Retirement of Sadadeen 22 kV switchboard

Non-network options notice

Notice of Determination under clause 5.17.4(c) of the Northern Territory National Electricity Rules

PowerWater

Contents

1. Summary

This document is Power and Water Corporation's (Power and Water) notice of its determination that there are no credible non-network or Stand Alone Power System (SAPS)[1] options to address all or part of the identified need at Sadadeen (SD) zone substation in Alice Springs. Power and Water's determination is made under clause 5.17.4(c) of the National Electricity Rules and is published pursuant to clause 5.17.4(d).

In accordance with those provisions, Power and Water will not publish a non-network options screening report in relation to the proposed works at Sadadeen zone substation.

Further, pursuant to clause 5.17.4(n), Power and Water will progress directly to the Final Project Assessment Report based on the estimated cost of the preferred option being less than the threshold of $12 million specified by the AER[2].

1.1 Identified network issue

The 22 kV switchboard at Sadadeen zone substation in Alice Springs is at end-of-life and investment is required to manage the risk to network reliability and security. As such, the network need relates to a reliability corrective action as defined in the Australian Energy Regulator's (AER) Regulatory Investment Test for Distribution (RIT-D) guidelines.

The primary network issue is the deteriorated condition of the 22 kV switchboard at Sadadeen zone substation as identified by increasing partial discharge[3] on the switchboard bus. Compounding this issue is a lack of spare parts to maintain the asset, a high number of recent asset failures and condition issues of the associated assets, including the distribution feeder protection relays and the switchboard building.

The poor asset condition has been operationally managed since 2008, however without sufficient spare parts available, it is not possible to continue to maintain the asset.

The consequences of asset failure are safety risk to our field crews, reduced network security and capacity constraints resulting in significant outages to our customers.

1.2 Options assessment

Power and Water has identified five network solutions, including the 'Do nothing' counterfactual that will require further analysis as part of the Final Project Assessment Report. We have defined this as the 'base case' as required under the AER's RIT-D guidelines. Two additional network solutions identified, have been rejected as not credible following initial assessment.

A detailed assessment undertaken of non-network solutions, as presented in this report, found there are no credible non-network solutions that address the identified need within the identified timeframe and are technically and commercially feasible.

[1] We note that a recent rule change requiring the consideration of SAPS is not operational under the NT NER.

[2] Australian Energy Regulator, 2021 RIT and APR cost thresholds review – Final Determination, November 2021, Table 3.

[3] Partial discharge is a localised arcing between 2 surfaces (an active phase and earth or 2 active phases) when there is insufficient insulation. The arcing does not completely bridge the gap/insulation between the 2 surfaces, hence being termed partial. It causes damage to the insulation so over time it will result in a fault occurring between the 2 surfaces.

1.3 Further information

Please direct any question regarding this notice or requests for further information to:

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2. Background

2.1 The Alice Springs network

The Alice Springs network is relatively small, providing power to over 10,000 residential households and close to 2,000 business customers. The MacDonnell Ranges pass along the south of Alice Springs and geographically splits the 2 regions. The suburb known as The Gap has a natural valley through the ranges and is the primary connection between the 2 regions including the electricity network.

Figure 1 provides an indicative overview of the network and Figure 8 (refer to Appendix A) provides an aerial view that highlights the impact of The Gap. Subtransmission is supplied at 66 kV from Owen Springs Power Station (OSPS) to Lovegrove zone substation. North of The Gap is supplied at 11 kV and is comprised of the Alice Springs CBD, older commercial areas and the majority of residential customers. South of The Gap are predominantly commercial and industrial customers supplied at 22 kV. Most future load growth, including future residential development, is expected south of The Gap.

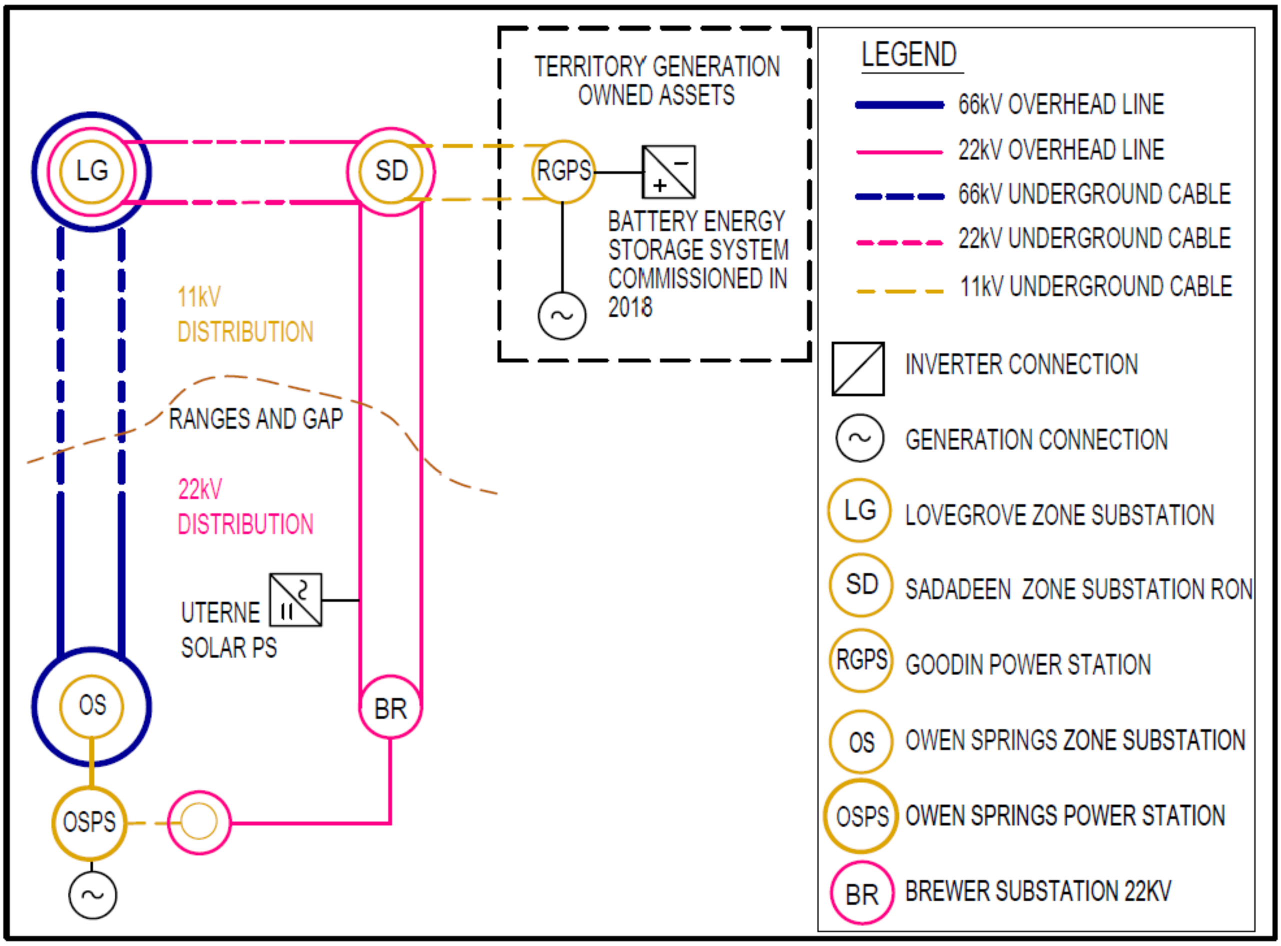

Figure 1 Simplified single line network diagram for Alice Springs

Prior to the construction of OSPS, Ron Goodin Power Station (RGPS) was the primary generator with support from the Brewer Generator (now decommissioned) and the network consisted of only 22 kV and 11 kV voltages. OSPS, commissioned in 2011, introduced the 66 kV assets for the subtransmission voltage. The additional voltage level has resulted in a more complex network topology.

The subtransmission network connects OSPS to Lovegrove Zone Substation and provides the majority of the capacity to Alice Springs. However, there is a transformer at the old Brewer generation site that provides supply at 22 kV directly to the 22 kV network south of The Gap. The Brewer transformer is limited to approximately 8 MVA due to cable capacity constraints and to maintain control of network voltage.

2.2 Retirement of Ron Goodin Power Station

OSPS is the primary power station with a firm capacity of 90 MVA that is sufficient to supply the total demand of the network. As a result, RGPS is scheduled to be retired.

Territory Generation (TGen) first identified RGPS for retirement in their 2019-20 Statement of Corporate Intent. RGPS has remained in service due to system black requirements, however recent consultation has identified that the need for retaining RGPS no longer exists. Expected retirement is around 2025-26, with the exact date yet to be confirmed.

Additional issues contributing to the retirement decision include:

- Noise and pollution abatement due to encroachment of residential development.
- Government decision not to install any new generation at the RGPS site and locate all new generation at OSPS.
- Deteriorated condition of the 1973 commissioned generators.
- Inefficiency of the generators and cost of the diesel fuel required.

While OSPS has sufficient capacity to meet the forecast demand at a whole of network level, even with RGPS retiring, existing embedded generation capacity on the 11 kV and 22 kV network will decrease and result in potential constraints, as discussed in section 3.2.

2.3 Capacity to meet system demand

Figure 2 shows the load duration curve for the entire Alice Springs network. The load duration curve is calculated from 30-minute load data from 1 July 2020 to 30 June 2021 and shows the period time, as a percentage of the year, that the load on the network exceeds the corresponding demand on the y-axis.

The N capacity represents the capacity available with all transformers in service, namely the two 66/22 kV 45 MVA transformers located at Lovegrove zone substation and the 11/22 kV 8 MVA Brewer transformer[4]. The N-1 capacity represents the capacity available if there is an outage on one of the 2 Lovegrove transformers.

The load duration curve shows there is no load at risk from a whole of network perspective. However, as discussed in section 3.2.3, there is some load at risk at a local level within the network.

Figure 3 also shows that overall, there is no significant forecast demand growth in the next 10 years. The demand on the 11 kV network north of The Gap is forecast to decrease slightly, while demand on the 22 kV network south of The Gap is forecast to increase slightly.

[4] The Brewer transformer is supplied directly from OSPS at 11 kV and steps up the voltage to 22 kV, therefore it provides additional capacity to the Alice Springs system in addition to Lovegrove zone substation. It does not have a tap changer so is unable to effectively control network voltage and limits its use operationally.

Power and Water has therefore concluded that there is insignificant risk regarding overall capacity to supply the Alice Springs network.

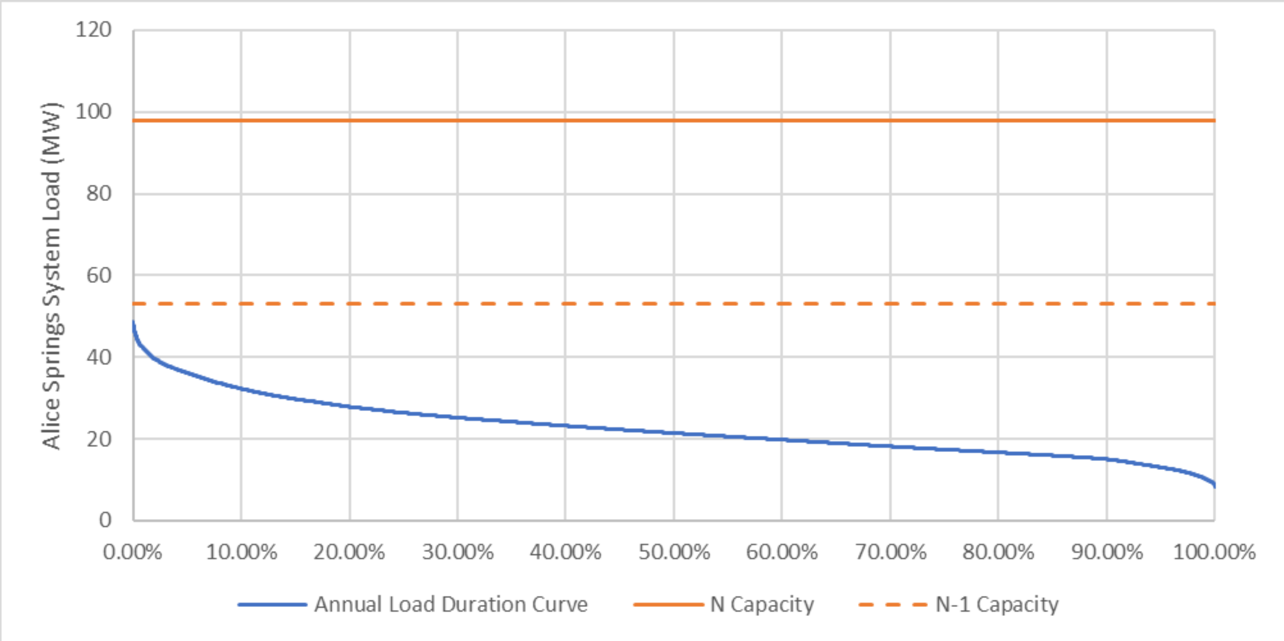

Figure 2 Load duration curve for the whole Alice Springs network for FY22

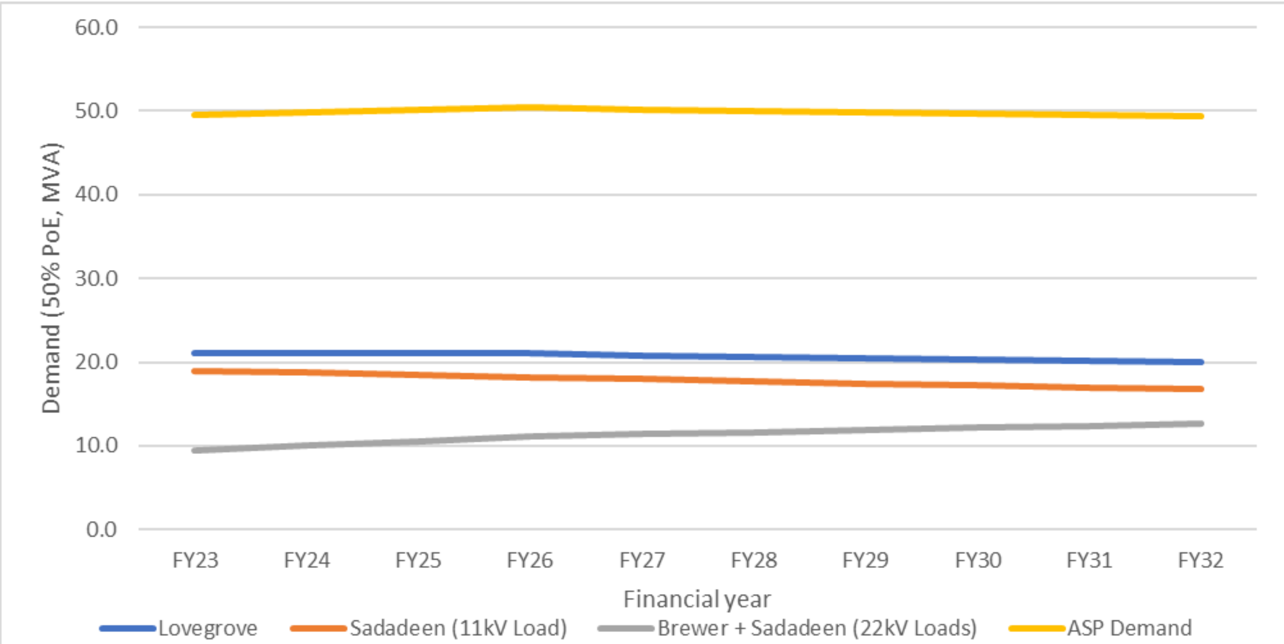

Figure 3 Forecast demand by zone substation and distribution voltage

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2.4 Load transfer capability

The load transfer was considered under N, N-1 and N-2 scenarios. Failure of the Sadadeen switchboard, considered a credible event for the reasons described in section 3 below, would cause an N-2 scenario as it will result in total loss of supply at Sadadeen because both express ties supplying Sadadeen are connected at 22 kV (refer to Figure 4 below).

There is capacity at Lovegrove zone substation at 11 kV and on the 11 kV distribution network to transfer load from the Sadadeen 11 kV switchboard to Lovegrove under N and N-1 scenarios. However, once RGPS is retired there will be a shortfall in capacity of approximately 8.5 MVA under a N-2 scenario. This is due to the capacity of the 22/11 kV transformers at Lovegrove zone substation and distribution network constraints.

On the 22 kV network, there is currently sufficient transfer capacity under N, N-1 and N-2 scenarios. However, the forecast load growth on the 22kV network means that there will be an increasing shortfall of supply capacity in the future.

Further information on the capacity required to address these shortfalls in transfer capacity is provided in section 3.2.

3. Identified need

Power and Water has assessed the Sadadeen 22 kV switchboard to be at end-of-life based on the condition of the asset and history of failures. The deteriorated condition of this asset presents a risk to the reliable and secure operation of a significant part of the Alice Springs distribution network.

3.1 Deteriorated asset condition

The Sadadeen 22 kV switchboard is a 33-year-old indoor switchboard with SF6 insulation that consists of 2 buses. It has two 22 kV feeders from Lovegrove zone substation, supplies three feeders at 22 kV (Jay Creek feeder is not in service) and three 22/11 kV transformers. There is one generator, Set 9 from RGPS, connected. The single line diagram is shown in Figure 4**.**

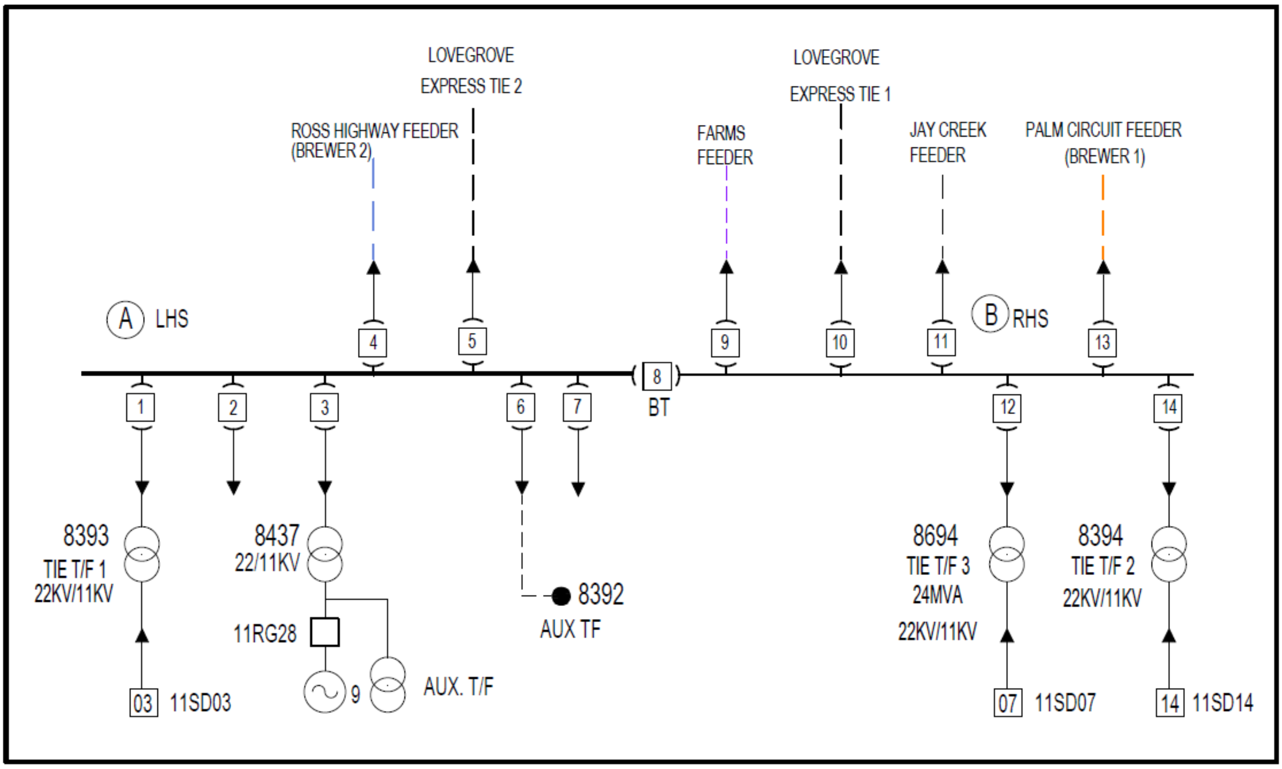

Figure 4 Single line diagram for the Sadadeen 22kV switchboard

There are multiple issues identified on the switchboard that result in both network reliability and health and safety hazards:

Partial discharge

- The switchboard is a Yorkshire YSF6 type exhibiting significant partial discharge across various parts of the board and circuit breaker trucks. The partial discharge issue on this make and model of switchboard has been observed across the electricity industry. The issue is attributed to the switchboard design resulting in significant electrical stress on specific parts, exacerbated by high humidity. Even when reduced through environmental controls, the low levels of partial discharge continue to deteriorate the insulation and increases the probability of a fault and asset failure when environmental conditions change, even for very brief periods. The result is a considerable reduction in serviceable life of the switchboard compared to industry expectations.

- The partial discharge is highest on the right-hand side (Bus B), which also is the most critical bus as it supplies 2 transformers for the 11kV network and 3 feeders to the 22kV network.
- In 2022, the Sadadeen switchboard was fitted with an online partial discharge monitoring system that provides data for analysis. Power and Water commissioned EA Technologies[5] to undertake analysis of the data recorded so far. The analysis found 5 instances of partial discharge recorded that were severe enough to require inspection and further investigation:
  - Multiple transient events between 15 July 2022 and 23 March 2023 on 22RG01 transformer 1 coupling and cable box.
  - Ongoing partial discharge identified on the spare circuit breaker 22RG02.
  - Ongoing partial discharge was recorded on the spare circuit breaker 22RG07.
  - Ongoing partial discharge identified on the bus tie and bus bars on 22RG 08.
  - Ongoing events recorded on 22RG12 transformer 3 coupling and cable box.

  Partial discharge should not occur within air insulated areas of a switchboard and is a lead indictor of asset deterioration. Any partial discharge is detrimental to the insulation system and overtime will eventually lead to failure.

  This switchboard is susceptible to high levels of partial discharge, which increases the probability of in-service failure.
- There are also water ingress issues with the building that create a high humidity environment within the switch room. The level of partial discharge has been observed to increase as humidity increases. The switchboard is reliant on the continued operation of large commercial dehumidifiers to maintain low humidity levels.

Asset failures

- This type of switchgear has a history of poor performance across Power and Water's network and other electricity businesses causing a high number of failures or near misses[6]. Inspection of the failures found the cause to be flashovers, with evidence of partial discharge demonstrating the deterioration of the insulation over time, supporting the identified issue at Sadadeen.
- On Power and Water's network, there have been 3 failures and 2 near misses in recent years on the YSF6 type switchboards. We note the removal and decommissioning of the Katherine and Manton switchboards in 2012 and 2013 respectively. The failures and near misses were:
  - 2005 – A partial discharge detected at Katherine zone substation. Inspection found a number of components had disintegrated due to prolonged partial discharge. Identification occurred before a failure.
  - 2008 – the cause of a failure at Manton zone substation was found to be a flashover from the bus bar to the metal frame, with evidence of partial discharge tracking at the flashover location.
  - 2008 – Following the failure at Manton zone substation, inspection of the Sadadeen switchboard identified extensive damaged due to partial discharge. These issues were identified before a failure.

[5] EA Technologies are an internationally recognised service provider specialising in partial discharge detection and analysis on electrical equipment.
[6] Where inspection has found significant deterioration of the asset that would have resulted in a failure if not found.

- 2009 – Katherine zone substation failure caused by flashover where the circuit breaker connected to the bus. Issues with partial discharge were ongoing until the asset was retired.
- 2010 – A bus section failed at Sadadeen zone substation due to deteriorated internal components. The fault resulted in flashover between SD07 and SD08 and demonstrates the reduced level of insulation. High humidity in the switch room contributed to the failure.

Obsolete technology

- This is the last switchboard of its make and model on the network. Switchboards were replaced at Manton and Katherine in 2008 and 2010, respectively. They were considered at end-of-life due to significant deterioration of insulation condition leading to multiple failures that also caused additional damage and contamination. The Sadadeen switchboard was retained as it is in a lower humidity environment. By using environmental controls and restricting access to limit exposure to the hazards produced by high voltage insulation failures, asset life could be extended.
- The decommissioned switchboards provided spare parts for minor failures at Sadadeen but are now exhausted. The spare circuit breakers have been in storage for more than 10 years and require refurbishment prior to being put into service. Some common components are readily available, however most of the major components need manufacturing on request, if they are available. The refurbishment of circuit breakers and manufacture of components has a lead time from 90 to 180 days and is expensive due to individual manufacture rather than being part of a large batch. Hence, any fault is likely to result in the network being at a reduced level of security for an extended period, with elevated potential for significant disruption to customers and increased risk of subsequent failures.
- Distribution feeder protection assets are also at end-of-life. These assets are showing signs of deterioration, use obsolete technology (first generation digital SPAJ relays) and have limited and insufficient functionality. They are 30 years old and require replacement by 2027. As these are mounted on the switchboard and in panels directly adjacent, maintenance of these assets increases exposure for workers to the 22kV switchboard, hence increasing the risk to their safety.

Lack of safety protection

- The switchboard is not arc-fault rated, therefore a failure poses a health and safety risk to field crews. Failure is most likely to occur during switching operations that requires the presence of field crews, increasing the safety risk.

  The switchboard is equipped with frame leakage protection rather than high speed differential protection, which operates more slowly than high speed differential protection and is tested less frequently as it can only be tested with the entire bus out of service. This increases the risk of an arc flash resulting in failure of the switchboard.

The current condition of the switchboard is considered poor and at the end of its serviceable life. This is supported by:

- the extent of partial discharge observed throughout the board via the online monitoring system
- deterioration of the insulation caused by historical partial discharge events that has also been observed during visual inspections and offline partial discharge testing.

Our view that the Sadadeen switchboard has reached end-of-life is further supported by the historical failures, all of which demonstrated partial discharge damage at the faulted location that reduced insulation integrity, leading to flashovers. Partial discharge is therefore considered a leading indicator of asset failure.

Management of these risks is done operationally through the deployment of dehumidifiers, permanent partial discharge monitoring for analysis, and operational restrictions to manage the health and safety of field crews.

3.2 Consequence of asset failure

As described in section 3.1, the switchboard condition is significantly deteriorated with a history of failures. Bus or switchboard failure are assessed as credible scenarios. The 3 key risks needing addressing by any credible network or non-network option are as follows:

3.2.1 Health and safety

As stated in section 3.1, the switchboard is not arc fault rated and only has frame leakage protection to prevent arc flash faults that can result in explosion. Frame leakage protection is an older type of protection, superseded by arc flash protection. Frame leakage protection is less effective and slower acting enabling a fault to be sustained for a longer period, increasing the energy released and therefore the chance of an explosion. As a result, this switchboard poses an increased risk to field crews.

Switchboard faults are more likely to occur when switching is undertaken, which means it is more likely for field crews to be present at the time of the fault.

Current risk management is through operational restrictions; however this only reduces the safety risk to our employees and does not resolve it.

3.2.2 Loss of network security

The failure of the entire Sadadeen switchboard would result in the sudden loss of a significant amount of load and impact the operation of the generators. There is a high risk that the generators would not be able to ride through the fault. The likely outcome is a system black event, where power is lost to the entire Alice Springs power system by disconnection of the generators from the network to protect themselves and network equipment from damage.

The likelihood of a system black occurring depends on the network conditions at the time of the asset failure and is most likely at times of high or low network demand. At high demand times, the loss of a significant amount of load will result in generators tripping off due to over frequency. At times of low demand, the loss of a significant amount of load will likely result in generators tripping off due to reaching lower operational limits.

We note that system black events have occurred in Alice Springs in the past:

- Most recently in 2019 due to a sudden reduction in generation from a solar generator.
- In 2012 and 2017 due to limitations on the operating state of the generators. After a significant network fault, the network and generation protection devices operated to shed load and avoid damage to the generators, network and customer assets.

Due to its configuration, restarting the Alice Springs network can be a time consuming process with some specific technical issues needing to be managed. This results in an extended outage for our customers.

While the capability to ride through disturbances and restore the network has improved since the 2019 system black, it demonstrates the susceptibility of the network to significant unexpected disturbances as well as reduced network security and the potential for a system black event to be credible outcomes.

Due to the unavailability of spare parts, switchboard repair and return to service following a failure is uncertain. If one bus fails, the network would be in a reduced level of security and with a single point of failure for an extended period. This increases the risk of a subsequent fault occurring and a system black.

3.2.3 Loss of supply to customers

As described in section 3.1, the switchboard is in significantly deteriorated condition and the failure of either a single bus or the entire switchboard are assessed to be credible scenarios. In addition, due to the lack of available spare components, it is not certain that the switchboard could be returned to service following a failure, leaving the network in a state of reduced security and increasing the consequence of a subsequent failure.

Power and Water assessed the impact of a failure to determine the load at risk and to present it in a way that enables assessment of whether network and/or non-network options can be applied to manage the consequence. In this assessment we noted where there would be outages during switching to restore supply, however have excluded that from our assessment of any sustained capacity constraints.

Figure 5 shows at 90% Probability of Exceedance, Average and the 10% Probability of Exceedance for the daily demand for each 30-minute period of the day on the 11kV network for the financial year July 2020 to June 2021. It also shows the profile of the day during the 2020-21 year with the maximum demand, illustrating the maximum shortfall that could occur. The network capacity under N, N-1 and N-2 scenarios are shown for comparison.

The network demand is consistently higher during the October to March period. This is also the time when humidity is highest, which elevates the probability and consequence of a fault.

Figure 6 illustrates the Load Duration Curve (LDC), which shows the percentage of the year that each level of demand is exceeded. For example, 25 MVA demand is exceeded for 12% of the year, or approximately 1,050 hours.

Under an N-2 scenario, once RGPS is retired, there is an expected supply constraint due to the capacity of transformers at Lovegrove zone substation.

Based on the annual LDC shown in Figure 6, there would be a shortfall across a year of 212 MWh over a duration of 114 hours, with a peak demand of 8.5 MW. The worst case, based on maximum demand, could result in the inability to supply 32.6 MWh with a peak of 8.5 MW, average of 4.1 MW for a duration of 8 hours. In a year, there are 36 days when there would be a capacity shortfall. These parameters describe the capacity and performance required from any solution to address the need.

We note a short-term outage is expected for some customers while network switching is undertaken. This is excluded from the consideration of the sustained outage.

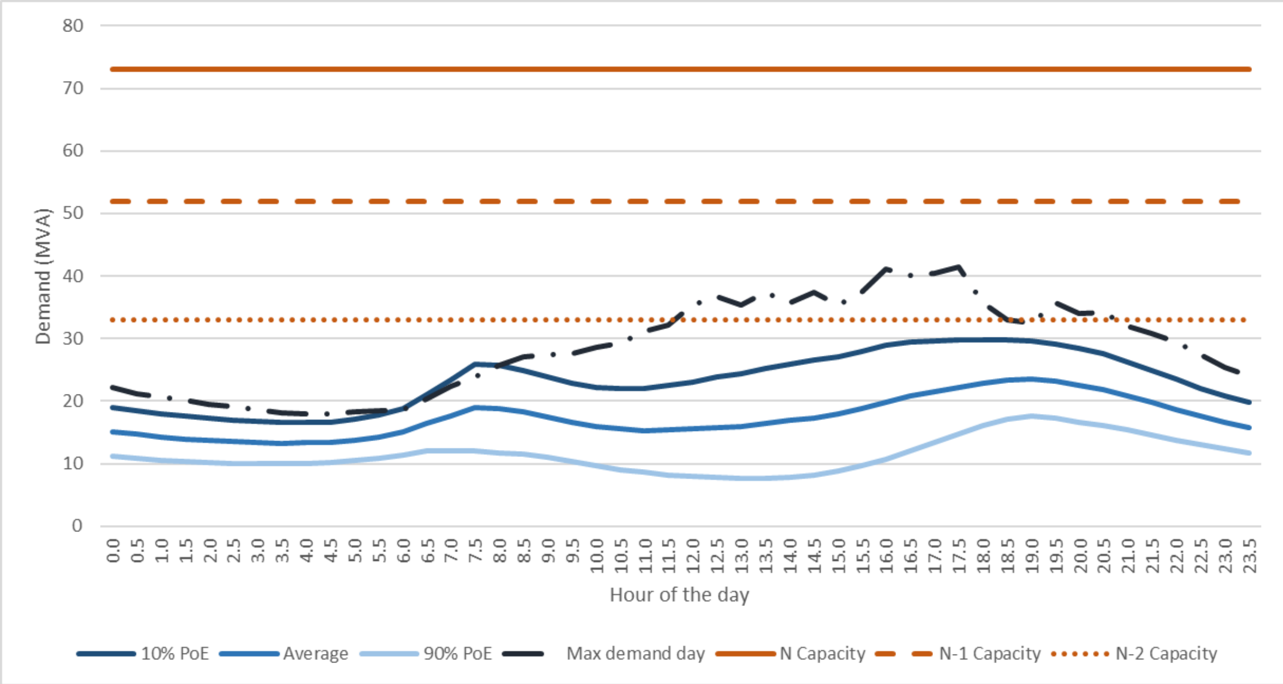

Figure 5 11kV network daily load profile compared to network capacity under credible scenarios

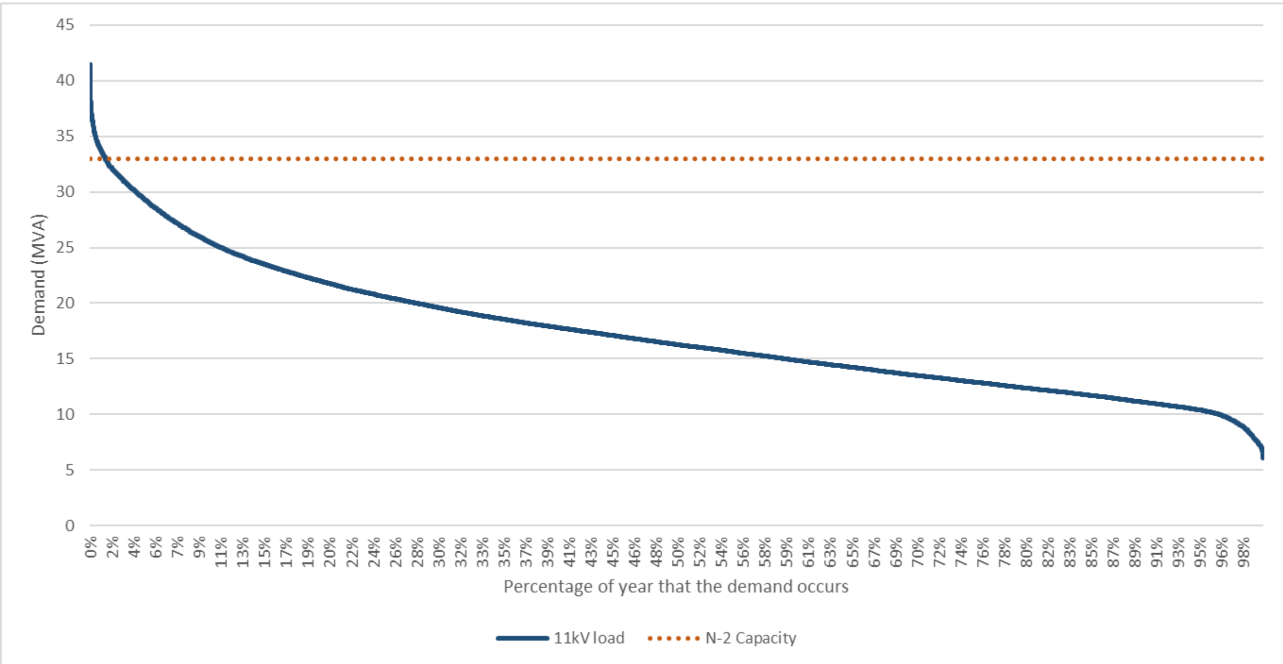

Figure 6 Load duration curve of the 11kV network compared to the N-2 capacity

Figure 7 shows the minimum, average and maximum daily demand for each 30-minute period on the 22 kV network for the financial year July 2020 to June 2021. The network capacity under N, N-1 and N-2 scenarios is shown for comparison.

It demonstrates that under N, N-1 and N-2 scenarios the Brewer transformer can currently supply the load on the 22 kV network, excluding any short-term interruptions that may be required to enable network switching to restore supply and current high voltage issues.

Demand on the 22 kV network is currently 8.1 MVA and within the Brewer transformer capacity. Therefore, no shortfall in supply is expected under any outage scenarios. However, demand forecast for the 22 kV network shows increasing demand, with the majority of future growth planned in Alice Springs south of The Gap. Therefore, the load at risk is expected to increase over time introducing an additional constraint to be addressed by any proposed solution.

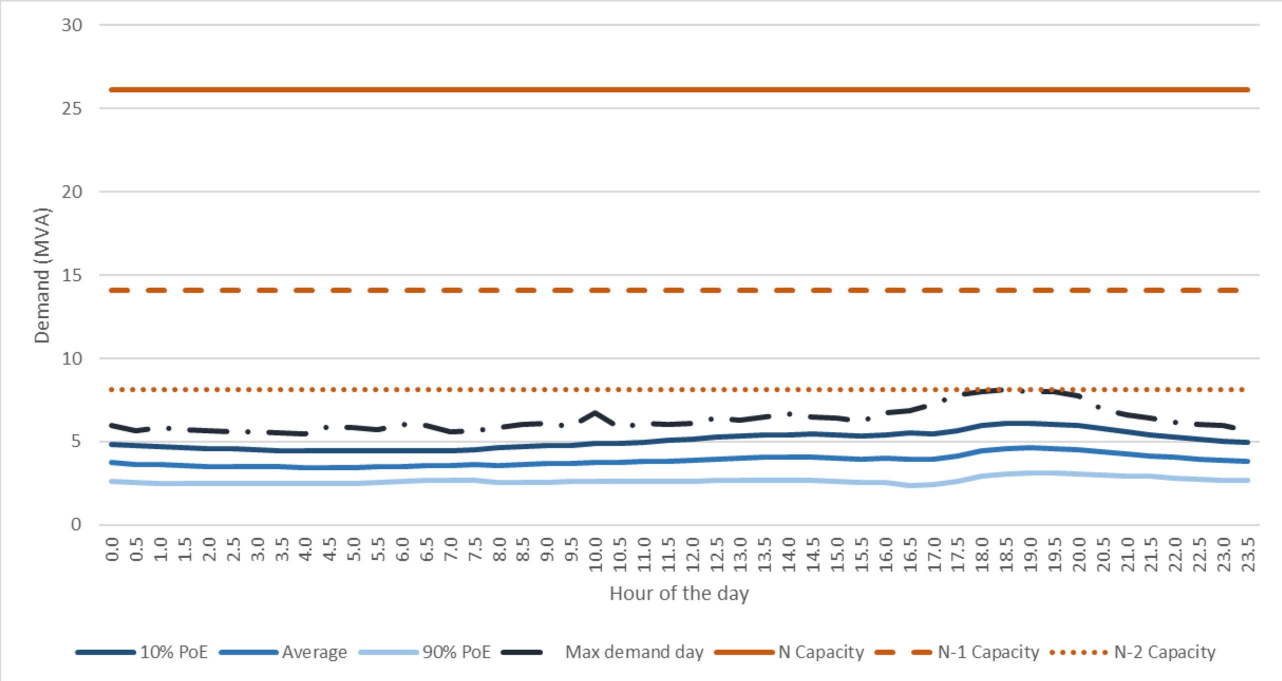

Figure 7 22kV network daily load profile compared to network capacity under credible scenarios

Note: Uterne solar power station provides approximately 2 MVA to the 22kV network and is excluded from Figure 7.

Table 1 summarises the impact to be managed on each network based on the current demand data. The value of lost load calculated is using the weighted average Value of Customer Reliability (VCR) of $26.08 per kWh based on the VCR published by the AER for customers in the Northern Territory.[7]

Scenario	Peak demand	Duration	Energy	Value of lost load
Max daily profile	8.5 MW	8 hrs	33 MWh	$0.67 million
Annual shortfall	8.5 MW	114 hrs	212 MWh	$4.32 million

Table 1 Summary of impact on supply capacity for the 11kV network

3.3 Timeframe to address the need

The 22 kV switchboard is at end-of-life and current mitigation and management approaches are no longer sufficient to ensure the reliability of the asset and the security of the network.

The switchboard condition continues to show signs of further deterioration, demonstrated by the partial discharge monitoring that is showing increasing frequency of significant partial discharge. When one of the dehumidifiers stops working, the partial discharge is observed to increase rapidly.

[7] Australian Energy Regulator, 2023 Values of Customer Reliability Annual Adjustment, December 2023

The planned retirement of RGPS further changes the network requirements and the ability for Sadadeen to continue to provide reliable and secure power supply to customers. The 11 kV switchboard at Sadadeen was rebuilt to separate the Power and Water owned assets from the TGen owned assets and create a clear connection point in preparation for the retirement of RGPS. The retirement of RGPS also provides a trigger for addressing the 22 kV switchboard.

Through preliminary risk modelling we have found that under most scenarios tested, the optimum time for replacement is past and in the optimum timing under the lowest risk scenario replacement is by the end of the 2030 financial year.

4. Potential credible network options

This section describes the various options analysed to address the increasing risk and identify the recommended option. The options were analysed based on ability to address the identified needs, prudency and efficiency, commercial and technical feasibility, deliverability, benefits and an optimal balance between long term asset risk and short-term performance.

4.1 Network options

This section provides details of credible options identified as part of network planning activities to date. All costs in this section are in real 2022/23 costs, unless otherwise stated.

Option overview	Concerns	Estimated capital cost
1. Do nothing: continue to manage the asset operationally.	Accepts the increasing risk.	**$0**
2. Replace with a modern equivalent switchboard: direct replacement to the current asset to maintain the same network configuration. • Construct new switch room or repair existing switch room. • Install new 22 kV switchboard. • Install new protection, SCADA, communications, and auxiliary secondary systems. • Decommission existing assets.	This option has a high capital cost and is likely to create a stranded asset once RGPS is retired.	**$10.3 million**
3. Replace with a temporary mobile switchboard: direct replacement with a temporary solution to defer larger expenditure. • Repair the mobile switchboard. • Upgrade protection, SCADA, communications, and auxiliary secondary systems. • Transport to site and install. • Cut over cables from the existing switchboard. • Decommission existing switchboard.	The temporary switchboard consists of only one bus. This option would introduce a single point of failure on the network and will not meet the objectives of maintaining network reliability and security.	**$5.3 million**
4. Retire the switchboard – 2 cable solution: install 2 new 22 kV cables to enable the switchboard to be bypassed and retired. • Install 2 cables from the Lovegrove 22 kV switchboard to connect to the existing 'Farms' feeder. • Connect the Sadadeen end of the Farms feeder to the Brewer ties (via Gas Circuit Breaker (GCB)). • Connect 22 kV express feeders to 22/11 kV transformers. • Decommission switchboard and RGPS Set 9.	This is currently the preferred option. Refer below.	**$7.4 million**

Option overview	Concerns	Estimated capital cost
5. Retire the switchboard – 11 kV express ties and 11/22 kV substation at Owen Springs: augment the existing 22 kV switchyard at Owen Springs to supply all the 22 kV network and retire the Sadadeen 22kV assets. • Establish a new zone substation at the Brewer site. Install two 22/11 kV transformers and associated assets to replace the unit transformer. • Upgrade the connection from OSPS to the new transformers. • Connect 22 kV express feeders to 22/11 kV transformers. • Decommission switchboard and RGPS Set 9.	This option is expected to be expensive. Feasibility of supply of sufficient capacity from OSPS to a new 11/22 kV switchyard is not confirmed.	**$17.7 million**

Table 2 Overview of potential credible options

Based on the initial analysis, Option 4 is currently preferred. It consists of installing two 22 kV cables from the Lovegrove 22 kV switchboard that will connect into an existing Farms feeder cable, which runs from the Sadadeen 22 kV switchboard through The Gap. Cable 1 will then provide supply through The Gap at 22 kV while cable 2 will provide supply back to Sadadeen, bypass the 22 kV switchboard and connect to the Old Brewer Ties via a GCB or ring main unit. The 22 kV express ties from Lovegrove will connect directly to 2 of the existing 22/11 kV transformers.

This will remove all load from the Sadadeen switchboard and enable it to be decommissioned and removed, addressing the risk to the network.

Power and Water has assessed possible long term network development possibilities and found that these cables can be repurposed and avoid becoming stranded assets. Cable 1 will be used to supply the single 22 kV feeder that extends north of Alice Springs, while cable 2 will become a third express tie to Sadadeen if required to meet N-1 capacity requirements. This ensures there are no stranded assets under this option and provides real options for network management in the future.

4.2 Network options considered and rejected

Our analysis identified an alternative option, however was found to be non-credible based on time to implement and cost, as described below.

Retire the switchboard – 11 kV express ties and 66/22 kV substation at Norris Belle

Build a new 66/22 kV zone substation at the Norris Belle site to supply all of the 22 kV network and decommission the existing 22 kV switchyard at Owen Springs and retire the Sadadeen 22 kV assets. This solution aligns with the long-term network development plan. However, the forecast demand is not enough to trigger the need for this scale of investment as the expected cost to construct a new zone substation and the related subtransmission works is more than $40 million. It would not be deliverable within the timeframe required to address the identified need.

5. Assessment of non-network options

Due to the type and function of these assets, there are no non-network alternatives or solutions that can be implemented to resolve all aspects of the identified network issue. A range of potential non-network options were assessed including additional generation, Battery Energy Storage System (BESS), demand management and SAPS. Table 3 summarises our assessment and the following sections describe the reasons underpinning this assessment, including the methodologies and assumptions applied.

We note that the RIT-D guidelines[8] clarify that an option is not considered credible if any one of the assessment criteria is not met.

Assessment criteria	Generation	BESS	Demand Management	SAPS
Addresses the identified need:				
Capacity to supply 11 kV demand	✓	✗	✗	✗
Capacity to supply 22 kV demand	✓	✓	✓	✗
Addresses the safety risk	✗ 1	✗ 1	✗	✗
Maintains network security	✗	✗ 2	✗	✗
Commercially feasible	✗	✗	✓	✗
Technically feasible	✓	✓	✓	✗
Implemented in sufficient time	✗	✓	✓	✗
Can form part of a credible option	✗	✗	✓	✗
Is a credible option	✗	✗	✗	✗

Table 3 non-network option assessment summary

Notes:

1. A generator or BESS designed and connected to the network to allow the switchboard to be retired may reduce the safety risk.
2. A high-spec BESS may assist riding through a fault and avoid an extended outage or system black, however additional capacity would be required for the ongoing capacity required to supply the load.

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[8] Australian Energy Regulator, Application Guidelines for the Regulator investment test for distribution, August 2022, page 75

5.1 Generation

To assess the installation of new generation as a credible non-network option, an assessment of the needs that a generator must meet was undertaken. The methodologies included analysis of actual historical load data to identify the supply shortfall that a generator must be capable of supplying. Table 1 shows the current supply shortfall only present on the 11 kV network but expected to emerge on the 22 kV network in the near future. Therefore, a generator solution would need to supply both the 11 kV and 22 kV networks.

The 3 most likely connection configurations considered for implementation are described as follows, including whether they will address the identified need:

- Connect to the Sadadeen 22 kV switchboard - This will not meet the identified need as it will require the switchboard to remain in service.
- Connection to the Sadadeen 11 kV switchboard -This will address the immediate need on the 11 kV network: however it will still require the 22 kV switchboard to remain in service for connection to the 22 kV network. This arrangement does not fully address the identified need.
- Connect directly to the 22 kV and 11 kV networks - This will require the generator to have both 11 kV and 22 kV switchyards and increase generator cost. Connecting directly to the network could limit power transfer across the network and impact the generator's ability to address the capacity shortfall.

In all 3 connection configurations, a generator is not likely to be available in time to meet the timeframe to resolve the identified need. The existing RGPS site cannot be re-used for a new generator due to the noise and pollution abatement issues currently affecting the site. A new generator location is required as well as easements for connection, for both the gas pipeline to supply the generator and electricity lines to connect to the network. Land acquisition requires approval from the Aboriginal Areas Protection Authority (AAPA). The process for approval typically takes one to 2 years prior to construction commencing. This does not enable the need to be addressed within the required timeframe.

A generator is also unlikely to be commercially feasible due to the capital and operating costs of a generator and the limited supply demand needed. We note that the generator needs to be dispatchable both day and night, which means an intermittent source such as solar is unlikely to be suitable to address the need. The estimated capital cost of a 10 MW thermal generator, operational expenditure for gas to fuel the generators and asset maintenance will be significantly more than the preferred solution (option 4), which has an estimated capital cost of $7.3 million and no ongoing operational costs.

Further, as stated above, depending on generator connection to the network, it may not enable the switchboard to be replaced or decommissioned, and therefore may not resolve the health and safety or the network security issues.

In addition, TGen first announced the planned retirement of RGPS in the FY2020 Statement of Corporate Intent (SCI). Since then, there have not been any applications or approaches to Power and Water from generation proponents for connection to the Alice Springs network. A new generator proponent within the required timeframe to resolve the need is unlikely.

Power and Water has determined that generation does not make a complete, or significant part of, a credible option.

5.2 Battery Energy Storage System (BESS)

To assess the installation of a new BESS as a credible non-network option, an assessment of the needs that a BESS must meet was undertaken. The methodologies included analysis of actual historical load data to identify the supply shortfall that a generator must be capable of supplying. Table 1 shows the supply shortfall is currently only present on the 11 kV network and is expected to emerge on the 22 kV network in the near future. A BESS solution would need to supply both the 11 kV and 22 kV networks.

TGEN owns an existing 5 MW 10 MWh BESS that is currently in operation and installed at the RGPS site connected to the Sadadeen 11 kV switchboard. It provides frequency support and is not intended to provide capacity to the network.

Similarly, to a generator, a BESS is not likely to be available to meet the timeframe for resolving the identified need. The existing RGPS site cannot be re-used due to the noise abatement issues currently affecting the site. A new location and easements for connection would be required, including Aboriginal Areas Protection Authority (AAPA) approval. The approval process typically takes one to 2 years prior to commencement of construction. This does not enable the need to be addressed within the required timeframe.

We note that the BESS would need to be available at the time of the network constraint, so it would not be able to supply the network under normal operations and would be limited to ancillary services to address the need. Further, the BESS would need to be sized at approximately 10 MW 35 MWh to meet demand on the maximum demand day with an estimated capital cost of $12 million to $20 million, compared to the preferred option 4 with an estimated capital cost of $7.3 million. With limited revenue achievable by the BESS, due to the operational requirements and high capital cost, it is not considered to be a commercially feasible option in this circumstance.

Depending on how the BESS is connected to the network, it may not enable the switchboard to be replaced or decommissioned, and therefore may not resolve the health and safety or the network security issues.

TGen announced the planned retirement of RGPS in the FY2020 SCI. Since then, there have not been any applications or approaches to Power and Water from BESS proponents for connection to the Alice Springs network. A new BESS proponent within the required timeframe to resolve the need is unlikely.

Power and Water has determined that a BESS does not make a complete, or significant part of a credible option.

5.3 Demand management

Demand management is not considered a credible option as it does not resolve the health and safety risk to field crews nor does it address or mitigate the reduced level of network security, as it relies on the switchboard remaining in service.

To achieve the required level of demand management, participation from approximately 20% of the load is needed. The 11 kV network predominately supplies residential customers and it is unlikely that the level of demand management would be achieved within the required timeframe.

Power and Water has determined that demand management does not make a complete, or significant part of a credible option.

5.4 Stand Alone Power System (SAPS)

A SAPS solution was considered for its's appropriateness to resolve the identified need in this case[9]. In the current network configuration, the 22 kV switchboard is a critical element. It enables the supply to both the 22 kV and 11 kV networks. While there are feasible network options to bypass and decommission the switchboard, it is not feasible to create a SAPS to resolve the identified need as the asset is not separable from the existing network.

[9] We note that a recent rule change that requires the consideration of SAPS is not operational under the NT NER.

6. Determination

For the reasons set out in this notice, pursuant to clause 5.17.4(c) of the NT NER, Power and Water has determined that there are no credible non-network options to address the identified need at Sadadeen zone substation.

Therefore, in accordance with clauses 5.17.4(c) and (d) of the NT NER, Power and Water will not publish a non-network options report in relation to the proposed works at Sadadeen zone substation and pursuant to clause 5.17.4(s), Power and Water will progress directly to the Final Project Assessment Report based on the estimated cost of the preferred option being less than the threshold of $12 million specified by the AER[10].

[10] Australian Energy Regulator, 2021 RIT and APR cost thresholds review – Final Determination, November 2021, Table 3

Appendix A. Satellite view of Alice Springs

Figure 8 provides a geographic satellite view of Alice Springs. It highlights the impact of The Gap on the connection between the northern and southern regions. It also shows that the majority of the customers are located north of The Gap.

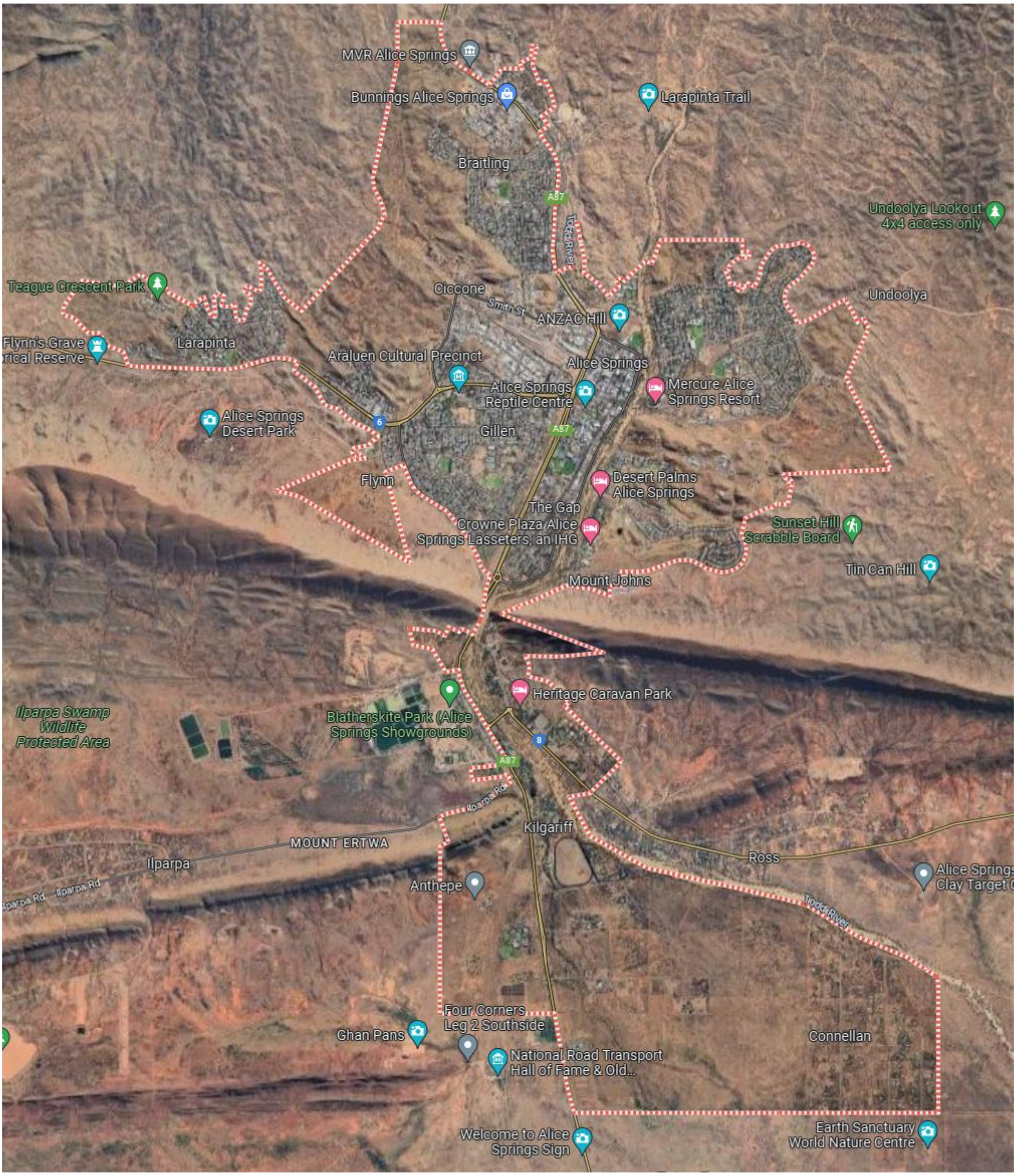

Figure 8 Satellite view of Alice Springs showing The Gap

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