Rowville Terminal Station Gas Insulated Lines (GIL) Replacement

TRR Network Study Results

AusNet Services

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Document Control

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1 Introduction

AusNet Services is preparing business cases for several major station replacement projects in connection with the 2027-2032 Transmission Revenue Reset (TRR). Some of these projects require network studies (steady-state load flow studies) to assess the market impact of asset failures. To that end, Elite Power Solutions Pty Ltd (“EPS”) were engaged by AusNet Services to conduct load flow studies for certain projects and scenarios using software, models, information and equipment provided by AusNet Services.

The avoided cost of an asset failure will be used to economically justify the investment in support of AusNet Services’ TRR Capex forecast and will be used as supporting information for the TRR revenue application. The economic justification and related calculations for these projects are not included in EPS’s scope but will be completed by others.

There are two Gas Insulated Lines (GIL) with a length of approximately 300m each at Rowville Terminal Station. These GIL are Rowville-Thomastown 220 kV line and Rowville-South Morang No.3 500 kV line were previously installed for the purpose and function of avoiding multiple 500kV and 220kV transmission line crossings. AusNet Services has conducted an asset condition assessment of these GIL of which they are found to be in poor condition with leaks and are targeted for replacement in the 2027-2032 TRR period.

The results in this document refer to network studies carried out for the potential replacement of the GIL section of the Rowville – Thomastown 220kV line and Rowville-South-Morang No.3 500kV line and are purely technical in nature.

Figure 1: Gas Insulated Lines (GIL) at Rowville Terminal Station

2 Study Methodology

2.1 Network Operation Scenarios

AusNet Services obtained an updated PSSE OPDMS network model from AEMO and provided to EPS. The assessment is conducted using this PSSE OPDMS network model to quantify the Maximum Supportable Demand (MSD) that may be impacted due to the failure (outage) of ROTS-TTS 220kV line and ROTS-SMTS No.3 500 kV line.

Loadflow modelling was conducted using the existing network and potential augmentation of installing a new ROTS A3 500/220 kV Transformer referencing the Project Specification Consultation Report (PSCR) for Eastern Victoria Grid Reinforcement [1]. The installation of the new ROTS A3 500/220 kV Transformer is to relieve N condition loading of ROTS A1 500/220 kV Transformer.

The specific operating scenarios are shown in Table 1 below.

Table 1: Status Quo Network Configuration & Operating Scenarios

Scenario	Asset Failure Contingency N-1	Asset Failure Contingency N-2	Asset Failure Contingency N-3	Secure Operating State Contingency
1	None	None	None	Trip of every element in VIC (one at a time)
2	ROTS-TTS 220kV line	None	None	Trip of every element in VIC (one at a time)
3	ROTS-SMTS No.3 500 kV line	None	None	Trip of every element in VIC (one at a time)
4	ROTS-TTS 220kV line	ROTS-SMTS No.3 500kV line	None	Trip of every element in VIC (one at a time)

2.2 General Approach for Contingency Analysis

Asset Failure Contingency N-1

- PSSE Contingency Analysis (ACCC) Simulation
  - Step 1: Switch Out Element and ensure that no other Element (transformer/lines) overloads its Continuous Rating. If overload is found, System Demand is reduced.
  - Step 2: Run N-1-1 Contingency Analysis by using Short-Term Rating. System Demand is reduced and re-run ACCC until no overload is found using Short Term Rating
- Maximum Supportable Demand: System Demand – Load Shed (Step 1) – Load Shed (Step 2)

Asset Failure Contingency N-2

- PSSE Contingency Analysis (ACCC) Simulation
  - Step 1: Switch Out 2 x Elements and ensure that no other Element (transformer/lines) overloads its Continuous Rating. If overload is found, System Demand is reduced.
  - Step 2: Run N-1-1 Contingency Analysis by using Short-Term Rating. System Demand is reduced and re-run ACCC until no overload is found using Short Term Rating
- Maximum Supportable Demand: System Demand – Load Shed (Step 1) – Load Shed (Step 2)

Asset Failure Contingency N-3

- PSSE Contingency Analysis (ACCC) Simulation
    - Step 1: Switch Out 3 x Elements and ensure that no other Element (transformer/lines) overloads its Continuous Rating. If overload is found, System Demand is reduced.
    - Step 2: Run N-1-1 Contingency Analysis by using Short-Term Rating. System Demand is reduced and re-run ACCC until no overload is found using Short Term Rating
- Maximum Supportable Demand: System Demand – Load Shed (Step 1) – Load Shed (Step 2)

2.3 PSSE Base Case & Load (Bus Numbers)

PSSE Base Case (VAPR20223) was used with the demand forecast of year 2025 and load are scaled up to its MSD. Below are the PSSE bus numbers used for load scaling.

Subsystem (SMTS+ROTS+CBTS Supply Points)
324001,324031,321030,381030,379001,379002,373030,371031,315033,315020,365032,315020,365032,365022,366030,366031,366020,377031,377002,374001,332001,349030,349020,340080,340081

ERTS
324001,324031

CBTS
321030

TBTS
381030

TTS
379001,379002

SMTS
373030,371031

BTS
315033
315020

RTS
365032
365022

RWTS
366030,366031
366020

TSTS
377031,377002

SVTS
374001

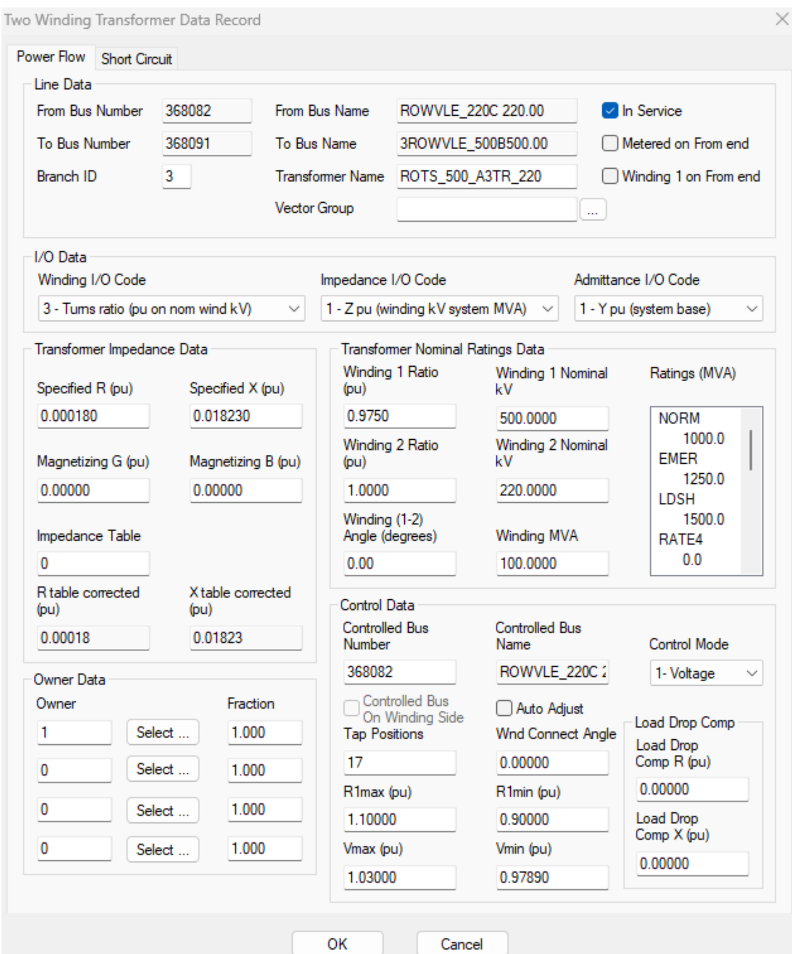
HTS
332001

MTS
349030
349020

JLA
340080,340081

2.4 New ROTS A3 1,000 MVA 500/220 kV Transformer Impedance

Below is the impedance used for the proposed option

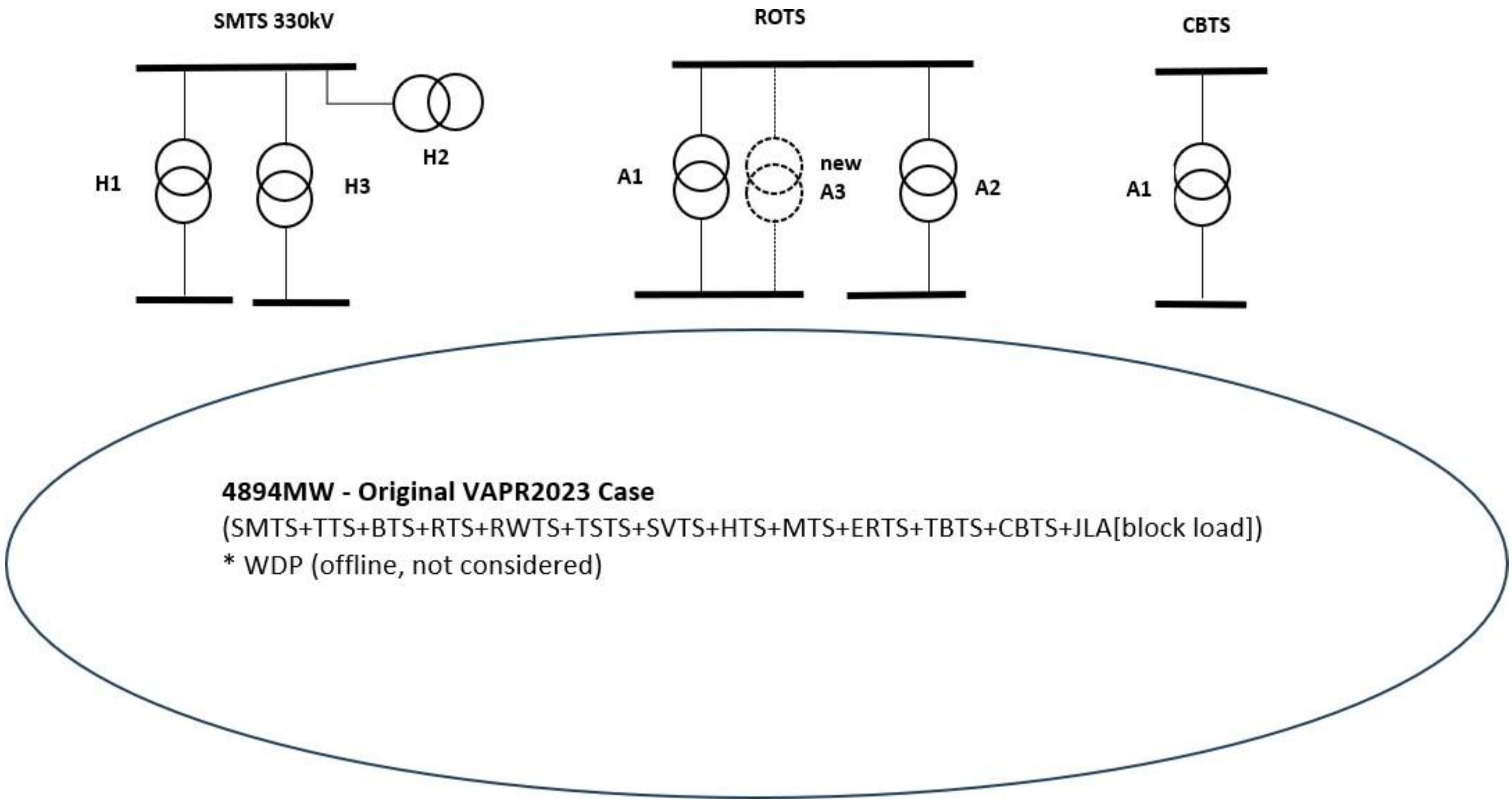


2.5 Assumptions used for the Element Ratings

- KTS A2, A3 & A4 Transformer: 750 MVA (Continuous) & 810 MVA (Short-Term)
- KTS A2, A3 & A4 Transformer: 1,000 MVA (Continuous) & 1,500 MVA (Short-Term)
- ROTS A1, A2 & A3 (new) Transformer: 1,000 MVA (Continuous) & 1,500 MVA (Short-Term)
- MLTS A1 & A2 Transformer: 1,000 MVA (Continuous) & 1,500 MVA (Short-Term)
- CBTS A1 Transformer: 1,000 MVA (Continuous) & 1,500 MVA (Short-Term)
- SMTS H1 Transformer: 700 MVA (Continuous & Short-Term)
- MLTS-GTS No.1 220kV line: 772 MVA (Continuous & Short-Term) / 1049 MVA (Uprate Continuous & Short-Term)
- MLTS-GTS No.2 220kV line: 775 MVA (Continuous & Short-Term) / 1049 MVA (Uprate Continuous & Short-Term)
- GTS-DPTS 220kV line: 425.5 MVA (Continuous & Short-Term)
- GTS-KTS No.1 & No.3 220kV line: 425.5 MVA (Continuous & Short-Term)
- 45degC ratings are applied on all other elements

2.6 Network Configuration (Status Quo & new ROTS A3 Transformer)

SMTS, ROTS & CBTS subsystems have a total demand of 4,894 MW.



3 Results

Summary of results are shown in Tables 2 and 3. Detailed results are presented in the Appendix section.

Table 2: Status Quo Network

No	Scenario	Summer			Winter		
		SMTS+ROTS + CBTS Subsystem (MW)	Maximum Supportable Demand (MW)	Load at Risk (MW)	SMTS+ROTS+CBTS Subsystem (MW)	Maximum Supportable Demand (MW)	Load at Risk (MW)
1	System Intact	4894	4894		4894	4894	
1a	Prior Outage ROTS-TTS	4894	4894	0	4894	4894	0
1b	Prior Outage ROTS-SMTS	4894	4894	0	4894	4894	0

Table 3: Install New ROTS A3 Transformer

No	Scenario	Summer			Winter		
		SMTS+ROTS + CBTS Subsystem (MW)	Maximum Supportable Demand (MW)	Load at Risk (MW)	SMTS+ROTS+CBTS Subsystem (MW)	Maximum Supportable Demand (MW)	Load at Risk (MW)
2	System Intact	5803	5803		5803	5803	
2a	Prior Outage ROTS-TTS	5803	5803	0	5803	5803	0
2b	Prior Outage ROTS-SMTS	5250	5250	553	5250	5250	553
2c	Prior Outages ROTS-TTS & ROTS-SMTS	5220	5220	583	5220	5220	583

4 Summary

1. **Status Quo Network**

   - **System Intact**: There are existing network constraints (loss of ROTS A1 Transformer) in the base case but is not attributed to ROTS-TTS 220 kV line or ROTS-SMTS No.3 500 kV line outage. Summer and Winter Maximum Supportable Demand is approximately **4,894 MW**. As such, no load at risk.

   - **Prior Outage of ROTS-TTS 220 kV line**: For a contingent trip of ROTS A1 Transformer (most critical), no overloads attributed to this prior outage. Note that there are existing network constraints as stated in the System Intact (base case). Summer and Winter Maximum Supportable Demand is approximately **4,894 MW**. As such, no load at risk.

   - **Prior Outage of ROTS-SMTS No.3 500 kV line**: For a contingent trip of ROTS A1 Transformer (most critical), no overloads attributed to this prior outage. Note that there are existing network constraints as stated in the System Intact case. Summer and Winter Maximum Supportable Demand is approximately **4,894MW**. As such, no load at risk.

2. **Install New ROTS A3 Transformer**

   In order to address the N loading of ROTS A1 Transformer, a new ROTS A3 Transformer is installed.

   - **System Intact**: SMTS-ROTS-CBTS subsystems are globally scaled to 5,803 MW as a base. For a contingent trip of KTS A3 Transformer (most critical), no overloads to any element found. Summer and Winter Maximum Supportable Demand is approximately **5,803 MW**. As such, no load at risk.

   - **Prior Outage of ROTS-TTS 220 kV line**: For a contingent trip of KTS A3 Transformer (most critical), no overloads to any element found. Summer and Winter Maximum Supportable Demand is approximately **5,803 MW**. As such, no load at risk.

   - **Prior Outage of ROTS-SMTS No.3 500 kV line**: For a contingent trip of CBTS-HWTS No.4 500 kV line (most critical), voltage collapse is observed in the 500 kV and 220kV part of the network, in the vicinity of HWTS and SMTS. Load shedding of 213 MW (load at risk) is required to address the voltage collapse. Summer and Winter Maximum Supportable Demand is approximately **5,590 MW**.

   - **Simultaneous Prior Outages of ROTS-TTS 220 kV line and ROTS-SMTS No.3 500 kV line**: For a contingent trip of CBTS-HWTS No.4 500 kV line (most critical), overload on SMTS-TTS No.1 220kV (**105%**). Load shedding of 583 MW (load at risk) is required to address the overload. Summer and Winter Maximum Supportable Demand is approximately **5,250 MW**.

5 Appendix

Detailed results are shown in the respective spreadsheets:

- Summary_ROTS_GIL_Rev2.xlsx

6 References

[1] Eastern Victoria Grid Reinforcement
https://www.aemo.com.au/initiatives/major-programs/eastern-victoria-grid-reinforcement