



# The Energy Queensland Group Notice for no non-network options for Energex

4 May 2021

## Addressing reliability requirements in the North Stradbroke Island network area



Part of Energy Queensland

# Notice of no non-network options

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## Executive summary

### About Energex

Energex Limited (Energex) is a subsidiary of Energy Queensland Limited and manages the electricity distribution network in the growing region of South East Queensland which includes the major urban areas of Brisbane, Gold Coast, Sunshine Coast, Logan, Ipswich, Redlands and Moreton Bay. Our electricity distribution area runs from the NSW border north to Gympie and west to the base of the Great Dividing Range.

Our electricity network consists of approximately 54,200 kilometres of powerlines and 680,000 power poles, along with associated infrastructure such as major substations and power transformers.

Today, we provide distribution services to more than 1.4 million domestic and business connections, delivering electricity to a population base of around 3.4 million people.

### Description of the network risks

Stradbroke Island Zone Substation (SSSIS) provides electricity supply to approximately 2,200 predominantly residential customers in the Dunwich, Amity Point and Point Lookout areas on North Stradbroke Island. Approximately 90% of the total number of customers supplied from SSSIS are residential customers amounting to 55% of the total energy supplied. And 10% of the total number of customers supplied from SSSIS are commercial and industrial customers, amounting to 45% of the total energy supplied.

SSSIS is a 110/33kV bulk supply substation and 33/11kV zone substation with a 110kV feeder from Beenleigh Substation (SST108). It previously provided a 33kV supply to a mining company on North Stradbroke Island that has since ceased operations. SSSIS provides alternate supply to other parts of North Stradbroke Island as back-up for Ibis Bulk Supply Substation (SSIBS) and Herring Lagoon Zone Substation (SSHLG) via a 33kV network.

The Substation Condition Assessment Report (SCAR) identified some primary and secondary plant and equipment that are reaching or have reached retirement age. It was also identified that the steel structures of the 33kV outdoor air-insulated switchgear are structurally unsound due to heavy corrosion. The deterioration of these structures and primary system assets poses safety risks to staff working within the switchyard, and reliability risk to the customers supplied from SSSIS.

The oil containment system at SSSIS was also identified to be in very poor condition as per the Substation Condition Report – Civil. This poses environmental risks to North Stradbroke Island.

Based on a Condition Based Risk Management (CBRM) analysis, the following have been deemed to reach their retirement age:

- 33/11kV transformer TR3;
- 33kV circuit breakers (2);
- 33kV air break switches (5);
- Disconnect links (10);

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- 11kV ring main unit;
- Audio Frequency Load Control (AFLC) coupling cell;
- Steel structures in the 33kV switchyard.

## Approach

The National Electricity Rules (NER) require that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Energex has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the North Stradbroke Island supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. An internal assessment has been conducted and it has been determined that there is not a non-network option that is potentially credible, or that forms a significant part of a potential credible option that will meet the identified need or form a significant part of the solution. This Notice has hence been prepared by Energex in accordance with the requirements of clause 5.17.4(d) of the NER.

# Notice of no non-network options

## TABLE OF CONTENTS

1.0	Summary.....	1
2.0	Existing network.....	2
2.1	Introduction.....	2
2.2	Identified need.....	4
2.3	Assessment of the existing network.....	4
	<b>2.3.1</b> Substation capacity.....	4
	<b>2.3.2</b> Substation Load.....	5
	<b>2.3.3</b> Substation condition.....	7
2.4	Impact of doing nothing.....	9
3.0	assessment of Options.....	9
3.1	Alternative options rejected.....	9
3.2	Network options.....	10
	<b>3.2.1</b> Preferred option: Replace TR3 and upgrade 33kV bus at SSSIS.....	10
3.3	Non-network alternative options.....	11
	<b>3.3.2</b> Result of non-network options assessment.....	12
4.0	CONCLUSION.....	12

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## 1.0 SUMMARY

This notice is being issued by Energex Limited (Energex) to declare that there are no credible non-network options to the proposed works to meet the identified need of maintaining a safe, sufficient and reliable supply to over 2,200 predominantly residential customers at Stradbroke Island Zone Substation (SSSIS) when the 33/11kV transformer TR3 and 33kV circuit breaker (CB) CB3T32 reaches retirement age in 2022. Moreover, it has assessed that the steel structures for the outdoor 33kV bus are heavily corroded and must be replaced. This determination is made under clause 5.17.4(c) of the National Electricity Rules (NER) and is published according to clause 5.17.4(d). In this regard, Energex will not be publishing a non-network options report for the proposed works at SSSIS.

The reasons for this conclusion are as follows:

- Continuous operation of the 33/11kV transformer TR3 and 33kV CB that have been deemed to reach retirement age impacts the safety to personnel and the reliability of supply to customers.
- Should the transformer TR3 and CB be recovered, the existing load will continue to be supplied via the existing 33/11kV transformer TR1. However, for the contingency event of a failure of TR1, the load cannot be transferred to any adjacent zone substations as there are no available 11kV feeder ties. Mobile generation can be deployed to the island to supply the load while repairing or replacing the failed transformer. However, restoration time does not meet Safety Net Standards as per requirements of the Energex Distribution Authority.
- Should the transformer TR3 and CB be recovered, the 33kV outdoor bus and steel structures must also be replaced and plant that have deemed to reach retirement age must be recovered.

Energex will publish the final project assessment report (FPAR) as the estimated capital cost of the preferred solution is below \$11 million.

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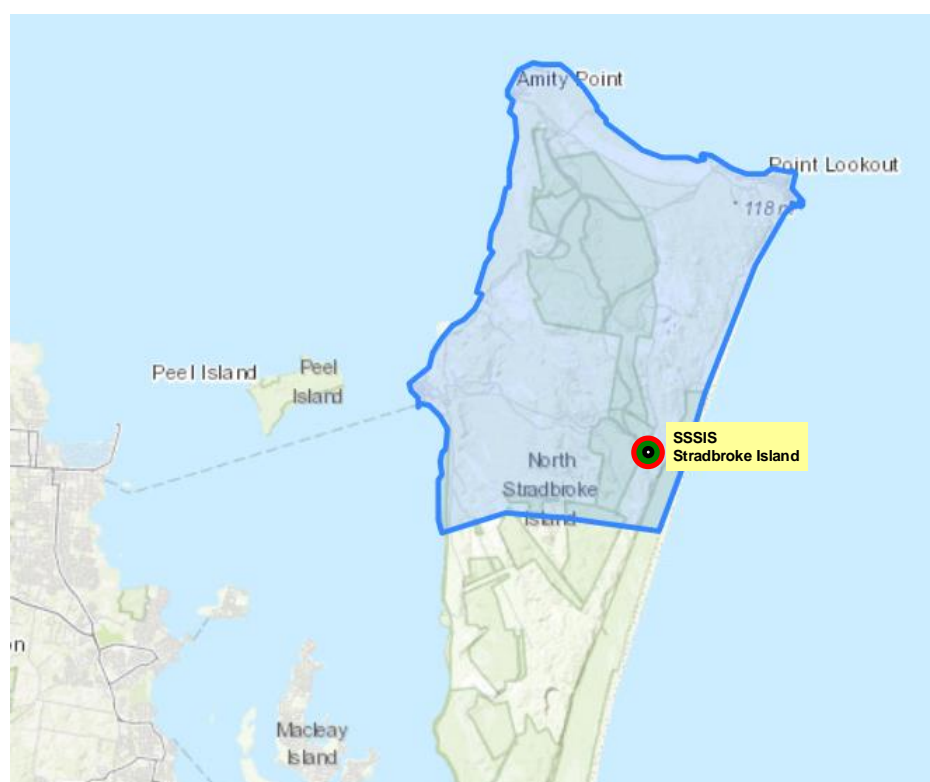
## 2.0 EXISTING NETWORK

### 2.1 Introduction

Stradbroke Island Zone Substation (SSSIS) provides electricity supply to approximately 2,200 predominantly residential customers in the Dunwich, Amity Point and Point Lookout areas on North Stradbroke Island. Approximately 90% of the total number of customers supplied from SSSIS are residential customers amounting to 55% of the total energy supplied. And 10% of the total number of customers supplied from SSSIS are commercial and industrial customers, amounting to 45% of the total energy supplied.

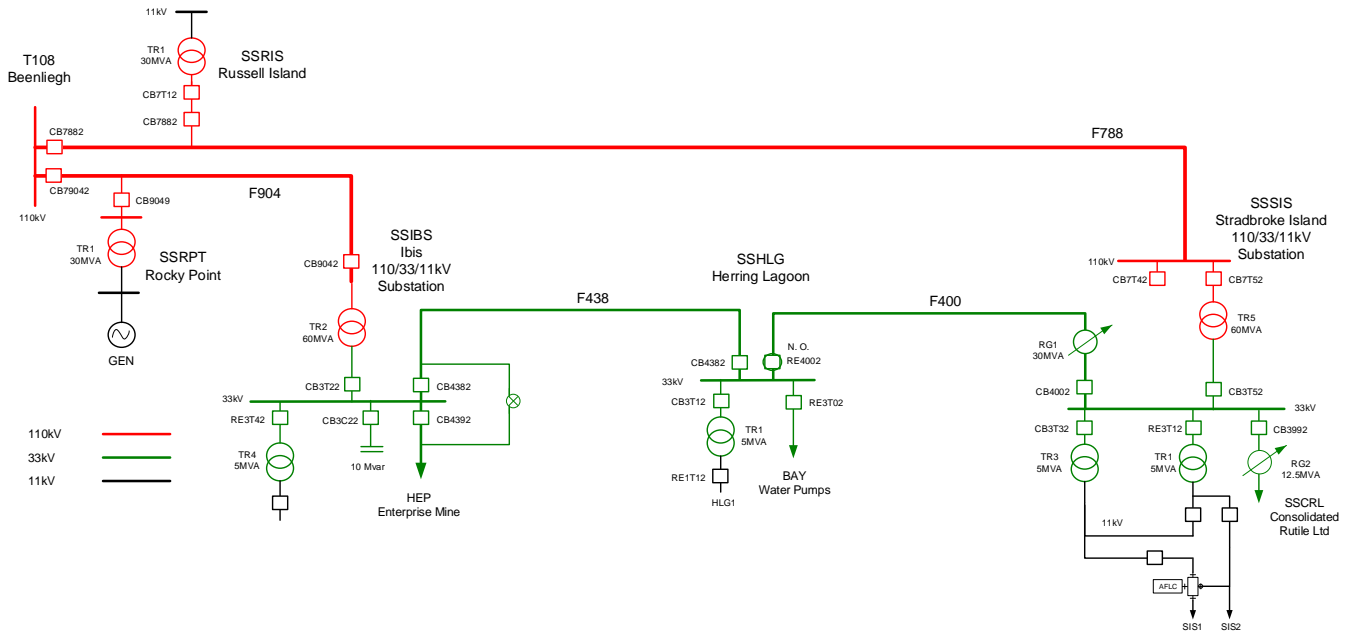
SSSIS is a 110/33kV bulk supply substation and 33/11kV zone substation with a 110kV feeder from Beenleigh Substation (SST108). It previously provided a 33kV supply to a mining company on North Stradbroke Island that has since ceased operations. SSSIS provides alternate supply to other parts of North Stradbroke Island as back-up for Ibis Bulk Supply Substation (SSIBS) and Herring Lagoon Zone Substation (SSH LG) via a 33kV network.

Geographic and schematic views of the network area under study are provided in Figure 1 and Figure 2.

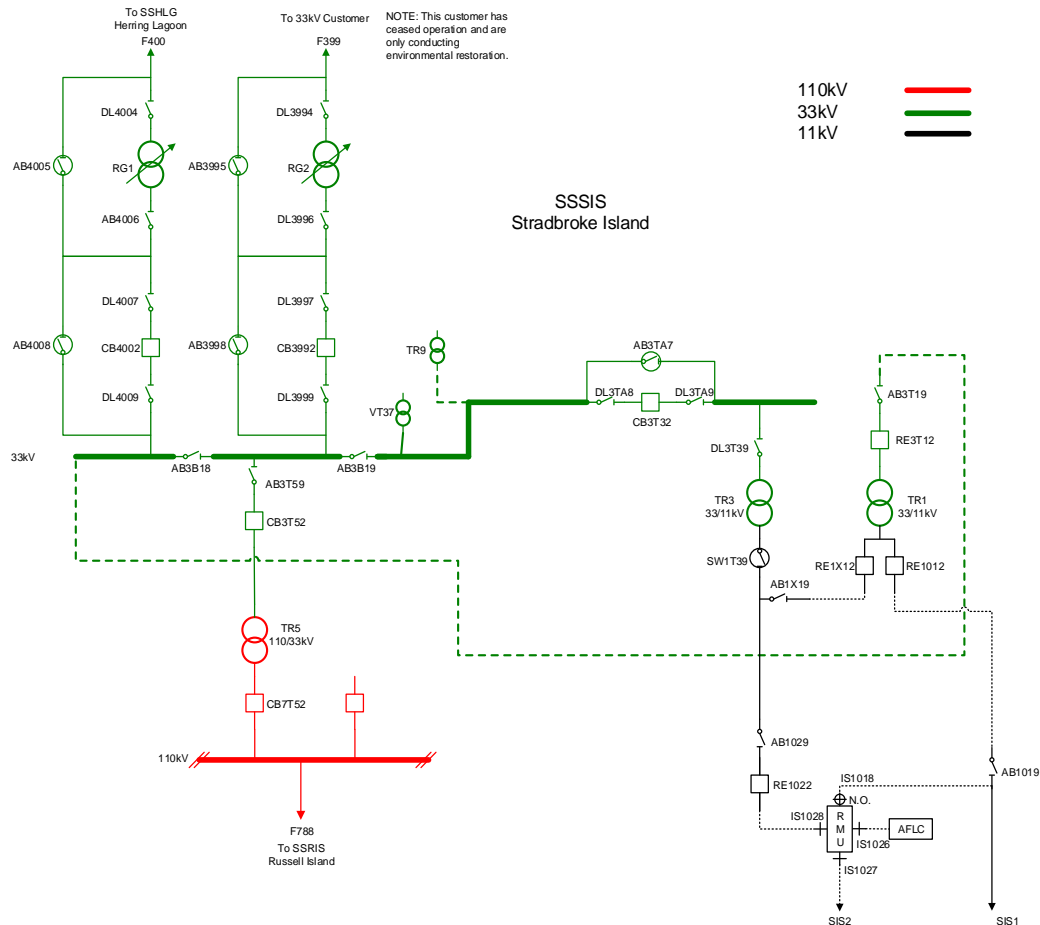


**Figure 1: Existing network (geographic view)**

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**Figure 2: Existing network arrangement (schematic view)**



**Figure 3: Existing substation network arrangement (schematic view)**



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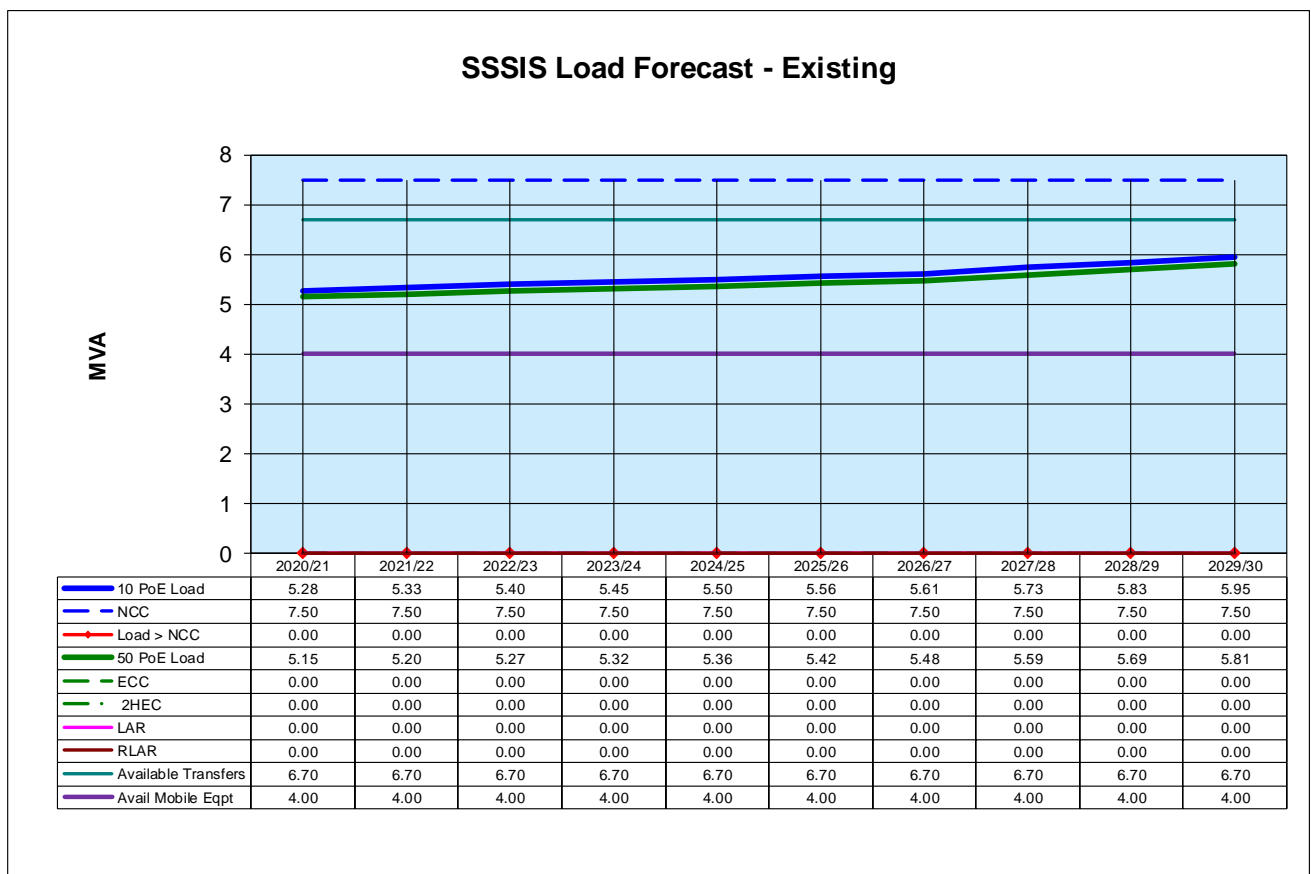
## 2.2 Identified need

To maintain a safe, sufficient and reliable electricity supply to over 2,200 predominantly residential customers, with an approximate total load of 5.2MVA, provided by SSSIS when the 33/11kV transformer TR3 and 33kV CB reaches retirement age in 2021/22.

## 2.3 Assessment of the existing network

### 2.3.1 Substation capacity

SSSIS Zone Substation is equipped with 1 x 5/6.5MVA (TR1) and 1 x 5MVA (TR3) 33/11kV transformers. The normal supply is provided via transformer TR1 with TR3 as hot standby. The substation capacity is limited by transformer TR1, providing a Normal Cyclic Capacity of 7.5MVA. The 10 year 10 PoE and 50 PoE load forecasts, and the existing Normal Cyclic Capacity (NCC), Emergency Cyclic Capacity (ECC), Two Hour Emergency Capacity (2HEC), Residual Load at Risk (RLAR) and available mobile equipment, are shown in Figure 4.



**Figure 4: Substation load forecast (existing network)**

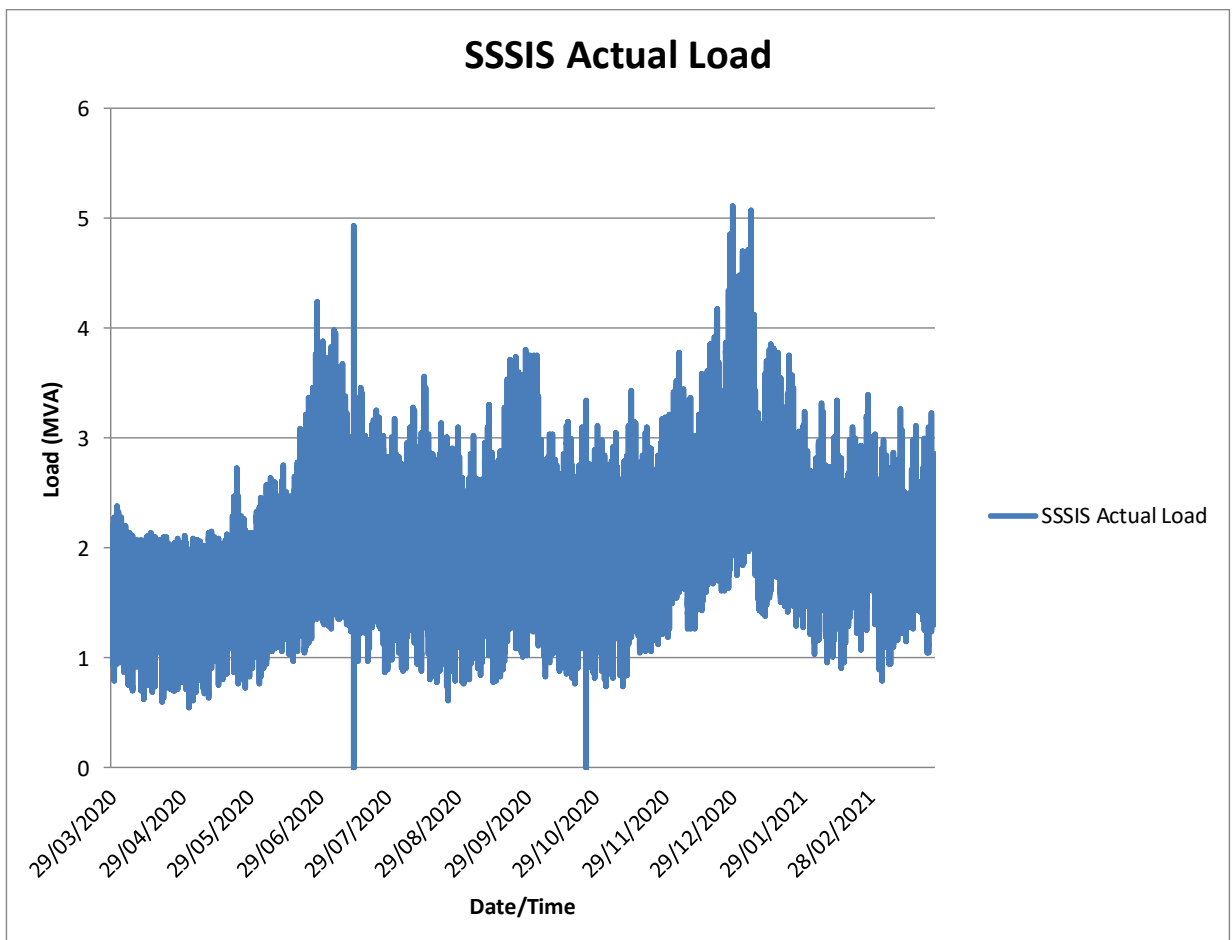
As outlined above there are no capacity limitations at SSSIS within the planning horizon. The available transfers in the graph is the emergency capacity of the hot standby transformer TR3, which can be remotely switched for a contingency of a failure of TR1.

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There are also identified generation connection points on the 11kV network of SSSIS. However, deploying generation on Stradbroke Island would depend on the time they are required. Transporting the generator sets will be dependent on the availability of the ferry services to the island and the availability of the generator sets. It is also required to have a high tide in order to be able to transport the generators to Stradbroke Island. There is no guarantee that mobile generation can be deployed to Stradbroke Island within the requirements of the Customer Outcome Standards (COS) or Service Safety Net Targets as specified in the Distribution Authority issued to Energex.

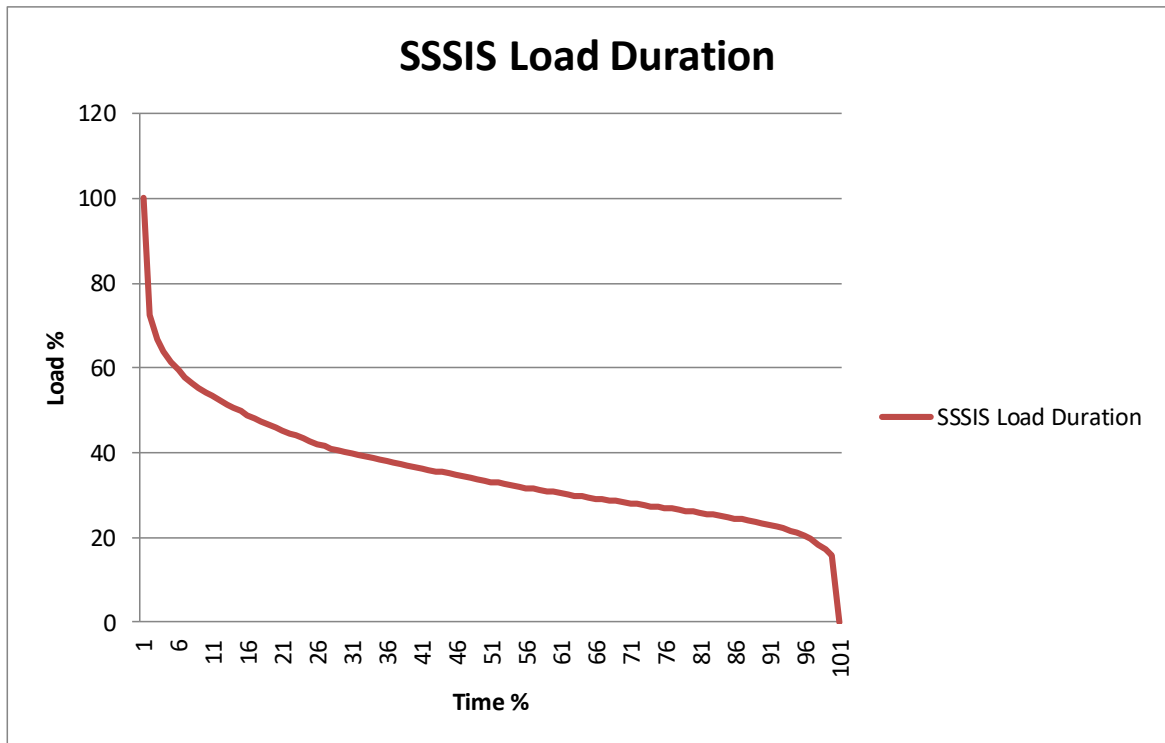
## 2.3.2 Substation Load

The actual load, load duration and peak day load curves for SSSIS for the 2020/21 period are shown in Figure 5, Figure 6 and Figure 7. Generally, the load peaks during the summer period since Stradbroke Island is a holiday destination and there are many holiday accommodations.

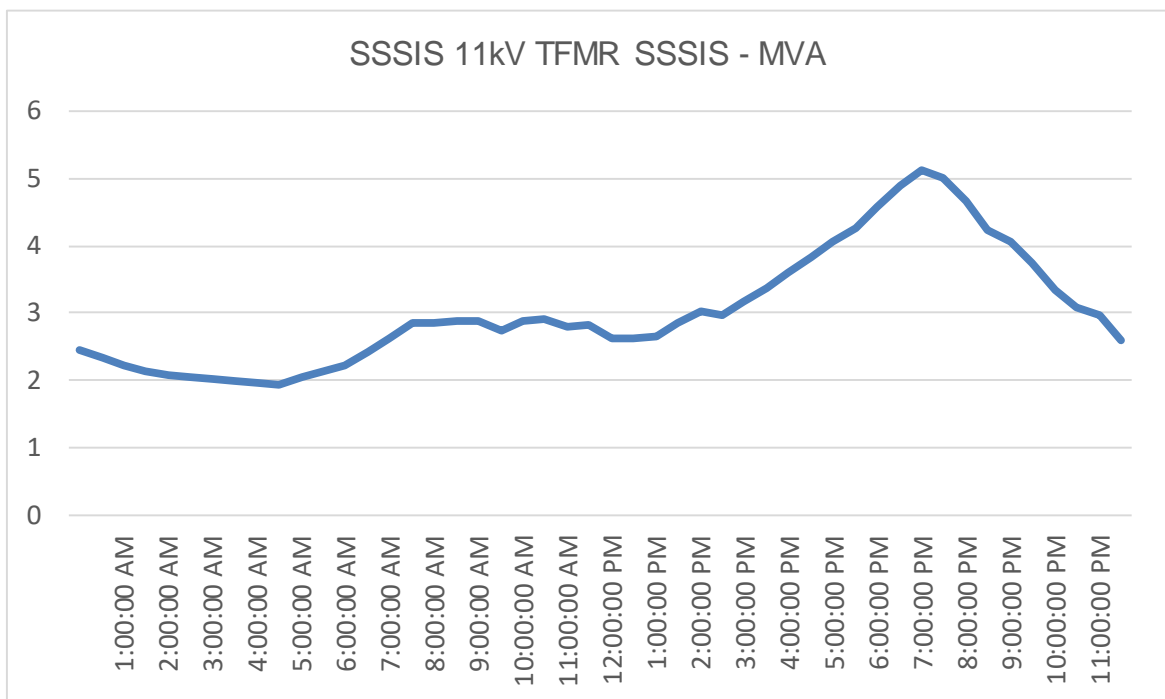


**Figure 5: Substation actual load curve – SSSIS**

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**Figure 6: Substation load duration curve – SSSIS**



**Figure 7: Peak day load curve – 29 Dec 2020 – SSSIS**

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### 2.3.3 Substation condition

Based on a Condition Based Risk Management (CBRM) analysis of the effect of current condition and ageing on the expected life of the asset, the following have been deemed to reach retirement age as follows:

- 33/11kV transformer TR3 by 2022 due to transformer condition;
- 33kV CB CB3T32 by 2021 due to potential bushing failures or being slow to operate for a fault on TR3 leading to catastrophic failure;
- 33kV CB CB3992 by 2021 due to failure to operate due to low gas pressure;
- 5 x 33kV and 1 x 11kV air break switches (ABS) by 2021;
- 11kV ring main unit by 2021;
- Audio Frequency Load Control (AFLC) coupling cell by 2021;
- Steel structures for the 33kV bus; and
- Oil-containment system.

#### 33/11kV transformer

The 33/11kV transformer TR3 was manufactured by AEI in 1965. This transformer has had significant issues with the OLTC due to age and wear. It has been consistently in the 'moderately wet insulation' range and leaking oil. Evidence of multiple leaks and corrosion have been found on TR3.

An oil top-up was performed prior to 2006 which improved the Dissolved Gas Analysis (DGA) results. As per the CBRM analysis, TR3 has been deemed to reach retirement age in 2022.

#### 33kV circuit breakers

The 33kV circuit breakers CB3T32 and CB3992 are AEI OCB (YOM 1962) and GECHED OX36 (YOM 1999).

Generally, oil circuit breakers are known to be slow to operate. Since CB3T32 is protecting transformer TR3, which has been deemed to reach retirement age, the risk of failure is greater. A slow operation of CB3T32 for a fault on TR3 may lead to a catastrophic failure of the transformer. The risk of oil from the CB and TR3 spilling into the environment is also greater.

CB3992 is gas insulated. Although it is relatively young, it has been known to have issues with gas leaks leading to several call out for maintenance and gas top-ups. This CB has led to high maintenance costs, attributed to the logistics of travelling to the island to address the issues, and is expected to continue to do so.

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### Air-break switches and disconnect links

5 x 33kV and 1 x 11kV air-break switches have been identified to be braid-type. As per feedback from field crews, this type of ABS has been known to become faulty over time with strands of the braided conductors becoming brittle and eventually breaking, leading to failure.

A total of 10 x disconnect links have also been identified in the substation. This type of plant has been identified as problematic and are to be replaced whenever possible. This type of disconnecter cannot be tagged and locked during switching for works within the substation. As such, it has been identified as a safety risk to staff.

### Audio frequency load control (AFLC)

The AFLC coupling cell at SSSIS is an outdoor unit, with evidence of poor condition of the enclosure due to corrosion. The asset strategy for AFLC is to replace on failure. However, considering the remoteness of SSSIS, exposure to high corrosive environment and the major substation upgrade project, it is recommended to replace the coupling cell with an indoor unit.

### 11kV ring main unit

The asset strategy for 11kV ring main units is to replace on failure. However, considering the remoteness of SSSIS, exposure to high corrosive environment and the major substation upgrade project, it is recommended to recover the RMU. There is evidence of corrosion and damage in the cable box and extension box with the risk of moisture ingress into the boxes that may lead to catastrophic failure. There is a motorised isolator retrofitted in the RMU that can be operated remotely. However, it was identified by field crews that there may be inconsistencies in the switch status. Thereby, making it unreliable as a remote close operation may fail.

### 33kV bus steel structure

As per the Substation Condition Assessment Report for Civil, the steel structures for the 33kV outdoor switchyard are assessed to be in very poor condition. Heavy corrosion on the vertical members of the structure are visible, with some sections having holes at the base. There are pipe-work endcaps and U-bolt connectors that are significantly corroded. There is evidence of treatments done by repainting some sections of the structures. As such, the level of corrosion underneath the paint cannot be determined. The steel structures are classified as for immediate attention due to the potential for failure.

### Oil containment system

The oil-containment system for the transformers and voltage regulators has been assessed to be in very poor condition. Valve actuators are missing, and the remaining actuators are not functional.

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### 2.4 Impact of doing nothing

The “do nothing” option is not acceptable as the following do not comply with the applied service standards:

- Greater than 5MVA of load is without supply for more than 12 hours following a contingency event of a failure of transformer TR1 at SSSIS. This poses an ongoing low-level risk to Energex customers due to the potential for in-service failure of TR1 and the time required for deploying mobile generation in the event of a transformer contingency scenario. This is with TR3 and CB3T32 being deemed as reaching retirement age and no longer fit to be used and motorised isolator on 11kV ring main unit unable to be switched remotely.
- Continuous operation of existing 33kV outdoor switchyard with steel structures that have been deemed to be in very poor condition at SSSIS poses an ongoing low-level risk to Energex personnel safety due to the potential for in-service failure of the assets.
- Continuous operation of existing 33kV circuit breakers that have been assessed to reach retirement age at SSSIS poses an ongoing low-level risk to Energex personnel safety due to the potential for in-service failure of the assets.
- Continuous operation of the existing oil-containment system that has been assessed as having very poor condition poses and ongoing low-level risk to the environment due to the potential for an in-service failure of a transformer or voltage regulator and the oil is dumped to the faulty oil-containment system.

## 3.0 ASSESSMENT OF OPTIONS

### 3.1 Alternative options rejected

For clarity, the following alternative options were considered but rejected as they were not practicable alternatives for the reasons indicated in Table 1.

Alternative option	Reasons for being rejected
Do nothing	<ul style="list-style-type: none"> <li>– The option of doing nothing is not acceptable since the risk of in-service failure of the transformer, voltage regulators, 33kV circuit breakers and the 33kV bus impacts on the safety of staff and the reliability of supply to the customers at SSSIS.</li> <li>– Leaving the plant and equipment that have been deemed to reach retirement age may also lead to unsupplied load for the contingency of a failure of TR1 and TR3 being unable to supply the load of SSSIS. This may lead to not satisfying the requirements of the Service Safety Net Targets as per the Energex Distribution Authority.</li> </ul>

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<p>Recover 33/11kV transformer TR3 and other plant reaching retirement age</p>	<p>– Recovery of the assets reaching retirement age and leaving SSSIS as a single 33/11kV transformer substation does not satisfy the requirements of the Service Safety Net Targets as per the Energex Distribution Authority. A portion of the outdoor 33kV bus must be rebuilt.</p>
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**Table 1: Alternative options rejected**

### 3.2 Network options

The following option has been assessed as meeting the applied service standards, but no other practically feasible and economically equivalent option has been identified in this analysis.

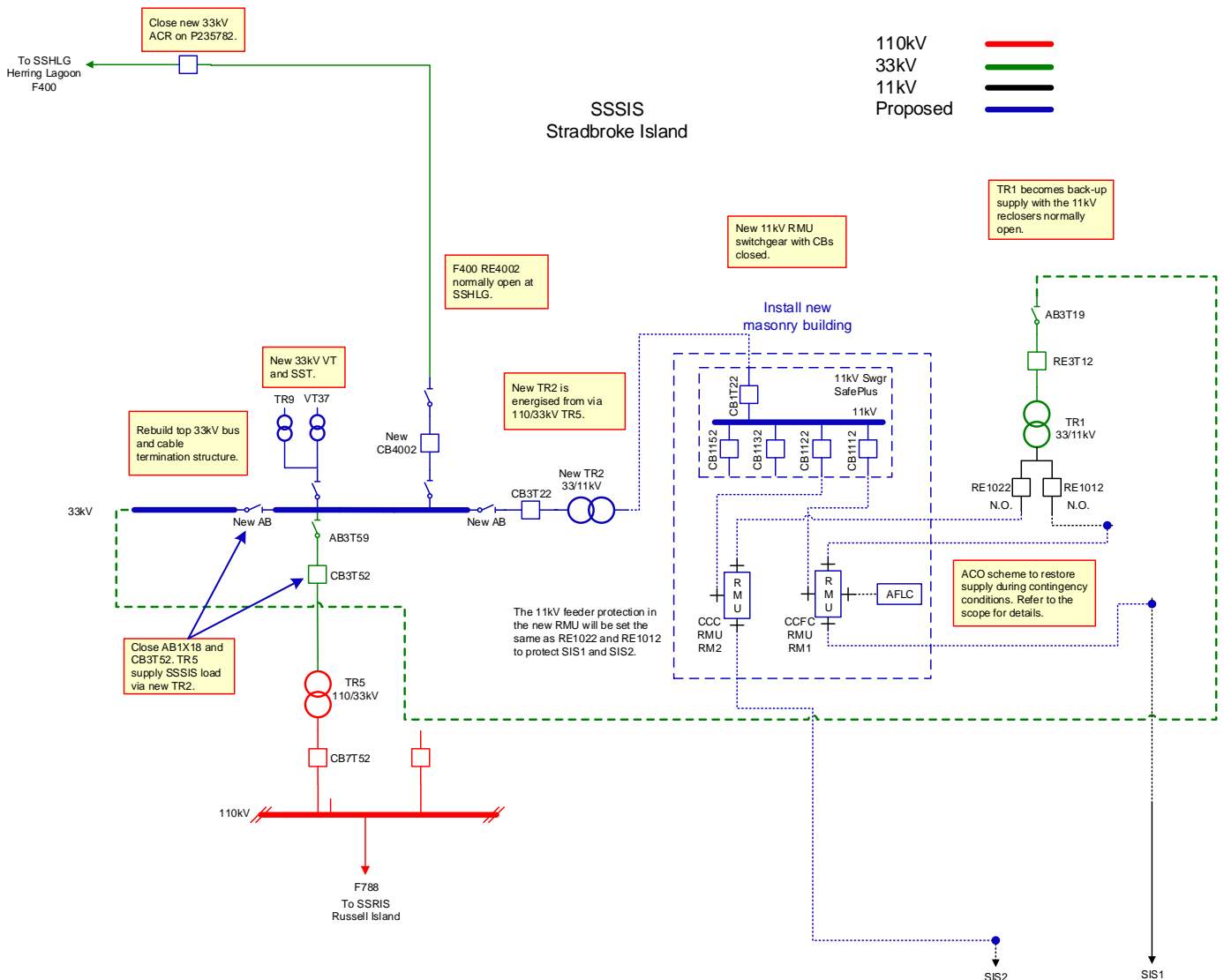
#### 3.2.1 Preferred option: Replace TR3 and upgrade 33kV bus at SSSIS

This option involves recovery of 33/11kV TR3, 33kV outdoor bus, 2 x 33kV CBs, voltage regulators RG1 and RG2, and AFLC coupling cell. It also involves installing a new 33/11kV transformer (TR2), rebuilding the outdoor 33kV bus and installing a new masonry building for the 11kV ring main unit switchgear, protection and control panels, and AFLC coupling cell. It also involves installing vertical oil separation tanks and upgrading substation security by installing a perimeter intrusion detection system.

The estimated capital cost of the preferred option is \$8.8m.

Figure 8 provides schematic diagram for the preferred option.

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**Figure 8: Proposed network arrangement (schematic view)**

## 3.3 Non-network alternative options

Once the 33/11kV transformer TR3, 33kV CBs and 33kV outdoor bus at SSSIS reaches retirement age and can no longer be safely operated, the existing load must be supplied via a single transformer TR1. Subsequent contingency condition of an outage of TR1 must be managed via non-network alternative solutions while satisfying the COS or Service Safety Net Targets as specified in the Distribution Authority issued to Energex.

Demand & Energy Management (DEM), a team within Energex, has been engaged to conduct a screen test to investigate potential non-network alternative solutions to defer or eliminate the requirement to install a new 33/11kV transformer and 33kV bus at SSSIS, while addressing the identified need.



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### 3.3.1 Potential non-network solutions considered

On-call demand reduction

- a. Customer embedded generation
- b. Customer demand response (commercial)
- c. Customer demand response (residential)

### 3.3.2 Result of non-network options assessment

The load at risk will be the total load of SSSIS, which will be unsupplied when the 33/11kV transformer TR3, 33kV CBs and outdoor 33kV bus reaches retirement age and a fault occurs on the remaining TR1.

As confirmed by DEM, it is considered that no available demand management products or strategies can provide sufficient demand support at SSSIS to address the identified need. It is evident that an economically feasible non-network option would not be available to defer or eliminate the requirement to replace the 33/11kV transformer TR3, 33kV CBs and outdoor 33kV bus and continue to provide a safe, sufficient and reliable supply to customers at SSSIS.

## 4.0 CONCLUSION

Considering the nature of the project, being the safety risk from failure of aged assets and breaching safety net targets, and as per clause 5.17.4(c) of the NER Energex has determined that there are no credible non-network options to address the identified need at SSSIS. Thus, with reference to clauses 5.17.4(c) and 5.17.4(d) of the NER, Energex will not publish a non-network options report for the proposed project to replace the 33/11kV transformer TR3, 33kV CBs and outdoor 33kV bus.

Since the estimate project cost is below \$11 million, Energex is exempt from publishing a draft project assessment report, as per clause 5.17.4(n) of the NER, and will therefore publish the final project assessment report as soon as practicable in accordance to clause 5.17.4(p) of the NER.