TD-0007772 TSTS Redevelopment

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]	Primary Engineer Project Engineer Civil/Structural Engineer Secondary Engineer	Technical Scope		**03/07/2020**
[C-I-C]	Engineering Estimating Lead	Estimation Risk assessment		**07/08/2020**
[C-I-C]	Team Leader		Technical Scope	**01/07/2020**
[C-I-C]	Project Manager			
[C-I-C]	Project Director			
[C-I-C] on behalf of Projects Review Board	Manager, Major Projects			

Revision History

Revision	Date	Description of Changes	Author
0	06/07/2020	First Issue – For Estimation	[C-I-C]
1	13/07/2020	Second Issue – For Estimation, minor changes to Section 4 and 6, added Section 7 and 8	[C-I-C]
2	30/07/2020	Third Issue – For Estimation, minor changes to D&C risk (S3.3), sewerage (S6.1.2.9), metering (S6.2.3) and lighting (S6.5)	[C-I-C]
3	12/08/2020	Final Issue – To Initiator	[C-I-C]
4	18/08/2020	Fourth Issue – For Estimation, minor/moderate changes to Section 2, Section 4 and Section 7 to include staging of the project	[C-I-C]
5	27/08/2020	Fifth Issue – To Initiator	[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 6 is a detailed technical scope intended for estimation only.

Table of Contents

1 GENERAL

1.1 Project Background

Templestowe Terminal Station (TSTS) is located in Templestowe next to the Manningham City Council Depot and is the main transmission connection point for distribution of electricity to about 84,000 customers in north-eastern metropolitan Melbourne. The communities supplied by TSTS spans from Eltham in the north to Canterbury in the south and from Donvale in the east to Kew in the west.

TSTS currently has three 150MVA 220/66/11kV transformers and is connected to the Eastern Metropolitan 220 kV network. TSTS is the transmission connection point for the following distribution businesses: CitiPower, United Energy, Jemena, and AusNet Electricity Services.

The current project drivers are mainly due to supply risk due to transformer or switchgear failures, safety risk presented by CT explosive failures, environmental risks due to oil spills and collateral risks from when assets fail explosively.

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.

A RIT-T process is to be initiated for a proposal to replace the B2 & B3 Transformers 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.

1.2 Basis Documents

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

- TSTS Functional Scope Rev 4.pptx
- TSTS relay condition.xlsx
- Primary Assets condition data.xlsx
- V-APD01812 – TSTS Transmission Revenue Reset (TRR) Project Scoping – revision 3.pdf

1.3 Other Interdependent Projects

There are no known interdependent projects at time of writing this document.

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 major assets included for replacement are the B2 and B3 150MVA 220/66/11kV transformers as well as 220kV and 66kV switchgear and protection relays with the condition score of C4 and C5 or otherwise identified by the Asset Management team.

2.1 Overview

This project will mitigate a number of risks by replacing the B2 & B3 Transformers, and selected 220kV and 66kV switchgear that has been identified as being in poor condition. Estimates and scopes have been grouped into a number of options for the Business Case analysis:

1. Option 1 – Replacement of B2 & B3 Transformer and all relevant 220kV & 66kV switchgear
2. Option 2 –
   Stage 1: Replacement of B3 Transformer and all relevant 220kV & 66kV switchgear
   Stage 2: Replacement of B2 Transformer
3. Option 3 –
   Stage 1: Replacement of B2 & B3 Transformer and all relevant 220kV switchgear
   Stage 2: Replacement of all relevant 66kV switchgear
4. Option 4 –
   Stage 1: Replacement of B2 & B3 Transformer and all relevant 66kV switchgear
   Stage 2: Replacement of all relevant 220kV switchgear

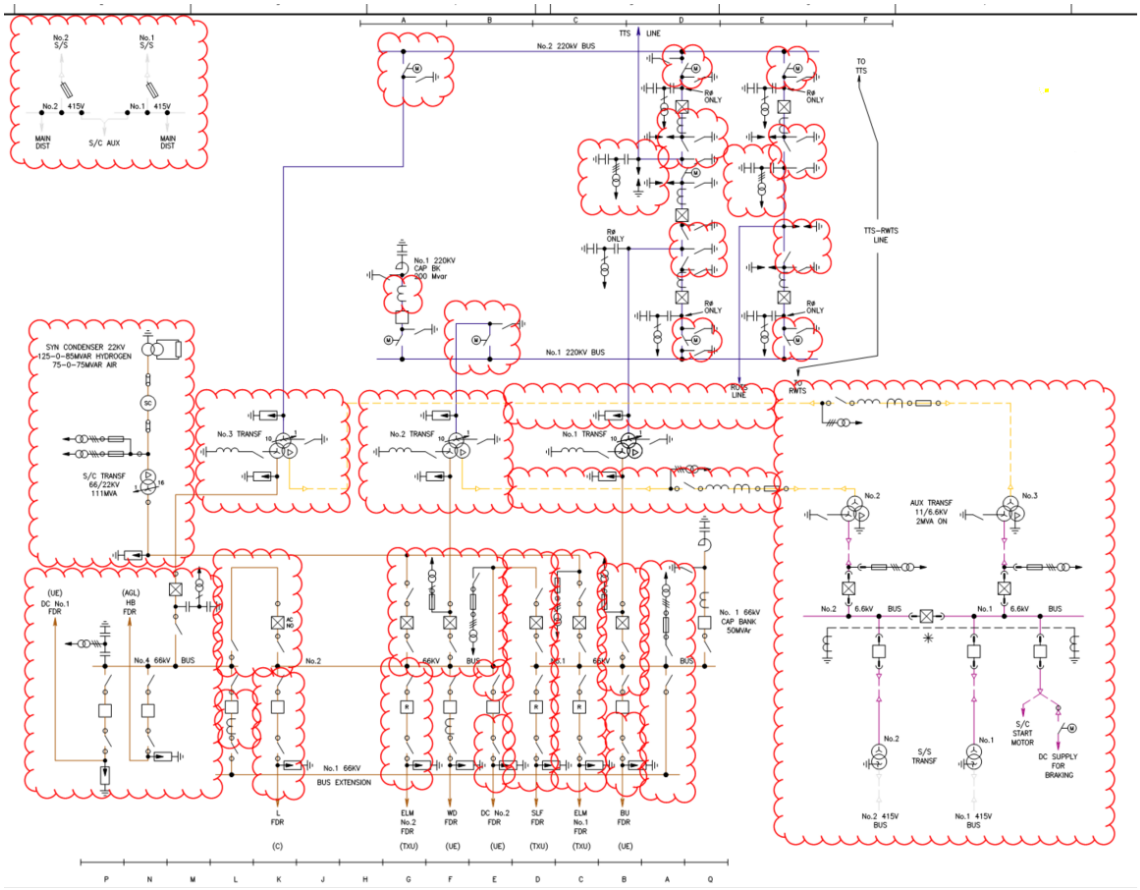
Option 1 is documented in full in the following sections, while the other options outlined in Section 7 are variations of how Option 1 can be separated into two stages.

The transformers that require replacements are being proposed to be installed in greenfield areas instead of an in-situ replacement. This is due to the security of the station supply and being unable to operate with the risk of incurring an N-2 scenario as well as to mitigate - through removal - the fire risk presented by a shared transformer gantry. Two new transformers of the same size and capacity will be installed at greenfield sites alongside the existing transformers while the existing B2 and B3 transformers will instead be retired.

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

a. Circuit breakers with the condition score of C4 or C5
b. Isolators, ROIs or earth switches with the condition score of C4 or C5
c. CTs, VTs and CVTs with the condition score of C4 or C5
d. Brown post insulators, glass insulators and pin & cap insulators will be replaced with the current standard insulators
e. Existing live tank CBs will be replaced with dead tank CBs
f. All earthing receptacles will be replaced by the ball and clam type which is aligned with the current standard

A single line diagram of the proposed works is shown below:



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 arises. Some in-equipment and panels will be cleared when the equipment gets replaced but those embedded in the station infrastructure need to be remedied through replacement. These include the main AC and DC distribution boards as well building sub-distribution boards and general power and lighting yard boxes which were installed when the station was established, and all contained asbestos. In addition, areas of the various building contain wall vinyl tiles and floor tiles that contain asbestos fibres which will require replacement as well. Some existing abandoned asbestos fire hydrant pipe will be removed.

Bulk remedial earthworks to stabilise areas of the perimeter embankments are also required.

2.2 Interfaces

Coordination is required with the 66kV lines connected to the station. These area with:

- United Energy – DC1, DC2, WD, BU
- Jemena – HB
- AusNet Services – ELM1, ELM2, SLF
- Citipower - L

2.3 Overall Risks

The following risks are noted:

1. The scope and estimate were based on “TSTS Functional Scope Rev 4” slides, condition scores in Power BI, site visits 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.

Please refer appendix B

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
- Allow room for a future 4th transformer
- The station cannot manage a N-2 scenario
- Retain three (3) B2 Transformer 220kV surge diverters as spare
- Retain three (3) B2 Transformer 66kV surge diverters as spare
- Retain three (3) B3 Transformer 220kV surge diverters as spare
- The B2 and B3 Transformer will be scrapped for metal (Estimated value of $70k payback per B transformer)
- The Synchronous Condenser will be scrapped for metal (Assume cost neutral)
- 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.
- The structural integrity (structures and footings) of the existing racks in 220kV yard to be checked to 40kA. The cost for the modification of the structures and footings will be a provisional sum.
- Existing racks may be reused without strengthening to 31.5kA for 66kV. No analysis of rack will be carried out in conjunction with replacement of glass insulating strings.
- The asbestos at TSTS is classified as residual risk IV. Asbestos in protection panels will not be specially removed but will wait for the retirement of panels with protection upgrade.
- New B4 and B5 transformers to be equipped with 4 x CTs on the 220kV transformer bushing suitable for Line and Transformer protection applications.

2.5 Exclusions

The following has been excluded from the scope and estimate:

- Any works not specifically mentioned in this scope of works
- Removal of Synchronous Condenser foundations
- Total replacement of existing structures within the switchyard
- Structural integrity check and strengthening work for the existing rack structures in the 66kV switchyard

3 Budget Estimate (P75)

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:

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0007772**
Project Title:	**TD-0007772 TSTS Redevelopment Option 1**
Estimate Type:	**Planning**
Revision:	**Original Rev 0**
Issued Date:	**11/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$3,266,667	$0	$233,333	$0	$3,500,000
2	INTERNAL LABOUR	$217,102	$308,514	$725,579	$702,726	$331,367	$2,285,287
3	MATERIALS	$0	$2,456,898	$6,142,245	$3,685,347	$0	$12,284,490
4	PLANT & EQUIPMENT	$0	$92,806	$556,835	$556,835	$278,417	$1,484,892
5	CONTRACTS	$0	$1,065,323	$6,391,936	$6,391,936	$3,195,968	$17,045,164
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$115,518	$693,109	$693,109	$346,555	$1,848,292
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$217,102**	**$7,305,725**	**$14,509,704**	**$12,263,286**	**$4,152,307**	**$38,448,125**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$768,963
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$217,102**	**$7,305,725**	**$14,509,704**	**$12,263,286**	**$4,152,307**	**$39,217,087**
11	OVERHEADS	$8,467	$284,923	$565,878	$478,268	$161,940	$1,499,477
12	FINANCE CHARGES (IDC)	$7,870	$167,664	$658,874	$630,624	$364,416	$1,829,447
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$233,439**	**$7,758,312**	**$15,734,457**	**$13,372,178**	**$4,678,663**	**$42,546,011**

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 X		
Project Y		

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 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)
- 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

The following is a list of Major Plants included in the estimate:

- Two (2) B Transformers
- Two (2) new 220kV DTCBs
- Nine (9) 220kV ROIs and earth switches
- Twelve (12) 66kV DTCBs
- Twenty-six (26) 66kV isolators
- Synchronous Condenser removal

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:

- Possibility for a Design & Construct delivery model and risks associated
- Internal resources to prepare scopes for a Design & Construct delivery model

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		
2.	Additional environmental or cultural heritage obligations and permits		

No.	Project Contingency Plan	Schedule Impact (days)	Costing Impact ($K)
3.	Additional unforeseen costs for delays in equipment delivery (Transformer, circuit breakers)		
4.	Delays in association with outages		
5.	Inclement weather		
6.	External 66kV Feeder Transfer Facilities		
7.	Contaminated soil disposal or removal of rock		
8.	Feeder asset failures during Testing		
9.	Design & Construct delivery model		

4 SCHEDULE

All project dates are based on a nominal business case approval date and the delivery of Option 1. 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	17/07/2020	
	Business Case Approved	18/02/2021	6 months
	RIT-T consultation process	07/09/2021	6 months
Detailed Design	Contract execution /DSP Scope of Works	21/09/2021	13 months
	DSP Tender / Award	19/10/2021	
	Detailed Design Start	09/12/2021	
	Design Completed	18/09/2022	
Delivery and Close	Project Handover for Implementation	27/09/2022	30 months
	ISP Tender / Award	27/12/2022	
	Site Works Commenced	10/01/2023	
	First outage taken	12/02/2023	
	Practical Completion	31/03/2025	
	Project Close-out Complete	31/06/2025	

Note: The delivery of this project in two stages will directly impact the schedule shown above and will need to be reassessed during the planning phase. This could result in major delays and a longer timeline till practical completion of both stages. Section 7 includes high-level schedules demonstrating the timeline for both stages.

4.1 Staging/Sequencing/Outages

A high-level proposed sequence of works has been developed as a conceptual sequence of works (refer to Appendix C) has been used as the basis for the cost estimation. This sequence is not complete

with all project works but rather is a proof of concept of the transformer replacement works only. At a high level the project stages will be:

1. Replacement of B2 and B3 Transformers with new B4 and B5 Transformers including new Transformer foundations, gantries and fire walls, noise enclosure buildings, new Transformer 220kV CBs and remediation works to the Shared Transformer Gantry. Alternative solutions considered during development of the proposed works sequence are outlined in Appendix D for background information purposes only.
2. Other 220kV works including ROI, ESW, CVT, SA and PI replacements
3. Other 66kV works including CB, Isolator, VT and PI replacements including temporary works for feeder bay replacements and cutovers

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

No	Outage Scope	Work Description	Duration	Notes
1	No.1 220kV Bus	B5 CB connection, retire B2 ROI, PI replacement,	3 x 8 hours	Daily outages
2	No.2 220kV Bus	B1 CB connection, retire B3 ROI, PI replacement	3 x 8 hours	Daily outages
3	TTS 220kV Line	ROI replacement, harp string connection, spark gap replacement	3 x 8 hours	Daily outages
4	ROTS 220kV Line	ROI replacements, spark gap replacement	3 x 8 hours	Daily outages
5	No.1 220kV Cap Bank	CT replacement	2 days	Continuous
6	B1 Transformer	Neutral isolator/reactor replacement, 66kV CB replacement, cutover to sync.con. bus, line swing to new 220kV CB	1 x 8 hours 5 days	Daily outage Continuous
7	No.1 66kV Bus	PI replacement, B/S isolator replacement	2 x 8 hours	Daily outages
8	No.2 66kV Bus	PI replacement, B/S isolator replacement	1 x 8 hours	Daily outages
9	No.1 extn 66kV Bus	PI replacement, B/S isolator replacement	7 x 8 hours	Daily outages
10	No.4 66kV Bus	PI replacement, B/S isolator replacement	1 x 8 hours	Daily outages
11	BU Feeder	Isolator replacement	2 x 8 hours	Daily outages
12	ELM1 Feeder	Feeder full bay replacement	2 x 8 hours	Daily outages
13	SLF Feeder	Feeder full bay replacement	2 x 8 hours	Daily outages
14	DC2 Feeder	Isolator replacement	2 x 8 hours	Daily outages
15	ELM2 Feeder	Feeder full bay replacement	2 x 8 hours	Daily outages
16	L Feeder	Feeder full bay replacement	2 x 8 hours	Daily outages
17	HB Feeder	Feeder full bay replacement and feeder exit relocation	5 days	Continuous

No	Outage Scope	Work Description	Duration	Notes
18	DC1 Feeder	Feeder full bay replacement and feeder exit relocation	5 days	Continuous
Total outages			53 outages	

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

N/A

4.3 Hazards at Site

The following know hazards currently existing at TSTS:

1. Existing buried asbestos pipe withing the 220kV and 66kV switchyard
2. Asbestos on wall tiles
3. Asbestos in panels inside the control room which will be removed as part of this project
4. Possible lead paint on legacy transformers and CBs

4.4 Standards

N/A

5 Validation Checklist

Doc Ref#	Check List Item Description	Drafted by (initials)	Reviewed by (Initials)	Comments
	PROJECT SCOPE			
1.	Concept development completed and documented	[C-I-C]	[C-I-C]	
2.	Detailed Technical Scope completed and documented	[C-I-C]	[C-I-C]	
3.	Submission consistent with the project scope of work	[C-I-C]	[C-I-C]	
4.	Major material/components identified	[C-I-C]	[C-I-C]	
5.	Procurement process/ responsibility clearly identified	[C-I-C]	[C-I-C]	
	RISK ANALYSIS AND CONTINGENCY			

6.	Assumptions and Exclusions clarified and documented from the Risk Matrix	[C-I-C]	[C-I-C]	
7.	Project Contingency is appropriate and documented	[C-I-C]	[C-I-C]	
	PROJECT COSTS			
8.	Major Plant costs included	[C-I-C]	[C-I-C]	
9.	The submission supported by firm sub-contract pricing agreements	[C-I-C]	[C-I-C]	
10.	The submission based on: First principles / Similar projects	[C-I-C]	[C-I-C]	
11.	Escalation has been included in the submission development	[C-I-C]	[C-I-C]	
12.	Budget Estimate validity	[C-I-C]	[C-I-C]	
	SCHEDULE AND RESOURCING			
13.	Appropriate Resources involved in the Submission development	[C-I-C]	[C-I-C]	
14.	Project Schedule reviewed and agreed	[C-I-C]	[C-I-C]	
15.	Resources forecast and scheduled timing shown	[C-I-C]	[C-I-C]	
16.	Practical Completion Date agreed and shown	[C-I-C]	[C-I-C]	
	GATE APPROVALS	[C-I-C]	[C-I-C]	
17.	Completed Gate form	[C-I-C]	[C-I-C]	

6 TECHNICAL NOTES

Section 6 is a detailed technical scope for Option 1 and is 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. This shall include more detail than included in Section 4.1 and Appendix C.

6.1 Primary and Civil Works

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

6.1.1 Primary Plant

Transformers:

- Decommission and removal of one (1) existing B transformer (B2 MVA 220/66/11kV)
- Decommission and removal of one (1) existing B transformer (B3 150MVA 220/66kV)
- Installation of one (1) new B transformer (B4 150MVA 22/66/11kV) in new location

- Installation of one (1) new B transformer (B5 150MVA 22/66/11kV) in new location
- Decommission and removal of three (3) 3-phase existing 220kV neutral isolators
- Decommission and removal of three (3) 3-phase existing 66kV neutral reactors
- Installation of three (3) 3-phase new standard 66kV neutral reactors
- Decommission and removal of three (3) 3-phase existing 66kV neutral isolators
- Installation of three (3) 3-phase new standard 66kV neutral isolators
- Decommission and removal of two (2) existing 6.6kV/415V station service transformers
- Installation two (2) new 11kV/415V station service transformers
- Installation of 900m of 1C 300mm^2 XLPE HDPE/PVC to connect both the S/S Transformers to the tertiary winding of the B Transformers
- Transformer testing including transformer capacitance, winding insulation, earthing connection, bushing insulation etc.
- Earth Grid extension including stranded copper conductor and copper earth straps
- Earth Grid testing
- Earthing study
- Installation of 420m of ACSR/Gz Pawpaw for connection from B4 and B5 Transformers to No.1 Rack

Synchronous Condenser:

- Removal of retired synchronous condenser
- Removal of retired gas hut and cooling tower associated to the synchronous condenser
- Removal of retired fire services associated to the synchronous condenser
- Decommission and removal of two (2) existing 11kV series reactors
- Decommission and removal of two (2) existing 11/6.6kV auxiliary transformers
- Decommission and removal of two (2) existing 66kV CBs associated to the synchronous condenser
- Decommission and removal of four (4) existing 3-phase 66kV isolators associated to the synchronous condenser
- Decommission and removal of one (1) 66kV VT associated to the synchronous condenser
- Decommission and removal of all 6.6kV switchgear from the 6.6kV building
- Decommission and removal of four (4) 66kV wood poles including all associated insulators, crossarms and footings
- Decommission and removal of two (2) 66kV steel towers including all associated insulators, crossarms and footings

220kV Switchyard:

- Installation of two (2) new 220kV CBs in Bay AA and Bay C (including earth tails)
- Installation of two (2) new 220kV 3-phase ROIs (with single earth switches) and two (2) new 220kV earth switches for the new CBs in Bay AA and Bay C
- Installation of one (1) new 1-phase 220kV CVT in Bay C for B1 Transformer
- Decommission and removal of six (6) existing 220kV 3-phase ROIs and earth switches for the following:
    - TTS Line No.2 Bus CB B/S ROI
    - ROTS Line No.2 BUS CB B/S ROI
    - ROTS Line No.1 BUS CB B/S ROI
    - B1 TR 1 BUS 220KV CB B/S ROI
    - B2 TR 220KV ROI (including structures and footings)
    - B3 TR 220KV ROI (including structures and footings)

- Decommission and removal of five (5) existing 220kV 3-phase isolators and earth switches for the following (including structures and footings):
    - B1 TR No.1 Bus 220KV CB TR/S Isol
    - ROTS Line No.1 Bus CB L/S Isol
    - TTS Line No.2 Bus CB L/S Isol
    - TTS Line B1 TR CB TR/S Isol
    - ROTS Line No.2 Bus CB L/S Isol
- Installation of nine (9) new standard 220kV 3-phase ROIs and earth switches for the following:
    - TTS Line No.2 Bus CB B/S ROI
    - ROTS Line No.2 BUS CB B/S ROI
    - ROTS Line No.1 BUS CB B/S ROI
    - B1 TR 1 BUS 220KV CB B/S ROI
    - B1 TR No.1 Bus 220KV CB TR/S Isol
    - ROTS Line No.1 Bus CB L/S Isol
    - TTS Line No.2 Bus CB L/S Isol
    - TTS Line B1 TR CB TR/S Isol
    - ROTS Line No.2 Bus CB L/S Isol
- Decommission and removal of two (2) existing 220kV bus earth switches
- Installation of two (2) new standard 220kV bus earth switches (including earth mats)
- Decommission and removal of two (2) existing 220kV 3-phase CVTs for the following:
    - ROTS Line CVT
    - TTS Line CVT
- Installation of two (2) new standard 220kV 3-phase CVTs for the following:
    - ROTS Line CVT
    - TTS Line CVT
- Decommission and removal of two (2) sets existing 220kV 3-phase CTs for the following:
    - No.1 220kV Cap Bank CT
    - TTS 220KV Line No.2 Bus CB CT
- Installation of two (2) new sets of standard 220kV 3-phase CTs for the following:
    - No.1 220kV Cap Bank CT
    - TTS Line No.2 Bus CB CT
- Installation of three (3) new harp strings on the TTS line (1-phase)
- Decommission and removal of two (2) existing spark gaps/arcing horns for the following:
    - ROTS Line
    - TTS Line
- Installation of six (6) new standard 220kV 1-phase surge arrestors for the following:
    - ROTS Line
    - TTS Line
- Decommission and removal of twenty-three (23) sets of 3-phase brown post insulators
- Installation of twenty-three (23) new standard 220kV 3-phase insulators
- Installation of 27m total of 160OD 10WT 6101-T6 Aluminium Busbars (Bay AA)
- Installation of three (3) 3-phase post insulators for the new bay extension (Bay AA)
- Installation of 50m total of AAC Venus conductor for interplant connection
- All necessary tests regarding new equipment must be done based on Ausnet Services' related standards
- Earth Grid extension for one bay (Bay AA) including stranded copper conductor and copper earth straps

- Earth Grid testing
- Earthing study

66kV Switchyard:

- Decommission and removal of fourteen (14) 66kV LTCBs for the following:
    - B1 Transformer 66kV CB
    - B2 Transformer 66kV CB
    - B3 Transformer 66kV CB
    - ELM1 Feeder CB
    - SLF Feeder CB
    - ELM2 Feeder CB
    - L Feeder CB
    - HB Feeder CB
    - DC1 Feeder CB
    - 1-2 B/T CB
    - 2-4 B/T CB
    - 1extn-4 B/T CB
    - Sync. Con. No.1 Bus 66kV CB (including footings and structures)
    - Sync. Con. No.2 Bus 66kV CB (including footings and structures)
- Installation of twelve (12) new 66kV DTCBs for the following:
    - B1 Transformer 66kV CB
    - B2 Transformer 66kV CB
    - B3 Transformer 66kV CB
    - ELM1 Feeder CB
    - SLF Feeder CB
    - ELM2 Feeder CB
    - L Feeder CB
    - HB Feeder CB
    - DC1 Feeder CB
    - 1-2 B/T CB
    - 2-4 B/T CB
    - 1extn-4 B/T CB
- Decommission and removal of six (6) 66kV 3-phase VTs for the following:
    - No.1 Bus 3ph VT
    - No.2 Bus 3ph VT
    - B1 Transformer 3ph VT
    - B2 Transformer 3ph VT
    - No.4 Bus 3ph CVT
    - B3 Transformer 3ph CVT
- Installation of six (6) new standard 66kV 3-phase VTs for the following:
    - No.1 Bus 3ph VT
    - No.2 Bus 3ph VT
    - B1 Transformer 3ph VT
    - B2 Transformer 3ph VT
    - No.4 Bus 3ph CVT
    - B3 Transformer 3ph CVT
- Decommission and removal of two (2) 66kV 3-phase fused isolators for the following:
    - No.1 Bus VT

- No.2 Bus VT

- Installation of two (2) new standard 66kV 3-phase fused isolators for the following:
  - No.1 Bus VT
  - No.2 Bus VT
- Decommission and removal of thirty (30) 66kV 3-phase underslung isolators in the following table below:

BU Fdr CB B/S Isol	BU Fdr CB Fdr/S Isol
ELM 1 Fdr CB B/S Isol	ELM 1 Fdr CB Fdr/S Isol
SLF Fdr CB B/S Isol	SLF Fdr CB Fdr/S Isol
DC 2 Fdr CB B/S Isol	DC 2 Fdr CB Fdr/S Isol
ELM 2 Fdr CB B/S Isol	ELM 2 Fdr CB Fdr/S Isol
L Fdr CB B/S Isol	L Fdr CB Fdr/S Isol
HB Fdr CB B/S Isol	HB Fdr CB Fdr/S Isol
DC 1 Fdr CB B/S Isol	DC 1 Fdr CB Fdr/S Isol
B1 TR 66kV CB B/S Isol	No.1 Bus VT DUO-ROLL Isol
B2 TR 66kV CB B/S Isol	No.2 Bus VT DUO-ROLL Isol
B3 TR 66kV CB B/S Isol	
1-2 B/T CB No.1 Bus B/S Isol	Sync. Con. No.1 Bus B/S Isol (including footings and structures)
1-2 B/T CB No.2 Bus B/S Isol	Sync. Con. No.1 Bus TR/S Isol (including footings and structures)
2-4 B/T CB No.2 Bus B/S Isol	Sync. Con. No.2 Bus B/S Isol (including footings and structures)
2-4 B/T CB No.4 Bus B/S Isol	Sync. Con. No.2 Bus TR/S Isol (including footings and structures)
1-1 EXTN B/T Isol	

- Installation of twenty-six (26) new standard 66kV 3-phase underslung isolators for the following in the table below:

BU Fdr CB B/S Isol	BU Fdr CB Fdr/S Isol
ELM 1 Fdr CB B/S Isol	ELM 1 Fdr CB Fdr/S Isol
SLF Fdr CB B/S Isol	SLF Fdr CB Fdr/S Isol
DC 2 Fdr CB B/S Isol	DC 2 Fdr CB Fdr/S Isol
ELM 2 Fdr CB B/S Isol	ELM 2 Fdr CB Fdr/S Isol
L Fdr CB B/S Isol	L Fdr CB Fdr/S Isol
HB Fdr CB B/S Isol	HB Fdr CB Fdr/S Isol
DC 1 Fdr CB B/S Isol	DC 1 Fdr CB Fdr/S Isol
B1 TR 66kV CB B/S Isol	No.1 Bus VT DUO-ROLL Isol
B2 TR 66kV CB B/S Isol	No.2 Bus VT DUO-ROLL Isol
B3 TR 66kV CB B/S Isol	
1-2 B/T CB No.1 Bus B/S Isol	
1-2 B/T CB No.2 Bus B/S Isol	

2-4 B/T CB No.2 Bus B/S Isol	
2-4 B/T CB No.4 Bus B/S Isol	
1-1 EXTN B/T Isol	

- Decommission and removal of eighty-nine (89) sets of existing 66kV cone earthing receptacles (3-phase per set)
- Installation of eighty-nine (89) sets of new spherical earthing receptacles (3-phase per set)
- Decommission and removal of the solenoid 66kV CB fuse box
- Replacement of seventeen (17) 3-phase brown post insulators
- Replacement of twenty-one (21) 3-phase sets of pin and cap insulators
- Replacement of line exit insulators:
    - Three (3) 3-phase grey disc insulators
    - Six (6) 3-phase glass insulators
- All necessary tests regarding new equipment must be done based on Ausnet Services' related standards
- Connection of the B4 Transformer to the 66kV switchyard (utilising existing B1 bus connection partially) (utilising existing B1 bus connection partially)
    - Seven (7) 66kV 3-phase post insulators
    - 100m of 61/3.75 AAC Venus
- Connection of the B1 Transformer to the 66kV switchyard (utilising existing B2 bus connection partially)
    - Seven (7) 66kV 3-phase post insulators
    - 100m of 61/3.75 AAC Venus
- Connection of the B5 Transformer to the 66kV switchyard (utilising existing B3 bus connection partially)
    - Seven (7) 66kV 3-phase post insulators
    - 100m of 61/3.75 AAC Venus

66kV Switchyard – Temporary Works:

- Temporary works to utilise the No.1 extension bus as a transfer bus during feeder CB replacements (Repeat six (6) times)
    - Temporarily repurpose 2-4 Bus Tie CB as a feeder CB
    - Open 1-1extn Bus Tie isol
    - Connect feeder prot to 2-4 Bus Tie CB
    - Test and commission 2-4 Bus Tie as a feeder CB
    - Connect Feeder to No.1 Extn Bus
- Temporary works to utilise the sync. con. bus during B1 Tr 66kV CB replacement
    - 100m of 61/3.75 AAC Venus

6.1.2 Additional Civil Infrastructure

6.1.2.1. Site Establishment / Demobilisation/ Landscaping (ISP)

- Site establishment for construction phase including minor earth grading, site huts, temporary amenities etc.

6.1.2.2. Footings & Structures

220kV Switchyard:

- Survey existing 220 kV isolator structures to assess reusability of structures and footings in the affected bays due this re-development:
    - Check strength of insulator structure
    - Check existing footings for strength and stability
- Design and augment/modify or construct new footings (including structure) for the following:
    - Nine (9) existing disconnectors/earth switches structures to be replaced with ROIs with earth switches (steel structure by vendor)
    - Two (2) new 220kV dead tank CBs (steel structure by vendor)
    - Four (4) new 220kV ROIs (with earth switches) (steel structure by vendor)
    - Six (6) new 220kV support structures for No.1 Bus extension
    - Three (3) new harp strings (1-phase)
    - Two (2) new CTs (3-phase for Bay A & D)
    - One (1) new 220kV 1-phase CVT
    - Replacement of two (2) 220kV 3ph CVT
    - Two (2) sets of new 220kV surge arrestors for TTS and ROTS line (1 set of 3)
- To provide the temporary bracing during the augmentation of the existing footings
- Design and construct one (1) 220kV lattice rack structure (extension with one leg) with ground wire peaks and footings.
- Design check on the structural integrity of the existing rack structures in the 220 kV switchyard. (Allow for twelve (12) rack legs footings to be strengthened – refer drawing TT-0137324-001 and four (4) tower columns to be strengthened – refer drawings TSTS-0166171-001)
- Design and construct cable trench from existing cable trench. (Allow approximately 150m long 600mm x 600mm cast in-situ cable trench)

Transformers:

- Design and construct tubular rack structures at new B4 and B5 transformer areas. (Allow for tubular rack structure similar to drawing SVTS-0156629-001 (SVTS B4 transformer tubular rack structure))
- Design and construct 1.5m diameter bore pile footings for tubular rack structure, extending 4m above ground. (Allow for four (4) OFF bored piles similar to drawing SVTS-0156630-001 (SVTS B4 transformer tubular rack structure bored pile footing))
- Design and construct 600mm thick concrete footing under and around transformers.
- Design footing to support for four (4) new fire walls. (Allow approximately 15m x 15m x 0.6m thick reinforced footing (135m^3 volume) plus 15m x 15m x 0.4m thick blinding (90m^3 volume) under the footing at each new transformer area)
- Demolish footings 300mm below the existing ground level for two (2) 220kV Bus ROIs and their associated earth switches
- Design and construct two (2) new noise enclosure buildings.
- Design and construct two (2) new footings for Station Service Transfomers
- Design and construct two (2) new footings for 415V AC Changeover Boards
- Design and construct three (3) new footings for transformer outdoor AC Changeover boards
- Carry out structural assessment on the existing fire walls at the north and south of B1 transformer. To strengthen these existing fire walls if inadequacy is found.
- Allow twenty-one (21) new footings to allow interplant connections between B4, B1, B5 transformer 66kV bushing connection and existing 66kV bus work
- Demolish two (2) of each existing items:
    - Firewalls
    - Noise enclosure buildings
    - Rack structure legs
    - Rack structure girders
    - Existing bund walls

66kV Switchyard:

- Survey existing 66kV isolator structures to assess reusability of structures and footings in the affected bays due this re-development
    - Check strength of insulator structures
    - Check existing footings for strength and stability
- Design and augment/modify footings for following:
    - Twelve (12) LTCB (live tank CB) that will be replaced with new DTCB (dead tank CB)
    - Eighteen (18) bus side isolators
    - Eight (8) line side isolators
    - Four (4) new 66kV VTs
    - Two (2) new 66kV CVTs
    - Two (2) new fused isolators
- Design and augment/modify or construct new footings (including structure) for the following:
    - Seven (7) new 66kV structures
- Demolish footings 300mm below the existing ground level for two (2) synchronous condensor's LTCBs .
- Perform additional geotechnical survey to assess bearing at shallow depths within the 66kV switchyard
- Strengthen structures for 66kV isolators by adding horizontal member (Allow for twenty-six (26) members)
- To provide the temporary bracing during the augmentation of the existing footings

6.1.2.3. Earthworks/Grading

- Embankment Slope (Southwest of 66 kV switchyard and South of Control Building)
- To engage a Geotechnical Engineer to assess the stability of the slope
- Design and construct slope mitigation work (allow approximately $450,000.00) as follows:
    - Relocation of one (1) light pole
    - Reinstate dish drain in front of batter (approximately 190m long concrete V drain, width 1m, side slopes 10:1)
    - Timber retaining walls:
        - Installation of approximate average height 1.5m at non rock areas and 0.9m at rock areas
        - Installation of approximate average height 5m, length 20m
        - Earthing of the steel columns between the sleepers
        - Landscaping / planting to stabilise batter (approximately 1100m^2 landscaping)
        - Installation of jute mesh (approximately 1100m^2) to help establish vegetation and temporary slope stabilisation prior to vegetation maturing

6.1.2.4. Roadway Pavement and Guard Rails

- Design and upgrade asphalt access road south of Control Room (from entrance gate to transformer area and maintenance building). (Allow approximately 10m wide by 250m length of asphalt road)
- Design and upgrade access road to asphalt road from northeast of 220 kV switchyard to 66 kV switchyard. (Allow approximately 4m wide by 100 m length road with spoon drains and flush 300mm x 300mm concrete edging. Provide 25m x 10m landscaping at batter of slope)
- Replace and construct existing guard rails and earth new steel guard rails east of maintenance building and at 66 kV switchyard. The length of the guard rails to be replaced is 80m length.

6.1.2.5. Switchyard Pavement

220kV Switchyard:

- Design and upgrade the maintenance access path 150m length x 4m wide at an average depth of 300mm with a layer of Geogrid

66kV Switchyard:

- Design, reinstate and re-surface whole switchyard (Allow 55m x 110m)

6.1.2.6. Pre-Site Investigations:

- GPR
- Survey (include underground and above ground structures)
- Soil Contamination
- Geotechnical
- Noise Assessment
- Vegetation and Environmental Management Plan for Slope Mitigation Works

6.1.2.7. Stormwater Drainage

- Design and construct new:
  - 50m DN150 PVC pipe for drainage of cable trenches

- Design and modify existing:
  - Modify existing 2 junction pits to connect cable trench drainage pipe
  - Demolish 30m existing kerb
  - Regrade/reconstruct 15m existing kerb

6.1.2.8. Water Supply

- Extend water supply in line with fire hydrant system. (Allow approximately 150m of DN32 of underground water pipe)

6.1.2.9. Sewer

- Existing Septic Tank to be decommissioned and removed.

6.1.2.10. Fire System

- Design and install three (3) new dual head fire hydrants at the new Transformer Bund Area. (Allow approximately 150m of DN130 pipe encased in 450 x 450 cement stabilized sand)
- Design and install a fire engine hardstand (6m x 4m) at northeast of the B4 transformer area.

6.1.2.11. Environmental Drainage

- Design and construct new:
  - 60m new DN300 DICL pipe
  - 20m new DN300 RCP pipe
  - 2 flame traps
  - 6 junction pits (with flap valves)
  - 40m rollover bund (at front and side)
  - 40m rollover bund (at back of Tx for cooler access)

    - 40m grated trench (at front and side)
    - 40m grated trench (at back of Tx for cooler access)
    - 90m, 300mm high bund wall (assume 3 sides per new transformer as there will be a firewall at each end)
    - Holding tank (80m^3, assume 4m wide x 8m long x 3m deep (this would allow for freeboard))
    - Approximately 300m^2 dense asphalt pavement within rollover bund
- Remove existing:
    - Remove 30m DN225 RCP
    - Remove 3 junction pits

6.1.2.12. Others

- ISP scope of works
- Planning Permit
- Building Permit

6.1.2.13. Asbestos Removal

- Allow for removal and substitution of following:
    - Workshop Building – floor vinyl tiles
    - Transformer Buildings 1 to 3 – fire doors
    - Abandoned existing fire hydrant – allow approximately 80m (removal only)

6.2 Secondary Works

Nominated cubicle locations are for determining building space requirements only, without sequential allowance and may be further optimised during design. Final cubicle allocation should look to allowing removal of entire rows of insert panel frames and ducts completely.

All IEDs removed shall not be disposed of without prior approval from Asset Engineers. Some IEDs made redundant shall be recovered as spares.

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

6.2.1 Protection & Control

220kV Protection and Control:

- Establish No.1 and No.2 220kV Bus X & Y High Impedance Bus Protection in cubicle locations P117-P120) (Allow four (4) 220kV bus protection cubicles and four (4) CT summation boxes)
- Establish B1 TR No.2 Bus 220kV CBM (cubicle P115) and interface to new 220kV CB, existing B1 Transformer protection, new 220kV Bus protection, SCADA, DIC and AC & DC supplies (Allow one (1) 220kV CBM cubicle)
- Establish B5 TR No.1 Bus 220kV CBM (cubicle P116) and interface to new 220kV CB, new 220kV Bus protection, SCADA, DIC and AC & DC supplies (Allow one (1) 220kV CBM cubicle)
- Rename existing B1 TR No.1 Bus 220kV CBM (cubicle P110) as B4 TR No.1 Bus 220kV CBM (Allow for label and ferrule changes and nameplate changes – noting drawing costs will be captured in design cost and SCADA costs will be captured in Section 6.2.2)
- Rename existing TTS Line/B1 TR 220kV CBM (cubicle P111) as TTS Line/B4 TR 220kV CBM (Allow for label and ferrule changes and nameplate changes – noting drawing costs will be captured in design cost and SCADA costs will be captured in Section 6.2.2)

Transformers:

- Establish B4 Transformer and 66kV CBM X & Y protection (cubicles P104 & P105) and interface to new B4 Transformer, new B4 TR No.1 Bus 220kV CBM, replaced 66kV CB, existing No.1 66kV Bus protection, SCADA, DIC and AC & DC supplies (Allow one (1) Transformer X cubicle and one (1) Transformer Y cubicle)
- Modify B1 Transformer and 66kV CBM X & Y protection (cubicles P102 & P103) to interface to the new 220kV CB, new 220kV CBM and replaced 66kV CB (Allow similar cost to two (2) transformer cubicles excluding cost of IEDs and cubicle steelwork)
- Modify B3 Transformer and 66kV CBM X & Y protection (cubicles P106 & P107) to be renamed as B5 transformer and interface to new B5 transformer, new 220kV CB, new 220kV CBM, replaced 66kV CB, new No.4 66kV Bus protection, SCADA, DIC and AC & DC supplies (Allow similar cost to two (2) transformer cubicles excluding cost of IEDs and cubicle steelwork)
- Include delta earth fault function in the protection IEDs of the two transformers ultimately used for station services supplies
- Remove B2 Transformer X & Y Medium Impedance protection panels P22 and P24
- Remove B2 Transformer X & Y Differential protection panels P21 & P23
- Remove B3 Transformer X & Y Medium Impedance protection panels P14 and P15
- Remove Tapcon 240 VRR cubicle P20
- Establish a new transformer voltage regulation scheme (3 IEDs) in location P121

66kV Protection and Control:

- Remove No.4 66kV Bus X & Y protection panels P58 & P59
- Establish new No.4 66kV X & Y protection panel P57 (Allow one (1) 66kV Bus protection cubicle)
- Remove No.1 66kV Cap Bank protection and control panel P61
- Establish new No1 66kV Cap Bank protection and control panel P60
- Remove 1-2 66kV, 1-4 66kV and 2-4 66kV Bus Tie current check relays from No.1, No.2 & No.4 66kV Bus protection in panels P42, P43 & P58 respectively
- Establish three (3) Bus Tie CBM panels for 1-2, 1-4 & 2-4 66kV Bus Tie CBs in panels P34-P36
- Remove SLF 66kV Y protection and auto reclose panels P89 & P79
- Establish new SLF 66kV Y protection in panel P80 (Allow for one (1) 66kV feeder protection cubicle with non-standard auto reclose arrangements and integration to existing X protection)
- Remove Auto Close scheme (no longer required with Syn Con out of service) from panel P63
- Remove the Load Shedding control panels P13 & P18
- Establish new 66kV Load Shedding control in panel P64

Sync. Con. and Auxiliaries:

- Decommission and removal of all protection and control panels associated with the retired synchronous condenser and associated 11kV and 6.6kV auxiliary switchgear including cubicles P39-P40, P76-P78 & P91-P94

ITCs and Secondary Cabling:

- New 220kV CB control cabling shall interface to new and existing protection and control panels in the Control Room by being routed via existing outdoor ITC G.
- Existing Syn Con (including gas handling) control cabling shall be removed including from existing outdoor ITCs E & F

- New secondary cabling for new Transformers, Transformer 66kV CBs, 66kV Cap Bank CB and 66kV Bus Tie CBs shall be routed to new and existing protection and control panels in the Control Room via existing outdoor ITCs E & F.
- For 66kV feeder CBs being replaced the field control cabling shall be replaced and shall re-terminate in the existing indoor ITCs to interface with existing indoor cabling to the protection and control cubicles

Temporary Design:

- To allow each feeder CB replacement to minimise feeder outages it is expected to utilise the Bus Extension CB as a temporary feeder CB. Each time (Allow this to be repeated 6 times) this will require:
    - Temporary CT and trip cabling to be run from the 1-4 66kV BT CB to the relevant feeder protection panel
    - Functional testing of the feeder protection on the 1-4 66kV BT CB
    - Removal and reverting back to the 1-4 66kV BT CB connection to the associated protection and control panel including functional testing

6.2.2 SCADA

The existing Foxboro SCD5200 RTU (Cubicle P41) is already at 3 racks. Whilst there is some capacity in rack 3 for expansion, the SCD5200 product range is no longer supported. Therefore, allow to expand the existing system with a new Foxboro SCD600 system (Allow for one new RTU cubicle in location P109 containing 1 rack of SCD6200 COPE modules and Serial cards – quote for rack/card hardware is $30,000)

- Decommission and remove DCIU RTU in panel 54, transferring points to existing Data Gatherer SEL2440 IEDs in cubicle P95
- Modify Data Gatherer panel P95 removing points transferred to new IEDs and incorporating points transferred from DCIU RTU
- Expand Data Gatherer functionality by establishing a new panel in location P73 (Allow equivalent cost of a new cubicle including 4 SEL2440 IEDs)
- Decommission and remove alarm racks and interposing and control relays on panels P7-P9, P52-P53, P65-P66 and P68-P69, transferring all relevant points to new Data Gatherers in cubicle P73
- Interface all new IEDS (34 no.s) to new SCIMS cubicle (Allow 68 days for RSG and 34 days for ENS teams)
- Modify SCADA points list and titles of eighteen (18) existing IEDs (ie transformer and 220kV CBM IEDS), (Allow 18 days for RSG and 18 days for ENS teams)

6.2.3 Metering & Monitoring

Remove two (2) existing Nemmco metering cubicles P47 & P48

Install two (2) new AEMO metering cubicles in P25 & P26, allowing for 9 revenue and 3 check meters). Assume cost of meters to be equivalent to EDMI MK6, noting a new standard product needs to be sourced as the MK6 will soon be obsolete.

Remove mimic panels 1-21 from the Control Room (including all associated cabling), transferring any remaining control, instrumentation or annunciation (including Station Services, Cap Bank and SLF feeder) to the Data Gatherers included in Section 6.2.2

- Remove 1-2-4 HSM Pot Selection panel P12
- Establish a new Pot Selection scheme for HSM in location P56 (Allow two (2) RMS 2P48 Pot Selectors)

6.2.4 AC & DC Supplies

- Installation of two (2) outdoor 415V AC Main Changeover Boards (Include an allowance also of 5000m of 1c 185 mm^2 600/1000V power cable from the station services transformers)
- Installation of three (3) transformer outdoor AC Changeover boards (Include an allowance also of 1000m of 4c 16mm^2 600/1000V power cable from the AC C/O boards)
- Installation of two (2) indoor AC Distribution board (AC5 & AC6) in location P125 & P126 (Include an allowance for a new row of 10m of overhead cable tray) in the Control Room (Include an allowance also of 400m of 4c 70mm^2 600/1000V power cable from the AC C/O boards)
- Removal of 220kV & 66kV switchyard GPOs, 220kV and 66kV switchyard light and power boxes and control room, maintenance building and auxiliaries building sub-boards (Allow removal of twenty (20) boards and sub-boards containing asbestos)
- Installation of 220kV and 66kV switchyard GPOs, 220kV and 66kV switchyard light and power boxes and maintenance building and auxiliaries building sub-boards (AC4 sub-board in the Control Room has recently been installed already) include an allowance of:
    - Eight (8) switchyard GPOs
    - Eight (8) switchyard L&P sub-boards
    - Two (2) building L&P sub-boards
    - 1500m of 4c 70 mm2 600/1000V power cable from AC4 and AC5)
- All new AC supplies shall be obtained from either the new Main Changeover Boards or AC4 and AC5 (cable costs allowed in each scheme separately already) and cutover four (4) existing battery charger supplies (include replacing an allowance of 200m of 4c 16 mm^2 600/1000V power cable)
- Decommission and remove cubicles AC1, AC2, AC3 (contain asbestos)
- Decommission and remove cubicles DC1, DC2, DC3 (contain asbestos) and cutover existing DC supplies to be obtained from X & Y Distribution Boards P123 and P124 or DC5 & DC6
- Remove CB Control Fuse cubicles P1, P84 & P85

6.3 Communications

6.3.1 Infrastructure

- Not Applicable

6.3.2 Exchanges

- Not Applicable

6.3.3 PLC

- Not Applicable

6.3.4 Digital Networks/Asset Data Gathering

- The 220kV DIC has been recently installed (cubicle P101) so as an allowance for connection of additional new IEDs allow for installation of one (1) RuggedComm RX1500 router and two (2) RuggedComm RSG2488 ethernet switches in the existing cubicle

- The 66kV DIC (cubicle P46) contains older network equipment and shall be removed and replaced with one (1) new standard DIC cubicle in location P74.

6.3.5 VF

- Not Applicable

6.4 Lines

- Decommission and removal of one (1) existing 66kV double circuit wood pole
- Decommission and removal of six (6) existing 66kV single circuit wood poles
- Decommission and removal of 250m 66kV 3-phase conductors (37/3.75 AAC) for HB Feeder
- Decommission and removal of 250m 66 kV 3-phase conductors (37/3.75 AAC) for DC1 Feeder
- Installation of six (6) new 66kV double circuit wood poles
- Installation of 250m 66kV 3-phase conductors (37/3.75 AAC) for HB Feeder
- Installation of 250m 66kV 3-phase conductors (37/3.75 AAC) for DC1 Feeder

6.5 General / Miscellaneous:

- Install electric fence around the perimeter of the station (Allow $725,000)
- Replacement of existing doors with Steel Clad Solid Core doors (Allow $130,000)
- Temporary onsite guarding (Allow $40,000)
- Environmental assessment (Allow $15,000)
- Aboriginal Cultural Heritage assessment (Allow $10,000)
- Customer engagement (Allow $50,000)
- Allow for thirty (30) lights to be replaced inside the control room with new standard lighting, including an allowance of 500m of 2c+e 2.5mm^2 power cable.
- Allow for fifteen (15) switchyard lights to be replaced, including 1000m of 2c+e 2.5mm^2 power cable

7 Options

Section 6 outlines the full scope of works in Option 1. Section 7 outlines the various options that the project can be separated and staged into two parts.

Common costs to be considered amongst stage 2 scope for the various options are:

- Additional Project Management, Project Engineering and other internal costs
- Additional ISP site mobilisation costs
- Additional Finance charges
- Additional DSP management costs
- Additional Design costs

Note: It is assumed that there is a 5-year gap between practical completion of Stage 1 and project commencement of Stage 2 for all the options listed in Sections 7.1, 7.2 and 7.3.

Below is a table summarising the cost estimates for the four options outlined in section 6, 7.1, 7.2 and 7.3:

Option	Stage	P50	P90	Total Expenditure	Option X – Option 1
Option 1		$38,448,125	$39,217,087	$42,546,011	$0
Option 2	Stage 1	$31,376,915	$32,004,453	$34,387,928	+$883,936
	Stage 2	$8,514,305	$8,684,591	$9,042,019	
Option 3	Stage 1	$30,718,312	$31,332,678	$33,761,492	+$375,880
	Stage 2	$8,624,491	$8,796,981	$9,160,399	
Option 4	Stage 1	$34,000,841	$34,680,858	$37,345,286	+$1,706,531
	Stage 2	$6,507,503	$6,637,653	$6,907,256	

7.1 Option 2

Option 2 scope separates the works into two stages. Stage 1 includes the replacement of the B3 Transformer and all relevant 220kV and 66kV switchgear. Stage 2 includes the replacement of the B2 Transformer. Stage 1 remains the same as the items (excluding the transformer associated items which are amended below) listed for Option 1 with the changes listed below for Stage 2 and additional costs associated which is listed in Section 7.

Stage 1 amended scope items for the Transformer associated works are:

- Decommission and removal of one (1) existing B transformer (B3 150MVA 220/66kV)
- Installation of one (1) new B transformer (B5 150MVA 22/66/11kV) in new location
- Decommission and removal of two (2) 3-phase existing 220kV neutral isolators
- Decommission and removal of two (2) 3-phase existing 66kV neutral reactors
- Installation of two (2) 3-phase new standard 66kV neutral reactors
- Decommission and removal of two (2) 3-phase existing 66kV neutral isolators
- Installation of two (2) 3-phase new standard 66kV neutral isolators
- Decommission and removal of one (1) existing 6.6kV/415V station service transformers
- Installation one (1) new 11kV/415V station service transformers
- Installation of 450m of 1C 300mm^2 XLPE HDPE/PVC to connect No.3 S/S Transformer to the tertiary winding of the B5 Transformer
- Installation of one (1) new 220kV CBs in Bay AA (including earth tails)
- Installation of one (1) new 220kV ROIs (with single earth switches) and one (1) new 220kV earth switches for the new CB in Bay AA
- Installation of 210m of ACSR/Gz Pawpaw for connection from B4 and B5 Transformers to No.1 Rack
- Transformer testing including transformer capacitance, winding insulation, earthing connection, bushing insulation etc.
- Earth Grid extension including stranded copper conductor and copper earth straps
- Earth Grid testing
- Earthing study
- Design and construct tubular rack structures for the new B5 transformer area. (Allow for tubular rack structure similar to drawing SVTS-0156629-001 (SVTS B4 transformer tubular rack structure))
- Design and construct 1.5m diameter bore pile footings for tubular rack structure, extending 4m above ground. (Allow for two (2) OFF bored piles similar to drawing SVTS-0156630-001 (SVTS B4 transformer tubular rack structure bored pile footing))
- Design and construct 600mm thick concrete footing under and around B5 Transformer.
- Design footing to support for one (1) new fire wall
- Design and construct one (1) new noise enclosure building

- Demolish footings 300mm below the existing ground level for two (2) 220kV Bus ROIs and their associated earth switches
- Design and construct new footings (including structure) for the following:
    - One (1) 220kV CB
    - Two (2) 220kV ROIs (with single earth switches)
- Design and construct new:
    - One (1) flame trap
    - 20m rollover bund (at front and side)
    - 20m rollover bund (at back of Tx for cooler access)
- Design and construct one (1) new footings for Station Service Transfomer
- Design and construct one (1) new footings for 415V AC Changeover Board
- Design and construct one (1) new footings for transformer outdoor AC Changeover board
- Carry out structural assessment on the existing fire walls at the north and south of B1 transformer. To strengthen these existing fire walls if inadequacy is found.
- Allow fourteen (14) new footings to allow interplant connections between B1, B5 transformer 66kV bushing connection and existing 66kV bus work
- Demolish the following items:
    - One (1) firewall
    - One (1) noise enclosure buildings
    - Two (2) transformer rack structure legs
    - One (1) transformer rack structure girders
    - One (1) existing bund walls

Stage 2 scope items are:

- Decommission and removal of one (1) existing B transformer (B2 MVA 220/66/11kV)
- Installation of one (1) new B Transformer (B4 150MVA 220/66/11kV) in new location
- Decommission and removal of one (1) 3-phase existing 220kV neutral isolators
- Decommission and removal of one (1)) 3-phase existing 66kV neutral reactors
- Installation of one (1) 3-phase new standard 66kV neutral reactors
- Decommission and removal of one (1) 3-phase existing 66kV neutral isolators
- Installation of one (1) 3-phase new standard 66kV neutral isolators
- Transformer testing including transformer capacitance, winding insulation, earthing connection, bushing insulation etc.
- Installation of 210m of ACSR/Gz Pawpaw for connection from B4 Transformer to No.1 Rack
- Installation of one (1) new 11kV/415V station service transformer
- Installation of 450m of 1C 300mm^2 XLPE HDPE/PVC to connect No.2 S/S Transformer to the tertiary winding of the new B4 Transformers
- Installation of one (1) new 220kV CBs in Bay AA (including earth tails)
- Installation of one (1) new 220kV 3-phase ROIs (with single earth switches) and one (1) new 220kV earth switches for the new CB in Bay AA
- Installation of one (1) new 1-phase 220kV CVT in Bay C for B1 Transformer
- Earth Grid extension including stranded copper conductor and copper earth straps
- Earth Grid testing
- Earthing study
- Connection of the B4 Transformer to the 66kV switchyard (utilising existing B1 bus connection partially) (utilising existing B1 bus connection partially)
    - Seven (7) 66kV 3-phase post insulators
    - 100m of 61/3.75 AAC Venus
- Design and augment/modify or construct new footings (including structure) for the following:
    - One (1) new 220kV dead tank CBs

    - Two (2) new 220kV ROIs
- Design and construct tubular rack structures at new B4 transformer area.
- Design and construct two (2) 1.5m diameter bore pile footings for tubular rack structure, extending 4m above ground.
- Design and construct 600mm thick concrete footing under and around transformer.
- Design footing to support for one (1) new fire wall
- Allow seven (7) new structures and footings to allow interplant connections between B4 transformer 66kV bushing connection and existing 66kV bus work
- Design and construct one (1) new noise enclosure buildings.
- Design and construct new:
    - One (1) flame trap
    - 40m rollover bund (at front and side)
    - 40m rollover bund (at back of Tx for cooler access)
- Establish B1 TR No.2 Bus 220kV CBM (cubicle P115) and interface to new 220kV CB, existing B1 Transformer protection, new 220kV Bus protection, SCADA, DIC and AC & DC supplies (Allow one (1) 220kV CBM cubicle)
- Rename existing B1 TR No.1 Bus 220kV CBM (cubicle P110) as B4 TR No.1 Bus 220kV CBM (Allow for label and ferrule changes and nameplate changes – noting drawing costs will be captured in design cost and SCADA costs will be captured in Section 6.2.2)
- Rename existing TTS Line/B1 TR 220kV CBM (cubicle P111) as TTS Line/B4 TR 220kV CBM (Allow for label and ferrule changes and nameplate changes – noting drawing costs will be captured in design cost and SCADA costs will be captured in Section 6.2.2)
- Establish B4 Transformer and 66kV CBM X & Y protection (cubicles P104 & P105) and interface to new B4 Transformer, new B4 TR No.1 Bus 220kV CBM, replaced 66kV CB, existing No.1 66kV Bus protection, SCADA, DIC and AC & DC supplies (Allow one (1) Transformer X cubicle and one (1) Transformer Y cubicle)
- Modify B1 Transformer and 66kV CBM X & Y protection (cubicles P102 & P103) to interface to the new 220kV CB, new 220kV CBM and replaced 66kV CB (Allow similar cost to two (2) transformer cubicles excluding cost of IEDs and cubicle steelwork)

Note: B1 and B2 still share a transformer gantry which means the fire risk remains with this option till stage 2 is complete.

Below is the estimate summary for Option 2:

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0007772**
Project Title:	**TD-0007772 TSTS Redevelopment Option 2_Stage 1**
Estimate Type:	**Planning**
Revision:	**Original Rev 0**
Issued Date:	**27/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$1,288,889	$1,482,222	$128,889	$0	$2,900,000
2	INTERNAL LABOUR	$180,125	$208,565	$568,815	$853,222	$85,322	$1,896,050
3	MATERIALS	$0	$899,355	$2,698,064	$4,496,773	$899,355	$8,993,547
4	PLANT & EQUIPMENT	$0	$0	$607,103	$667,814	$0	$1,274,917
5	CONTRACTS	$0	$0	$7,049,543	$7,754,497	$0	$14,804,039
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$718,268	$790,094	$0	$1,508,362
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$180,125**	**$2,396,809**	**$13,124,015**	**$14,691,289**	**$984,677**	**$31,376,915**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$627,538
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$180,125**	**$2,396,809**	**$13,124,015**	**$14,691,289**	**$984,677**	**$32,004,453**
11	OVERHEADS	$7,025	$93,476	$511,837	$572,960	$38,402	$1,223,700
12	FINANCE CHARGES (IDC)	$6,121	$38,610	$472,390	$505,357	$137,297	$1,159,775
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$193,270**	**$2,528,894**	**$14,108,241**	**$15,769,607**	**$1,160,376**	**$34,387,928**

PROJECT COST SUMMARY — **UNCERTAINTY ADJUSTED ESTIMATE**

Project Number: TD-0007772
Project Title: TD-0007772 TSTS Redevelopment Option 2_Stage 2
Estimate Type: Planning
Revision: Original Rev 0
Issued Date: 27/08/2020

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	TOTAL
1	DESIGN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$734,667	$25,333	$760,000
2	INTERNAL LABOUR	$64,174	$0	$0	$0	$0	$0	$0	$0	$0	$106,956	$606,732	$777,862
3	MATERIALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,566,486	$3,566,486
4	PLANT & EQUIPMENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$267,246	$267,246
5	CONTRACTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,733,408	$2,733,408
6	METER COSTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$409,303	$409,303
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$64,174**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$841,623**	**$7,608,509**	**$8,514,305**
9	MANAGEMENT RESERVE [P(90)-P(50)]												$170,286
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$64,174**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$841,623**	**$7,608,509**	**$8,684,591**
11	OVERHEADS	$2,503	$0	$0	$0	$0	$0	$0	$0	$0	$32,823	$296,732	$332,058
12	FINANCE CHARGES (IDC)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,369	$0	$25,369
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$66,676**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$899,815**	**$7,905,241**	**$9,042,019**

The table below is a high-level schedule for Option 2:

Phase	Deliverable Title	Date	Duration
Idea	High Level Estimate Handover to Initiator	17/07/2020	
	Business Case Approved	18/02/2021	6 months
	RIT-T consultation process	07/09/2021	6 months
Stage 1 Detailed Design	Contract execution /DSP Scope of Works	21/09/2021	13 months
	DSP Tender / Award	19/10/2021	
	Stage 1 Detailed Design Start	09/12/2021	
	Stage 1 Design Completed	18/09/2022	
Stage 1 Delivery and Close	Project Handover for Implementation	27/09/2022	26 months
	ISP Tender / Award	27/12/2022	
	Stage 1 Site Works Commenced	10/01/2023	
	First outage taken	12/02/2023	
	Stage 1 Practical Completion	05/08/2024	
	Project Close-out Complete	01/11/2024	
Stage 2 Detailed Design	Contract execution /DSP Scope of Works	14/01/2030	7 months
	DSP Tender / Award	11/02/2030	
	Stage 2 Detailed Design Start	11/03/2030	
	Stage 2 Design Completed	29/07/2030	
Stage 2 Delivery and Close	Project Handover for Implementation	05/08/2030	12 months
	ISP Tender / Award	04/11/2030	
	Stage 2 Site Works Commenced	09/12/2030	
	First outage taken	06/01/2031	
	Stage 2 Practical Completion	28/04/2031	
	Project Close-out Complete	28/07/2031	

7.2 Option 3

Option 3 scope separates the works into two stages. Stage 1 includes the replacement of the B2 and B3 Transformer and all relevant 220kV switchgear. Stage 2 includes the replacement of all relevant

66kV switchgear. Stage 1 remains the same as the items listed for Option 1 with the changes listed below for Stage 2 and additional costs associated which is listed in Section 7.

Stage 2 scope items are:

- Decommission and removal of fourteen (14) 66kV LTCBs for the following:
  - B1 Transformer 66kV CB
  - B2 Transformer 66kV CB
  - B3 Transformer 66kV CB
  - ELM1 Feeder CB
  - SLF Feeder CB
  - ELM2 Feeder CB
  - L Feeder CB
  - HB Feeder CB
  - DC1 Feeder CB
  - 1-2 B/T CB
  - 2-4 B/T CB
  - 1extn-4 B/T CB
  - Sync. Con. No.1 Bus 66kV CB (including footings and structures)
  - Sync. Con. No.2 Bus 66kV CB (including footings and structures)
- Installation of twelve (12) new 66kV DTCBs for the following:
  - B1 Transformer 66kV CB
  - B2 Transformer 66kV CB
  - B3 Transformer 66kV CB
  - ELM1 Feeder CB
  - SLF Feeder CB
  - ELM2 Feeder CB
  - L Feeder CB
  - HB Feeder CB
  - DC1 Feeder CB
  - 1-2 B/T CB
  - 2-4 B/T CB
  - 1extn-4 B/T CB
- Decommission and removal of six (6) 66kV 3-phase VTs for the following:
  - No.1 Bus 3ph VT
  - No.2 Bus 3ph VT
  - B1 Transformer 3ph VT
  - B2 Transformer 3ph VT
  - No.4 Bus 3ph CVT
  - B3 Transformer 3ph CVT
- Installation of six (6) new standard 66kV 3-phase VTs for the following:
  - No.1 Bus 3ph VT
  - No.2 Bus 3ph VT
  - B1 Transformer 3ph VT
  - B2 Transformer 3ph VT
  - No.4 Bus 3ph CVT
  - B3 Transformer 3ph CVT
- Decommission and removal of two (2) 66kV 3-phase fused isolators for the following:
  - No.1 Bus VT

    - No.2 Bus VT
- Installation of two (2) new standard 66kV 3-phase fused isolators for the following:
    - No.1 Bus VT
    - No.2 Bus VT
- Decommission and removal of thirty (30) 66kV 3-phase underslung isolators in the following table below:

BU Fdr CB B/S Isol	BU Fdr CB Fdr/S Isol
ELM 1 Fdr CB B/S Isol	ELM 1 Fdr CB Fdr/S Isol
SLF Fdr CB B/S Isol	SLF Fdr CB Fdr/S Isol
DC 2 Fdr CB B/S Isol	DC 2 Fdr CB Fdr/S Isol
ELM 2 Fdr CB B/S Isol	ELM 2 Fdr CB Fdr/S Isol
L Fdr CB B/S Isol	L Fdr CB Fdr/S Isol
HB Fdr CB B/S Isol	HB Fdr CB Fdr/S Isol
DC 1 Fdr CB B/S Isol	DC 1 Fdr CB Fdr/S Isol
B1 TR 66kV CB B/S Isol	No.1 Bus VT DUO-ROLL Isol
B2 TR 66kV CB B/S Isol	No.2 Bus VT DUO-ROLL Isol
B3 TR 66kV CB B/S Isol	
1-2 B/T CB No.1 Bus B/S Isol	Sync. Con. No.1 Bus B/S Isol (including footings and structures)
1-2 B/T CB No.2 Bus B/S Isol	Sync. Con. No.1 Bus TR/S Isol (including footings and structures)
2-4 B/T CB No.2 Bus B/S Isol	Sync. Con. No.2 Bus B/S Isol (including footings and structures)
2-4 B/T CB No.4 Bus B/S Isol	Sync. Con. No.2 Bus TR/S Isol (including footings and structures)
1-1 EXTN B/T Isol	

- Installation of twenty-six (26) new standard 66kV 3-phase underslung isolators for the following in the table below:

BU Fdr CB B/S Isol	BU Fdr CB Fdr/S Isol
ELM 1 Fdr CB B/S Isol	ELM 1 Fdr CB Fdr/S Isol
SLF Fdr CB B/S Isol	SLF Fdr CB Fdr/S Isol
DC 2 Fdr CB B/S Isol	DC 2 Fdr CB Fdr/S Isol
ELM 2 Fdr CB B/S Isol	ELM 2 Fdr CB Fdr/S Isol
L Fdr CB B/S Isol	L Fdr CB Fdr/S Isol
HB Fdr CB B/S Isol	HB Fdr CB Fdr/S Isol
DC 1 Fdr CB B/S Isol	DC 1 Fdr CB Fdr/S Isol
B1 TR 66kV CB B/S Isol	No.1 Bus VT DUO-ROLL Isol
B2 TR 66kV CB B/S Isol	No.2 Bus VT DUO-ROLL Isol
B3 TR 66kV CB B/S Isol	
1-2 B/T CB No.1 Bus B/S Isol	
1-2 B/T CB No.2 Bus B/S Isol	

2-4 B/T CB No.2 Bus B/S Isol	
2-4 B/T CB No.4 Bus B/S Isol	
1-1 EXTN B/T Isol	

- Decommission and removal of eighty-nine (89) sets of existing 66kV cone earthing receptacles (3 phases per set)
- Installation of eighty-nine (89) sets of new spherical earthing receptacles (3 phases per set)
- Decommission and removal of the solenoid 66kV CB fuse box
- Replacement of seventeen (17) brown 3-phase post insulators
- Replacement of twenty-one (21) sets of 3-phase pin and cap insulators
- Replacement of line exit insulators:
    - Three (3) 3-phase grey disc insulators
    - Six (6) 3-phase glass insulators
- All necessary tests regarding to equipment must be done based on Ausnet Services related standards
- Temporary works to utilise the No.1 extension bus as a transfer bus during feeder CB replacements (Repeat six (6) times)
    - Temporarily repurpose 2-4 Bus Tie CB as a feeder CB
    - Open 1-1extn Bus Tie isol
    - Connect feeder prot to 2-4 Bus Tie CB
    - Test and commission 2-4 Bus Tie as a feeder CB
    - Connect Feeder to No.1 Extn Bus
- Temporary works to utilise the sync. con. bus during B1 Tr 66kV CB replacement
    - 100m of 61/3.75 AAC Venus
- Survey existing 66kV isolator structures to assess reusability of structures and footings in the affected bays due this re-development
    - Check strength of insulator structures
    - Check existing footings for strength and stability
- Design and augment/modify footings for following:
    - Twelve (12) LTCB (live tank CB) that will be replaced with new DTCB (dead tank CB)
    - Eighteen (18) 3-phase bus side isolators
    - Eight (8) 3-phase line side isolators
    - Four (4) new 66kV 3-phase VTs
    - Two (2) new 66kV 3-phase CVTs
    - Two (2) new 3-phase fused isolators
- Demolish footings 300mm below the existing ground level for two (2) synchronous condensor's LTCBs .
- Perform additional geotechnical survey to assess bearing at shallow depths within the 66kV switchyard
- Strengthen structures for 66kV isolators by adding horizontal member (Allow for twenty-six (26) members)
- To provide the temporary bracing during the augmentation of the existing footings
- Design, reinstate and re-surface whole switchyard (Allow 55m x 110m)
- Remove No.4 66kV Bus X & Y protection panels P58 & P59
- Establish new No.4 66kV X & Y protection panel P57 (Allow one (1) 66kV Bus protection cubicle)
- Remove No.1 66kV Cap Bank protection and control panel P61
- Establish new No1 66kV Cap Bank protection and control panel P60

- Remove 1-2 66kV, 1-4 66kV and 2-4 66kV Bus Tie current check relays from No.1, No.2 & No.4 66kV Bus protection in panels P42, P43 & P58 respectively
- Establish three (3) Bus Tie CBM panels for 1-2, 1-4 & 2-6 66kV Bus Tie CBs in panels P34-P36
- Remove SLF 66kV Y protection and auto reclose panels P89 & P79
- Establish new SLF 66kV Y protection in panel P80 (Allow for one (1) 66kV feeder protection cubicle with non-standard auto reclose arrangements and integration to existing X protection)
- Remove Auto Close scheme (no longer required with Syn Con out of service) from panel P63
- Remove the Load Shedding control panels P13 & P18
- Establish new 66kV Load Shedding control in panel P64
- For 66kV feeder CBs being replaced the field control cabling shall be replaced and shall re-terminate in the existing indoor ITCs to interface with existing indoor cabling to the protection and control cubicles
- New secondary cabling for new Transformer 66kV CBs, 66kV Cap Bank CB and 66kV Bus Tie CBs shall be routed to new and existing protection and control panels in the Control Room via existing outdoor ITCs E & F.
- To allow each feeder CB replacement to minimise feeder outages it is expected to utilise the Bus Extension CB as a temporary feeder CB. Each time (Allow this to be repeated six (6) times) this will require:
    - Temporary CT and trip cabling to be run from the 1-4 66kV BT CB to the relevant feeder protection panel
    - Functional testing of the feeder protection on the 1-4 66kV BT CB
    - Removal and reverting back to the 1-4 66kV BT CB connection to the associated protection and control panel including functional testing

Below is the estimate summary for Option 3:

PROJECT COST SUMMARY — **UNCERTAINTY ADJUSTED ESTIMATE**
Project Number: **TD-0007772**
Project Title: **TD-0007772 TSTS Redevelopment Option 3_Stage 1**
Estimate Type: **Planning**
Revision: **Original Rev 0**
Issued Date: **27/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$1,244,444	$1,431,111	$124,444	$0	$2,800,000
2	INTERNAL LABOUR	$180,180	$208,629	$568,989	$853,483	$85,348	$1,896,630
3	MATERIALS	$0	$938,333	$2,814,999	$4,691,666	$938,333	$9,383,331
4	PLANT & EQUIPMENT	$0	$0	$461,587	$507,746	$0	$969,333
5	CONTRACTS	$0	$0	$6,758,246	$7,434,070	$0	$14,192,316
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$703,191	$773,510	$0	$1,476,701
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$180,180**	**$2,391,407**	**$12,738,123**	**$14,384,920**	**$1,023,681**	**$30,718,312**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$614,366
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$180,180**	**$2,391,407**	**$12,738,123**	**$14,384,920**	**$1,023,681**	**$31,332,678**
11	OVERHEADS	$7,027	$93,265	$496,787	$561,012	$39,924	$1,198,014
12	FINANCE CHARGES (IDC)	$6,123	$38,638	$463,682	$574,194	$148,163	$1,230,800
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$193,329**	**$2,523,310**	**$13,698,592**	**$15,520,126**	**$1,211,768**	**$33,761,492**

PROJECT COST SUMMARY — **UNCERTAINTY ADJUSTED ESTIMATE**
Project Number: **TD-0007772**
Project Title: **TD-0007772 TSTS Redevelopment Option 3_Stage 2**
Estimate Type: **Planning**
Revision: **Original Rev 0**
Issued Date: **27/08/2020**

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	TOTAL
1	DESIGN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$773,333	$26,667	$800,000
2	INTERNAL LABOUR	$72,142	$0	$0	$0	$0	$0	$0	$0	$0	$120,236	$682,068	$874,446
3	MATERIALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,901,159	$2,901,159
4	PLANT & EQUIPMENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$560,352	$560,352
5	CONTRACTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,073,935	$3,073,935
6	METER COSTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$414,600	$414,600
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$72,142**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$893,570**	**$7,658,780**	**$8,624,491**
9	MANAGEMENT RESERVE [P(90)-P(50)]												$172,490
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$72,142**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$893,570**	**$7,658,780**	**$8,796,981**
11	OVERHEADS	$2,814	$0	$0	$0	$0	$0	$0	$0	$0	$34,849	$298,692	$336,355
12	FINANCE CHARGES (IDC)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$27,063	$0	$27,063
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$74,955**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$955,482**	**$7,957,472**	**$9,160,399**

The table below is a high-level schedule for Option 3:

Phase	Deliverable Title	Date	Duration
Idea	High Level Estimate Handover to Initiator	17/07/2020	
	Business Case Approved	18/02/2021	6 months
	RIT-T consultation process	07/09/2021	6 months
Stage 1 Detailed Design	Contract execution /DSP Scope of Works	21/09/2021	13 months
	DSP Tender / Award	19/10/2021	
	Stage 1 Detailed Design Start	09/12/2021	
	Stage 1 Design Completed	18/09/2022	
Stage 1 Delivery and Close	Project Handover for Implementation	27/09/2022	21 months
	ISP Tender / Award	27/12/2022	
	Stage 1 Site Works Commenced	10/01/2023	
	First outage taken	12/02/2023	
	Stage 1 Practical Completion	29/03/2024	
	Project Close-out Complete	28/06/2024	
Stage 2 Detailed Design	Contract execution /DSP Scope of Works	04/06/2029	9 months
	DSP Tender / Award	02/07/2029	
	Stage 2 Detailed Design Start	30/07/2029	
	Stage 2 Design Completed	28/01/2030	
Stage 2 Delivery and Close	Project Handover for Implementation	11/02/2030	15 months
	ISP Tender / Award	06/05/2030	
	Stage 2 Site Works Commenced	03/06/2030	
	First outage taken	01/07/2030	
	Stage 2 Practical Completion	06/01/2031	
	Project Close-out Complete	07/04/2031	

7.3 Option 4

Option 4 scope separates the works into two stages. Stage 1 includes the replacement of the B2 and B3 Transformer and all relevant 66kV switchgear. Stage 2 includes the replacement of all relevant 220kV switchgear. Stage 1 remains the same as the items listed for Option 1 with the changes listed below for Stage 2 and additional costs associated which is listed in Section 7.

Stage 2 scope items are:

- Decommission and removal of four (4) existing 220kV 3-phase ROIs and earth switches for the following:
    - TTS Line No.2 Bus CB B/S ROI
    - ROTS Line No.2 BUS CB B/S ROI
    - ROTS Line No.1 BUS CB B/S ROI
    - B1 TR 1 BUS 220KV CB B/S ROI

- Decommission and removal of five (5) existing 220kV 3-phase isolators and earth switches for the following (including structures and footings):
    - B1 TR No.1 Bus 220KV CB TR/S Isol
    - ROTS Line No.1 Bus CB L/S Isol
    - TTS Line No.2 Bus CB L/S Isol
    - TTS Line B1 TR CB TR/S Isol
    - ROTS Line No.2 Bus CB L/S Isol
- Installation of nine (9) new standard 220kV 3-phase ROIs and earth switches for the following:
    - TTS Line No.2 Bus CB B/S ROI
    - ROTS Line No.2 BUS CB B/S ROI
    - ROTS Line No.1 BUS CB B/S ROI
    - B1 TR 1 BUS 220KV CB B/S ROI
    - B1 TR No.1 Bus 220KV CB TR/S Isol
    - ROTS Line No.1 Bus CB L/S Isol
    - TTS Line No.2 Bus CB L/S Isol
    - TTS Line B1 TR CB TR/S Isol
    - ROTS Line No.2 Bus CB L/S Isol
- Decommission and removal of two (2) existing 220kV bus earth switches
- Installation of two (2) new standard 220kV bus earth switches (including earth mats)
- Decommission and removal of two (2) existing 220kV 3-phase CVTs for the following:
    - ROTS Line CVT
    - TTS Line CVT
- Installation of two (2) new standard 220kV 3 phase 3-phase CVTs for the following:
    - ROTS Line CVT
    - TTS Line CVT
- Decommission and removal of two (2) sets existing 220kV 3-phase CTs for the following:
    - No.1 220kV Cap Bank CT
    - TTS 220KV Line No.2 Bus CB CT
- Installation of two (2) new sets of standard 220kV 3-phase CTs for the following:
    - No.1 220kV Cap Bank CT
    - TTS Line No.2 Bus CB CT
- Installation of three (3) new harp strings on the TTS line (1 per phase)
- Decommission and removal of two (2) existing spark gaps/arcing horns for the following:
    - ROTS Line
    - TTS Line
- Installation of six (6) new standard 220kV 1-phase surge arrestors for the following:
    - ROTS Line
    - TTS Line
- Decommission and removal of twenty-three (23) sets of 3-phase brown post insulators
- Installation of twenty-three (23) new standard 220kV 3-phase insulators
- All necessary tests regarding to equipment must be done based on Ausnet Services related standards
- Survey existing 220 kV isolator structures to assess reusability of structures and footings in the affected bays due this re-development:
    - Check strength of insulator structure
    - Check existing footings for strength and stability
- Design and augment/modify or construct new footings (including structure) for the following:

- Nine (9) existing disconnectors/earth switches to be replaced with ROIs (with earth switches) (steel structure by vendor)
- Three (3) new harp strings (1-phase)
- Two (2) new CTs (3-phase for Bay A & D)
- One (1) new 220kV 1-phase CVT
- Replacement of two (2) 220kV 3-phase CVT
- Six (6) sets of new 220kV 1-phase surge arrestors

- To provide the temporary bracing during the augmentation of the existing footings

Below is the estimate summary for Option 4:

PROJECT COST SUMMARY — **UNCERTAINTY ADJUSTED ESTIMATE**
Project Number: TD-0007772
Project Title: TD-0007772 TSTS Redevelopment Option 4_Stage 1
Estimate Type: Planning
Revision: Original Rev 0
Issued Date: 27/08/2020

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
1	DESIGN	$0	$1,422,222	$1,635,556	$142,222	$0	$3,200,000
2	INTERNAL LABOUR	$189,410	$219,317	$598,138	$897,207	$89,721	$1,993,794
3	MATERIALS	$0	$1,104,587	$3,313,762	$5,522,936	$1,104,587	$11,045,872
4	PLANT & EQUIPMENT	$0	$0	$579,935	$637,929	$0	$1,217,864
5	CONTRACTS	$0	$0	$7,099,434	$7,809,377	$0	$14,908,811
6	METER COSTS	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$778,333	$856,167	$0	$1,634,500
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$189,410**	**$2,746,127**	**$14,005,158**	**$15,865,838**	**$1,194,308**	**$34,000,841**
9	MANAGEMENT RESERVE [P(90)-P(50)]						$680,017
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$189,410**	**$2,746,127**	**$14,005,158**	**$15,865,838**	**$1,194,308**	**$34,680,858**
11	OVERHEADS	$7,387	$107,099	$546,201	$618,768	$46,578	$1,326,033
12	FINANCE CHARGES (IDC)	$6,866	$43,308	$519,052	$609,633	$159,536	$1,338,395
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$203,663**	**$2,896,534**	**$15,070,411**	**$17,094,239**	**$1,400,422**	**$37,345,286**

PROJECT COST SUMMARY — **UNCERTAINTY ADJUSTED ESTIMATE**
Project Number: TD-0007772
Project Title: TD-0007772 TSTS Redevelopment Option 4_Stage 2
Estimate Type: Planning
Revision: Original Rev 0
Issued Date: 27/08/2020

	PROJECT EXPENDITURE FORECASTS	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	TOTAL
1	DESIGN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$435,000	$15,000	$450,000
2	INTERNAL LABOUR	$48,094	$0	$0	$0	$0	$0	$0	$0	$0	$80,156	$454,703	$582,953
3	MATERIALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,238,618	$1,238,618
4	PLANT & EQUIPMENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$311,821	$311,821
5	CONTRACTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,611,280	$3,611,280
6	METER COSTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	OTHER - RISK ALLOWANCE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$312,831	$312,831
8	**PROJECT DIRECT EXPENDITURE P(50)**	**$48,094**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$515,156**	**$5,944,253**	**$6,507,503**
9	MANAGEMENT RESERVE [P(90)-P(50)]												$130,150
10	**PROJECT DIRECT EXPENDITURE PLUS RISK P(90)**	**$48,094**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$515,156**	**$5,944,253**	**$6,637,653**
11	OVERHEADS	$1,876	$0	$0	$0	$0	$0	$0	$0	$0	$20,091	$231,826	$253,793
12	FINANCE CHARGES (IDC)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15,810	$0	$15,810
13	OPERATING EXPENDITURE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	WRITTEN DOWN VALUES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	**TOTAL EXPENDITURE FOR APPROVAL**	**$49,969**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$551,058**	**$6,176,079**	**$6,907,256**

The table below is a high-level schedule for Option 4:

Phase	Deliverable Title	Date	Duration
Idea	High Level Estimate Handover to Initiator	17/07/2020	
	Business Case Approved	18/02/2021	6 months
	RIT-T consultation process	07/09/2021	6 months
Stage 1 Detailed Design	Contract execution /DSP Scope of Works	21/09/2021	13 months
	DSP Tender / Award	19/10/2021	
	Stage 1 Detailed Design Start	09/12/2021	
	Stage 1 Design Completed	18/09/2022	
Stage 1 Delivery and Close	Project Handover for Implementation	27/09/2022	24 months
	ISP Tender / Award	27/12/2022	
	Stage 1 Site Works Commenced	10/01/2023	
	First outage taken	12/02/2023	
	Stage 1 Practical Completion	01/07/2024	

Phase	Deliverable Title	Date	Duration
	Project Close-out Complete	30/09/2024	
Stage 2 Detailed Design	Contract execution /DSP Scope of Works	05/11/2029	7 months
	DSP Tender / Award	03/12/2029	
	Stage 2 Detailed Design Start	14/01/2030	
	Stage 2 Design Completed	27/05/2023	
Stage 2 Delivery and Close	Project Handover for Implementation	10/06/2030	12 months
	ISP Tender / Award	26/08/2030	
	Stage 2 Site Works Commenced	23/09/2030	
	First outage taken	21/10/2030	
	Stage 2 Practical Completion	31/03/2031	
	Project Close-out Complete	30/06/2031	

8 Appendices

8.1 Appendix A – Fixed Assets WDV

The written down value of fixed assets is: $1,232,278.52

TD-0007772 - WDV (completed).xlsb

8.2 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	• Revised requirements from Initiator	• Increase costs • Delay in works • Project will be unbuildable	• Advise Initiator any change to the Functional Requirements will have adverse impact on overall project delivery • Assumption of no change to the Functional Requirements	SH	Fully Effective								
Uncertainty in start timing impacts on project implementation	• RIT-T • 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	HdB & SH	Fully Effective								
Commissioning outage constraints	• Unable to get outages	• Cost overruns • Missing practical completion • Revenue stream delayed	• Forward planning • Get in touch with the CEOT and DBs in advance • Consultation with Maintenance and Operations staff • Commissioning plans	SH	Substantially Effective	• Submit commissioning plan to CEOT & DBs for approval	3	B	III	$100k	3	B	III
Delay on Practical Completion	• Design changes due to site conditions •	• Finance charges increased • Revenue stream delayed	• Forward planning • QA Process • Sign contracts before start	SH	Partially Effective	•	2	B	III	$100k-$500k	2	B	III
Safety Incident	• Safe approach distances • Equipment failure • HEI's	• Accident (s) and injuries to staff and contractors	• HSE processes and procedures • Pre-approved contractor list	SH	Fully Effective	• Safety Management plan							

8.3 Appendix C – High Level Proposed Sequence of Works for Transformer Replacements

The attached documents show the staging methodology for the B2 and B3 Transformer replacements.

Note: Other 220kV and 66kV switchgear works are not shown in these drawings.

TSTS REDEVELOPMENT GA

TSTS REDEVELOPMENT SLI

8.4 Appendix D – Alternative Solutions Investigated for Transformer Replacement Sequencing

Objective:

To replace B2 & B3 Transformers at TSTS and selected 220kV and 66kV switchgear

Challenges:

Rebuilding the transformers in a manner that removes the present fire risks posed by a transformer rack common to all transformers while maintaining secure supply at TSTS (no more than 1 transformer off supply at any time)

Options:

On 22nd June 2020, four options were developed to stage the transformer cutover sequencing. An agreed option was decided amongst some key stakeholders and was detailed out further. It was proposed to proceed with Option 1a but noted a “cradle-block” work method would be required.

All options were costed at a high level and can be considered as being additional costs to the project baseline cost of $48M. Only additional or changed scope was included in each option, ie CB cost common to all options is not included and increased costs or cost differences only were considered. Andy R has now raised that Option 1 had an additional risk (cradle-block) that was not costed. Below are options/constraints of each option summarised noting that Option 1 is split into 1a (with cradle block) and 1b (without cradle block) and added further future planning notes to Option 3.

Option 1 (New Bay AA):

- Scope is to extend No.1 220kV Bus one bay into Bay AA and also extend 220kV No.1 Rack by one bay
- Cost is $800k excluding any cost associated with an unplanned outage
- Benefits – leaves room for future 4th TR and imposes no constraints on any other bays
- Residual risk is an outage caused by incident during cradle block (B1 TR will be out of service during the cradle-block, and should an incident take place No.1 220kV Bus and B2 TR will trip leaving the station supplied only on B3 TR). @Graeme B – is it correct that there may be shoulder periods in autumn or spring where the station load could be carried by B3 only possibly using its cyclic rating capability? @Graeme B – can OSSCA be used by arming it during the cradle-block (which would I think widen the outage window to also include winter and should a trip occur OSSCA would load shed sufficiently to not overload B3 TR)? In addition, overload protection settings of B3 TR would need to be checked prior to ensure no cascade tripping.

Option 1b (New Bay AA after battery rooms relocated):

- Scope would be to relocate 2 x battery rooms (including trenching and re-cabling) and extend No.2 220kV Bus one bay into Bay AA and extend 220kV No.1 and No.2 Racks by one bay
- Cost is $800k + battery room relocation (Stanley Ho to provide a cost estimate) + No.2 Rack extension at $180k
- Benefits – leaves room for future 4th TR and imposes no constraints on any other bays
- No residual risk

Option 2 (Direct O/H connection):

- Use of spans directly across bays inter-racks was technically ruled out by Peter Kilevics due to lack of clearance from rack legs
- Not considered further

Option 3 (Monopole):

- Scope would require 3 monopoles and OH lines to connect B5 TR to 220kV switchyard
- Cost is $600k
- Con: constrains further development of Bay AA or Bay A and would only allow future 4th TR to be single switched sharing Bay B with B5 TR

Option 4 (220kV cable connection):

- Scope use of 220kV cables for B5 TR connection with cable support structures to 220kV switchyard
- Still requires cradle blocking of B4 and B1 TR connection
- Cost is $2.3M
- Con: constrains further development of Bay AA and possibly Bay A and would only allow future 4th TR to be single switched sharing Bay B with B5 TR

		A TO P INFORMATION			OPTIONS					
									PREFERRED	
ITEM	DESCRIPTION				500-220-66 (1)	Option 1	Option 2	Option 3	Option 4	TOTAL
1	Design				$0	$71,996	$35,036	$50,169	$169,279	$169,279
2	AusNet Services Internal Costs				$0	$57,597	$30,031	$40,135	$169,279	$169,279
3	Sub-Contractor Indirect Costs				$0	$57,597	$25,026	$40,135	$169,279	$169,279
4	Lines Works				$0	$0	$0	$0	$0	$0
5	High Voltage Equipment				$0	$466,472	$100,103	$334,462	$1,410,662	$1,410,662
6	Medium Voltage Equipment				$0	$0	$0	$0	$0	$0
7	Low Voltage Equipment				$0	$0	$0	$0	$0	$0
8	Transformers				$0	$0	$0	$0	$0	$0
9	Protection & Control Systems				$0	$0	$0	$0	$0	$0
10	Infrastructure (Buildings)				$0	$0	$0	$0	$0	$0
11	Infrastructure (Services)				$0	$0	$0	$0	$0	$0
12	Civil Works (Earthworks, Cable Trenches, Drainage , etc)				$0	$13,500	$0	$0	$0	$0
13	Land / Easements				$0	$0	$0	$0	$0	
14	Outage Costs (Excluding Rebates)				$0	$0	$0	$0	$0	$0
15	Spares				$0	$0	$0	$0	$0	$0
16	Nominal Risk Allowance				$0	$50,037	$14,265	$34,868	$143,888	$143,888
17	**DIRECT COSTS SUB-TOTAL**				**$0**	**$717,199**	**$204,461**	**$499,770**	**$2,062,388**	**$2,062,388**
18	Management Contingency				$0	$35,860	$10,223	$24,989	$103,119	$103,119
19	**DIRECT COSTS INCL CONTINGENCY**				**$0**	**$753,059**	**$214,684**	**$524,759**	**$2,165,507**	**$2,165,507**
20	Overheads				$0	$28,186	$8,035	$19,641	$81,052	$81,052
21	Finance Charges				$0	$22,277	$5,497	$15,203	$64,306	$64,306
22	Operating Expenditure				$0	$0	$0	$0	$0	$0
23	Written Down Values				$0	$0	$0	$0	$0	$0
24	Tax									
25	**TOTAL**				**$0**	**$803,522**	**$228,216**	**$559,603**	**$2,310,865**	**$2,310,865**