TC-0007404 : ERTS Redevelopment – Stage2

Business Case Estimate Submission

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Business Case Estimate Accountability Matrix

The table below provides delineation and shows *that* is responsible to review *which* section of the BC estimate. This will expedite approval as only the person best placed to review a specific section will be accountable for it.

Name	Role	Section Developed	Section Reviewed	Reviewed / Endorsed
[C-I-C]	Engineering Project Lead	Technical Scope		**10/07/2020**
[C-I-C]	Engineering Estimating Lead	Estimation Risk assessment		**10/07/2020**
[C-I-C]			Technical Scope	**[DATE]**
[C-I-C]	Project Manager			**[DATE]**
Project Director	Project Director			**[DATE]**
				[DATE]
[C-I-C] on behalf of Projects Review Board	Manager, Major Projects			**[DATE]**

Revision History

Revision	Date	Description of Changes	Author
0	22/06/2020	For estimation	[C-I-C]
1	10/07/2020	Estimate adjusted after Challenge Workshop	[C-I-C]
2	30/07/20	AEMO revenue meters included in the scope	[C-I-C]

Disclaimer

This document is for internal purposes only. This document outlines all works to be completed as part of the project. It is intended to be used to develop Business Case Estimates. It is not a scope of works suitable for issue to the general industry market for either design or installation. Section 3 is a detailed technical scope intended for estimation only.

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1 GENERAL

1.1 Project Background

- ERTS supplies a significant part of United Energy (UE) and AusNet Electricity Services' distribution network in the outer south-eastern corridor of Melbourne. It has four 150 MVA 220/66 kV transformers operating in two groups onto a split bus. Three Toshiba units were installed as B1, B3 and B4 when the station was established in 1970, and of these B3 was replaced in 2019 to anchor the B3/B4 Bus Group. Besides having aged substantially, the transformers are of similar design to a failed unit at RWTS where investigation detected a vulnerability in the 66kV winding design to 'free buckling' faults.
- A high proportion of the switchyard equipment were assessed in 2019 as being in poor condition. Most date back to the establishment of the station and have seen 50 years of service. This includes AEI LG4C bulk-oil circuit breakers which are maintenance intensive and an environmental risk without oil bunding, as well as most of the underslung isolators (abbreviated u/s isol hereafter). There are also ceramic type surge arrestors for which the present practice from a safety perspective is to substitute by polymeric types.
- The protection equipment had been progressively updated over the years but a number remains that are in poor condition. The electromechanical relays have been in service for over 30 years. This includes electromechanical distance relays still in use on two 66kV feeders.
- The station was built at a time when asbestos was hailed for its insulation property. Residual risk IV asbestos is found on backing boards in old panels, switchboards, and outdoor yard boxes as well as wall tiles in the control/relay building.
- A RIT-T process is to be initiated for a proposal to replace the B1 & B4 and selected switchgear that are in poor condition. The broader aim is to bring the station close to present day requirements, dependable for use without hassle in the coming decades. Some assets are being replaced under the ongoing Stage 1.

1.2 Basis Documents

This document has been prepared based on the following information and documentation:

- Project Handover presentation dated 30/04/2020. Project slides "East Rowville Terminal Station Transformer and Circuit Breaker Replacement Project TD-0007404 Functional scope for TRR cost estimates".
- 2019 Asset Condition Report

1.3 Other Interdependent Projects

TD-0003440 – ERTS Redevelopment Stage 1

TD 0006940 : Cap Bank Reactor Replacement

1.4 Project Categorisation and fit for purpose governance

The project is classified as (pick one)

- High Value High Complex (requires all 6 stage gates)

2 Project Scope Summary

The works will be designed and installed in accordance with AusNet Services' current standards. Where existing schemes are to be modified or extended, the work will be carried out consistent with the existing schemes.

2.1 Overview

The project will mitigate equipment failure risks by replacing B1, B4 and selected switchgear identified as being in poor condition. Estimates are grouped by the following implementation options for Business Case analysis

OPTION 1 - Replacement of B1 & B4 transformers

OPTION 2 - replace selected switchgear

OPTION 3 - Replace B1 & B4 transformers and selected switchgear in an integrated project

The transformers will be replaced in situ with new transformers of the same capacity. This would be the most economical outcome given the possibilities of scheduling long outage of a transformer over spring or autumn and of tailoring the new transformers to suit existing installation including foundations.

Switchyard equipment are selected for replacement based on the following criteria:

i. Condition score of circuit breakers is key. There are 14 nos. of 66kV CBs in C4/C5 condition which are not being replaced in Stage 1. Excluding one under the REFCL project and another which is a Spare, 12 nos of 66kV CBs is proposed for replacement here.

ii. There are 20 units of u/s isol in C4/C5 condition which are to be replaced Another 3 u/s isol not in C4/C5 condition will be replaced concurrent with CBs to which they connected.

iii. In transformer bays where live tank CBs are being replaced by DTCBs, Post CTs will become redundant and will be removed to stores as spares.

iv. Ceramic type surge arrestors will be replaced by polymeric type.

v. Cap Bank Balance CTs in C4/C5 condition will be replaced

vi. Brown post insulators and glass string insulators which are aged will be replaced where incidental to the work being carried out.

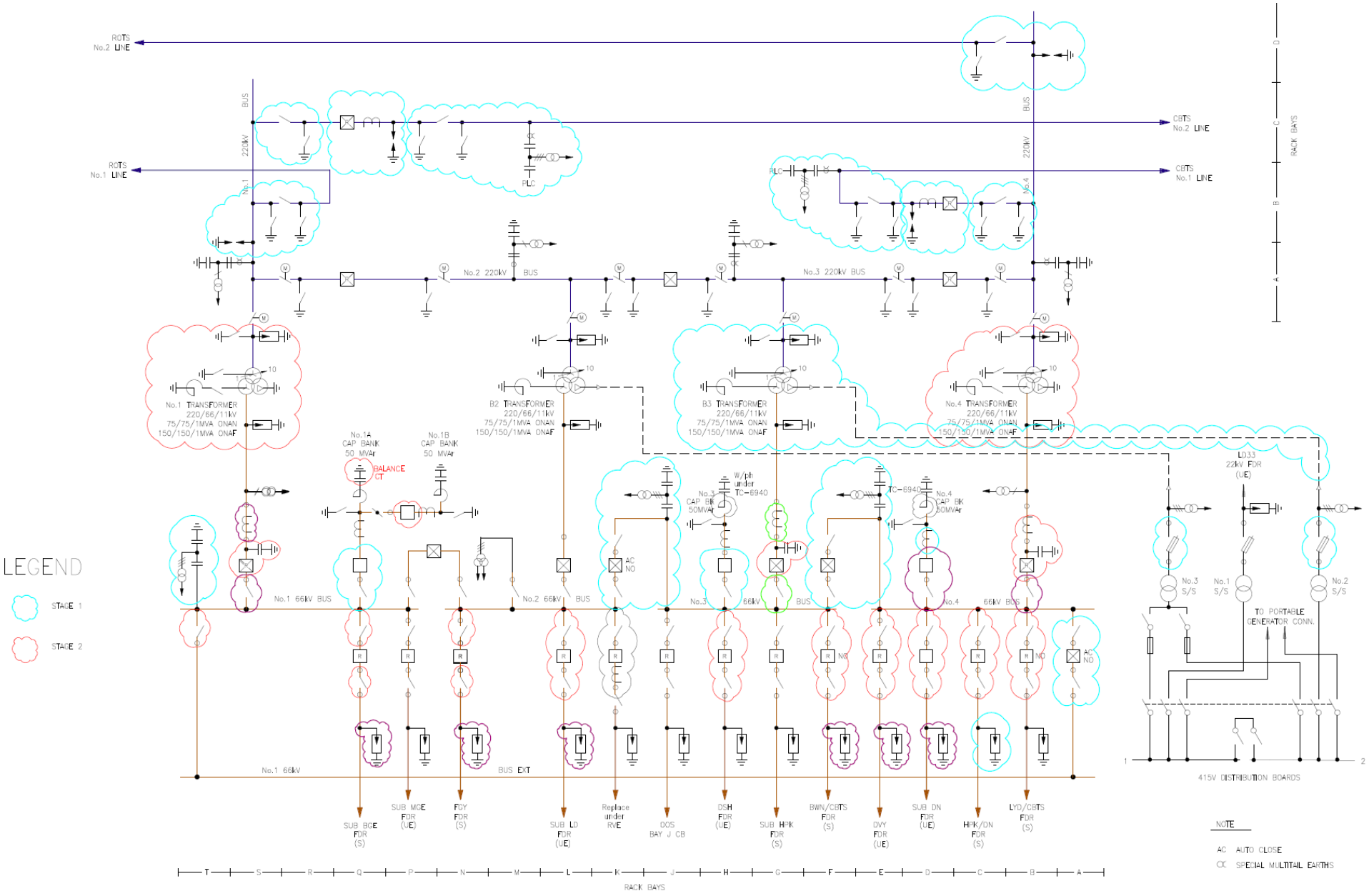
vii. All earthing receptacles will be replaced by the ball and clamp type which is the current standard.

Switchyard equipment proposed for replacement are tabulated below

Bay	Circuit	Equipment to be Replaced
	66kV	
S, G, B	B1, B3, B4 Transformer	LTCB, Surge Capacitor,Bus ISOL, CT, PI, GI
D	No.4 66KV Cap Bank	LTCB, Bus ISOL
-	No.1B 66KV Cap Bank	LTCB
D,E,F,L	DN, DVY, BWN/CBTS, LD	DTCB, Bus ISOL, Fdr ISOL, SD, PI, GI
B,C,H	LYD/CBTS, HPK/DN, DSH	DTCB, Bus ISOL, Fdr ISOL, PI, GI
N,Q	FGY, BGE	Bus ISOL, Fdr ISOL, PI
T	1-1 EXTN 66KV BUS TIE	Bus ISOL
-	1A 66KV Cap Bk	36kV 5/5A Balance CT

Note: PI – Brown Post Insulators, GI – Glass insulator strings

Single line diagram of the proposed works is shown overleaf.


ROTS
No.2 LINE
ROTS
No.1 LINE
CBTS
No.2 LINE
CBTS
No.1 LINE
BUS
220kV
No.1
No.4
PLC
No.2 220kV BUS
No.3 220kV BUS
RACK BAYS
No.1 TRANSFORMER
220/66/11kV
75/75/1MVA ONAN
150/150/1MVA ONAF
B2 TRANSFORMER
220/66/11kV
75/75/1MVA ONAN
150/150/1MVA ONAF
B3 TRANSFORMER
220/66/11kV
75/75/1MVA ONAN
150/150/1MVA ONAF
No.4 TRANSFORMER
220/66/11kV
75/75/1MVA ONAN
150/150/1MVA ONAF
No.1A
CAP BANK
50 MVAr
No.1B
CAP BANK
50 MVAr
BALANCE
CT
W/ph
under
TC-6940
No.3
CAP BK
50MVAr
TC-6940
No.4
CAP BK
50MVAr
LD33
22kV FDR
(UE)
No.1 66kV BUS
No.2 66kV BUS
No.3 66kV BUS
No.4 66kV BUS
AC
NO
No.1 66kV
BUS EXT
No.3
S/S
No.1
S/S
No.2
S/S
TO PORTABLE
GENERATOR CONN.
415V DISTRIBUTION BOARDS
SUB BGE
FDR
(S)
SUB MOE
FDR
(UE)
FGY
FDR
(S)
SUB LD
FDR
(UE)
Replace
under
RWE
OOS
BAY J CB
DSH
FDR
(UE)
SUB HPK
FDR
(S)
BWN/CBTS
FDR
(S)
DVY
FDR
(UE)
SUB DN
FDR
(UE)
HPK/DN
FDR
(S)
LYD/CBTS
FDR
(S)
T S R Q P N M L K J H G F E D C B A
RACK BAYS
LEGEND
STAGE 1
STAGE 2
NOTE
AC AUTO CLOSE
SPECIAL MULTITAIL EARTHS

Secondary equipment identified as being in C4/C5 conditions and not touched in Stage 1 are to be replaced. New X & Y Prot panels are proposed for

No.1 & 1 Extn 66KV Bus Prot

No.3 66KV Bus Prot

No.4 66KV Bus Prot

No.4 66KV Cap Bank

BWN/CBTS feeder Prot

LYD/CBTS feeder Prot

ROTS No.1 220KV Line Prot, at ERTS and ROTS

ROTS No.2 220KV Line Prot, at ERTS and ROTS

New Control panels are proposed for

Transformers Voltage Regulation

66kV Auto reclose scheme, presently based on PLC which is no longer supported

AutoLoad shedding

AEMO Revenue meters

New duplicate 250V battery banks are to be installed, housed in separate enclosures as per current AusNet standards.

The station has residual risk IV asbestos which is not the immediate focus of the current asbestos removal plan but is to be removed when the opportunity arise. Some in equipment and panels will be cleared when the equipment gets replaced but those embeded in the station infrastructure needs addressing.

Existing AC distribution boards AC1 and AC2, DC distribution boards DC1 and DC2, Control Building services sub-distribution boards No1 and 2 which were installed when the station was established, all contain asbestos. These are to be replaced with new boards.

Others are the general power yard boxes, fan isolation panel, 50V battery fuse panels and tiles. An area of the relay room renovated from a mess room has wall vinyl tiles and floor tiles tested to contain asbestos fibre.

Project completion is 2024 with close out in 2025.

2.2 Interfaces

Co-ordination is required with the 66kV lines connected to the station. These are with

United Energy – MGE, LD, DSH, DVY, DN

AusNet Electricity ZSS - BGE, FGY, RVE, HPK, BWN/CBTS, HPK/DN, LYD/CBTS

2.3 Overall Risks

The following risks are noted:

1. The scope and estimate were based on and the “East Rowville Terminal Station Transformer and Circuit Breaker Replacement Project TD-0007404 Functional scope for TRR cost estimates” slides, condition scores in Power BI, a site visit and COM0. Any change to the Functional Scope document has adverse effect on the estimate scope and costs.
2. Potential delays to schedule in the event that budget and contract awards are not available as per indicated time frames.
3. Potential delays to schedule should the outages be not granted.

4. Potential delays due to property and planning approvals may impact on the delivery schedule.

2.4 Technical Scope Assumptions and Clarifications

The following assumptions and clarifications are made:

- All rating, sizing, plant and cable, dimensioning and volume allowance of materials and areas is for Business Case Estimation purposes and not to be used as a design scope. All rating and sizing calculations are to be completed and verified during detailed design
  - No rollover of works under Stage 1 into Stage 2. It is assumed that all necessary 220kV replacement work will be completed under Stage 1 or subsequent CCR.
  - that the capacity of the existing environmental treatment system is adequate and no allowance has been made for expansion of the existing drainage or oil treatment facilities. The existing facilities are based on the Toshiba transformers which have outline dimensions of 15290 (L) x 7575 (W) x 7905 (H) and contains 63000 litres of oil
  - Fire hydrants were upgraded under XC34 in 2015 and adequate
  - Structures for underslung isolators may be reused after strengthening with a horizontal member and packers added to adjust for different 66kV insulator lengths.
  - Footings for underslung isolator structures can be reused after augmentation.
- Existing racks may be reused without strenghtening to 40kA for 220kV or 31.5kA for 66kV. No analysis of rack will be carried out in conjunction with replacement of glass insulating strings.
- It suffices for installation to meet AEMO publication “Short-Circuit Levels for the Victorian Electricity Transmission Network 2018-2023” forecasted fault level at ERTS in 2022-23 as follows:

	220kV Bus	66kV Bus *
3ph kA	28.7	22.8
Ig kA	32.0	21.4

* with normally open No.2-3 bus tie closed for the outage of a 220/66 kV transformer

  - As station service to a terminal station is typically sourced from 2 station service transformers plus provision for a generator supply, street supply is now not needed at ERTS and the related fuse switch will not be replaced though in C4 condition.
  - The asbestos at ERTS is classified as residual risk IV. Asbestos in prot panels will not be specially removed but wait for the retirement of panels with prot upgrade.
  - Extension of the control building by 11.5m x 12.2m approved in Stage 1 CCR of the project TD-0003440. The new 220kV line protection panels will be installed in the extended control room.
  - New B1 and B4 transformers to be equipped with 4 x CTs on 220kV transformer busing suitable for Line and Transformer protection applications.
  - The existing SCIMS panels will adequate serial/ ethernet ports to interface the new IED’s being added as part of the project.
  - The new DC System will be installed in a separate enclosure

2.5 Exclusions

The following has been excluded from the scope and estimate:

- Earthing studies and upgrade to earth grid
- Any increase of capacity to Environmental system
- Upgrade of existing drainage system is excluded;
- Analysis of rack structures and Bus Support structures

- Total replacement of existing structures within the switchyard
- Cost of any 66kV line works
- Any 220kV works
- Further extension of control room
- Any works not specifically mentioned in this scope of works

3 Budget Estimate (P50/P75/P90)

This is a P75 estimate for the given scope. The uncertainty adjusted estimate has been compiled using a top-down model based on typical bay and component prices. These costs are based on the 2018 dollars. Escalation has not been included in this estimate.

A monte-carlo risk assessment has been undertaken on the project estimate to determine the risk and management reserve. Following is the estimate summary:

OPTION 1

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0007404**
Project Title:	**TD-0007404 - ERTS TR & 66kV Replacement Option 1**
Estimate Type:	**Planning**
Revision:	**Original Rev 0**
Issued Date:	**10/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$380,000	$380,000	$40,000	$0	$800,000
2	INTERNAL LABOUR	$73,285	$53,999	$212,139	$289,281	$142,712	$771,416
3	MATERIALS	$0	$0	$1,594,657	$3,189,315	$531,552	$5,315,525
4	PLANT & EQUIPMENT	$0	$0	$75,513	$129,450	$53,938	$258,901
5	CONTRACTS	$0	$0	$923,514	$1,583,167	$659,653	$3,166,333
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$165,424	$283,585	$118,160	$567,170
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$73,285**	**$433,999**	**$3,351,248**	**$5,514,798**	**$1,506,015**	**$10,879,344**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$271,984
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$73,285**	**$433,999**	**$3,351,248**	**$5,514,798**	**$1,506,015**	**$11,151,328**
11	OVERHEADS	$2,858	$16,926	$130,699	$215,077	$58,735	$424,294
12	FINANCE CHARGES (IDC)	$0	$5,724	$94,142	$224,518	$231,371	$555,756
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$76,143**	**$456,649**	**$3,576,089**	**$5,954,393**	**$1,796,121**	**$12,131,378**

OPTION 2

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0007404**
Project Title:	**TD-0007404 - ERTS TR & 66kV Replacement Option 2**
Estimate Type:	**Planning**
Revision:	**Original Rev 1**
Issued Date:	**10/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$855,000	$855,000	$90,000	$0	$1,800,000
2	INTERNAL LABOUR	$94,543	$69,664	$273,678	$373,198	$184,111	$995,194
3	MATERIALS	$0	$0	$1,001,310	$2,002,619	$333,770	$3,337,699
4	PLANT & EQUIPMENT	$0	$0	$157,041	$269,213	$112,172	$538,425
5	CONTRACTS	$0	$0	$1,238,490	$2,123,125	$884,635	$4,246,250
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$159,215	$272,939	$113,725	$545,878
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$94,543**	**$924,664**	**$3,684,733**	**$5,131,094**	**$1,628,413**	**$11,463,446**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$282,123
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$94,543**	**$924,664**	**$3,684,733**	**$5,131,094**	**$1,628,413**	**$11,745,569**
11	OVERHEADS	$3,687	$36,062	$143,705	$200,113	$63,508	$447,074
12	FINANCE CHARGES (IDC)	$0	$14,690	$139,944	$211,830	$220,286	$586,750
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$98,231**	**$975,415**	**$3,968,381**	**$5,543,036**	**$1,912,207**	**$12,779,394**

OPTION 3

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0007404**
Project Title:	**TD-0007404 - ERTS TR & 66kV Replacement Option 3**
Estimate Type:	**Planning**
Revision:	**Original Rev 1**
Issued Date:	**10/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$1,140,000	$1,140,000	$120,000	$0	$2,400,000
2	INTERNAL LABOUR	$142,418	$104,940	$412,262	$562,176	$277,340	$1,499,136
3	MATERIALS	$0	$0	$2,645,881	$5,291,762	$881,960	$8,819,603
4	PLANT & EQUIPMENT	$0	$0	$208,114	$356,767	$148,653	$713,533
5	CONTRACTS	$0	$0	$2,167,926	$3,716,445	$1,548,519	$7,432,891
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$304,284	$521,629	$217,345	$1,043,258
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$142,418**	**$1,244,940**	**$6,878,467**	**$10,568,779**	**$3,073,818**	**$21,908,421**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$378,989
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$142,418**	**$1,244,940**	**$6,878,467**	**$10,568,779**	**$3,073,818**	**$22,287,410**
11	OVERHEADS	$5,554	$48,553	$268,260	$412,182	$119,879	$854,428
12	FINANCE CHARGES (IDC)	$4,839	$20,871	$221,540	$329,293	$379,588	$956,132
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$152,812**	**$1,314,364**	**$7,368,267**	**$11,310,254**	**$3,573,285**	**$24,097,970**

3.1 Benchmarking

This project is similar to following range of similar projects and the estimate is within the estimate benchmark (defined as 1 standard deviation)

Project	Estimate	Comments
This Project		
Project TD-0003440	20,004,102*	*PM's forecast in SAP
Project TD-0006252		One B transf, Nine 66kV CBs

3.2 Pricing Conditions / Assumptions

Major Projects Budget Estimate Submission is based on the following:

3.2.1 Estimate assumptions

- All system outages being available when required.
- Overhead Rates as shown in advised by Corporate Finance at time of estimate.
- No allowance for customer negotiations or contract development
- No allowance for vegetation control
- No allowance for rock.
- No allowance for asbestos being present other than where specifically included
- No allowance for contaminated soil
- No allowance for MIPS
- No allowance for costs to Third Parties in accordance with Roads Management Act consent conditions.
- No allowance for Easement negotiation, remuneration, registration on titles (if applicable)
- No allowances have been made for CHMP
- Existing assets other than those identified in the scope are fit to remain in service and meet Electricity Network Technical Standards
- No allowance for Generators or Bypass cables.
- Free and unhindered access to required sites at all times.

- No out of the ordinary environmental, site or client concerns that would require inordinate amount of design
- Timely approval of Business Case, Project Plan and other requirements by Initiator
- Any changes to the original scope agreement may result in additional charges being applied for variations to the original scope.
- All other Authorities providing approvals as requested.
- Design and Construction of this project will utilise Network Engineering Technical Standards.

3.2.2 Major Plant Items / Key costs

- B transformer - 220kV/66/11kV 150MVA Transformer
- 66 kV dead tank circuit breakers
- 66kV live tank circuit breakers
- 66kV CVDs
- 66kV underslung isolator

3.3 RISK ASSESSMENT AND CONTINGENCY PLAN

3.3.1 Risk Allowance:

The Project Risk Assessment is conducted using historical data. Full detail of the Project Risk Assessment can be provided upon request.

The Project Team determine the Project Risks which have the potential to change the expected project costs as at the time of estimating. The Schedule and Costings impacted by the Project Risk Contents are included in this Budget Estimate Submission.

The risk allowance includes the following:

- Transformer Cost
- Foreign exchange
- Equipment Cost
- Ground conditions
- Outage restriction

3.3.2 Project Contingency Plan (Management Reserve)

The following Project Contingency Plan has been setup as a provisional sum that covers events of probable eventuality, i.e. a condition or sequencing of occurrences must take place to cause the probable event to come true. This is an additional allocation over and above the Project Risks.

The Project Contingency costing impact shown below will be reflected as a separate costing item outside the Budget Estimate Submission.

All Project Contingency amounts will be subject to formal governance approvals from the Project Sponsor.

No.	Project Contingency Plan	Schedule Impact (days)	Costing Impact ($K)
1.	Delays in Town Planning and Regulatory Approvals		15
2.	Additional environmental or cultural heritage obligations and permits		15
3.	Additional unforeseen costs for delays in equipment delivery (Transformer, circuit breakers)		50
4.	Delays in association with outages		75
5.	Inclement weather		50
6.	External 66kV Feeder Transfer Facilities		75
7.	Contaminated soil disposal or removal of rock		50
8.	Feeder asset failures during Testing		50

4 SCHEDULE

All project dates are based on a nominal business case approval date. Any change in business case approval dates may trigger a change in project dates.

Phase	Deliverable Title	Date	Duration
Idea	High Level Estimate Handover to Initiator	3/07/2020	
	RIT-T	18/12/2020	6 months
	Business Case Approved	7/7/2021	6 months
Detailed Design	Contract execution /DSP Scope of Works	21/7/2021	9 months
	DSP Tender / Award	28/7/2020	
	Detailed Design Start	11/8/2021	
	Design Completed	18/4/2022	
Delivery and Close	Project Handover for Implementation	27/4/2022	30 months
	ISP Tender / Award	27/7/2022	
	Site Works Commenced	10/8/2022	
	First outage taken	12/9/2022	
	Practical Completion	31/10/2024	
	Project Close-out Complete	31/1/2025	

4.1 Staging/Sequencing/Outages

Our preliminary investigations have indicated following key outages are required to deliver the project.

No	Outage Scope	Work Description	Duration	Notes
1	B1	Decom/ remove existing, civil rebuild, install and connect new B1; Replace B1 66kV CB, u/s isol, glass insulator strings	21 weeks	Continuous outage
2	B4	Same as above for B4	21 weeks	Continuous outage
3	B3	Replace B3 66kV CB, u/s isol, glass insulator strings	6 weeks	Continuous outage
4	No.1A Cap Bank	Replace balancing CT	2 weeks	Continuous outage
5	No.1B Cap Bank	Replace CB, balancing CT	6 weeks	Continuous outage
6	No.3 Cap Bank	Replace balancing CT	2 weeks	Continuous outage
7	No.4 Cap Bank	Replace CB, u/s isol, reactor, balancing CT	6 weeks	Continuous outage
8	No1 66kV Bus, No1 66kV ext bus	Augment footings, strengthen bracing, Replace bus u/s isol	2 x 8 hours	Daily outage
9	Replace BGE feeder bay equipment			
9a	No1 66kV ext bus,	Repurpose No.4 BT CB as BGE fdr CB	8 hours	Daily outage
9b	No1 66kV ext bus, Sub BGE fdr	Connect BGE to No1 66kV ext bus	8 hours	Daily outage
9c	No1 66kV bus	Replace BGE fdr bus u/s isol;	2x8 hours	Daily outage
9d	No1 66kV ext bus, Sub BGE feeder	Restore BGE to own fdr bay	8 hours	Daily outage
10	Replace FGY feeder bay equipment – similar to BGE		5x8 hours	Daily outage
11	Replace LD feeder bay equipment – similar to BGE		5x8 hours	Daily outage
12	Replace DVY feeder bay equipment – similar to BGE		5x8 hours	Daily outage
	plus BWN/CBTS	proximity outage	2x8 hours	Daily outage
13	Replace DN feeder bay equipment – similar to DVY		7x8 hours	Daily outage
14	Replace HPK/DN feeder bay equipment – similar to DVY		7x8 hours	Daily outage
15	Replace LYD/CBTS feeder bay equipment – similar to DVY		7x8 hours	Daily outage
16	Replace BWN/CBTS feeder bay equipment – use alternative supply from CBTS			
16a	BWN/CBTS feeder	Open O/H jumper	5 hours	Daily outage
16b	No3 66kV bus,	Replace BWN/CBTS feeder bus u/s isol;	2x8 hours	Daily outage
16c	HPK feeder	proximity outage	2x8 hours	Daily outage
17	Replace DSH feeder bay equipment – similar to DVY except through Bay J or BWN/CBTS to avoid loop on No4 bus or rebuild in present Bay J and transfer fdr		7x8 hours	Daily outage
Total outages			67	

Table 1 Outage Requirements

The works associated with above have been included in the estimate with further discussions with CEOT and operations to be held during detailed design to finalise the works requirements.

4.2 Works at Other Sites

ROTS - Replace Line prot on ERTS No.1 and 2 lines

Work on opening jumpers and re-bridging on BWN/CBTS lines to isolate feeder bay at ERTS to facilitate replacement work.

4.3 Hazards at Site

The following known hazards currently existing at ERTS:

1. Existing buried asbestos pipe within 220 and 66kV switchyard.
2. Asbestos in tiles on part of the control building
3. Asbestos in blackboard panels in the existing control building, including panels which will be removed or interfaced with as part of this project.
4. Physically restricted working area within the existing control room.
    a) Control cables overflowing on top of ITC panels.
    b) Exposed post type terminals, DC buswork & wiring in the rear of panels.

The following potential hazards may be present on site:

1. Schedule PCB in dismantled 220kV CVTs waiting for disposal in switchyard (may penetrate the soil).
2. Lead paint on legacy transformers and CBs.

4.4 Standards

N/A

5 Validation Checklist

Doc Ref#	Check List Item Description	Drafted by (initials)	Reviewded by (Initials)	Comments
	PROJECT SCOPE			
1.	Concept development completed and documented	SCC	[TECH LEAD]	
2.	Detailed Technical Scope completed and documented	SCC	[TECH LEAD]	
3.	Submission consistent with the project scope of work	SCC	[TECH LEAD]	
4.	Major material/components identified	SCC	[TECH LEAD]	
5.	Procurement process/ responsibility clearly identified	[PM]	[Project Director]	
6.	RISK ANALYSIS AND CONTINGENCY			
7.	Assumptions and Exclusions clarified and documented from the Risk Matrix	[PM]	[Project Director]	
8.	Project Contingency is appropriate and documented	[PM]	[Project Director]	
9.	PROJECT COSTS			
10.	Major Plant costs included	[Estimator]	[DSM]	
11.	The submission supported by firm sub-contract pricing agreements	[Estimator]	[DSM]	
12.	The submission based on: First principles / Similar projects	[Estimator]	[DSM]	
13.	Escalation has been included in the submission development	[Estimator]	[DSM]	
14.	Budget Estimate VALIDITY	[Estimator]	[DSM]	
15.	SCHEDULE AND RESOURCING			
16.	Appropriate Resources involved in the Submission development	[PM]	[Project Director]	
17.	Project Schedule reviewed and agreed	[PM]	[Project Director]	
18.	Resources forecast and scheduled timing shown	[PM]	[Project Director]	
19.	Practical Completion Date agreed and shown	[PM]	[Project Director]	
20.	GATE APPROVALS	[PM]	[Project Director]	
21.	Completed Gate f**orm**	[PM]	[Project Director]	

6 TECHNICAL NOTES

Section 6 is a detailed technical scope intended for estimation only.

An Outage Management Plan including a Commissioning Overview and Sequence Plan shall be produced early in the design process and shall include input from an AusNet Services Commissioning Engineer.

6.1 OPTION 1 – Replacement of B1 & B4 Transformers

Only one transformer may be taken out of service at a time. Replace one in spring and the other in autumn.

6.1.1 Primary and Civil Works – Option1

Primary works within ERTS will include but are not limited to the design, procurement and installation/modification of the following:

6.1.1.1 Preliminaries

Noise study, Planning permit, GPR survey

Geotech investigation, soil contamination

6.1.1.2 Primary Plant

- **B1 Transformer**

Decommission and dispose the existing Transformer and NER

Supply and install one new 220kV/66/11kV 150MVA Transformer,

Install new 220 kV(3 phase) and 66 kV (3 phase) Surge Arrestors

Install one 66kV Neutral Earthing Reactor on a new steel support structure

Install one 2-core set each of 220 and 66kV neutral CTs

Primary connections (Venus - 220kV single, 66kV twin, 32 connectors) and secondary connections

Install 25m 0.6/1kV 1C 240mm² Cu XLPE/PVC

Reinstate earth grid (allow 40M 19/3.0 bcc)

Connect earthing (allow 200m of 50 X 4MM Cu)

- **B4 Transformer**

– same as for B1 except that existing diverter switch mechanism contains non-scheduled PCB. Allow for disposal of 200 litres of contaminated oil.

6.1.1.3 Civil Works

- **B1 Transformer**

Modify transfomer plinths, bunds and drainage (assume existing foundation and bund are largely suitable)

Build noise enclosure (fully enclosed with roof)

One new steel support structure (5m) for NER and footing

One plinth for Transformer auxiliary supply Autochangeover Board
Conduits (allow 150m 100mm O.D)
Reinstate and dress disturbed surface (allow 140m²)

- **B4 Transformer**

– same as for B1

6.1.2 Secondary Works – Option1

Secondary works within ERTS will include but are not limited to the design, procurement and installation/modification of the following (including cabling):

6.1.2.1 Protection & Control

Table 6.1-1 220/66kV Transformer Schemes at ERTS

Item	Application	Description
1	B1 Transformer	Interface the bushing CTs of the new transformer to existing ROTS1 line protection and B1 transformer protection schemes. Enable B1 Transformer HV and LV REF protection functions in the 2 x existing schemes. Remove Auto CTs from the B1 transformer protection scheme.
2	B4 Transformer	Interface the bushing CTs of the new transformer to existing ROTS2 line protection and B1 transformer protection schemes. Enable B4 Transformer HV and LV REF protection functions in the 2 x existing schemes. Remove Auto CTs from the B4 transformer protection scheme.
3	Voltage Regulation	Install a new voltage regulation scheme using on A.eberle REG-D relays for all 4 transformers. The new VRR scheme shall be installed at existing spare panel location P64. The old Tapcon VRR scheme on panel P2 shall be decommissioned.
5	Transformer Temperature	Decommission the Transformer temperature transduces and implement temperature monitoring through new DRMCC devices. The oil monitoring Calosto devices shall also be integrated to existing SCIMS.

6.1.2.2 Scada

- Existing SCADA panel at ERTS to be expanded to Interface all new IEDs for remote monitoring and control of the 220/66kV transformer plant and equipment.
- For the purpose of business case estimate, allow 16 days for RSG group and 8 days for ENS group for the testing and HMI screen update works of the 8 x new IEDs.

6.1.2.3 Metering & Monitoring

- Interface all new IEDs to SCADA system for metering and monitoring

6.1.2.4 AC & DC Supplies

6.1.2.5 415V AC supplies

- Extend 2 x auxiliary supplies from the existing AC Autochangeover Boards to each new transformer control systems.

6.1.2.6 250V DC Supplies

- Install 2 x 32A MCBs on the existing DC8 and DC9 distribution boards for B1 and B4 transformer control schemes

6.1.3 Communications – Option1

6.1.3.1 Infrastructure

- Install 1 x Ruggedcom RX1500 device in the existing DIC cubicle P77.

6.1.3.2 Exchanges

- N/A

6.1.3.3 PLC

- N/A

6.1.3.4 Digital Networks/Asset Data Gathering

- Interface all new IEDs having ethernet or serial capability to existing DIC panels for Engineering access and asset data gathering.

6.1.3.5 VF

- N/A

6.2 OPTION 2 – Replacement of Switchyard Equipment

6.2.1 Primary and Civil Works – Option2

6.2.1.1 Preliminaries

TRV study, feature survey, GPR survey, Geotech investigation

6.2.1.2 220kV Switchyard

1) N/A

6.2.1.3 66kV Switchyard

Bay	Circuit	Equipment to be Replaced
	66kV	
S, G, B	B1, B3, B4 Transformer	LTCB, Capacitor,Bus ISOL, CT, brown PI, glass insulator
D	No.4 66KV Cap Bank	LTCB, Bus ISOL
-	No.1B 66KV Cap Bank	LTCB
D,E,F,L	DN, DVY, BWN/CBTS, LD	DTCB, Bus ISOL, Fdr ISOL, SD, brown PI, glass insulator
B,C,H	LYD/CBTS, HPK/DN, DSH	DTCB, Bus ISOL, Fdr ISOL, brown PI, glass insulator
N,Q	FGY, BGE	Bus ISOL, Fdr ISOL, brown PI
T	1-1 EXTN 66KV BUS TIE	Bus ISOL
-	1A 66KV Cap Bk	36kV 5/5A Balance CT

- **B1, B3, B4 66kV Transformer Bays (Bays S, G, B) –**

Decommission and remove the existing CBs, surge capacitor, u/s isol and CTs
Supply and install three 66kV DTCB 3150A 31.5kA,
Supply and install nine 1Ø 66kV CVDs,
Supply and install three sets 66kV 2000A bus-side u/s isol
Three 3-phase sets of bus connection to bipods
Three 3-phase sets of droppers from 66kV O/H spans
Six 3-phase sets flexible primary connections;
Secondary connections.(x 3)
Replace 9 pcs of 66kV post insulators
Replace 18 sets of 66kV glass insulator strings on O/H spans with 66kV Twin Paw Paw termination assembly (for estimate)
Install 18 nos. ball type earth receptacles
Install earth connection to all new equipment and receptacles

- **No.4 66KV Cap Bank Bay (Bay D) –**

Decommission and remove the existing CB and u/s isol.
Supply and install one 66kV LTCB 3150A 31.5kA (with POW),
Supply and install one 3-phase set of 66kV 2000A bus-side u/s isol
One 3-phase sets of bus connection to bipods
Two 3-phase sets flexible primary connections.
Secondary connection
Install 6 nos. ball type earth receptacles
Install earth connection

- **No.1B 66KV Cap Bank Bay**

Decommission and remove the existing CB.
Supply and install one 66kV LTCB 3150A 31.5kA (with POW), ,
Two 3-phase sets flexible primary connections.
Secondary connection
Install 6 nos. ball type earth receptacles
Install earth connection

(The following temporary work to borrowthe No1 66kV Ext Bus to maintain supply to feeder during feeder bay outage will be repeated. Prepare Block Estimate for repeated use: Set up No.1 66kV Ext Bus temporarily for feeder)

Temporarily repurpose No.4 Bus Tie CB as feeder CB

Open 1-1 EXTN 66KV Bus Tie ISO

Connect feeder prot to No.4 Bus Tie CB

Test and commission No.4 Bus Tie CB as feeder CB

Connect feeder to 1 EXTN 66KV Bus

- **DN, DVY, BWN/CBTS, LD 66kV Feeder Bays (Bays D,E,F,L) -**

Set up No.1 66kV Ext Bus temporarily for feeder. (4 times)

Decommission and remove the existing CB and Isolators. (x 4)

Supply and install four 66kV DTCB 3150A 31.5kA,

Eight 3-phase sets of 66kV 2000A underslungs,

Four 3-phase sets of bus connection to bipods

Eight 3-phase sets flexible primary connections;

Secondary connections. (x 4)

Replace 12 pcs of 66kV post insulators

Install 48 nos. ball type earth receptacles

Install earth connection

Replace 24 sets of 66kV glass insulator strings on O/H spans with 66kV single Triton termination assembly

- **LYD/CBTS, HPK/DN, DSH 66kV Feeder Bays (Bays B,C,H) -**

Set up No.1 66kV Ext Bus temporarily for feeder. (3 times)

Decommission and remove the existing CB and Isolators. (x 3)

Supply and install three 66kV DTCB 3150A 31.5kA,

Six 3 phase sets of 66kV 2000A underslungs,

Three 3-phase sets of bus connection to bipods

Six sets flexible primary connections;

Secondary connections. (x 3)

Install 36 nos. ball type earth receptacles

Install earth connection

Replace 18 sets of 66kV glass insulator strings on O/H spans with 66kV single Triton termination assembly

- **FGY, BGE 66kV Feeder Bay (Bay N,Q)**

Set up No.1 66kV Ext Bus temporarily for feeder. (2 times)

Decommission and remove the existing Isolator (x 2)

Supply and install two 3 phase sets of 66kV 2000A underslungs,

Two 3-phase sets of bus connection to bipods

Four sets flexible primary connections;

Secondary connections. (x 2)

Install 24 nos. ball type earth receptacles

Earth connection

- **1-1 EXTN 66KV BUS TIE (Bay T)**

Decommission and remove the existing Isolator

Supply and install one 3 phase sets of 66kV 2000A underslungs,
Two 3-phase sets bus primary connections
Install 12 nos. ball type earth receptacles
Earth connection

- **1A 66KV Cap Bk**

Replace 3 nos of Balance CT for 1A 66KV Cap Bk
Primary and secondary connection for CTs
Earth connection

- **Bay J**

Demolish Bay J CB (LG4C)

- **Earth receptacle replacement for balance of switchyard**

Arrange short outages for feeders
Replace 96 no. of receptacles with earthing balls.
Earth connection (allow 250m 50 x 4 Cu BCC)

- **Equipment Labels**

All labels as required for equipment

- **Disposal of PCB**

Dispose of oil classified as non-scheduled PCB contaminated in DVY Fdr CB and Sub BGE Fdr CB (allow 76 gallons per tank, total 6 tanks = 2070 l)

- **Asbestos Removal**

- Replace in the switchyard
  - 6 nos. of yard boxes in the 220kV switchyard
  - 4 nos, of yard boxes in the 66kV switchyard
- Remove 2 nos of Closing Supply Fuse Boxes which will be redundant after replacing LG4C circuit breakers
- Replace in control building
  - No.1 and 2 building services distribution boards
  - Fan isolation panel
  - 2 nos. of 48V battery fuse panels

- **Salvage**

Refurbish and salvage nine 66kV CTs to keep at Yarraville as spare.

6.2.1.4 Civil Works

- Survey existing 66kV isolator structures to assess reusability of structures and footings.

Check strength of insulator structures.
Check existing footings for strength and stability

- Augment/modify footings for following

LTCB – 2
Bus Isolator – 14

Feeder isolator – 7

Modify existing Isolator footings (21 nos.) similar to modifications on SVTS drawing T2/547/793. Perform additional geotechnical survey to assess bearing at shallow depths within the 66kV switchyard

- Strengthen structures for isolators (21 nos.) by adding horizontal member

- Demolish footings for existing DTCB and reconstruct new footings for

CB – 10 nos.

Note: The 66kV switchyard has deep fill necessitating the installation of bore piles

- Construct new footings for

Yard box – 10 nos.

When replacing bus post insulators, check cap plate bolts replaced to high strength bolts.

Install 280m 100mm O.D. conduit direct buried from equipment to trenches

Reinstate/ Resurface disturbed areas (allow 350m²)

- **Asbestos Removal**

Allow for removal and substitution of following

Wall vinyl tiles (control room renovated from previous messroom) – 10m²

Green vinyl floor tiles – 25m²

Ceiling (Hot Water service room) – 3m²

6.2.1.5 Additional Civil Infrastructure

Assume possible to reuse existing switchyard trenches.

6.2.2 Secondary Works – Option2

Secondary works within ERTS will include but are not limited to the design, procurement and installation/ modification of the following (including cabling):

6.2.2.1 Protection & Control

Table 6.2-1 220/66kV Transformer Schemes at ERTS

Item	Application	Description
1	B1 Transformer	Interface new 66kV CB/CT to existing transformer protection and 66kV CB management schemes
2	B4 Transformer	Interface new 66kV CB/CT to existing transformer protection and 66kV CB management schemes
3	B3 Transformer	Interface new 66kV CB/CT to existing transformer protection and 66kV CB management schemes.
4	Voltage Regulation	Install a new voltage regulation scheme using on A.eberle REG-D relays for all 4 transformers. The new VRR scheme shall be installed at existing spare panel location P64. The old Tapcon VRR scheme on panel P2 shall be decommissioned.

Table 6.2-2 66kV Schemes at ERTS

Item	Application	Description
1	No3 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.3 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P51 and P53. Existing outdoor CT summation box for X and Y bus CT summations to be retained. Run new cables from all new CB/CTs of No.3 66kV bus and to the existing X and Y bus protection schemes.
2	No4 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.4 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P67 and P68. Re-use the existing Bus CT summation box (Installed as part of ERTS Stage project TD-0003440) Run new cables from all new CB/CTs of No.4 66kV bus and to the existing X and Y bus protection schemes.
3	No1 & 1A Ext 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.1 & No1A Ext 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P23 and P24. Existng outdoor CT summation box for X and Y bus CT summations to be retained. Run new cables from all new CB/ CTs of No.2 66kV bus and to the existing X and Y bus protection schemes.
4	No.2 66kV Bus Protection	Reconenct the new CT contributions to existing No.2 CT Summation box and extend all necessary interface cables to/from new 66kV CBs connected to no.2 busbar
5	No4 66kV Cap Bank Protection	Install new duplicate capacitor prot panel for No.4 66kV Cap bank using ABB REV615 and GE C70 relays. The new prot panel insert shall be installed at existing spare panel location P39. The Point on Wave relay ABB F236 on existing panel shall also be relocated on to this new panel. Decommission the existing prot schemes on panels P33 and P34 along with existing AVC controls on panel P40
6	No.1A/1B Cap Bank Protection	Interface the new balance CT to No.1A Cap bank X Prot device. The Cap bank tripping and control shall also be interfaced to new 66kV No1B Cap bank CB
7	BWN/CBTS 66kV Feeder protection	Install a new duplicate Distance protection scheme for 66kV feeder BWN/CBTS using Siemens 7SL87 and GE L90 relays with distance protection enabled to protect ERTS-BWN under emergency (when CBTS OOS). The new feeder prot panel insert shall be installed at the existing spare panel location P41. Decommission the existing prot schemes on panels P43 and P44. Allow

Item	Application	Description
		new cabling from switchyard to the new prot and control equipment via existing CTCs.
8	LYD/CBTS 66kV Feeder protection	Install a new duplicate Distance protection scheme for 66kV feeder LYD/CBTS using Siemens 7SL87 and GE L90 relays with distance protection enabled to protect ERTS-LYD under emergency (when CBTS OOS). The new feeder prot panel insert shall be installed at the existing spare panel location P31. Decommission the existing prot schemes on panels P65 and P66. Allow new cabling from switchyard to the new prot and control equipment via existing CTCs.
9	LD 66kV Feeder	Reconnect existing LD 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
10	DSH 66kV Feeder	Reconnect existing DSH 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
11	DVY 66kV Feeder	Reconnect existing DVY 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
12	DN 66kV Feeder	Reconnect existing DN 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
13	HPK/DN 66kV Feeder	Reconnect existing HPK/DN 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
14	Voltage Regulation	Install a new voltage regulation scheme using on A.eberle REG-D relays for all 4 transformers. The new VRR scheme shall be installed at existing spare panel location P64. The old Tapcon VRR scheme on panel P2 shall be decommissioned.
15	B1 and B4 Transformer 66kV CB ARC	Install new Auto reclose scheme using SEL2440 device. The new ARC for B1 and B4 66kV CBs shall be installed at spare panel location P29. The existing PLC based ARC scheme on P55 for B1 and B4 66kV CBs shall be decommissioned.
16	Auto Load Shedding	Install new Auto Load Shedding panel at spare location P15. Allow Siemens 7VK87 and GE C60 relays to implement new ALS scheme due to absence of Standard template design. The Old Auto load shedding scheme shall be decommissioned from Panel P42

Item	Application	Description
17	66kV CB Alarm interposing relays and Mimic Controls	Decommission existing 66kV CB alarm interposing relays in panels P12 and P13 and implement their monitoring through SCIMS. The existing Mimic control board incluidng all associated control/ instrumenatation devices shall also be decommissioned.
18	66kV Feeder and Bus Transducers	Decommission the existing transducers in panels P3, P4 & P5 of 66kV feeders and Buses and implement analogue instrumentation through SCIMS
19	66kV Metering POT Sel	Decommission the existing Metering POT selection scheme in Panel P9 and implement its functionality via individual feeder CBM schemes
20	Temporary Works	The out of service Spare Bay J feeder and its proetction scheme (SEL311L and L90) shall be used to transfer loads during feeders are cut over. The 2 x proetction relays on the spare Bay J fedeer shall be decommissioned after the last feeder cut-over and returnd to stores.
21	AEMO Metering Panel	Install 2 x new AEMO Metering panels at spare panel locations next to PQM panel (P86). Decommission the existing Nemmco metering panels P87 and P88.

6.2.2.2 Scada

- Existing SCADA panel at ERTS to be expanded to Interface all new IEDs for remote monitoring and control of the 220kV and 66kV plant and equipment. Update the station mapping table for all interface signals.
- For the purpose of business case estimate, allow 60 days for RSG group and 30 days for ENS group for the testing and HMI screen update works of the 23 x new IEDs +15 x Revenue/ Check meters.

6.2.2.3 Metering & Monitoring

- Install 15 x new Revenue meters. Two new metering panels will be required and they will be installed at the spare panel locartions next to Panel P86. (refer item 21 in Table 6.2-2 above)
- Install 4 x POT Selection relays RMS 2P48 to establish VT supplies requitred for each revenue or check meter.
- All new revenue meters shall be interfaced to new / existing CB/CT and AEMO metering registration package to be compiled and submitted.
- Interface all new meters to SCADA system for metering and monitoring.

Note The device type for AEMO Revenue meters has not been finalised yet. As such, for the estimation purpose, AUD 3000.00 + GST will be allowed for each revenue meter.

6.2.3 AC & DC Supplies – Option2

6.2.3.1 415V AC supplies

- 415V AC Auto changeover Boards to be supplied from the auxiliary transformers connected to B2 and B3 Tertiary windings. New AC distribution board shall be installed, and all existing services supplied from old AC1 & AC2 to be transferred new distribution board.
- Existing AC1 & AC2 distribution boards which contain asbestos shall be decommissioned and disposed safely.
- The AC supplies to new 66kV CB equipment shall be derived from the new AC distribution board.

6.2.3.2 250V DC Supplies

- Install 2 x 250V DC Systems including batteries, battery chargers, Isolation boxes and Distribution boards in a separate enclosure.
- The existing X and Y 250V DC distribution boards DC8 and DC9 shall be fed from the new Battery isolation boxes.
- Decommission existing DC3 and DC4 boards
- Decommission and dispose old battery including Isolation boxes and distribution boards. The DC1 & DC2 distribution boards containing Asbestos shall be decommissioned and safely disposed.
- Install 11 x 32A MCBs on existing DC8 distribution board to supply new X protection and control schemes
- Install 8 x 32A MCBs on existing DC9 distribution board to supply new Y protection and control schemes

6.2.4 Communications – Option2

6.2.4.1 Infrastructure

- Install 1 x Ruggedcom RX1500 device in the existing DIC cubicle P77.

6.2.4.2 Exchanges

- N/A

6.2.4.3 PLC

- N/A

6.2.4.4 Digital Networks/Asset Data Gathering

- Interface all new IEDs having ethernet or serial capability to existing DIC panels for Engineering access and asset data gathering.

6.2.4.5 VF

- N/A

6.2.5 Lines

- 66kV Lines not included

6.3 OPTION 3 – Replace B1, B4 and selected Switchyard Equipment in an integrated project

6.3.1 Primary and Civil Works – Option3

For the Primary and Civil OPTION 3, repeat OPTION 1 and OPTION 2
OPTION 3 = OPTION1 + OPTION 2
With savings in design, mobilisation and project administration

6.3.2 Secondary Works – Option3

Secondary works within ERTS & ROTS will include but are not limited to the design, procurement and installation/modification of the following (including cabling):

6.3.2.1 Protection & Control

Table 6.3-1 220kV Schemes at ERTS

Item	Application	Description
1	220kV ROTS1 Line	Install duplicate current differential schemes for ROTS1 line in separate cubicles using Siemens 7SL87 and GE L90 relays. The two panels for X and Y Line protection shall be installed in the control building extension. Decommission the X and Y protection cubicles P95 and P96
2	220kV ROTS2 Line	Install duplicate current differential schemes for ROTS1 line in separate cubicles using Siemens 7SL87 and GE L90 relays. The two panels for X and Y Line protection shall be installed in the control building extension. Decommission the X and Y protection cubicles P97 and P98
3	220kV POT Selection	Installed new POT selection scheme at spare panel location P69. The old POT selection scheme at Panel P7 shall be decommissioned and its functionality to be transferred to new POT selection scheme.
4	220kV CB Interposing relays	Decommission the existing alarm interposing relays on panel P11 for 220kV CBs and implement the monitoring through SCIMS

Table 6.3-2 220/66kV Transformer Schemes at ERTS

Item	Application	Description
1	B1 Transformer	Interface the bushing CTs of the new transformer to existing ROTS1 line protection and B1 transformer protection schemes. Enable B1 Transformer HV and LV REF protection functions in the 2 x existing schemes. Remove Auto CTs from the B1 transformer protection scheme.

Item	Application	Description
2	B4 Transformer	Interface the bushing CTs of the new transformer to existing ROTS2 line protection and B1 transformer protection schemes. Enable B4 Transformer HV and LV REF protection functions in the 2 x existing schemes. Remove Auto CTs from the B4 transformer protection scheme.
3	B3 Transformer	Interface new 66kV CB/CT to existing transformer protection and 66kV CB management schemes.
4	Voltage Regulation	Install a new voltage regulation scheme using on A.eberle REG-D relays for all 4 transformers. The new VRR scheme shall be installed at existing spare panel location P64. The old Tapcon VRR scheme on panel P2 shall be decommissioned.
5	Transformer Temperature	Decommission the Transformer temperature transduces and implement temperature monitoring through new DRMCC devices. The oil monitoring Calosto devices shall also be integrated to existing SCIMS.

Table 6.3-3 66kV Schemes at ERTS

Item	Application	Description
1	No3 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.3 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P51 and P53. Existing outdoor CT summation box for X and Y bus CT summations to be retained. Run new cables from all new CB/CTs of No.3 66kV bus and to the existing X and Y bus protection schemes.
2	No4 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.4 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P67 and P68. Re-use the existing Bus CT summation box (Installed as part of ERTS Stage project TD-0003440) Run new cables from all new CB/CTs of No.4 66kV bus and to the existing X and Y bus protection schemes.
3	No1 & 1A Ext 66kV Bus Protection	Install a new duplicate high impedance bus prot panel for No.1 & No1A Ext 66kV bus using Siemens 7VK87 and GE F35 relays. The new bus prot panel insert shall be installed at the existing spare panel location P54. Decommission the existing prot schemes on panels P23 and P24. Existng outdoor CT summation box for X and Y bus CT summations to be retained. Run new cables from all new CB/ CTs of No.2 66kV bus and to the existing X and Y bus protection schemes.
4	No.2 66kV Bus Protection	Reconenct the new CT contributions to existing No.2 CT Summation box and extend all necessary interface cables to/from new 66kV CBs connected to no.2 busbar

Item	Application	Description
5	No4 66kV Cap Bank Protection	Install new duplicate capacitor prot panel for No.4 66kV Cap bank using ABB REV615 and GE C70 relays. The new prot panel insert shall be installed at existing spare panel location P39. The Point on Wave relay ABB F236 on existing panel shall also be relocated on to this new panel. Decommission the existing prot schemes on panels P33 and P34 along with existing AVC controls on panel P40
6	No.1A/1B Cap Bank Protection	Interface the new balance CT to No.1A Cap bank X Prot device. The Cap bank tripping and control shall also be interfaced to new 66kV No1B Cap bank CB
7	BWN/CBTS 66kV Feeder protection	Install a new duplicate Distance protection scheme for 66kV feeder BWN/CBTS using Siemens 7SL87 and GE L90 relays with distance protection enabled to protect ERTS-BWN under emergency (when CBTS OOS). The new feeder prot panel insert shall be installed at the existing spare panel location P41. Decommission the existing prot schemes on panels P43 and P44. Allow new cabling from switchyard to the new prot and control equipment via existing CTCs.
8	LYD/CBTS 66kV Feeder protection	Install a new duplicate Distance protection scheme for 66kV feeder LYD/CBTS using Siemens 7SL87 and GE L90 relays with distance protection enabled to protect ERTS-LYD under emergency (when CBTS OOS). The new feeder prot panel insert shall be installed at the existing spare panel location P31. Decommission the existing prot schemes on panels P65 and P66. Allow new cabling from switchyard to the new prot and control equipment via existing CTCs.
9	LD 66kV Feeder	Reconnect existing LD 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
10	DSH 66kV Feeder	Reconnect existing DSH 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
11	DVY 66kV Feeder	Reconnect existing DVY 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
12	DN 66kV Feeder	Reconnect existing DN 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
13	HPK/DN 66kV Feeder	Reconnect existing HPK/DN 66kV feeder prot panel to the new 66kV feeder CB. Allow new cabling from switchyard to existing to existing prot and control

Item	Application	Description
		equipment via existing CTCs. Allow for functional testing of the protection and control with the new CB
14	Voltage Regulation	Install a new voltage regulation scheme using on A.eberle REG-D relays for all 4 transformers. The new VRR scheme shall be installed at existing spare panel location P64. The old Tapcon VRR scheme on panel P2 shall be decommissioned.
15	B1 and B4 Transformer 66kV CB ARC	Install new Auto reclose scheme using SEL2440 device. The new ARC for B1 and B4 66kV CBs shall be installed at spare panel location P29. The existing PLC based ARC scheme on P55 for B1 and B4 66kV CBs shall be decommissioned.
16	Auto Load Shedding	Install new Auto Load Shedding panel at spare location P15. Allow Siemens 7VK87 and GE C60 relays to implement new ALS scheme due to absence of Standard template design. The Old Auto load shedding scheme shall be decommissioned from Panel P42
17	66kV CB Alarm interposing relays and Mimic Control	Decommission existing 66kV CB alarm interposing relays in panels P12 and P13 and implement their monitoring through SCIMS. The existing Mimic control board incluidng all associated control/ instrumenatation devices shall also be decommissioned.
18	66kV Feeder and Bus Transducers	Decommission the existing transducers of 66kV feeders and Buses and implement analogue instrumentation through SCIMS
19	66kV Metering POT Selection	Decommission the existing Metering POT selection scheme in Panel P9 and implement its functionality via individual feeder CBM schemes
20	Temporary Works	The out of service Spare Bay J feeder and its proetction scheme (SEL311L & L90) shall be used to transfer loads during feeders are cut over. The 2 x proetction relays on the spare Bay J fedeer shall be decommissioned after the last feeder cut-over and returnd to stores.
21	AEMO Metering Panel	Install 2 x new AEMO Metering panels at spare panel locations next to PQM panel (P86). Decommission the existing Nemmco metering panels P87 and P88.

Table 6.3-4 Schemes at Remote ROTS end

Item	Application	Description
1	220kV ERTS1 Line	Install duplicate current differential schemes for ERTS1 line in separate cubicles using Siemens 7SL87 and GE L90 relays. The two panels for X and Y Line protection shall be installed P?? & P??. Decommission the X and Y protection cubicles P?? & P??
2	220kV ERTS2 Line	Install duplicate current differential schemes for ERTS1 line in separate cubicles using Siemens 7SL87 and GE L90 relays. The two panels for X and Y Line protection shall be installed at P?? & P??. Decommission the X and Y protection cubicles in P?? & P??

6.3.2.2 Scada

- Existing SCADA panel at ERTS to be expanded to Interface all new IEDs for remote monitoring and control of the 220kV and 66kV plant and equipment. Update the station mapping table for all interface signals.
- Update Mapping table at ROTS for the new IEDs of the ERTS line proetction
- For the purpose of business case estimate, allow 85 days for RSG group and 42 days for ENS group for the testing and HMI screen update works of the 35 x new IEDs + 15 x Revenue /Check meters.

6.3.2.3 Metering & Monitoring

- Install 15 x new Revenue meters. Two new metering panels will be required and they will be installed at the spare panel locartions next to Panel P86. (refer item 21 in Table 6.3-3 above)
- Install 4 x POT Selection relays RMS 2P48 to establish VT supplies requitred for each revenue or check meter.
- All new revenue meters shall be interfaced to new / existing CB/CT and AEMO metering registration package to be compiled and submitted.
- Interface all new meters to SCADA system for metering and monitoring.

Note - The device type for AEMO Revenue meters has not been finalised yet. As such, for the estimation purpose AUD 3000.00 + GST will be allowed for each revenue meter.

6.3.3 AC & DC Supplies – Option3

6.3.3.1 415V AC supplies

- 415V AC Auto changeover Boards to be supplied from the auxiliary transformers connected to B2 and B3 Tertiary windings. New AC distribution board shall be installed, and all existing services supplied from old AC1 & AC2 to be transferred new distribution board.
- The existing AC1 & AC2 distribution boards which contain asbestos shall be decommissioned and disposed safely.
- Extend 2 x auxiliary supplies from the existing AC Autochangeover Boards to each new transformer control systems
- The AC supplies to new 66kV CB equipment shall be derived from the new AC distribution board.

6.3.3.2 250V DC Supplies

- Install 250V DC duplicate DC Systems including batteries, battery chargers, Isolation boxes and Distribution boards in a separate enclosure.
- The existing X and Y 250V DC distribution boards DC8 and DC9 shall be fed from the new Battery isolation boxes.
- Decommission existing DC3 and DC4 boards
- Decommission and dispose old battery including Isolation boxes and distribution boards. The DC1 & DC2 distribution boards containing Asbestos shall be decommissioned and safely disposed.
- Install 15 x 32A MCBs on existing DC8 distribution board to supply new X protection and control schemes
- Install 9 x 32A MCBs on existing DC9 distribution board to supply new Y protection and control schemes

6.3.4 Communications – Option3

6.3.4.1 Infrastructure

- Install 1 x Ruggedcom RX1500 device in the existing DIC cubicle P77.

6.3.4.2 Exchanges

- N/A

6.3.4.3 PLC

- N/A

6.3.4.4 Digital Networks/Asset Data Gathering

- Interface all new IEDs having ethernet or serial capability to existing DIC panels for Engineering access and asset data gathering.

6.3.4.5 VF

- N/A

6.4 Lines

- 66kV lines not included

7 Appendices

7.1 Appendix A – Fixed Assets WDV

The written down value of fixed assets is outlined below.

As at 30/11/2024

OPTION 1 - $ 135,620
OPTION 2 - $ 444,571
OPTION 3 - $ 580,191

7.2 Appendix B – Risks Assessment

Risk identification			Risk TREATMENT				Risk Analysis						
							Residual Risk				Target Risk		
Risk	Causes	Impacts	Controls (Current)	Owner	RCE	Treatment Actions (Future)	Conseq Rating	Like. Rating	Residual Risk Rating	Project Financial Exposure (Residual)	Conseq Rating	Like. Rating	Target Risk Rating
Scope change	• Scope varied by RIT-T tests	• Increase costs • Delay in works • Project will be unbuildable	• Notify Asset owner of any change that will have adverse impact on overall project delivery • Assumption of no change to the draft scope	initiator	Fully Effective								
Uncertainty in start timing impacts on project implementation	• AEMO RIT-T approval • AusNet Services internal approvals	• Increase risks on site due to compression • Increase costs • Increase risk of design errors due to compression • Risk of project becoming fast-tracked	• Internal Processes/ Procedures and Project Controls • Project Plan establishment • Design QA • Assumption of start date in contracts	initiator	Fully Effective								
Commissioning outage constraints	• Unable to get B Transformer or 66kV outages	• Cost overruns • Missing practical completion • Revenue stream delayed	• Forward planning • Get in touch with the Generators in advance • Consultation with Maintenance and Operations staff • Commissioning plans	PM	Substantially Effective	• Submit commissioning plan to generators and TOC for approval	3	B	III	$100k	3	B	III
Delay on Practical Completion	• Design changes due to site conditions • Unable to satisfy AEMO requirements	• Finance charges increased • Revenue stream delayed	• Forward planning • QA Process • Sign contracts before start	PM	Partially Effective	• Get AEMO PC earlier	2	B	III	$100k-$500k	2	B	III

Risk identification			Risk TREATMENT				Risk Analysis						
							Residual Risk				Target Risk		
Risk	Causes	Impacts	Controls (Current)	Owner	RCE	Treatment Actions (Future)	Conseq Rating	Like. Rating	Residual Risk Rating	Project Financial Exposure (Residual)	Conseq Rating	Like. Rating	Target Risk Rating
Safety Incident	• Safe approach distances – tight site • Equipment failure • HEI's	• Accident (s) and injuries to staff and contractors	• HSE processes and procedures • Pre-approved contractor list	PM	Fully Effective	• Safety Management plan							