators. Conductor or pole faults are less common.

Historical outage data indicates there is an average of 3.3 unplanned outages per annum. Due to the conditions and patrol requirements the average outage timeframe is approximately 3 hours. Maintaining a reliable supply is a key investment driver in determining network augmentation expenditure.

Examples of some of the longer outages that have occurred are detailed below:

5/01/2022: 25 hours; multiple pole failures during a storm and flooded access via creeks preventing crews access to site.

30/09/2021: 16 hours; Broken insulator at pole 21 during lightning and storm. Below shows the locations of the fault and the impact of that on the network downstream.

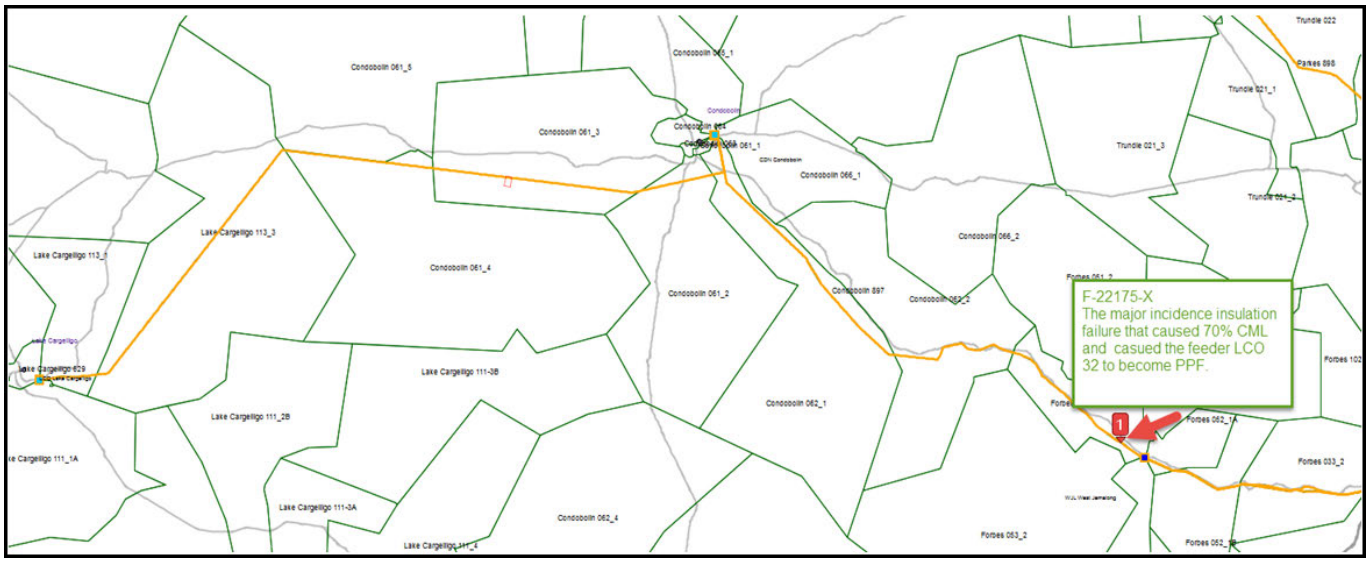

Figure 2 - Insulation failure INCD-23275-x and F-22175-x

18/12/21: 11 hours; T&R on WWL5B2, spring charge manual handle slide limit switch failed preventing reclose.

Further historical reliability data for this feeder can be found in Appendix A. Any faults on the radial 152km of the 66kV line from West Jemalong ZS via Condobolin ZS to Lake Cargelligo ZS, impacts the reliability of Lake Cargelligo customers.

The SAIDI and SAIFI of the LCO32 feeder is as shown in Figure 3. Out of the 2 feeders the longest feeder is 780km in length and the feeder with the highest number of customers is 1285.

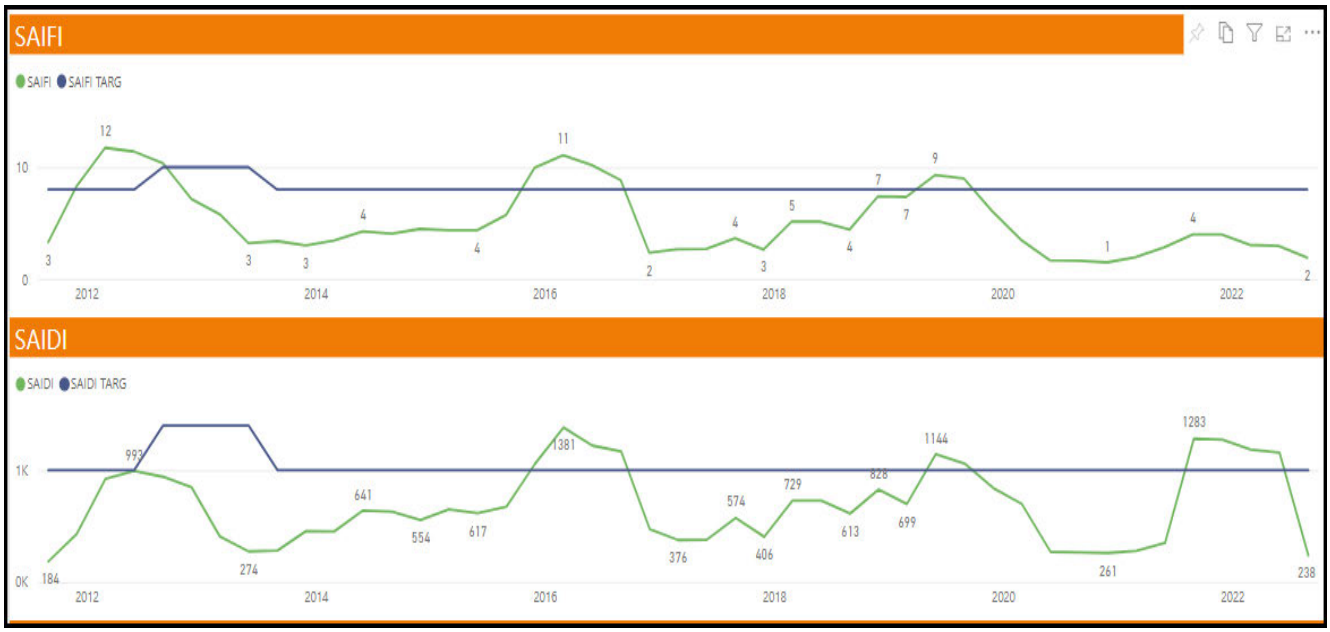

Figure 3 - SAIDI/SAIFI Performance of the LCO32 feeders

The breach of Licence Conditions reliability standards has occurred primarily due to SAIDI thresholds being exceeded. The feeder LCO32 has been non-compliant since Sept 2021 qtr. And has been frequently non-compliant in the past as show in Figure 3.

3.1 Climate Impact Assessment

This project forms part of our Resilience Plan (**Attachment 6.02**) and strengthening the resilience of the network. As shown in heatmap below (Figure 4) combined impact on asset failures due to bushfire, flood, and windstorm in this region is approximately 20% increase using RCP4.5 by 2070.

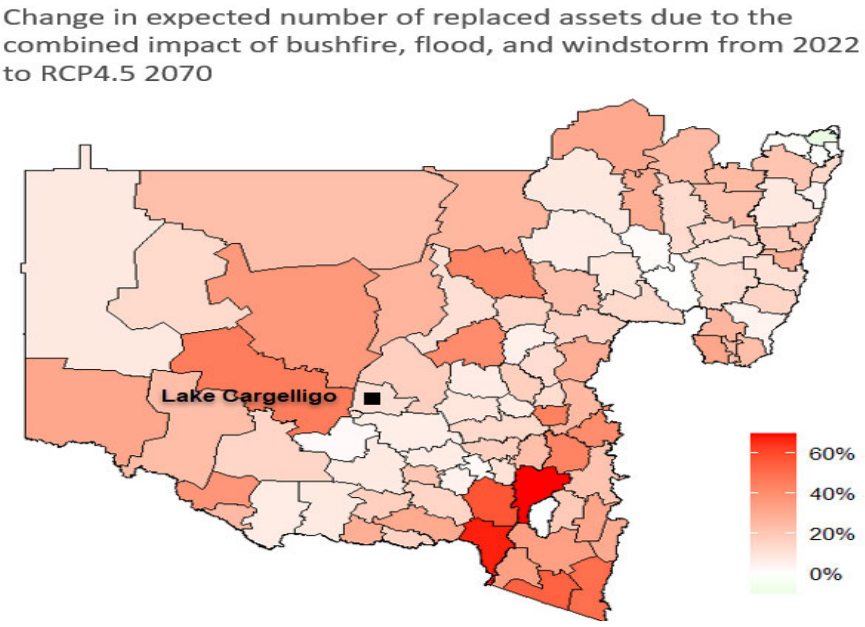

Figure 4 – Expected increase in asset replacement due of climate impact

(Attachment 6.01 Climate Impact Assessment)

The forecast climate impact due to windstorm on the number of failure of assets in Lake Cargelligo depot is shown below in Figure 5.

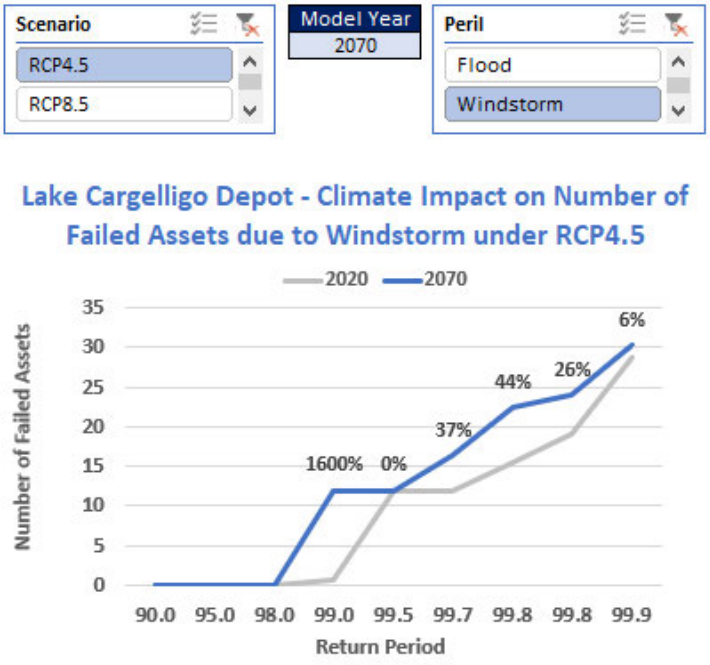

Figure 5 - Current and forecasted analysis of windstorm impact (Attachment 6.01.01 Climate Summary Line Graph)

Climate impact modelling **has not** been included in the NPV analysis for this project but does offer additional qualitative benefits.

4. Options Analysis

Several options were investigated to improve reliability in the Lake Cargelligo ZS. One of the options was for lightning protection, but it was ruled out of further analysis due to excessive capital costs due to the length of exposed network. The following three options below were compared via Net Present Value (NPV) analysis. NPV analysis considers both costs and benefits over typical life of asset (40 years). Costs include both capital and operating. The key benefit in this case is the Value of Customer Reliability (VCR).

Beyond reliability benefit other risk value benefits were considered as per Appraisal Value Framework (**Attachment 6.03.03**). The benefit of alleviating specific network risks such as safety, environment (bushfire), financial, reputation and compliance were also considered. A summary of the risk framework assessment is detailed below in Section 5

Table 1 includes the primary variable assumptions to calculate the Baseline risk of the overhead network supplying the Lake Cargelligo ZS.

Table 1 - Variables for Baseline Risk

Variable	Value	Source
Discount Rate	3.54%	Current internal rate for standard control CAPEX
Failure Rate of OH Line	3.7	Historical performance over the past seven years
Load Impacted	3.8MW	Average customer load on Lake Cargelligo ZS
Outage Timeframe	3hrs	Historical performance over the past seven years
NPV Period	40yrs	Current internal common modelling window

4.1 Option 1 - Diesel Generation- Lake Cargelligo ZS

This option has a capital cost of [redacted] and would require diesel powered generator units to be installed at the Lake Cargelligo ZS. The unit would be semi containerised standard 415V output and connect to the 22kV busbars at the zone substation via a 415V/22kV step-up transformer.

Considering peak demand, optimised generator protection and operation, one 4MVA unit would be installed at Lake Cargelligo ZS. The unit would have fuel storage for at least eight hours of running. The NPV analysis assumes the life of the generator to be 20 years, thus for the 40 year NPV analysis the cost of a replacement of the generator at 20 years has been considered. For the purpose of residual risk, a conservative assumed failure rate of 1 in 10 years has been included for the diesel generator in the event that the generator fails to supply the ZS.

Qualitative benefits exist for this option that have not been quantified in the NPV analysis. In particular generation will allow field staff to perform construction activities for both unplanned and planned outages. This benefits field staff in reducing time constraints on outage timeframes and the requirement to perform live-line work. Planned outages for customers will also reduce as the generator can be utilised during activities that can't be performed live. Fault and emergency response can be better planned (i.e. resources, materials etc) improving efficiencies.

On loss of the 66kV supply, the 22kV transformer circuit breakers would open, and generator start-up would occur within minutes.

Option 1 has estimated capital cost of [redacted] and 40-year NPV benefit of $10.5M with an adjustment to STPIS targets included in Service Target Performance Incentive Scheme (STPIS) Approach (Attachment 8.04).

4.2 Option 2 - Network Solution

The network solution would be to construct a new 66kV line between Anona and Lake Cargelligo to create a ring. This solution will reduce outage times but is restricted by the time taken to validate the fault and ensure the alternate supply can be safely and practically utilised.
The initial cost is very high; therefore this option was deemed economically unfeasible.

Option 2 has a capital cost estimated in excess of [redacted] and is deemed uneconomical.

4.3 Option 3 Battery Back-up Storage for Lake Cargelligo ZS

Battery storage would require installation of containerised battery banks at Lake Cargelligo ZS.
The battery banks would be connected directly to the 22kV network in Lake Cargelligo ZS. On loss of the 66kV supply, auto-changeover to the battery banks would occur. With a peak demand of 3.8MVA, the battery banks would

need significant capacity to provide backup supply over the extended unplanned outage periods, which is anticipated to be at least 24 hours.
The advantages of battery storage are they are fast acting sources of supply, they are relatively quick to install, can be extended readily and have low running cost. They can provide benefits beyond backup supply: stabilise the grid in frequency events and sale of spare capacity into the grid at high wholesale price points. Neither of these benefits can be considered as Essential Energy is not in a regulated position to do so. Disadvantages of batteries are they are relatively costly, and at this stage the battery life is expected to be less than 20 years. In comparison to other network options with typical asset life of 40 years, it is assumed the battery would be replaced after 20 years.
It is estimated that the average power consumption is 3.8MVA, for 24 hours requires a battery bank of 92MWh. This option has been ruled out of further analysis due to an estimated capital cost of [redacted], with an expected cost of [redacted] per MWh based on energy storage costs received from Essential Energy network battery trial project in 2022.

Option 3 has a capital cost estimated in excess of [redacted] and is deemed not economical without subsidies or grants.

4.4 Option 4 Market led Non-Network Solution

The requirements to improve resilience and reliability to the Lake Cargelligo ZS may be advertised via an EOI process to enable the market to respond with alternative non-network solutions. The response from the market could include another option not previously investigated by Essential Energy and could include other market benefits driven from 3rd party owned solutions. The basis of the EOI will be to request alternative energy storage and backup power solutions under any business model and operational conditions to ensure all new solutions can be assessed. Because of this approach, submissions may need to be reviewed against any applicable regulatory rules and if a solution is deemed to be economically viable, engagement with regulators may be required. Solutions from this market exercise will then be assessed against network solutions.

As such, Option 4 does not have NPV analysis at this stage but will be considered as part of the project development.

4.5 Recommended Option

In recommending a preferred option, the initial capital costs are considered along with the NPV analysis of overall 40-year benefit which is primarily based on improved reliability.

Option 2 has a capital cost estimated in excess of [redacted] and is deemed not economical.

Option 3 has been evaluated as not being economically viable solution due to the high initial and cyclical capex cost.

Option 4 will be evaluated prior to Essential Energy commencing the project to ensure up to date market pricing and solutions are used in the final evaluation.

Option 1 diesel generation is currently the recommended option due to lower capital cost, and positive NPV benefit over a 40 year period.

5. Risk Framework

Essential Energy's Corporate Risk Management Procedure (**Attachment 6.03.01**) and Network Risk Management Manual (**Attachment 6.03.02**) underpins network investments in line with the risk Appraisal Value Framework (**Attachment 6.03.03**) and provide a consistent approach to network asset risk management and augmentation evaluation. The purpose of the procedures is to estimate the level of risk via probability of failure, likelihood of consequence and evaluate cost of consequence for network investments. The framework looks at overall network risk across six key areas: Safety, Network (Reliability), Environment, Compliance, Reputation and Financial.

5.1 Safety

Safety consequence considers the risk to both public and Essential Energy personnel. The existing risk in this case is live conductor dropping to the ground mostly from storm activity or possible vehicular contact with pole, leading to possible injury or fatality. The protection equipment which opens the feeder when conductor drops to the ground is fast acting and reinforced by secondary backup equipment if primary equipment fails. Although the consequence is severe, the probability of failure and likelihood of consequence deems the risk to public and personnel safety to be acceptable. Options 1 and 3 offer reliability and resilience to the network and will allow repair/maintenances work to be done as best as possible as without a negative impact on the customers in the ZS. Option 2 solution will reduce the outage for the ZS caused by equipment failure only. Unplanned outages due to weather and subtransmission failures will still be an ongoing issue, hence, the network solution may not be the ideal solution. Due to the low probability and likelihood of consequence a value for Safety has been deemed negligible and excluded from the NPV for all options.

5.2 Network (Reliability)

Network risk captures the consequences associated with loss of supply. As noted above in Section 3 Reliability, the existing reliability to customers supplied by Lake Cargelligo ZS is the main risk that is addressed in this network investment evaluation. The probability of failure and the consequence associated with loss of supply are relatively straight forward and readily valued, via average unplanned outages rates and VCR. Loss of supply is assessed utilising the historic failure rate and length projected forward utilising a Value of Customer Reliability (VCR) [1] based on 6.03.03 Appraisal Value Framework.

5.3 Environmental

The prevalent environmental risk is bushfire. As a pole top/conductor fails and live conductor touches the ground, it may, dependant on conditions and environment ignite fire, causing property damage. Essential Energy uses the Phoenix Rapid Fire system and internal modelling to determine a fire risk per pole. The area between Condobolin and Lake Cargelligo is deemed to be a moderate bushfire risk. All three proposed augmentation options have the existing feeder remain in service. Although the consequence is moderate, the probability of failure and likelihood of consequence deems the risk to be acceptable. Other environmental risks would be transformer oil and diesel fuel spillage. Essential Energy complies to all relevant standards with oil containment and fuel storage. The risk and consequences associated with transformer oil and diesel fuel is negligible and acceptable. Due to a lack of difference between baseline and residual risks environmental risk has been excluded from the NPV.

5.4 Compliance

Compliance risk is assessed for issues that may arise because of not complying to relevant Standards, Acts or Guidelines. Essential Energy complies to all relevant Standards and Acts. There is no compliance risk that needs to be addressed.

5.5 Reputation

Reputational consequences are categorised as those risks associated with the tarnishing of the company's reputation as the result of mostly, in this case, ongoing loss of supply due to overhead asset failure. This investment will address some of the risk associated with Lake Cargelligo ZS having long outage durations.

[1] AER Values of Customer Reliability Final report on VCR values Dec 2019

5.6 Financial

Financial consequences, in this case, are generally those costs associated with fault and emergency work, over-and-above typical planned maintenance costs. Ongoing asset failure has a consequence of ongoing fault and emergency work, which could be costly if the annual probability of failure was significant and increasing exponentially. The existing 66kV network will remain in service. The addition of new assets (Diesel Generator, switchgear, control, and communication devices) will require maintenance. The generator will require regular maintenance to ensure that it will be able to perform as expected. The life of the generator is expected to be 20 years.

References

Doc No.	Document Name	Relevance
1	Lake Cargelligo Generator NPV.xlsx	NPV Option Analysis
2	4.02 How Engagement Informed our Proposal	Reference material, justification
3	6.01 Climate impact assessment	Reference material
4	6.01.01 Climate summary line graph	Reference material
5	6.02 Resilience Plan	Reference material
6	6.03.01 Corporate Risk Management Procedure	Reference material
7	6.03.02 Network Risk Management Manual	Reference material
8	6.03.03 Appraisal Value Framework	Reference material, risk evaluation
9	8.04 Service Target Performance Incentive Scheme (STPIS) Approach	STPIS target adjustment

Key Terms and Definitions

Term	Definition
$M	Dollars expressed in millions
CML	Customer Minutes Lost
DNSP	Distribution Network Service Provider
FY	Financial Year
MW	MegaWatt
NPB	Net Present Benefit (Benefits over 40-year expressed in present value)
NPC	Net Present Cost (Capital and operation costs over 40-year expressed in present value)
NPV	Net Present Value
NPVM	Net Present Value to Market (NPB subtract NPC)
RIT-D	Regulatory Investment Test – Distribution
VCR	Value of Customer Reliability
VUE	Value of Unserved Energy

Appendix A – Historic unplanned outages for Lake Cargelligo ZS

DATE	REGIC	EQUIPMENT	CAUSE	START TIMI	FINISH TIMI	TOTAL CUST AI	TOTAL LC	Sub Trans Y/N	IR	Min	LCM
Wed 05/01/22	Central	Pole - HV Failed	Environ - Weather - High Winds	05/01/22 20 20	06/01/22 20 55	3000	3407502	Y	INCD-102445-q	1475	4424500
Wed 05/01/22	Central	Pole - HV Failed	Environ - Weather - High Winds	05/01/22 20 20	06/01/22 20 55	617	778747	Y	INCD-102445-q	1475	909972
Fri 30/12/16	Southern	CB	NF - Likely Weather - Wind	30/12/16 18 09	31/12/16 11 51	4404	358781	Y	INCD-1364988-a	1062	4676681
Fri 30/12/16	Southern	CB	NF - Likely Weather - Wind	30/12/16 18 09	31/12/16 11 51	4404	358781	Y	INCD-1364988-a	1062	4676681
Thu 30/09/21	Central	Insulator Failed	Environ - Weather - Lightning	30/09/21 19 28	01/10/21 11 20	2648	2372198	Y	INCD-23249-x	951	2518601
Thu 30/09/21	Central	Insulator Failed	Environ - Weather - Lightning	30/09/21 19 28	01/10/21 11 20	1495	1346995	Y	INCD-23249-x	951	1421944
Fri 02/11/18	Northern	Pole - HV Failed	Environ - Weather - High Winds	02/11/18 17 18	03/11/18 08 58	2610	420416	Y	INCD-1981617-a	941	2455010
Mon 13/03/17	Northern	Conductor - HV Failed	Environ - Weather - Lightning	13/03/17 11 17	14/03/17 01 51	2663	495991	N	INCD-54166-g	874	2327373
Sat 18/12/21	Central	Sectionaliser / Recloser Fa	Environ - Weather - Lightning	18/12/21 17 22	19/12/21 04 07	645	348056	Y	INCD-97416-q	644	415584
Fri 14/04/17	Southern	Pole - HV Failed	Environ - Fire - Bush	14/04/17 13 42	15/04/17 00 16	2972	1319834	Y	INCD-55571-g	634	1883356
Wed 27/02/13	Southern	Pole - HV Failed	Environ - Weather - Lightning	27/02/13 23 48	28/02/13 09 37	946	272044	N	INCD-8363-g	589	557194
Fri 14/04/17	Southern	Pole - HV Failed	Environ - Fire - Bush	14/04/17 13 42	14/04/17 23 16	653	365862	Y	INCD-55571-g	574	374626
Mon 20/03/17	Southern	Conductor - HV Failed	Environ - Weather - Lightning	20/03/17 20 52	21/03/17 06 11	2924	312868	Y	INCD-1445471-a	558	1631738
Sat 27/01/18	Southern	Pole - HV Failed	Environ - Weather - Lightning	27/01/18 10 55	27/01/18 19 17	2939	1467661	Y	INCD-64373-g	502	1475378
Sat 27/01/18	Southern	Pole - HV Failed	Environ - Weather - Lightning	27/01/18 10 55	27/01/18 19 17	650	322400	Y	INCD-64373-g	502	326300
Mon 13/03/17	Northern	Conductor - HV Failed	Environ - Weather - Lightning	13/03/17 11 17	13/03/17 18 39	1461	241289	N	INCD-54166-g	442	645713
Wed 06/04/16	Southern	Pole - HV Failed	Environ - Fire - Bush	06/04/16 14 02	06/04/16 20 17	609	227965	Y	INCD-40759-g	374	228050
Sat 20/04/19	Central	Conductor - HV Failed	Equip - Fatigue	20/04/19 11 07	20/04/19 16 55	1466	510168	Y	INCD-2110284-a	348	510559
Mon 15/02/16	Northern	Pole - HV Failed	Environ - Fire - Bush	15/02/16 20 38	16/02/16 02 10	1456	483392	Y	INCD-1094352-a	332	483416
Thu 23/03/17	Northern	Transmission System Fault	Environ - Weather - Lightning	23/03/17 11 39	23/03/17 17 08	2663	251472	N	INCD-54721-g	329	875106
Wed 19/12/18	Southern	Cross-arm - Failed	Equip - Decay or Rot	19/12/18 04 18	19/12/18 09 38	157357	157357	N	INCD-2024530-a	321	50506352
Wed 19/12/18	Southern	Cross-arm - Failed	Equip - Decay or Rot	19/12/18 04 18	19/12/18 09 38	34450	34450	N	INCD-2024530-a	321	11057302
Sat 31/10/15	Southern	Conductor - HV Failed	Environ - Weather - High Winds	31/10/15 02 00	31/10/15 06 48	654	175008	Y	INCD-34470-g	288	188297
Tue 12/02/19	Central	Conductor - HV Failed	Equip - Fatigue	12/02/19 20 08	13/02/19 00 52	1467	416628	Y	INCD-2076150-a	285	417459
Fri 09/03/12	Southern	Conductor - HV Failed	Equip - Mid Span Splice Failure	09/03/12 07 36	09/03/12 11 43	2285	453695	Y	INCD-1685248-G	247	564395
Fri 09/03/12	Southern	Conductor - HV Failed	Equip - Mid Span Splice Failure	09/03/12 07 36	09/03/12 11 43	1407	255142	Y	INCD-1685248-G	247	347529
Sat 19/10/13	Southern	Pole - HV	Urgent Network Repair	19/10/13 00 31	19/10/13 04 31	1320	316800	Y	INCD-14692-g	240	316404
Sun 11/03/18	Southern	Cross-arm	Urgent Network Repair	11/03/18 09 01	11/03/18 12 58	135	31995	N	INCD-65682-g	237	32058
Mon 20/03/17	Southern	Conductor - HV Failed	Environ - Weather - Lightning	20/03/17 20 52	21/03/17 00 49	651	69657	Y	INCD-1445471-a	237	154124
Sat 19/10/13	Southern	Pole - HV	Urgent Network Repair	19/10/13 00 31	19/10/13 04 23	2437	565384	N	INCD-14690-g	232	565100
Wed 19/12/18	Northern	CB	Environ - Weather - Lightning	19/12/18 15 55	19/12/18 19 46	141746	141746	Y	INCD-2024815-a	231	32743326
Wed 19/12/18	Northern	CB	Environ - Weather - Lightning	19/12/18 15 55	19/12/18 19 46	76336	76336	Y	INCD-2024815-a	231	17633616
Mon 14/04/14	Southern	Conductor - HV	Other - Specify in comments	14/04/14 11 35	14/04/14 15 12	2467	535339	Y	INCD-20069-g	217	535339
Mon 14/04/14	Southern	Conductor - HV	Other - Specify in comments	14/04/14 11 35	14/04/14 15 12	1341	290997	Y	INCD-20069-g	217	290997
Sun 07/01/18	Northern	Cross-arm - Failed	Environ - Weather - Lightning	07/01/18 17 48	07/01/18 21 19	2666	517705	Y	INCD-63468-g	211	562526
Sun 07/01/18	Northern	Cross-arm - Failed	Environ - Weather - Lightning	07/01/18 17 48	07/01/18 21 19	1394	292414	Y	INCD-63468-g	211	294134
Thu 06/01/22	Central	Unknown - No Fault Found	NF - Likely Weather - Lightning	06/01/22 02 16	06/01/22 05 44	1475	306800	N	INCD-102507-q	208	307120
Fri 13/11/15	Northern	Cross-arm - Failed	Environ - Weather - Lightning	13/11/15 16 29	13/11/15 19 50	2685	505314	Y	INCD-35185-g	201	539730
Fri 13/11/15	Northern	Cross-arm - Failed	Environ - Weather - Lightning	13/11/15 16 29	13/11/15 19 50	1478	276375	Y	INCD-35185-g	201	296733
Wed 20/12/17	Southern	Unknown - No Fault Found	NF - Specify in comments	20/12/17 14 42	20/12/17 17 52	650	119126	N	INCD-62995-g	190	123500
Tue 19/05/15	Southern	Insulator Failed	Environ - Weather - Lightning	19/05/15 17 48	19/05/15 20 51	1315	240645	Y	INCD-28955-g	183	240842
Mon 21/10/13	Southern	Unknown - No Fault Found	NF - Likely Weather - Lightning	21/10/13 19 06	21/10/13 22 09	1320	241560	N	INCD-364449-a	182	240658
Tue 19/05/15	Southern	Insulator Failed	Environ - Weather - Lightning	19/05/15 17 48	19/05/15 20 50	2425	441350	Y	INCD-28955-g	181	439855
Tue 09/01/18	Northern	Conductor - HV	Environ - Weather - Lightning	09/01/18 14 37	09/01/18 17 37	2970	463322	Y	INCD-1713079-a	180	534600
Tue 09/01/18	Northern	Conductor - HV	Environ - Weather - Lightning	09/01/18 14 37	09/01/18 17 37	1462	255850	Y	INCD-1713079-a	180	263160
Mon 21/10/13	Southern	Unknown - No Fault Found	NF - Likely Weather - Lightning	21/10/13 19 06	21/10/13 22 02	2436	428736	N	INCD-364449-a	175	427071
Sun 20/12/15	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	20/12/15 21 19	21/12/15 00 10	2685	427556	Y	INCD-1046224-a	172	461014
Sun 20/12/15	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	20/12/15 21 19	21/12/15 00 10	1478	235467	Y	INCD-1046224-a	172	253773
Fri 10/01/20	Central	Conductor - HV	Environ - Weather - High Winds	10/01/20 21 12	11/01/20 00 03	1474	252054	Y	INCD-8180-q	171	252373
Fri 10/01/20	Central	Conductor - HV	Environ - Weather - High Winds	10/01/20 21 12	10/01/20 23 59	2513	406691	Y	INCD-8180-q	167	420383
Wed 27/02/13	Southern	Pole - HV Failed	Environ - Weather - Lightning	27/02/13 23 48	28/02/13 02 35	2714	444410	N	INCD-140459-a	167	453238
Tue 01/03/16	Southern	Conductor - HV	Unauth Contact - Other	01/03/16 16 00	01/03/16 18 46	643	105782	Y	INCD-39299-g	166	106642
Wed 24/01/18	Southern	CB	Environ - Weather - Lightning	24/01/18 10 29	24/01/18 12 39	650	84014	Y	INCD-64157-g	130	84500
Mon 04/01/21	Central	CB	Environ - Weather - Lightning	04/01/21 11 21	04/01/21 13 28	1478	187706	Y	INCD-14316-x	127	187435
Thu 23/03/17	Northern	Transmission System Fault	Environ - Weather - Lightning	23/03/17 11 39	23/03/17 13 44	1461	182625	N	INCD-54721-g	125	182625
Mon 04/01/21	Central	CB	Environ - Weather - Lightning	04/01/21 11 21	04/01/21 13 24	2664	327672	Y	INCD-14316-x	123	328960
Thu 25/01/18	Northern	Conductor - HV	Environ - Weather - Lightning	25/01/18 15 39	25/01/18 17 32	2667	287034	N	INCD-64257-g	113	301371
Thu 25/01/18	Northern	Conductor - HV	Environ - Weather - Lightning	25/01/18 15 39	25/01/18 17 32	1462	165206	N	INCD-64257-g	113	165206
Sat 19/03/16	Northern	Cross-arm - Failed	Equip - Weathered/Decayed	19/03/16 14 19	19/03/16 16 11	1458	163296	Y	INCD-40043-g	112	163806
Sat 18/06/16	Southern	Cross-arm - Failed	Equip - Decay or Rot	18/06/16 08 55	18/06/16 10 44	645	70305	N	INCD-43607-g	109	70305
Tue 14/05/19	Central	Unknown - No Fault Found	NF - Likely Animals - Bird	14/05/19 06 34	14/05/19 08 22	2666	282075	Y	INCD-2113412-a	109	289794
Sat 30/03/19	Central	CB	NF - Likely Network - Protection	30/03/19 02 41	30/03/19 04 28	2974	310094	N	INCD-2107506-a	107	317276
Tue 14/05/19	Central	Unknown - No Fault Found	NF - Likely Animals - Bird	14/05/19 06 34	14/05/19 08 17	1467	151101	Y	INCD-2113412-a	103	151174
Mon 27/03/17	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	27/03/17 19 40	27/03/17 21 20	2663	264485	Y	INCD-1452820-a	100	266078
Mon 27/03/17	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	27/03/17 19 40	27/03/17 21 17	1461	141717	Y	INCD-1452820-a	97	141985
Fri 02/11/18	Northern	Pole - HV Failed	Environ - Weather - High Winds	02/11/18 17 18	02/11/18 18 48	1438	129420	Y	INCD-1981617-a	91	130211
Sat 26/01/19	Southern	Conductor - HV	Environ - Weather - Lightning	26/01/19 18 08	26/01/19 19 32	2969	249396	Y	INCD-2059005-a	84	250831
Sat 26/01/19	Southern	Conductor - HV	Environ - Weather - Lightning	26/01/19 18 08	26/01/19 19 32	650	54600	Y	INCD-2059005-a	84	54914
Mon 07/01/19	Southern	Conductor - HV	Veg - Trees Blown into Cond.	07/01/19 20 51	07/01/19 22 15	2970	249480	Y	INCD-2038570-a	84	249480
Mon 07/01/19	Southern	Conductor - HV	Veg - Trees Blown into Cond.	07/01/19 20 51	07/01/19 22 15	642	53928	Y	INCD-2038570-a	84	53928
Wed 18/10/17	Southern	Cross-arm - Failed	Equip - Fatigue	18/10/17 09 47	18/10/17 11 07	651	51264	N	INCD-1636183-a	79	51679
Wed 18/10/17	Southern	Cross-arm - Failed	Equip - Fatigue	18/10/17 09 47	18/10/17 11 04	2952	220129	N	INCD-1636183-a	77	227009
Wed 16/06/21	Central	Conductor - HV	Environ - Weather - Lightning	16/06/21 19 08	16/06/21 20 23	2595	189435	Y	INCD-19844-x	75	194712
Wed 16/06/21	Central	Conductor - HV	Environ - Weather - Lightning	16/06/21 19 08	16/06/21 20 23	1448	108600	Y	INCD-19844-x	75	108648
Wed 10/10/18	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	10/10/18 18 40	10/10/18 19 46	2672	171281	Y	INCD-71450-g	67	178222
Wed 10/10/18	Northern	Unknown - No Fault Found	NF - Likely Weather - Lightning	10/10/18 18 40	10/10/18 19 42	1463	90706	Y	INCD-71450-g	62	90706
Fri 30/06/17	Southern	Isolator	Animal - Bird	00/01/00 10 48	00/01/00 11 45	2947	167979	N	INCD-57964-g	57	167979
Tue 05/02/19	Central	CB	Environ - Weather - High Winds	05/02/19 18 01	05/02/19 18 49	1465	70320	Y	INCD-2068995-a	48	69929
Mon 01/12/14	Southern	CB	Environ - Weather - Lightning	01/12/14 20 20	01/12/14 21 02	1346	37808	Y	INCD-701875-a	42	56128
Sat 14/02/15	Southern	Conductor - HV	Environ - Weather - High Winds	14/02/15 19 22	14/02/15 20 01	3667	133013	N	INCD-768481-a	39	144113
Sat 14/02/15	Southern	Conductor - HV	Environ - Weather - High Winds	14/02/15 19 22	14/02/15 20 01	3667	133013	N	INCD-768481-a	39	144113
Thu 12/11/15	Northern	Conductor - HV	Environ - Weather - Lightning	12/11/15 16 17	12/11/15 16 56	1478	53625	Y	INCD-1009316-a	39	57470
Wed 22/02/12	Southern	Conductor - HV	NF - Likely Weather - Lightning	22/02/12 15 14	22/02/12 15 52	2589	71306	Y	INCD-59302-s	37	96483
Wed 22/02/12	Southern	Conductor - HV	NF - Likely Weather - Lightning	22/02/12 15 14	22/02/12 15 52	558	21204	Y	INCD-59302-s	37	20795
Thu 12/11/15	Northern	Conductor - HV	Environ - Weather - Lightning	12/11/15 16 17	12/11/15 16 54	2685	87092	Y	INCD-1009316-a	37	99569
Wed 19/02/14	Southern	Transmission System Fault	Environ - Weather - Lightning	19/02/14 14 18	19/02/14 14 53	2659	69054	N	INCD-476473-a	36	94395
Fri 08/02/19	Central	CB	Environ - Weather - Lightning	08/02/19 18 42	08/02/19 19 16	1460	49640	Y	INCD-2072149-a	35	50905
Fri 08/02/19	Central	CB	Environ - Weather - Lightning	08/02/19 18 42	08/02/19 19 15	2479	79189	Y	INCD-2072149-a	34	84121
Sun 07/10/12	Southern	CB	Animal - Bird	07/10/12 09 36	07/10/12 10 10	1252	42568	N	INCD-62491-s	34	42338
Wed 01/02/12	Southern	CB	NF - Likely Animals - Bird	01/02/12 06 29	01/02/12 07 02	2306	46120	Y	INCD-1641963-G	33	75560
Wed 01/02/12	Southern	CB	NF - Likely Animals - Bird	01/02/12 06 29	01/02/12 07 02	1267	41811	Y	INCD-1641963-G	33	41515