Regulatory Investment Test for Distribution

Final Project Assessment Report

Addressing Reliability Requirements in the Garbutt Network Area

Ergon Energy Network
Part of Energy Queensland

Publication Date: 13 **March 2020**

Executive Summary

ABOUT ERGON ENERGY

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres – around 97% of the state of Queensland – from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

IDENTIFIED NEED

Garbutt 132/66/11kV (T046) Substation (GARB) is a Powerlink Queensland (PLQ) / Ergon Energy (EE) shared site located in Townsville. GARB Substation was established in 1958 and progressively developed since to be a critical node within the Townsville sub transmission (66kV) network. GARB links two transmission feeders to seven zone substations (inclusive) and supplies 48,500 customers and 86MVA of load (directly and indirectly).

There is minimal forecast load growth at the substation however many assets are approaching or at the end of service life. Most notably the structures that support the 66kV air insulated busbar and bay equipment have been assessed to have insufficient structural integrity to safely provide support for the equipment. Some equipment and the majority of structures are 40-60 years old.

The deteriorated condition of the assets at Garbutt Substation poses significant safety risks to staff working in proximity to these assets and reliability of supply risks to customers supplied from Garbutt Substation.

The identified need for investment is to remediate the safety and reliability risks currently associated with the aged assets at Garbutt Substation in order to maintain a safe, reliable supply of electricity to customers in the Townsville region.

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). Ergon Energy has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the Garbutt supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D.

Ergon Energy published a Draft Project Assessment Report for the above described identified need on the 13th December 2019. No submissions were received by the closing date of the 31st January 2020.

Two potentially feasible options have been investigated:

- **Option A:** Replacement of the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS)
- **Option B:** Replacement of the aged 66kV assets at Garbutt Substation with 66kV Air Insulated Switchgear (AIS).

This Final Project Assessment Report (FPAR), where Ergon Energy provides both technical and economic information about possible solutions, has been prepared in accordance with the requirements of clause 5.17.4(o) of the NER. Ergon Energy's preferred solution to address the identified need is Option A – Replacement of the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS) located within the existing Garbutt Substation boundary.

1 Introduction

This FPAR has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(o) of the NER.

This report represents the final stage of the consultation process in relation to the application of the RIT-D on potential credible options to address the identified need in the Garbutt network area.

In preparing this RIT-D, Ergon Energy is required to consider reasonable future scenarios. With respect to major customer loads and generation, Ergon Energy has, in good faith, included as much detail as possible while maintaining necessary customer confidentiality. Potential large future connections that Ergon Energy is aware of are in different stages of progress and are subject to change (including outcomes where none or all proceed). These, and other customer activity can occur over the consultation period and may change the timing and/or scope of any proposed solutions.

1.1. Response to the DPAR

Ergon Energy published a Draft Project Assessment Report for the identified need in the Garbutt network area on 13 December 2019. No submissions were received by the closing date of 31 January 2020.

1.2. Structure of this report

This report:

- Identifies the need which Ergon Energy is seeking to address, together with the assumptions used in identifying and quantifying that need
- Describes the credible options that are considered in this RIT-D assessment
- Quantifies costs and classes of material market benefits for each of the credible options
- Describes the methods used in quantifying each class of market benefit
- Provides details of classes of market benefits that are not considered material to this RIT-D assessment and provides explanations as to why these classes of market benefits are not considered material
- Provides the results of Net Present Value (NPV) analysis of each credible option and accompanying explanatory statements regarding the results
- Identifies the proposed preferred option, including detailed characteristics, estimated commissioning date, indicative costs, and noting that it satisfies the RIT-D
- Provides contact details for queries on this RIT-D.

1.3. Dispute Resolution Process

In accordance with the provisions set out in clause 5.17.5(a) of the NER, Registered Participants or Interested Parties may, within 30 days after the publication of this report, dispute the conclusions made by Ergon Energy in this report with the Australian Energy Regulator. Accordingly, Registered Participants and Interested Parties who wish to dispute the conclusions outlined in this report based on a manifest error in the calculations or application of the RIT-D must do so within 30 days of the publication date of this report. Any parties raising a dispute are also required to notify Ergon Energy. Dispute notifications should be sent to demandmanagement@ergon.com.au

If no formal dispute is raised, Ergon Energy will proceed with the preferred option to replace the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS) located within the existing Garbutt Substation boundary.

1.4. Contact Details

Inquiries about this RIT-D may be sent to:

E: demandmanagement@ergon.com.au

P: 13 74 66

2 Background

2.1. Geographic Region

The geographic region covered by this RIT-D is Garbutt Substation and the connected substations through its 66kV Network. Garbutt Substation supplies approximately 48,500 customers and is located in the Townsville area of the Northern Region of Ergon Energy's Network.

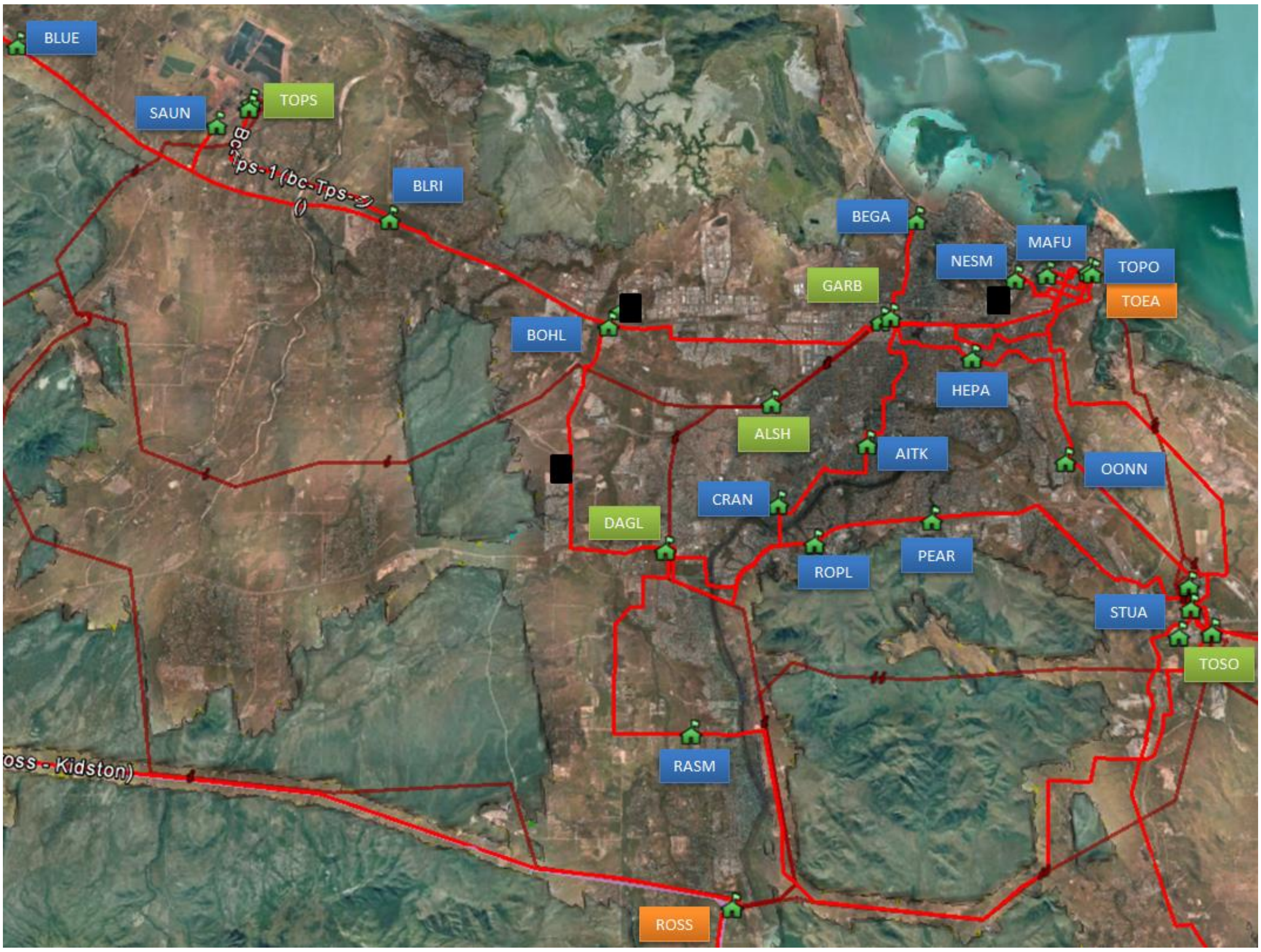

Figure 1: Townsville's 132kV transmission and 66kV sub transmission Networks (PLQ Sites Orange, PLQ/EE Sites Green, EE sites Blue)

2.2. Existing Supply System

Garbutt 132/66/11kV Substation is supplied via a Powerlink Queensland (PLQ) owned double circuit transformer ended 132kV feeder from Alan Sherriff Substation. The PLQ-EE asset boundary at Garbutt Substation is the 66kV bushings on the 132/66kV transformers. Garbutt Substation has seven 66kV feeders that supply a number of zone substations in the Townsville area. Garbutt Substation has eleven outgoing 11kV feeders that supply approximately 1,472 commercial/industrial customers and 4,201 domestic customers.

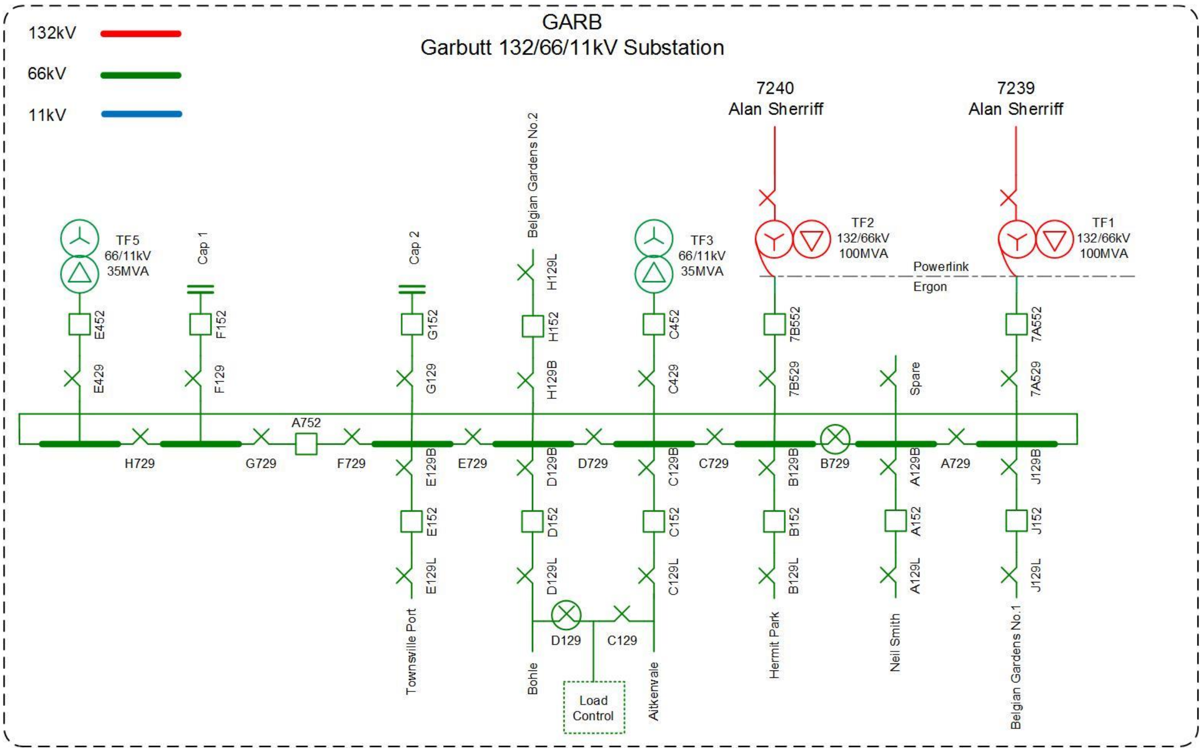

Figure 2 Single Line Diagram of the 66kV bus at Garbutt Substation

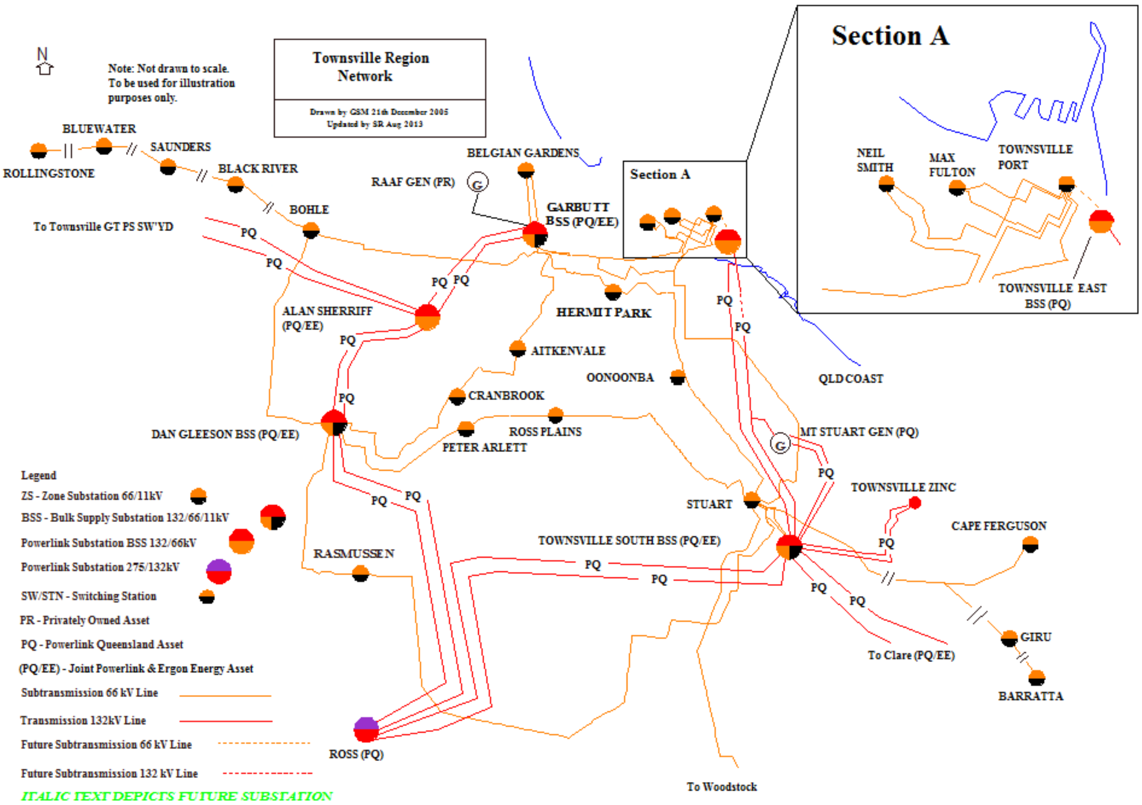

Figure 3 Existing Townsville Network Arrangement (Sub-transmission)

The Townsville 66kV network is supplied by four PLQ 132/66kV substations (T056 Townsville South, T094 Townsville East, T092 Dan Gleeson and T046 Garbutt) as shown in the diagram above. Garbutt Substation is a crucial node in the interconnected 66kV ring arrangement that supplies the 66/11kV zone substations in the Townsville urban area. The following Zone substations would be directly impacted for a Garbutt Substation 66kV bus outage:

- Garbutt 11kV network (complete outage of supply)
- Belgian Gardens (complete outage of supply)
- Bohle (supply maintained via Dan Gleeson – Bohle 66kV feeder)
- Black River (supply maintained via Dan Gleeson – Bohle 66kV feeder)
- Saunders (supply maintained via Dan Gleeson – Bohle 66kV feeder)
- Bluewater (supply maintained via Dan Gleeson – Bohle 66kV feeder)
- Rollingstone (supply maintained via Dan Gleeson – Bohle 66kV feeder)
- Neil Smith (supply maintained via Townsville Port – Neil Smith 66kV feeder)
- Aitkenvale (supply maintained via Dan Gleeson – Cranbrook 66kV feeder)
- Cranbrook (supply maintained via Dan Gleeson – Cranbrook 66kV feeder)
- Hermit Park (supply maintained via Stuart – Oonoonba 66kV feeder)
- Oonoonba (supply maintained via Stuart – Oonoonba 66kV feeder)

With the Townsville network configured in a normal state, an outage on both 66kV bus sections at Garbutt Substation should normally only result in an outage to customers supplied from the Garbutt Substation 11kV distribution network and the Belgian Gardens 11kV distribution network.

2.3. Load Profiles / Forecasts

2.3.1. Garbutt and Belgian Gardens substation load forecasts

The plots below show the historical maximum demands and the 50% Probability of Exceedance (50 PoE) forecast demands for the Garbutt Substation 66kV load, the Garbutt Substation 11kV load and the Belgian Gardens Substation 11kV load.

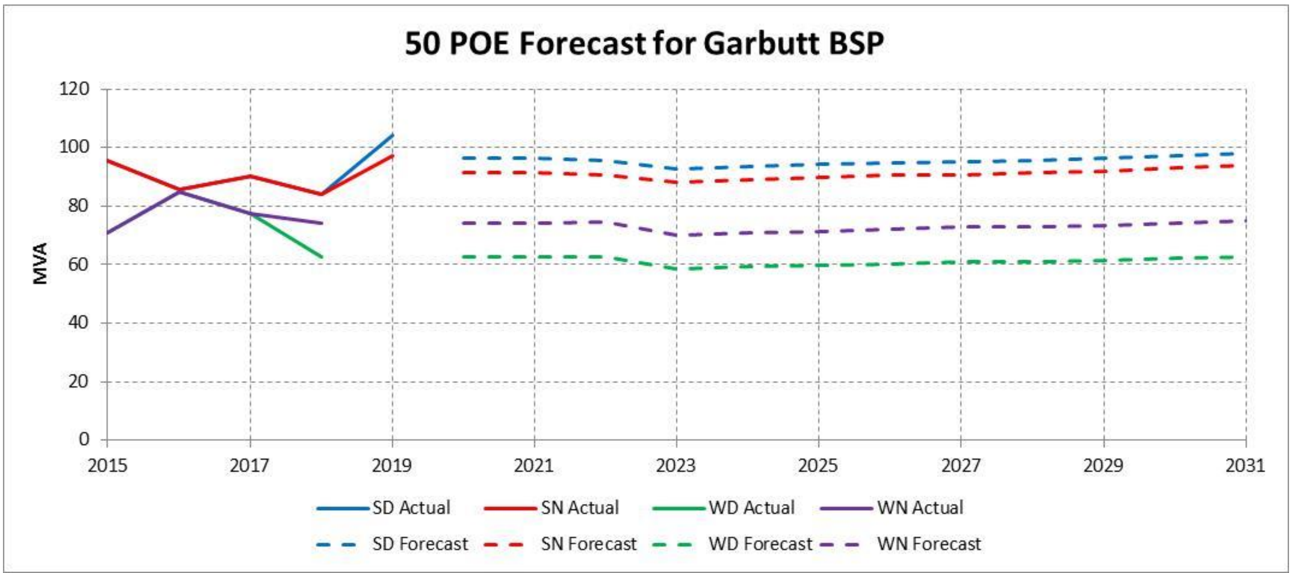

Figure 4 50 PoE Demand Forecast for the Garbutt Substation 66kV load

The 66kV network is highly meshed around Townsville and an outage to one of the 132/66kV transformers does not result in all 66kV load being carried on the remaining 132/66kV transformer due to the impedance change at Garbutt Substation. Therefore, the loading shown in the forecast for Garbutt Substation 66kV load would normally not be applicable with one 132/66kV transformer out of service as some of this load would shift, based on the impedance changes, to adjacent bulk supply points in the Townsville 66kV network.

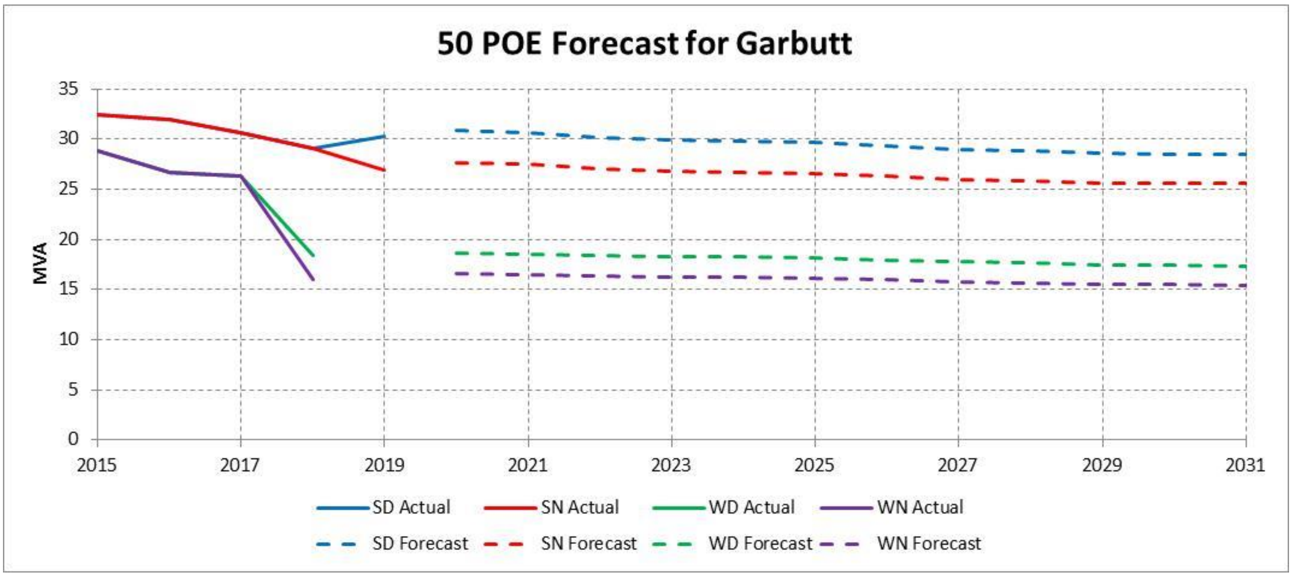

Figure 5 50 PoE Demand Forecast for the Garbutt Substation 11kV load

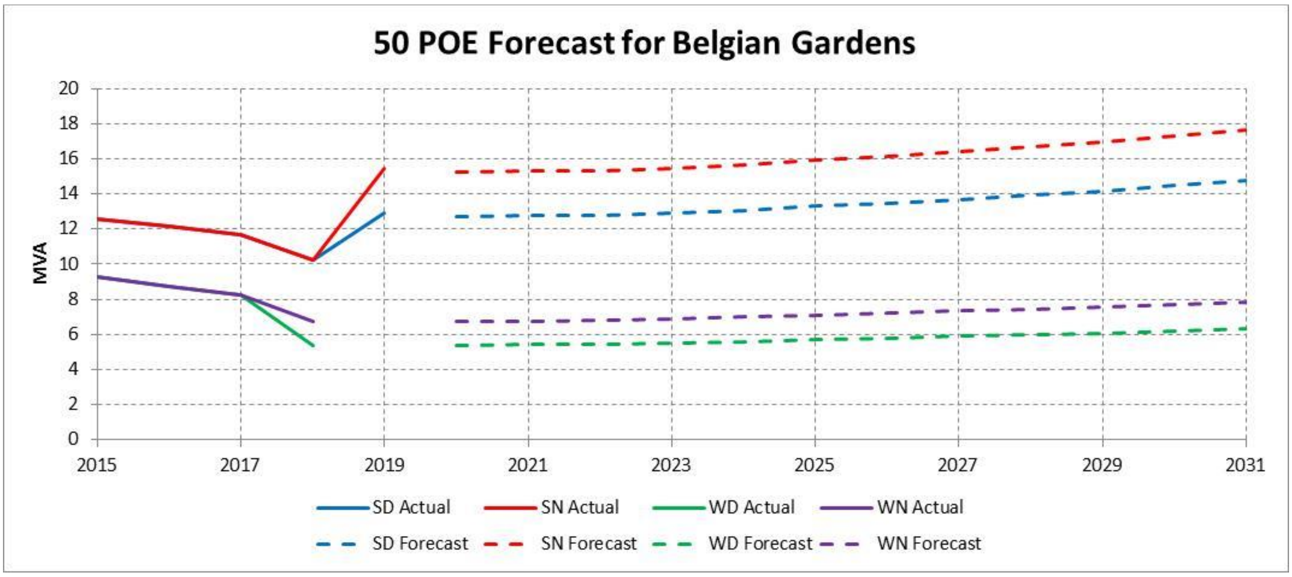

Figure 6 50 PoE Demand Forecast for the Belgian Gardens Substation 11kV load

2.3.2. Garbutt and Belgian Gardens substation load profiles

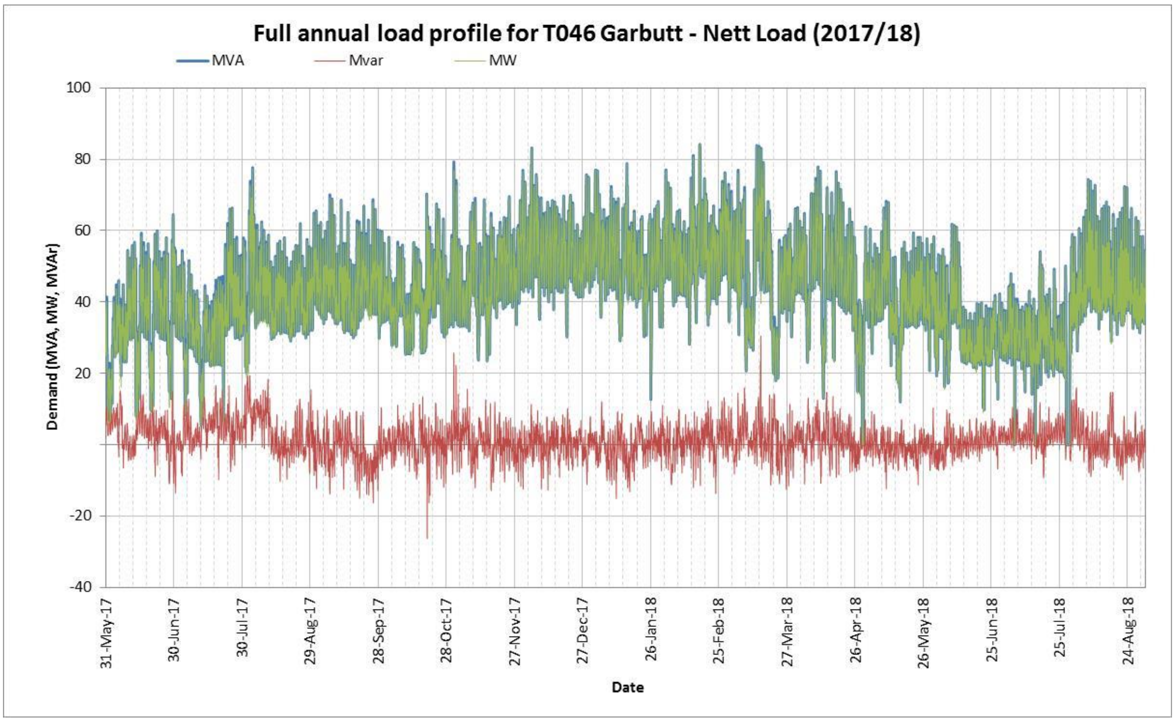

Figure 7 GARB 66kV load profile (2017/18)

The plot above shows the half hourly average daily load profile for Garbutt Substation 66kV load for the 2017/18 period. The plot shows that the Garbutt Substation 66kV load peaks during the summer period. Note that the configuration of the Townsville 66kV network and the status of local generation can influence the 66kV loading at Garbutt Substation.

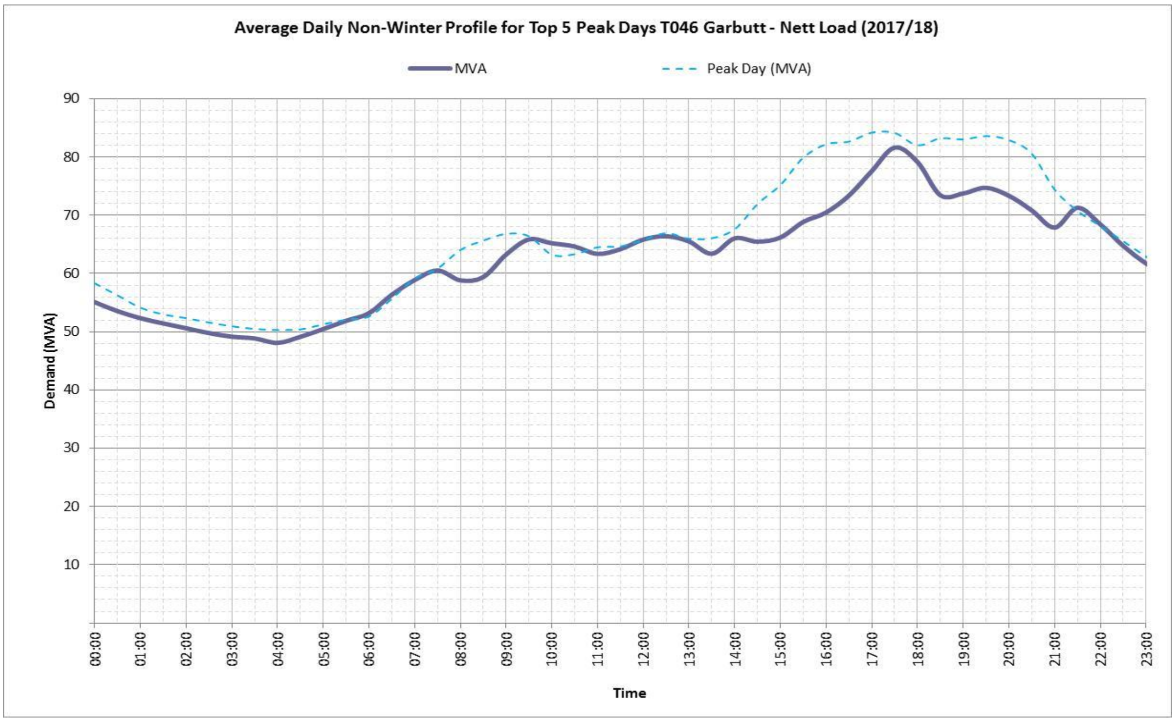

Figure 8 GARB 66kV load profile – Average of Top 5 Peak Days (2017/18)

The summer peak for the Garbutt Substation 66kV load typically occurs in the late afternoon early evening as shown in the plot above.

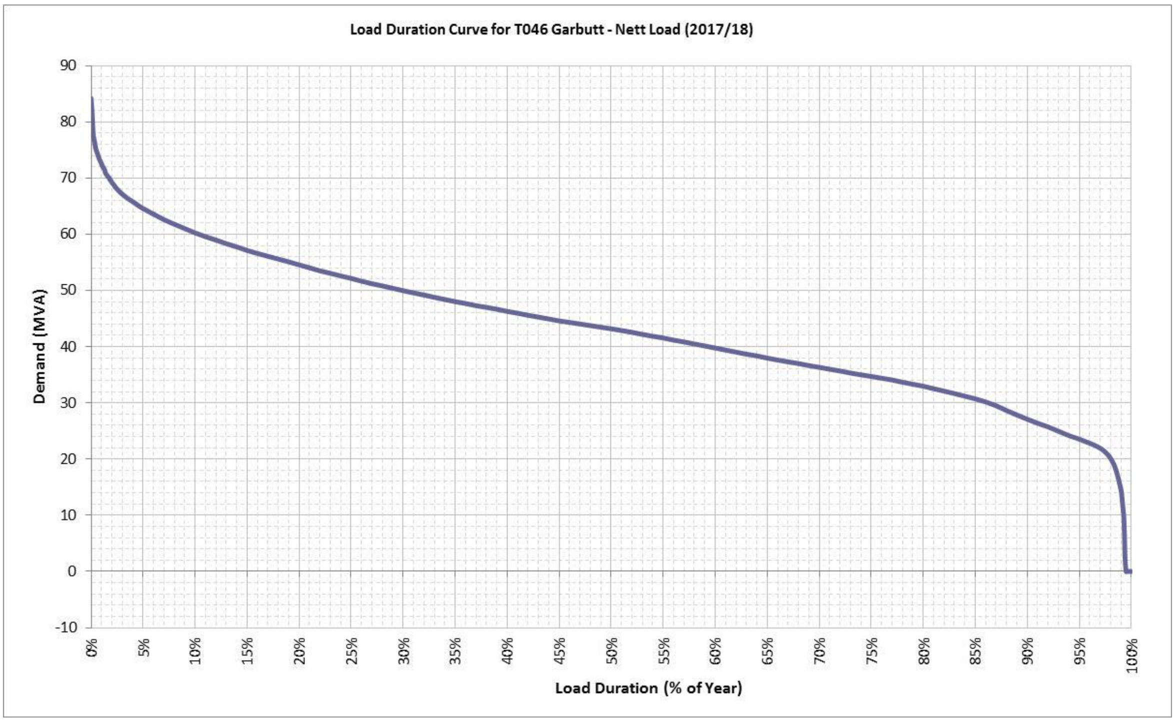

Figure 9 GARB 66kV Load Duration Curve (2017/18)

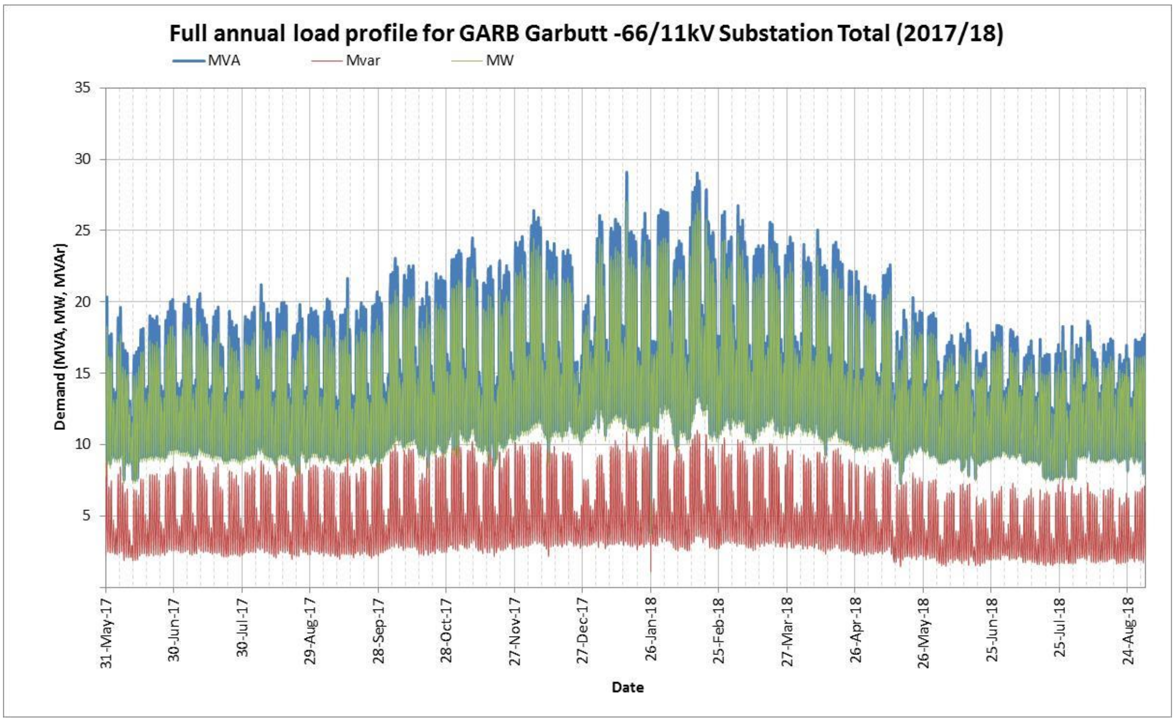

Figure 10 GARB 11kV load profile (2017/18)

The plot above shows the half hourly average daily load profile for Garbutt Substation 11kV load for the 2017/18 period. The plot shows that the Garbutt Substation 11kV load peaks during the summer period.

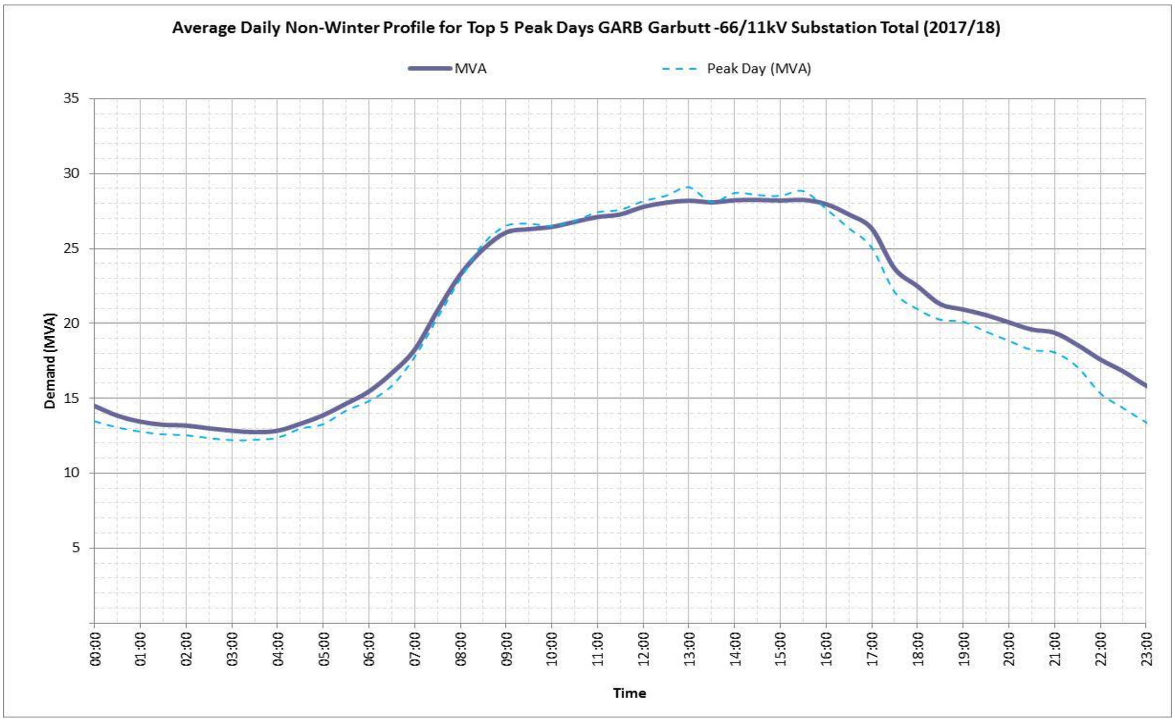

Figure 11 GARB 11kV load profile – Average of Top 5 Peak Days (2017/18)

The summer peak for the Garbutt Substation 11kV load typically occurs during the day as shown in the plot above. The Garbutt Substation 11kV distribution network supplies a large proportion of industrial / commercial customers that predominantly operate during normal business hours.

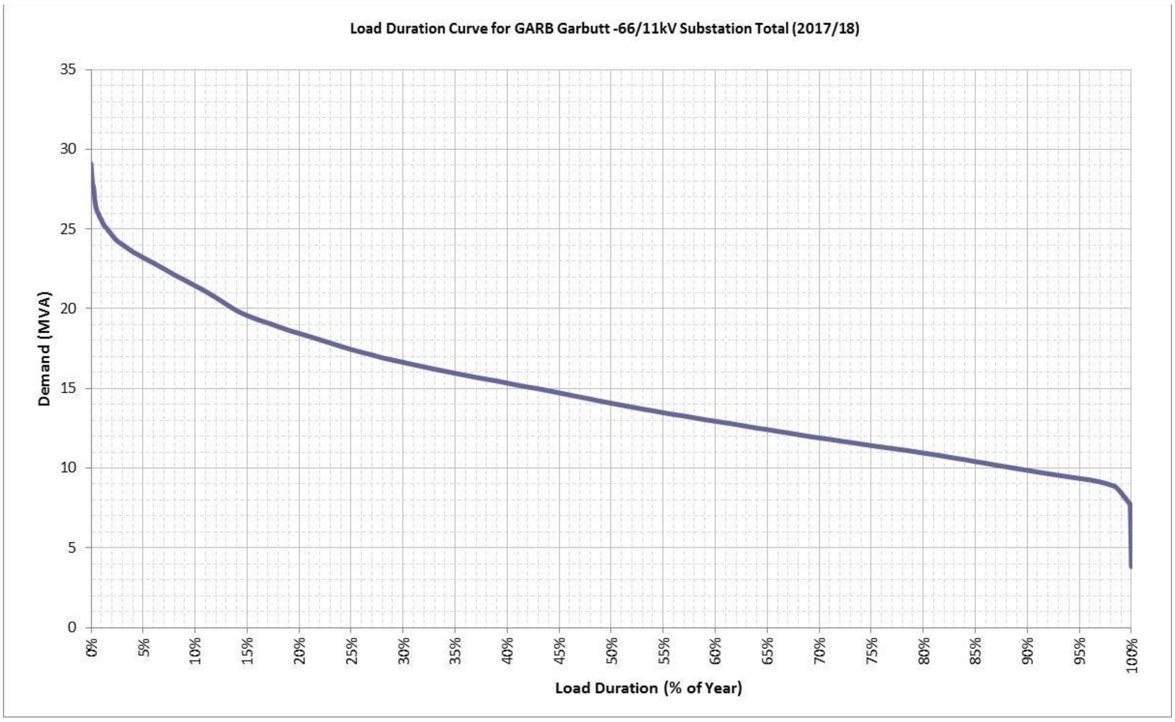

Figure 12 GARB 11kV Load Duration Curve (2017/18)

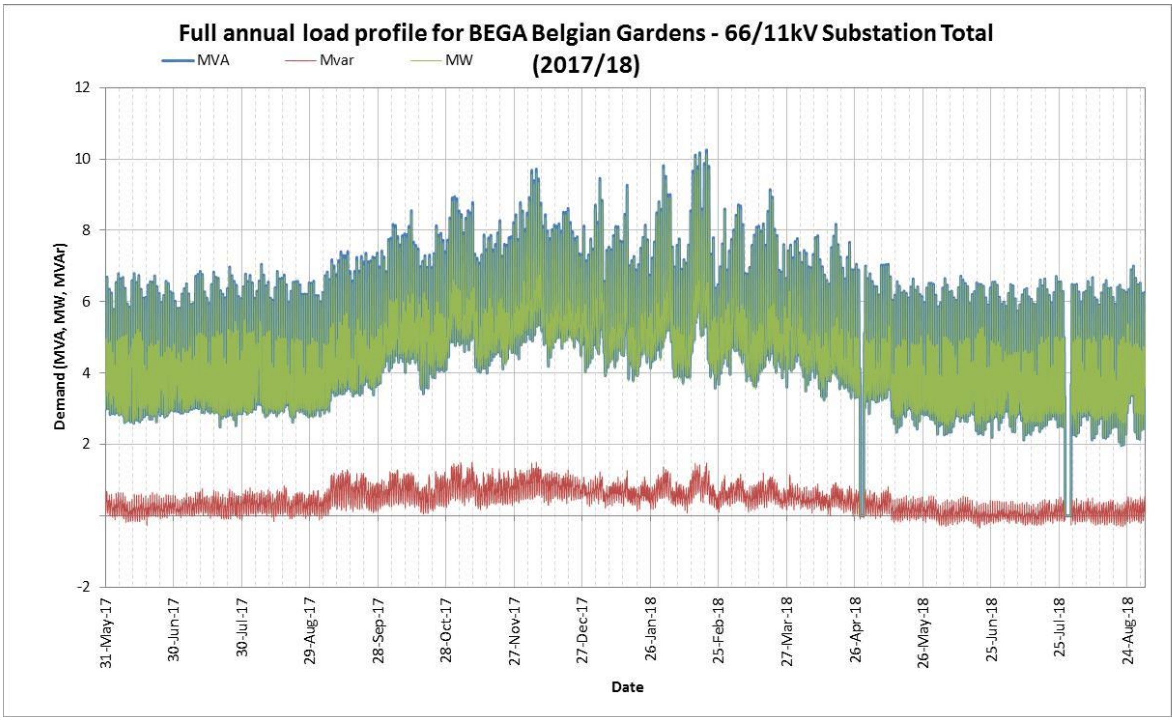

Figure 13 BEGA 11kV load profile (2017/18)

The plot above shows the half hourly average daily load profile for Belgian Gardens Substation 11kV load for the 2017/18 period. The plot shows that this substation load peaks during the summer period.

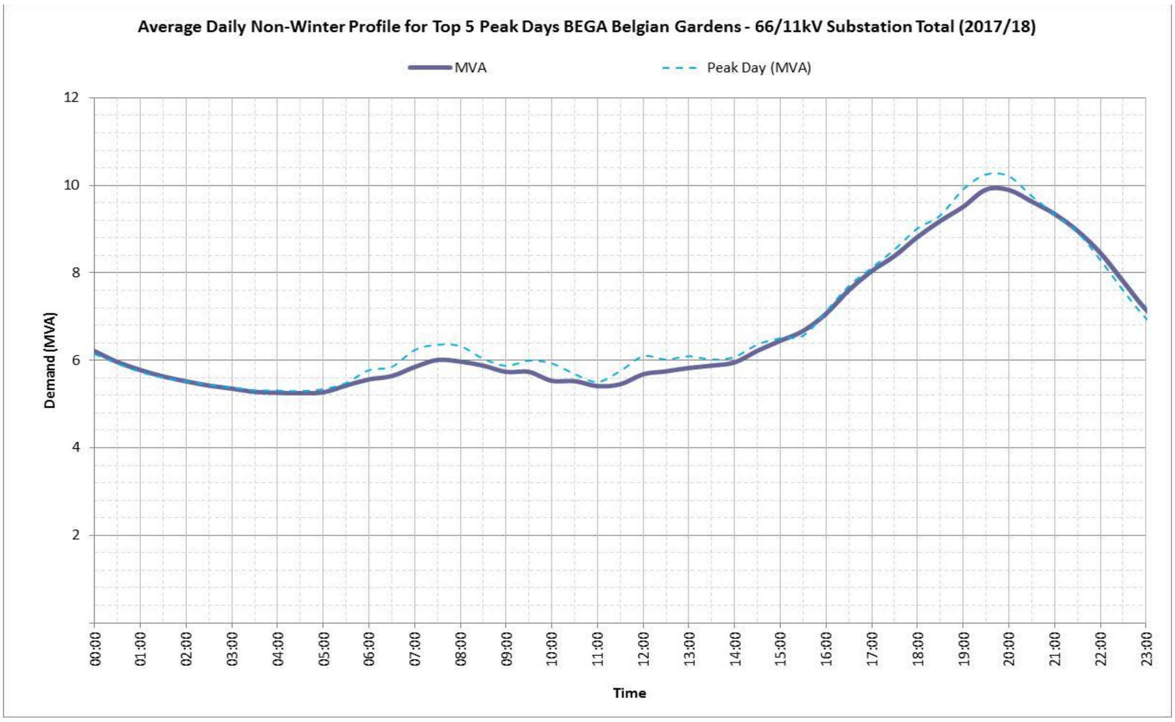

Figure 14 BEGA 11kV load profile – Average of Top 5 Peak Days (2017/18)

The summer peak for the Belgian Gardens Substation 11kV load typically occurs in the early evening as shown in the plot above. The Belgian Gardens Substation 11kV distribution network supplies a large proportion of residential customers resulting in an evening peak.

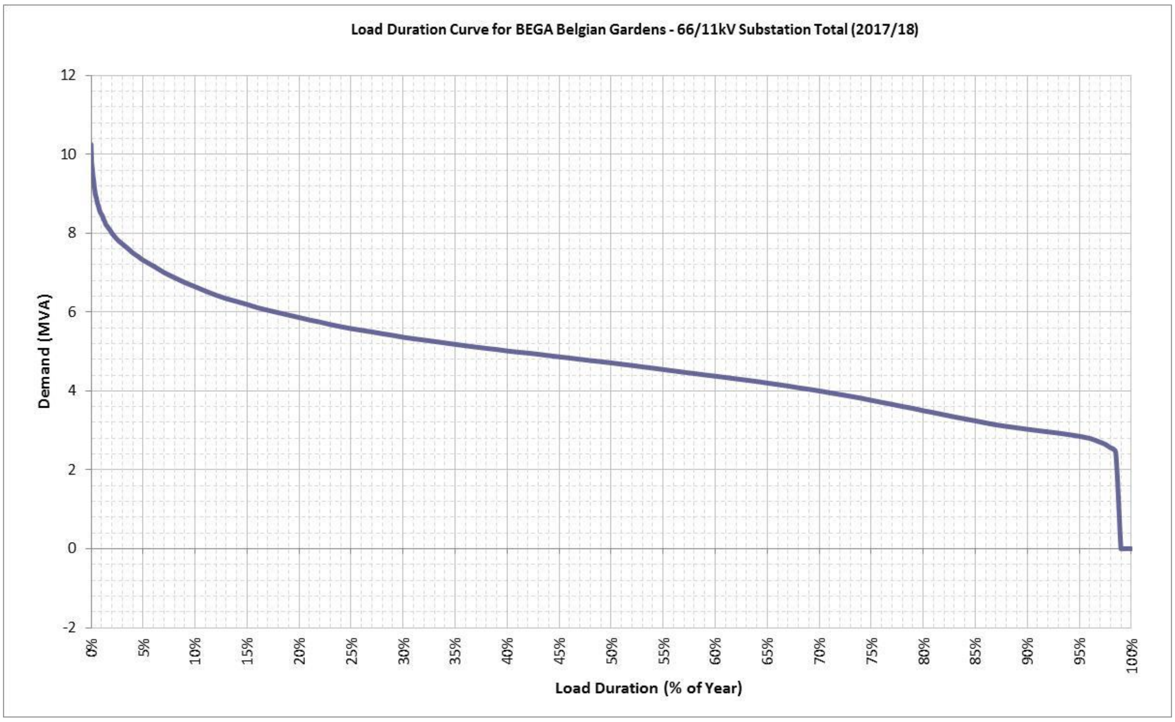

Figure 15 BEGA 11kV Load Duration Curve (2017/18)

3 Identified Need

3.1. Description of the Identified Need

Garbutt 132/66/11kV (T046) Substation (GARB) is a Powerlink Queensland (PLQ) / Ergon Energy (EE) shared site with outdoor 132kV and 66kV assets and indoor 11kV assets, which supplies 48,500 customers and 86MVA of load (directly and indirectly). Development of the substation commenced in 1958 with upgrades and augmentations in subsequent years. Garbutt Substation is now an integral node within the Townsville sub transmission (66kV) network with seven 66kV feeders supplying a number of zone substations. There is minimal forecast load growth at the substation however many assets are approaching or at the end of service life, with some equipment and the majority of structures 40-60 years old.

Figure 16 Aerial image of Garbutt Substation

A Civil Engineering Condition Assessment of the Garbutt Substation in 2016 made the following key observations about the pre 1980 concrete supports:

- All concrete structures supporting isolators on the low bus have a high risk of failure;
- All concrete structures supporting isolators on the high bus have a high risk of failure;
- All concrete line termination structures have a high risk of failure in the east-west direction.

The report also included the following key observations about the risk that operators switching isolators mounted on these structures are exposed to:

- There is a medium risk of failure of the structures supporting the A729, D729, B729 C729 and G729 isolators on the high bus. For the other isolators there is a low risk of failure;
- There is a medium risk of failure of the B129L line termination structure. For the other line termination structures, the risk is low.

In January 2018 a segmented porcelain insulator supporting a 66kV isolator failed catastrophically. Shards of porcelain were located up to 25m from the point of failure. This incident caused a significant supply interruption and triggered a reactive project to replace all segmented porcelain insulators in the Garbutt Substation yard.

Subsequent to this incident a Substation Condition Assessment Report was completed for Garbutt Substation which identified the assets nearing or at end of life and requiring replacement. The predominant primary system assets identified for replacement were the 66kV outdoor switchgear including; circuit breakers, voltage and current transformers, insulators stacks, isolators, the strung bus, the solid bus and all their supporting structures.

The deteriorated condition of the assets at Garbutt Substation poses significant safety risks to staff working in proximity to these assets and reliability of supply risks to customers supplied from Garbutt Substation.

The identified need for investment is to remediate the safety and reliability risks currently associated with the aged assets at Garbutt Substation in order to maintain a safe, reliable supply of electricity to customers in the Townsville region.

3.2. Quantification of the Identified Need

3.2.1. Reduced substation operational capability

The condition of the 66kV bus isolators and supporting structures limits operational flexibility at Garbutt Substation. A majority of the isolators are in poor condition with sticky contacts and some are inoperable. The isolator structures have an increased risk of failure during operation of the isolators due to the necessary force required to open and close the isolators.

Due to the proximity of the isolators to the aerial bus there are a number of isolators that cannot have maintenance performed on them without a complete 66kV bus outage at Garbutt Substation. The 66kV bus configuration does not provide the operational flexibility to de-energise both the aerial bus and the isolators on the rigid bus without a complete bus outage.

Figure 17 Garbutt Substation elevation diagram showing the 66kV bus configuration

Due to concerns associated with the integrity of the concrete support structures, switching operators assess the condition of each isolator prior to operating and consider the likelihood of structure failure or dislodgement of concrete pieces when subjected to the lateral forces during switching. The controls applied to maintain safety range from a safety observer to refusal to switch resulting in switching at adjacent devices. Switching at adjacent devices can be operationally inefficient and can result in wider network affected by the operation.

3.2.2. Increased risk of involuntary load shedding going forward

Townsville is located in a tropical environment and is subject to harsh atmospheric conditions including tropical cyclones[1]. The aged assets at Garbutt Substation, particularly the deteriorating concrete support structures, will become more susceptible to failure during periods of increased wind loading.

With the Townsville network configured in a normal state, a credible contingency at Garbutt Substation is not expected to result in loss of supply to any customers as there is generally full N-1 backup capability available up to the Garbutt and Belgian Gardens Substation 11kV busbars.

A non-credible event such as an outage to both 66kV bus sections at Garbutt Substation would result in loss of supply to at least 10,000 customers. Although considered a non-credible event (or high consequence low probability event), due to the 66kV aerial bus arrangement at Garbutt Substation an aerial bus conductor failure or supporting structure failure is likely to result in an outage to both 66kV bus sections. As the Townsville 66kV network has a meshed arrangement, an outage on both 66kV bus sections should normally only result in an outage to customers supplied from the Garbutt Substation 11kV distribution network and the Belgian Gardens 11kV distribution network.

Figure 18 Photo showing the aerial bus spanning the bus tie circuit breaker

In the event of an extended 66kV bus outage at Garbutt Substation Ergon Energy will use 'best endeavours' to partially restore supply using 11kV feeder transfers and generation support. It has been assumed that for a majority of bus faults supply can typically be fully restored within 24 hours. The restoration times would generally be dependent on a number of factors including location of

[1] http://www.bom.gov.au/cyclone/about/

staff, time of fault, severity of the fault, asset accessibility, availability of suitable spares, weather conditions and would vary under extenuating circumstances such as a natural disaster scenario.

Based on the existing peak load profiles at GARB and BEGA the load at risk over a 24-hour period would be in the order of 630MWh which would reduce to around 430MWh after accounting for load transfers and generation support.

Based on Condition Based Risk Management analysis the probability of a 66kV primary plant or structural asset failure that would lead to a full 66kV bus outage could occur as infrequently as once in 20 years. The average annual probability of failure (PoF) is therefore 0.05 and the estimated unserved energy in the next 10 years is estimated at 215MWh.

3.3. Assumptions in Relation to Identified Need

Below is a summary of key assumptions that have been made when the identified need has been analysed and quantified.

It is recognised that the below assumptions may prove to have various levels of correctness, and they merely represent a 'best endeavours' approach to predict the future identified need.

3.3.1. Forecast Maximum Demand

It has been assumed that maximum demand at Garbutt Substation will have minimal growth over the next 10 years as per the forecasts in Section 2.3.1.

Factors that have been taken into account when the load forecast has been developed include the following:

- load history
- known future developments (new major customers, network augmentation, etc.)
- temperature corrected start values (historical peak demands)
- forecast growth rates for organic growth.

3.3.2. Load Profile

It has been assumed that the average daily load profiles shown in Section 2.3.2 will not change substantially over the coming years. Although the assumption is that there will be minimal change, the load profiles could potentially be influenced by changes to customer generation or usage patterns and the uptake of electric vehicles and battery storage in the area.

4 Credible Options Assessed

4.1. Assessment of Network Solutions

Ergon Energy investigated a number of network options to address the identified need at Garbutt Substation. Details of the credible options are presented in the following sections.

4.1.1. Option A: Replacement of the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS)

This option involves replacement of the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS) located within the existing Garbutt Substation boundary.

This option includes:

- A new building for the GIS switchgear and new control building for the protection and control equipment.
  - 66kV bus protection
  - 66kV feeder protection
  - Transformer 3 & 5 protection
- 15 x GIS Modular CB/Isolator/CT/VT (as required):
  - 4 x 66kV Transformer Bays (2 x Plink 132/66kV, 2 x EQ 66/11kV)
  - 8 x 66kV Feeder Bays (7 x existing feeders and 1 x Load control / Future Feeder)
  - 2 x 66kV Capacitor Bank Bays
  - 1 x 66kV Bus Tie Bay
- Connection of existing plant to the new GIS switchgear:
  - 66kV UG cables between the GIS switchgear and the transformers (x4), cap banks (x2), feeders (x7) and AFLC (x1).
  - 7 x 66kV Feeder Terminations
  - 2 x 66kV cable term poles (Aitkenvale and Bohle Feeders)
  - 5 x 66kV cable connections (Belgian Gardens 1 & 2, Neil Smith, Hermit Park, Townsville Port)
- Replacement of aged AFLC components; controller, transmitter and coupling cell
- Replacement of the pilot wire protection schemes on the Hermit Park and Townsville Port 66kV feeders including removal of the redundant pilot wires
- Removal of all aged and redundant 66kV AIS bays and associated plant.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $30,867,660. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in late 2019 and construction completed by late 2022.

4.1.2. Option B: Replacement of the aged 66kV assets at Garbutt Substation with 66kV Air Insulated Switchgear (AIS)

This option involves replacement of the aged 66kV assets at Garbutt Substation with 66kV Air Insulated Switchgear (AIS) located within the existing Garbutt Substation boundary.

This option includes:

- replacement of the 66kV bus and structures with new rigid busbar in a staged manner to limit outages, rationalising the bus section isolators and removing the aerial / strung bus.
    - removal of the bus isolators A729, B729, C729, D729, E729 and H729
- rebuild feeder bays to replace defective structures and to replace identified end of life equipment;
    - rebuild existing 66kV bays connecting: CAP 1, CAP 2, TRANSF 3, AITK FDR, 2T, HEPA FDR, NESM FDR, 1T
- removal of the Belgian Gardens 2, Bohle 66kV and 66kV bus tie bays;
- expansion of the 66kV switchyard to allow optimal distribution of feeders and transformers across the bus sections;
    - establish two new outdoor 66kV feeder bays in the South East corner of the yard and rerouting/extension of Belgian Gardens 2 66kV UG feeder and Bohle OH 66kV feeder to the new bays
- repositioning of the 66kV bus tie bay and realignment of the capacitor banks, transformers and feeder bays providing redundancy in the bus arrangement
    - establish a new 66kV bus tie bay at the location adjacent to where the Bohle 66kV feeder bay was connected;
    - relocate CAP 2 to take supply from the existing 2T feeder bay
    - realign connection from 2T to existing CAP 2 feeder bay
- replacement of aged 66kV protection relays
- Replacement of the pilot wire protection schemes on the Hermit Park and Townsville Port 66kV feeders including removal of the redundant pilot wires
- replacement of two aged RTUs
- replacement of aged AFLC components; controller, transmitter and coupling cell.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $35,434,450. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in late 2019 and construction completed by late 2022.

Option B has been considered and is not recommended as it exposes the network and staff to undue risk and fails to me the identified need (section 3.1). The condition assessment indicates that various support structures, multiple items of plant and protection relays are in poor condition which poses a number of risks.

Construction works carried out in a live substation yard in proximity to these structures presents an intolerable risk to staff safety and network supply interruption. This option, though presented and considered for options analysis does not apply sound, risk-based engineering judgement and is not considered feasible and as such not proposed to progress.

4.2. Assessment of Non-Network Solutions

Ergon Energy's Demand & Energy Management team has assessed the potential non-network alternative options required to defer the network option and determine if there is a viable demand management option to replace or reduce the need for the network options proposed.

4.2.1. Customer Energy efficiency and power factor correction

Energy efficiency and power factor correction while offering permanent reductions has been assessed as not technically viable as this would only contribute to a fraction of the support required for the Garbutt and Belgian Gardens substations 11kV load.

4.2.2. Demand Response (curtailment of load)

Customer curtailment of load is an effective technique for network support where the need is for a short time period but is generally not viable for extended periods of time.

A small portion of the Garbutt and Belgian Gardens substations residential load such as hot water systems, pool pumps and air conditioning is controllable load that can be switched off for short periods of time.

In the Townsville region large customer demand response is valued at $40-100 per kVA (excluding acquisition costs). Ergon Energy has identified a small number of large customers in the Garbutt area with a total call off load of around 1400kVA that could potentially be suitable for network support for short periods of time.

These options have been assessed as technically not viable as they would not provide the identified demand reduction required at Garbutt and Belgian Gardens substations and the load reduction would only be available for short periods of time.

Similarly, these options would not be able to provide the identified demand reduction at the other substations in the wider Townsville area that require support for 66kV feeder contingencies.

4.2.3. Customer Solar Power / Energy Storage Systems

Business customers with large solar arrays are deemed to present a significant opportunity for targeted load control or load curtailment if coupled with a Battery Energy Storage System (BESS).

There are currently around 1,509 customers connected to the Garbutt and Belgian Gardens substation 11kV network with inverter energy systems installed with a combined capacity of approximately 8950kVA.

At present, only a very small percentage of customer solar power systems are coupled with a BESS. Solar customers without a BESS will not meet the technical needs of the demand reduction as their solar contribution may not be available when network support is required.

This option has been assessed as technically not viable as it would not provide the identified demand reduction required to support the Garbutt and Belgian Gardens substation loads, would only provide support during daylight hours and the majority of these systems cease to operate during a network outage.

Similarly, this option would not be able to provide the identified demand reduction at the other substations in the wider Townsville area that require support for 66kV feeder contingencies.

4.2.4. Large-Scale Customer Generation / Energy Storage

Large scale customer generation or energy storage is an effective technique for network support where the need is for a short time period but is generally not viable for extended periods of time.

In the Townsville region large customer generation support is valued at $40-100 per kVA (excluding acquisition costs). Ergon Energy has identified approximately five sites that have existing diesel generation that could potentially be used for network support in the Garbutt and Belgian Gardens areas with a combined capacity of around 8000kVA. These generators are typically operated as backup generators in parallel with the network or separated from the network in an islanded arrangement to supply the customer's facility.

This option has been assessed as technically not viable as it would only support around 18% of the identified capacity required to support the Garbutt and Belgian Gardens substation loads.

Apart from the Bohle and Black River substations which could potentially be supplied from the Townsville Power Station, the levels of generation support at the other substations in the wider Townsville area requiring support for 66kV feeder contingencies would not be sufficient to meet Ergon Energy's safety net requirements.

4.3. Preferred Network Option

Ergon Energy's preferred network option is to replace the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS) located within the existing Garbutt Substation boundary.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $30,867,660. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in late 2019 and construction completed by late 2022.

5 Summary of Submissions Received in Response to Draft Project Assessment Report

On 13 December 2019, Ergon Energy published the Draft Project Assessment Report providing details on the identified need in the Garbutt area. This report provided both technical and economic information about possible solutions and sought information from interested parties about possible alternate solutions to address the need for investment.

In response to the Draft Project Assessment Report, Ergon Energy received no submissions by 31 January 2020, which was the closing date for submissions to the Draft Project Assessment Report.

6 Market Benefit Assessment Methodology

The purpose of the RIT-D is to identify the option that maximises the present value of net market benefits to all those who produce, consume and transport electricity in the National Electricity Market.

In order to measure the increase in net market benefit, Ergon Energy has analysed the classes of market benefits required to be considered by the RIT-D.

6.1. Classes of Market Benefits Considered and Quantified

The following classes of market benefits are considered material, and have been included in this RIT-D assessment:

- Changes in involuntary load shedding

6.1.1. Changes in Involuntary Load Shedding

Involuntary load shedding is where a customer's load is interrupted from the network without their agreement or prior warning. Ergon Energy has calculated the impact of changes in involuntary load shedding caused by outages on the Garbutt Substation 66kV bus, by comparing the expected unserved energy under the base case (where no action is undertaken by Ergon Energy) with credible options in place.

Probability weighted values of expected unserved energy have been calculated based on the probability of the failure, the energy at risk and the estimated restoration time. The derived values of expected unserved energy have been converted to a dollar figure, which reflects the customer financial consequence of the unserved energy. Ergon Energy has applied a location specific Value of Customer Reliability (VCR) of $40,836/MWh, which has been derived from the 2014[2] AEMO VCR estimates.

[2] The AEMO VCR methodology has been used for this RIT-D as the RIT-D for this investment commenced prior to the publication of the AER VCR methodology

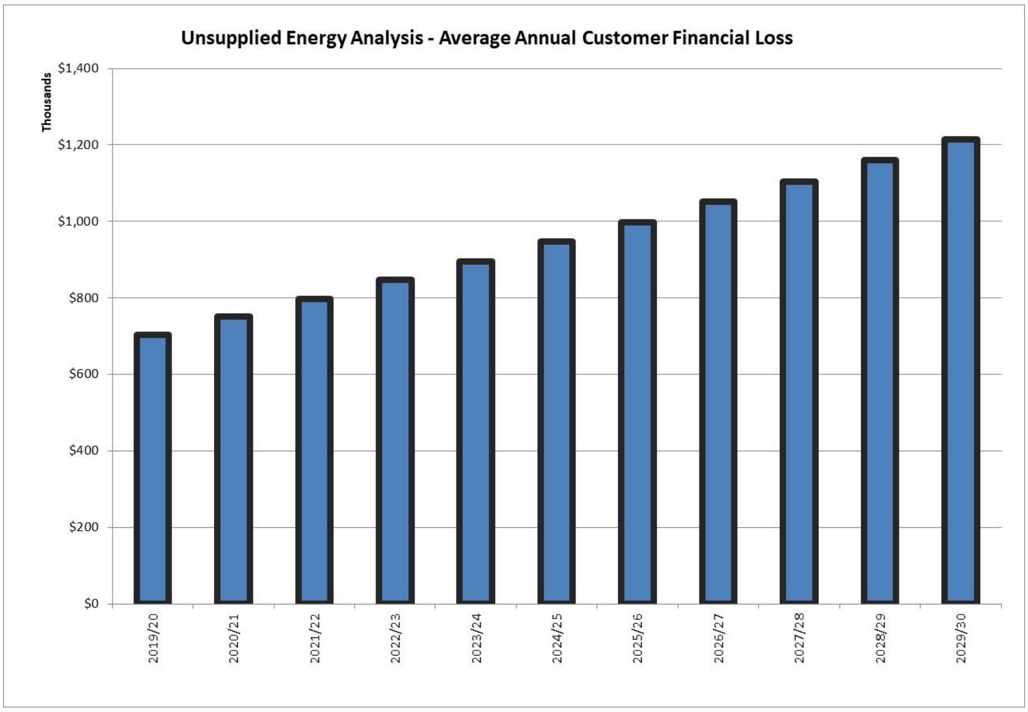

Figure 19 Assumed Average Annual Customer Financial Loss if no credible option is commissioned

The plot above shows the assumed average annual customer financial loss due to outages on the Garbutt Substation 66kV bus if no credible option is commissioned. The increase in financial loss over the 10-year period is based purely on the increase in probability of failure of existing assets and the CPI adjustments to VCR. The assessment has assumed minimal growth in maximum demand and energy over the 10-year period and minimal change in restoration times.

Under the proposed credible network option, the risk of an outage on the Garbutt Substation 66kV bus is assumed to be small enough to be set to zero, therefore there is not expected to be any unserved energy with the proposed credible network option in place.

Based on these assumptions, the reduction in expected unserved energy due to outages on the Garbutt Substation 66kV bus that the credible option is expected to deliver would be as presented in Figure 19 and has been included as a material market benefit.

6.2. Classes of Market Benefits not Expected to be Material

The following classes of market benefits are not considered to be material for this RIT-D, and have not been included in this RIT-D assessment:

- Changes in voluntary load curtailment
- Changes in costs to other parties
- Changes in timing of expenditure
- Changes in load transfer capability
- Changes in network losses
- Option value.

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https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/values-of-customer-reliability/decision.

6.2.1. Changes in Voluntary Load Curtailment

Because none of the credible options include any voluntary load curtailment, and because there are no customers on voluntary load curtailment agreements in the Garbutt area at present, any market benefits associated with changes in voluntary load curtailment have not been considered.

6.2.2. Changes in Costs to Other Parties

Ergon Energy does not anticipate that any of the credible options included in this RIT-D assessment will affect costs incurred by other parties.

6.2.3. Changes in Timing of Expenditure

None of the credible options included in this RIT-D assessment is expected to affect the timing of other distribution investments for unrelated identified needs.

6.2.4. Changes in Load Transfer Capability

None of the credible options included in this RIT-D assessment are expected to affect load transfer capability between substations in the Townsville area as the transfer capability is predominantly limited by the 66kV feeders. The proposed network option will improve plant rating capacity at Garbutt Substation however the market benefits from this are not considered to be material due to the feeder limitations.

6.2.5. Changes in Network Losses

Ergon Energy does not anticipate that any of the credible options included in the RIT-D assessment will lead to any significant change in network losses.

6.2.6. Option Value

The AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change[3].

Ergon Energy does not consider that the identified need for the options included in this RIT-D would be affected by uncertain factors about which there may be more clarity in future.

[3] AER "Regulatory Investment Test for Distribution Application Guidelines", Section A6. Available at: http://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-distribution-rit-d-and-application-guidelines

7 Detailed Economic Assessment

7.1. Net Present Value (NPV) Results

Net Present Values of the credible options are presented in Table 1 below. The NPV analysis demonstrates that Option A has the lowest Net Present Cost.

Note that the figures in the table below are the discounted present values evaluated over a 20-year period. These direct costs are preliminary estimates which are subject to change as costs are refined, and do not include any interest, risk, contingencies or overheads, but does include residual life values at the end of the 20-year period. Operating and maintenance costs and market benefits are assumed to be similar for the two options (GIS vs AIS).

$ Millions	Option A	Option B
Capex	(10.30)	(11.94)
Opex	(1.41)	(1.41)
Direct Benefits	0.00	0.00
Commercial NPV	**(11.71)**	**(13.35)**
Ranking	*1*	*2*
Invol. Load Shed	11.91	11.91
Commercial + Risk	**0.20**	**(1.44)**
Ranking	*1*	*2*

Table 1 – Net Present Value Analysis

Note: The above NPV analysis does not include the monetised values of all the network risks as well as the quantified values of all the market benefits that are not significant enough to make a difference in the preferred option.

8 Conclusion

The Final Project Assessment Report (FPAR) represents the final stage of the consultation process in relation to the application of the RIT-D.

Ergon Energy intends to take steps to progress the proposed preferred option to ensure any statutory non-compliance is addressed and undertake appropriately justified network reliability improvements, as necessary.

8.1. Preferred Option

Ergon Energy's preferred network option is option A - to replace the aged 66kV assets at Garbutt Substation with 66kV Gas Insulated Switchgear (GIS) located within the existing Garbutt Substation boundary. The details of option A are set out in section 4.1.1 of this report.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $30,867,660. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in late 2019 and construction completed by late 2022.

8.2. Satisfaction of RIT-D

The proposed preferred option satisfies the RIT-D.

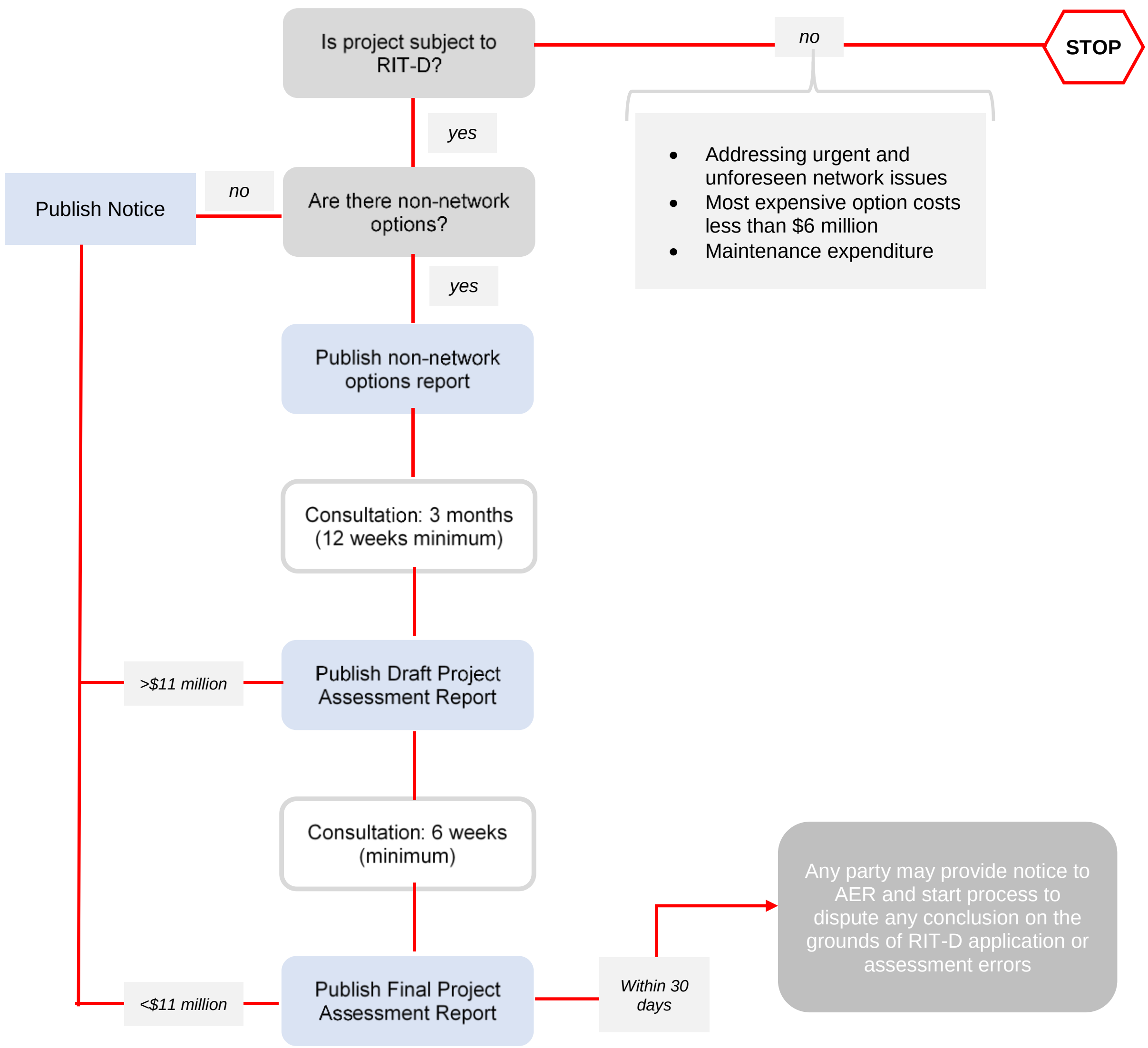
This statement is made on the basis of the detailed analysis set out in this report. The proposed preferred option is the credible option that has the highest net economic benefit under the most likely reasonable scenarios.

9 Compliance Statement

This Final Project Assessment Report complies with the requirements of NER section 5.17.4(j) as demonstrated below:

Requirement	Report Section
(1) a description of the identified need for investment;	3.1
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary);	3.3
(3) if applicable, a summary of, and commentary on, the submissions received on the DPAR;	5
(4) a description of each credible option assessed	4
(5) where a *Distribution Network Service Provider* has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit of each credible option	6
(6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	4
(7) a detailed description of the methodologies used in quantifying each class of costs or market benefit	6
(8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	6.2
(9) the results of a NPV analysis of each credible option and accompanying explanatory statements regarding the results	7.1
(10) the identification of the proposed preferred option	8.1
(11) for the proposed preferred option, the RIT-D proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (ii) the indicative capital and operating costs (where relevant); (iv) a statement and accompanying analysis that the proposed preferred option satisfied the RIT-D; and (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	8
(12) contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed.	1.4

Appendix A – The RIT-D Process



Source: AEMC, *Rule determination: National Electricity Amendment (Replacement expenditure planning arrangements) Rule 2017*, July 2017, p. 64.