APD ENGINEERING

THOMASTOWN TERMINAL STATION

TRANSMISSION REVENUE RESET (TRR) PROJECT SCOPING

REV	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY	DATE
A	First issue	[C-I-C]	[C-I-C]	[C-I-C]	18/12/2019
B	Second issue	[C-I-C]	[C-I-C]	[C-I-C]	03/03/2020
C	Third issue	[C-I-C]	[C-I-C]	[C-I-C]	06/03/2020

REVISION HISTORY

PREPARED FOR

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EXECUTIVE SUMMARY

AusNet Services engaged APD Engineering to prepare project scopes and estimates relating to options for replacement of poor condition primary equipment at Thomastown Terminal Station (TTS) for inclusion in AusNet Services' 2022 – 2027 Transmission Revenue Reset.

APD Engineering has reviewed a functional scope prepared by AusNet Services and developed detailed scopes and estimates for each planning option required by AusNet Services.

The planning options considered, along with the associated costs, are included in Table 1 below. These costs exclude contingency but include an allowance for overheads and finance charges. The cost estimates have an accuracy of ±30% and are based on the limitations outlined in Section 2 of this report.

Option	Option Title	Capital Cost (M)
1	Integrated project	$19.63
2	B4 Transformer Replacement	$6.10
3a	220kV Switchgear replacement	$4.64
3b	66kV Switchgear replacements	$9.46

[C-I-C]
DESIGN MANAGER

1. INTRODUCTION

AusNet Services engaged APD Engineering to prepare project scopes and estimates relating to options for replacement of poor condition primary equipment at Thomastown Terminal Station (TTS) for inclusion in AusNet Services' 2022 – 2027 Transmission Revenue Reset.

The equipment for replacement, along with planning options for consideration, have been prepared as per reference [1] Thomastown Terminal Station (TTS) B4 Transformer and Circuit Breaker Replacement Project TD-0003597.

2. LIMITATIONS

In preparing this report, APD Engineering has relied on information provided by AusNet Services, including (but not limited to):

1. Site drawings and documentation outlining the existing equipment on site;

2. Condition assessments and functional scopes identifying poor condition primary and secondary assets for replacement prepared by AusNet Services, along with supporting information to allow the development of the scopes and estimates;

3. A top down estimating spreadsheet provided by AusNet Services to calculate the capital costs associated with each project;

4. Unit costs for major items of plant and equipment, labour costs and other costs assumptions provided by AusNet Services as part of the top down estimating spreadsheet.

3. ASSUMPTIONS

1. The replacement of 66kV CB primary equipment requires replacement of associated secondary equipment and includes the remote ends for both distance and line differential scheme protections.

2. No allowance has been made for telecommunications replacement.

3. It is assumed that, where required, the existing 415 VAC and 250VDC equipment can be modified as part of the project. Replacement of the full 415V AC/ 250VDC or 48VDC distribution boards and batteries has not been considered.

4. It is assumed that SCIMS hardware can be modified as part of the project. Only modification to existing SCIMS equipment has been included in the estimates. Full replacement of the RTU/SCIMS alarm modification or panel replacement has not been considered.

5. Allowance has been made to replace all Condition 4 and Condition 5 relays, including relays older than 9 years under Condition 2 and 3.

4. OPTION 1 – INTEGRATED PROJECT

4.1. OUTLINE OF PROJECT

This planning option delivers a single integrated project undertaking all works identified as required for the replacement of poor condition assets at Thomastown Terminal Station.

A single line diagram of Thomastown has been included as Figure 1 and an aerial view of the terminal station has been included as Figure 2.

4.2. B4 TRANSFORMER WORKS

AusNet Services has identified the need to replace the B4 transformer due to poor condition.

APD Engineering has reviewed the functional scope provided by AusNet Services. In the proposed scope, to replace the B4 transformer, APD Engineering has recognised that a long duration outage of a single transformer is likely to be available.

APD Engineering therefore proposes the in-situ replacement of the B4 transformer as part of this integrated project.

A detailed scope of works has been prepared for the replacement of the B4 transformer to allow capital cost estimation. This scope has been included in scope in Appendix A.

4.3. SWITCHGEAR REPLACEMENT

AusNet Services has identified that there is one poor condition 220kV circuit breaker and twenty-one poor condition 66kV circuit breakers at Thomastown Terminal Station requiring replacement. Four of the 66kV circuit breakers are out of service and three will be replaced by other projects. In addition, there are a number of isolators, instrumentation transformers and earth switches that have been identified by AusNet Services as in poor condition and require replacement.

Based on the information provided to APD Engineering, APD Engineering expects that in-situ replacement (with associated outages) will be viable for each of these replacements.

4.4. PLANNING ESTIMATE

The detailed scope of works has been included in Appendix A and Appendix B of this report. The cost to implement the identified project scope of work as an integrated project has been estimated using the AusNet Services estimating spreadsheet at a total capital cost of $19.63 M (±30%).

These costs exclude contingency but include an allowance for overheads and finance charges.

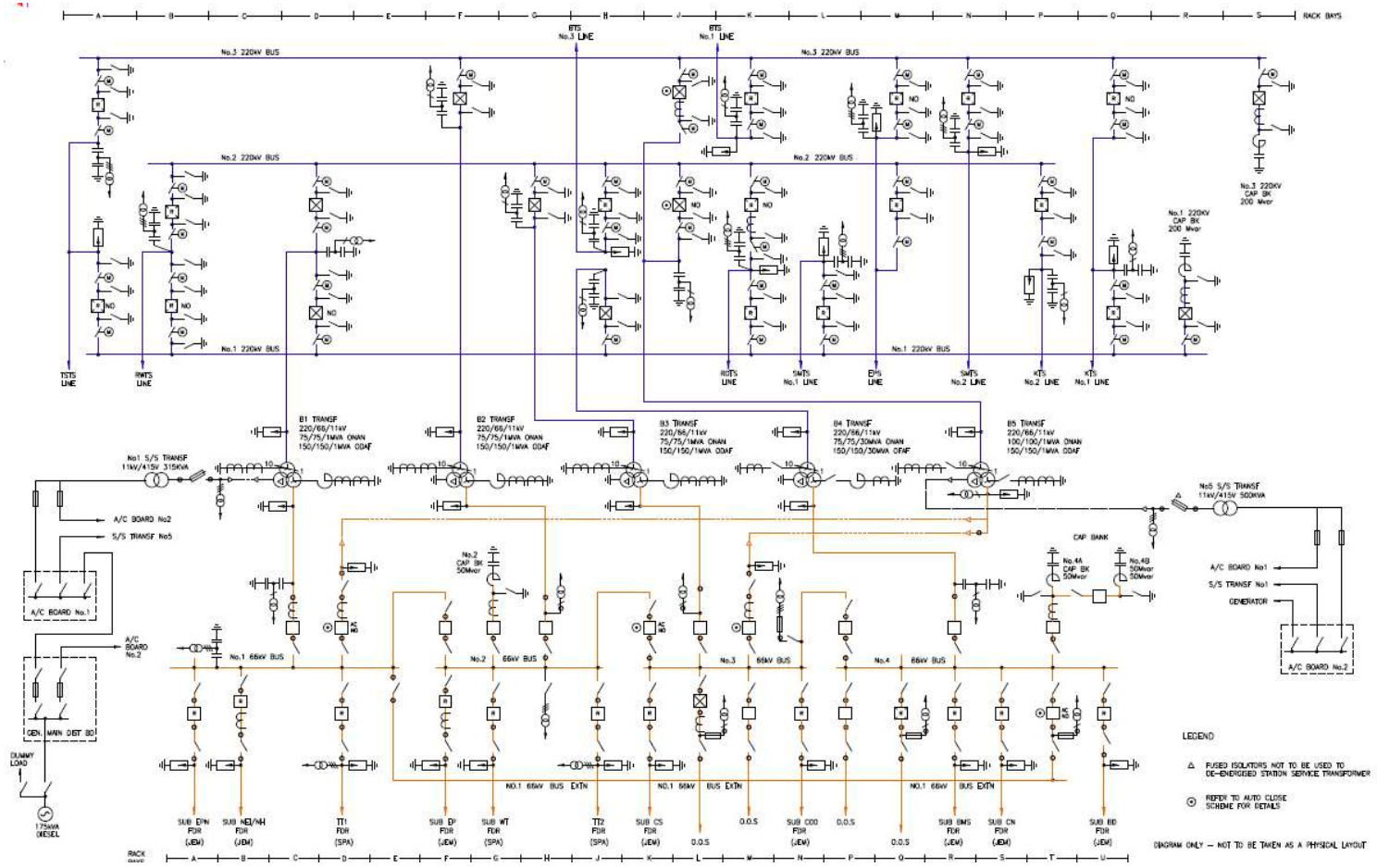

Figure 1 – Thomastown Terminal Station SLD

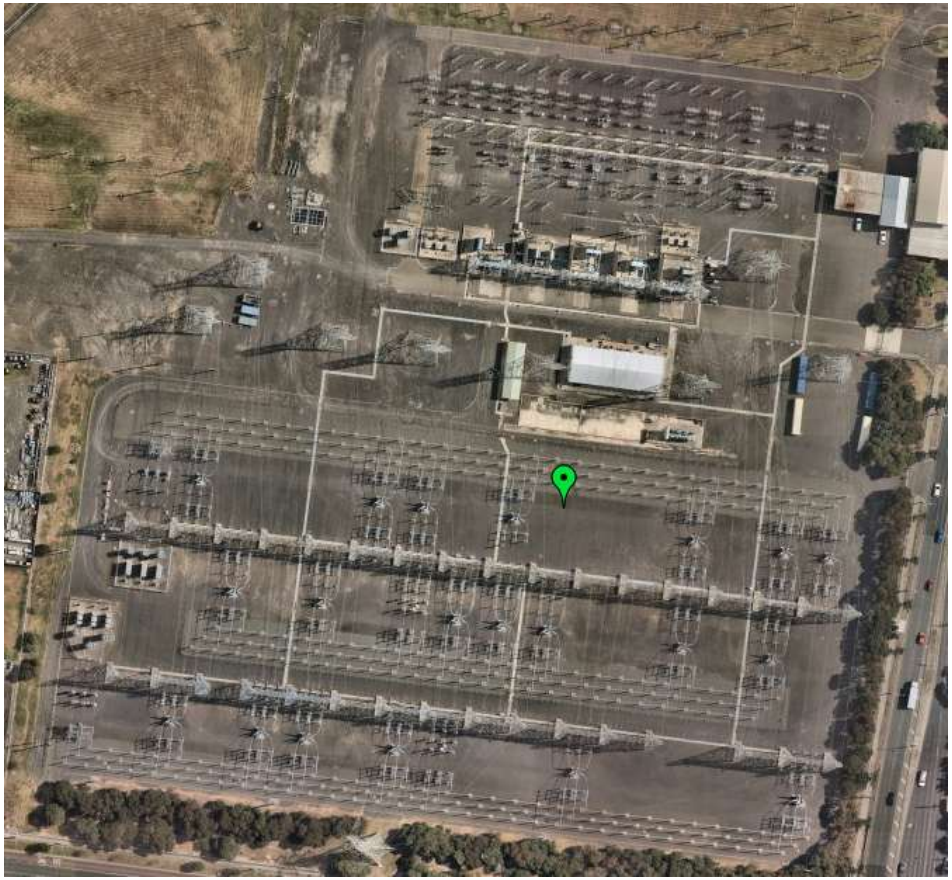

Figure 2 – Thomastown Terminal Station Aerial View

5. OPTION 2 – REPLACE B4 TRANSFORMER

5.1. OUTLINE OF PROJECT

This planning option delivers the replacement of the B4 transformer.

5.2. B4 TRANSFORMER WORKS

This option would result in the replacement of the B4 transformer due to condition.

APD Engineering has identified that the replacement of a single transformer can be done in-situ with associated outages.

5.3. PLANNING ESTIMATE

The detailed scope of works has been included in Appendix B of this report. The cost to implement the identified project scope of work has been estimated using the AusNet Services estimating spreadsheet at a total capital cost of $6.10 M (±30%).

These costs exclude contingency but include an allowance for overheads and finance charges.

6. OPTION 3 – REPLACE SWITCHGEAR ONLY

6.1. OUTLINE OF PROJECT

This planning option delivers the replacement of the poor condition switchgear only.

6.2. SWITCHGEAR REPLACEMENT

The works required as part of this option are identical to those in the integrated option.

6.3. PLANNING ESTIMATE

The detailed scope of works has been included in Appendix B of this report. The cost to implement the identified project scope of work has been estimated using the AusNet Services estimating spreadsheet at a total capital cost of $4.64 M (±30%) for the 220kV switchgear and $9.46 M (±30%) for the 66kV switchgear.

These costs exclude contingency but include an allowance for overheads and finance charges.

7. REFERENCES

The following document were applied in preparation of this report.

TYPE	OWNER	TITLE
Document	AusNet	Thomastown Terminal Station (TTS) - B4 Transformer and Circuit Breaker Replacement Project TD-0003597
Document	AusNet	Top-down Transmission Estimate for Option Selection Rev 2.7
Document	AusNet	Relays Condition Score Status as off 07.05.2019
Drawing	AusNet	Thomastown Terminal Station 66kV and 220kV Single Line Diagram – T14/31/170

APPENDIX A.

Transformer B4 transformer replacement works within TTS.

APPENDIX A.1.

Primary equipment

B4 Trans	Activity	Description (Primary Equipment)
New B4 TRANS (Existing Bay H)	Remove	Existing 220/66/11kV 150MVA Transformer (B4)
		Existing B4 TRANS 66kV CB
		Existing B4 TRANS 66kV CB Isolator
		Existing B4 220/66kV TRANS 220kV Neutral Isolator
		Existing B4 TRANS 220kV Cool Temp Control
		Existing B4 220/66kV TRANS 66kV Neutral Isolator
		Existing B4 220/66kV TRANS 66kV VT Fused Isolator
	Install	New B4 Transformer Installation - Install 1 220/66/11kV 150MVA Power Transformer (B4) - Install 3 220kV Surge Arresters - Install 1 220kV Neutral Isolators - Install 3 66kV Surge Arresters - Install 1 66kV Neutral Reactor - Install 1 66kV Neutral Isolators - Install 4 Neutral CT's - B4 TRANS 66kV Dead Tank Circuit Breaker - B4 TRANS 66kV CB Isolator - B4 220/66kV TRANS 66kV VT Fused Isolator

Secondary equipment

B4 Trans	Activity	Description (Secondary Equipment)
New B4 TRANS (Existing Bay H)	Remove	Decommissioning of B4 Transformer X & Y Protection & Control Scheme from Panel
	Install	- Install new one B4 Transformer X Protection & Control Scheme
		- Install new one B4 Transformer Y Protection & Control Scheme
		- Install new one 220/66kV Transformer Voltage Control Scheme

APPENDIX B.

220kV and 66kV switchyard replacement primary and secondary works within TTS includes the following primary and secondary assets replacement.

APPENDIX B.1.

The scope to replace selected 220kV switchgear.

220kV Bay	Activity	Description (Primary Equipment)
No.1 Cap (Bay R)	Remove	Existing No.1 220kV Capacitor Bank CB
		No.1 220kV Capacitor Bank CB CT "R Phase"
		No. 1 220kV Capacitor Bank Balance CT R/W/B
	Install	Install new No.1 220kV Capacitor Bank CB
		Install new No.1 220kV Capacitor Bank CB CT "R Phase"
		No. 1 220kV Capacitor Bank Balance CT R/W/B
No.3 Cap (Bay S)	Remove	Existing No.3 220kV Capacitor Bank CB CT "R Phase"
		Existing No.3 220kV Capacitor Bank CB CT "W Phase"
		Existing No.3 220kV Capacitor Bank CB CT "B Phase"
	Install	Install new No.3 220kV Capacitor Bank CB CT "R, W, B" Phase - Including 3 x Single Phase Post Type 220kV CT
No.3 Bus VT (Bay??)	Remove	Existing No.3 220kV Bus VT "R Phase"
		Existing No.3 220kV Bus VT "W Phase"
		Existing No.3 220kV Bus VT "B Phase"
	Install	Install new No.3 220kV Bus CVT "R, W, B" Phase - Including 3 x Single Phase Post Type 220kV CVT

The scope to replace selected secondary equipment associated with the 220kV switchgear.

220kV Bay	Activity	Description (Secondary Equipment)
B1 TRANS (Bay D)	Remove	Existing B1 TR 220kV Cool Temp Control
	Install	- Install and replace one-B1 TR 220kV Cool Temp Control Relay
B3 TRANS (Bay G)	Remove	Existing B3 TR X Differential Protection
		Existing B3 TR X Differential Protection CB Fail & Control
	Install	- Install new one B3 Transformer X Protection & Control Scheme
RWTS Line (Bay B)	Remove	Existing RWTS X Digital Current Differential
		Existing RWTS Y Digital Current Differential
		Existing RWTS 1B Single End Auto Re-Energise Relay
		Existing RWTS 2B Single End Auto Re-Energise Relay
	Install	- Install new RWTS 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme
		- Install new RWTS 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme to Remote End
		- Install and replace RWTS 1B Single End Auto Re-Energise Relay
		- Install and replace RWTS 2B Single End Auto Re-Energise Relay
KTS No.1 Line (Bay Q)	Remove	Existing KTS1 X Digital Current Differential
		Existing KTS1 Y Digital Current Differential
	Install	- Install new KTS No.1 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme
		- Install new KTS No.1 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme to Remote End

KTS No.2 Line (Bay P)	Remove	Existing KTS2 X Digital Current Differential
		Existing KTS2 Y Digital Current Differential
	Install	- Install new KTS No.2 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme
		- Install new KTS No.2 220kV Line X & Y Protection with ARC Current Diff/Distance Scheme to Remote End
SMTS No.1 Line (Bay L)	Remove	Existing SMTS1 Y Digital Current Differential
		Existing SMTS1 Y Receive Remote Trip Timer
		Existing SMTS1 Single End Auto Re-Energise Relay
	Install	- Install new SMTS No.1 220kV Line Y Protection with ARC Current Diff/Distance Scheme
		- Install new SMTS No.1 220kV Line Y Protection with ARC Current Diff/Distance Scheme to Remote End
		- Install and replace one-SMTS1 Single End Auto Re-Energise Relay
TSTS Line (Bay A)	Remove	Existing TSTS 1B Single End Auto Re-Energise Relay
		Existing TSTS 3B Single End Auto Re-Energise Relay
	Install	- Install and replace TSTS 1B Single End Auto Re-Energise Relay
		- Install and replace TSTS 3B Single End Auto Re-Energise Relay
ROTS Line (Bay K)	Remove	Existing ROTS Single End Auto Re-Energise Relay
	Install	- Install and replace ROTS Single End Auto Re-Energise Relay
No.1 Cap (Bay R)	Remove	Existing #1 220kV Capacitor Bank Overcurrent & Earth Fault
		Existing #1 220kV Capacitor Bank X Overload & Current
		Existing #1 220kV Capacitor Bank Y Overcurrent Relay
		Existing #1 220kV Capacitor Bank Y Overload Relay
		Existing #1 220kV Capacitor Bank Auto Control Relay
		Existing #1 220kV Capacitor Bank BU CB Backup Timer Relay

		Existing #1 220kV Capacitor Bank BU Current Check Relay
	Install	- Install new No.1 Capacitor X & Y Protection & Control Scheme
No.3 Cap (Bay S)	Remove	Existing #3 220kV Capacitor Bank X Overcurrent & Earth Fault
		Existing #3 220 kV Capacitor Bank X Overload & Current
		Existing #3 220 kV Capacitor Bank Y Overcurrent & Earth Fault
		Existing #3 220 kV Capacitor Bank Y Overload & Current
		Existing #3 220 kV Capacitor Bank Auto Control Relay
		Existing #3 220 kV Capacitor Bank BU No.3 Bus CB Backup Timer
		Existing #3 220 kV Capacitor Bank BU CB Fail Protection Current
	Install	- Install new No.3 Capacitor X & Y Protection & Control Scheme
Common Panels	Remove	Existing 220kV Potential Selector
	Install	- Install new 220kV Bus Potential Selectors Scheme
	Remove	Existing #1-2 220kV Bus Undervoltage Relay
	Install	- Install and replace #1-2 220kV Bus Undervoltage Relay
	Remove	Existing 220KV Station Trip Off Timer Relay
	Install	- Install and replace 220KV Station Trip Off Timer Relay

APPENDIX B.2.

The scope to replace selected 66kV switchgear.

66kV Bay	Activity	Description (Primary Equipment)
B1 Trans (Bay C)	Remove	Existing B1 TRANS 66kV CB
		Existing B1 TRANS 66kV CB Isolator
		Existing B1 TRANS 66kV CB CT "R Phase"
		Existing B1 TRANS 66kV CB CT "W Phase"
		Existing B1 TRANS 66kV CB CT "B Phase"
		B1 TR 66KV VT B/PH
	Install	B1 TRANS 66kV Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		B1 TR 66KV VT B/PH
B3 Trans (Bay L)	Remove	Existing B3 220/66kV TRANS 66kV VT Fused Isolator
	Install	B3 220/66kV TRANS 66kV VT Fused Isolator - Install Single Phase VT Fused Isolator
B5 Trans (Bay D)	Remove	B5 TR 1 BUS 66KV CB CT B/PH
	Install	B5 TR 1 BUS 66KV CB CT B/PH
EP FDR (Bay F)	Remove	Existing EP 66kV Feeder CB
		Existing EP 66kV Feeder CB CT "R Phase"
		Existing EP 66kV Feeder CB CT "W Phase"
		Existing EP 66kV Feeder CB CT "B Phase"
	Install	EP 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
TT No.1 FDR	Remove	Existing TT No.1 66kV Feeder CB
		Existing TT No.1 66kV Feeder CB Bus Side Isolator

(Bay D)		Existing TT No.1 66kV Feeder CB Feeder Side Isolator
	Install	TT No.1 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		TT No.1 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		TT No.1 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
TT No.2 FDR (Bay J)	Remove	Existing TT No.2 66kV Feeder CB
		Existing TT No.2 66kV Feeder CB Bus Side Isolator
		Existing TT No.2 66kV Feeder CB Feeder Side Isolator
	Install	TT No.2 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		TT No.2 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		TT No.2 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
CN FDR (Bay S)	Remove	Existing CN 66kV Feeder CB
		Existing CN 66kV Feeder CB Bus Side Isolator
		Existing CN 66kV Feeder CB Feeder Side Isolator
	Install	CN 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		CN 66kV Feeder CB Bus Side Isolator Install on the bus side of CB three off 66kV disconnector
		CN 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
CS FDR (Bay K)	Remove	Existing CS 66kV Feeder CB
		Existing CS 66kV Feeder CB Bus Side Isolator

		Existing CS 66kV Feeder CB Feeder Side Isolator
	Install	CS 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		CS 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		CS 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
COO FDR (Bay N)	Remove	Existing COO 66kV Feeder CB
		Existing COO 66kV Feeder CB Bus Side Isolator
		Existing COO 66kV Feeder CB Feeder Side Isolator
	Install	COO 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		COO 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		COO 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
WT FDR (Bay G)	Remove	Existing WT 66kV Feeder CB
		Existing WT 66kV Feeder CB Bus Side Isolator
		Existing WT 66kV Feeder CB Feeder Side Isolator
	Install	WT 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		WT 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		WT 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
Bay L FDR	Remove	Existing Bay L 66kV Feeder CB (Out of Service)
		Existing BAY L 66kV Feeder CB Bus Side Isolator (Out of Service)

		Existing BAY L 66kV Feeder CB Feeder Side Isolator (Out of Service) Existing BAY L 66kV Feeder VT Fused Isolator (Out of Service)
	Install	Bay L 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker Bay L 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector Bay L 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector - Install Single-Phase VT Fused Isolator "R Phase"
Bay Q FDR	Remove	Existing Bay Q 66kV Feeder CB (Out of Service) Existing BAY Q 66kV Feeder CB Bus Side Isolator (Out of Service) Existing BAY Q 66kV Feeder CB Feeder Side Isolator (Out of Service) Existing BAY Q 66kV Feeder VT Fused Isolator "R Phase" (Out of Service)
	Install	BAY Q 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker BAY Q 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector BAY Q 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector - Install Single-Phase VT Fused Isolator "R Phase"
Bay M FDR	Remove	Existing Bay M 66kV Feeder CB (Out of Service)
		Existing BAY M 66kV Feeder CB Bus Side Isolator (Out of Service)
		Existing BAY M 66kV Feeder CB Feeder Side Isolator (Out of Service)

	Install	BAY M 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		BAY M 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		BAY M 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
Bay P FDR	Remove	Existing Bay P 66kV Feeder CB (Out of Service)
		Existing BAY P 66kV Feeder CB Bus Side Isolator (Out of Service)
		Existing BAY P 66kV Feeder CB Feeder Side Isolator (Out of Service)
	Install	BAY P 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		BAY P 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		BAY P 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
BD FDR (Bay U)	Remove	Existing BD No.1 66kV Feeder CB Bus Side Isolator
		Existing BD No.1 66kV Feeder CB Feeder Side Isolator
	Install	BD No.1 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		BD No.1 66kV Feeder CB Feeder Side Isolator - Install on the feeder side of CB three off 66kV disconnector
P FDR (Bay ??)	Remove	Existing P 66kV Feeder CB Bus Side Isolator
		Existing P 66kV Feeder CB Feeder Side Isolator
	Install	P 66kV Feeder CB Bus Side Isolator - Install on the bus side of CB three off 66kV disconnector
		P 66kV Feeder CB Feeder Side Isolator

		- Install on the feeder side of CB three off 66kV disconnector
NH/NEI FDR (Bay B)	Remove	Existing NH/NEI 66kV Feeder CB
		NH/NEI 66KV FDR CB CT B/PH NH/NEI 66KV FDR CB CT R/PH NH/NEI 66KV FDR CB CT W/PH
	Install	NH/NEI 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
BMS FDR (Bay R)	Remove	Existing BMS 66kV Feeder CB
	Install	BMS 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
EPN FDR (Bay A)	Remove	Existing EPN 66kV Feeder CB
	Install	EPN 66kV Feeder Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
No.2 Cap BK (Bay G)	Remove	Existing No.2 66kV Capacitor Bank CB
		Existing No.2 66kV Capacitor Bank Current Balance CT "R Phase"
		Existing No.2 66kV Capacitor Bank Current Balance CT "W Phase"
		Existing No.2 66kV Capacitor Bank Current Balance CT "B Phase"
	Install	No.2 66kV Capacitor Bank Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		Install new No.2 66kV Capacitor Bank Current Balance CT "R, W, B" Phase - Including 3 x Single Phase Post Type 66kV CT
No.4 & 4B Cap BK (Bay T)	Remove	Existing No.4 66kV Capacitor Bank CB
		Existing No.4B 66kV Capacitor Bank CB
		Existing No.4A 66kV Capacitor Bank Current Balance CT "R Phase"

		Existing No.4A 66kV Capacitor Bank Current Balance CT "W Phase"
		Existing No.4A 66kV Capacitor Bank Current Balance CT "B Phase"
	Install	No.4 66kV Capacitor Bank Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		No.4B 66kV Capacitor Bank Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		Install new No.4A 66kV Capacitor Bank Current Balance CT "R, W, B" Phase - Including 3 x Single Phase Post Type 66kV CVT
1-2 BT (Bay F)	Remove	Existing 1-2 66kV Bus-Tie CB No.1 Bus Side Isolator
		Existing 1-2 66kV Bus-Tie CB No.2 Bus Side Isolator
	Install	1-2 66kV Bus-Tie No.1 Bus Side Isolator - Install on the No.1 bus side of CB three off 66kV disconnector
		1-2 66kV Bus-Tie No.2 Bus Side Isolator - Install on the No.2 bus side of CB three off 66kV disconnector
2-3 BT (Bay K)	Remove	Existing 2-3 66kV Bus-Tie CB
		Existing 2-3 66kV Bus-Tie CB No.2 Bus Side Isolator
		Existing 2-3 66kV Bus-Tie CB No.3 Bus Side Isolator
	Install	2-3 66kV Bus-Tie Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		2-3 66kV Bus-Tie No.2 Bus Side Isolator - Install on the No.2 bus side of CB three off 66kV disconnector
		2-3 66kV Bus-Tie No.3 Bus Side Isolator - Install on the No.3 bus side of CB three off 66kV disconnector
	Remove	Existing 3-4 66kV Bus-Tie CB No.3 Bus Side Isolator

3-4 BT (Bay P)		Existing 3-4 66kV Bus-Tie CB No.4 Bus Side Isolator
	Install	3-4 66kV Bus-Tie No.3 Bus Side Isolator - Install on the No.3 bus side of CB three off 66kV disconnector
		3-4 66kV Bus-Tie No.4 Bus Side Isolator - Install on the No.4 bus side of CB three off 66kV disconnector
1-4 BT (Bay T)	Remove	Existing 1-4 66kV Bus-Tie CB
		Existing 1-4 66kV Bus-Tie CB No.4 Bus Side Isolator
		Existing 1-4 Extension 66kV Bus-Tie CB No.1 Bus Extension Side Isolator
		Existing 1-4 66kV Bus-Tie CB Sync VT Fused Isolator
		1-4 66KV B/T CB SYNCH VT
	Install	1-4 66kV Bus-Tie Circuit Breaker - Install 66kV Dead Tank Circuit Breaker
		1-4 66kV Bus-Tie No.4 Bus Side Isolator - Install on the No.4 bus side of CB three off 66kV disconnector
		1-4 66kV Bus-Tie No.1 Bus Side Isolator - Install on the No.1 bus side of CB three off 66kV disconnector
		- Install Three Phase VT Fused Isolator "R Phase"
		1-4 66KV B/T CB SYNCH VT
No.1 BUS VT (Bay A)	Remove	Existing No.1 66kV Bus VT (R, W, B)
	Install	No.1 66kV Bus VT (R, W, B)
No.2 BUS VT (Bay H)	Remove	Existing No.2 66kV Bus VT Isolator
		Existing No.2 66kV Bus VT Fuse Isolator
	Install	No.2 66kV Bus VT, Fused Isolator and Isolator Switch - Install three off Single Phase Fused Isolator

		- Install three off Single Phase Isolator Switch
No.3 BUS VT (Bay N)	Remove	Existing No.3 66kV Bus VT Existing No.3 66kV Bus VT Isolator Existing No.3 66kV Bus VT Fuse Isolator
	Install	No.3 66kV Bus VT, Fused Isolator and Isolator Switch - Install three off Single Phase Post Type 66kV VT - Install three off Single Phase Fused Isolator - Install three off Single Phase Isolator Switch
No.4 BUS VT (Bay ??)	Remove	Existing No.4 66kV Bus VT Isolator
		Existing No.4 66kV Bus VT Fuse Isolator
	Install	No.4 66kV Bus VT, Fused Isolator and Isolator Switch - Install three off Single Phase Fused Isolator
		- Install three off Single Phase Isolator Switch

The scope to replace secondary equipment associated with the selected 66kV switchgear.

66kV Bay	**Activity**	**Description (Secondary Equipment)**
B5 Trans (Bay D & Bay M)	Remove	Existing B5 TR 66kV CB Auto Control Relay
		Existing B5 TR 66kV CB Auto Control Relay
	Install	- Replace existing B5 TR 66kV CB Auto Control Relay for Bay D
		- Replace existing B5 TR 66kV CB Auto Control Relay for Bay M
BMS FDR (Bay R)	Remove	Existing BMS X CB Protection O/C & CB Fail Protection & Control
		Existing BMS X Digital Current Differential Relay
		Existing BMS CB Control/ Monitor Relay

	Install	- Install new BMS Feeder X Protection & Control Scheme
EP FDR (Bay F)	Remove	Existing EP Y Inverse Time Overcurrent Relay
		Existing EP Y Inverse Time Overcurrent Relay
		Existing EP Y Inverse Time Overcurrent Relay
		Existing EP Y Definite Time Sensitive Leakage
		Existing EP BU Instantaneous Overcurrent Relay
	Install	- Install new EP Feeder Y Protection & Control Scheme
		- Install new EP Feeder Y Protection & Control Scheme to Remote End
WT FDR (Bay G)	Remove	Existing WT Y Inverse Time Overcurrent Relay
		Existing WT Y Inverse Time Overcurrent Relay
		Existing WT Y Inverse Time Overcurrent Relay
		Existing WT Y Definite Time Sensitive Leakage
	Install	- Install new WT Feeder Y Protection & Control Scheme
		- Install new WT Feeder Y Protection & Control Scheme to Remote End
COO FDR (Bay N)	Remove	Existing COO X Digital Current Differential Relay
		Existing COO BU CB Protection O/C & CB Fail Protection & Control
		Existing COO CB Control/ Monitor Relay
	Install	- Install new COO Feeder X Protection & Control Scheme
		- Install new COO Feeder X Protection & Control Scheme to Remote End
BD FDR (Bay M)	Remove	Existing BD BU CB Management Relay
		Existing BD CB Control/ Monitor Relay
	Install	- Install new BD BU CB Management & Control/ Monitor Relay
CN FDR	Remove	Existing CN BU Instantaneous Overcurrent Relay

(Bay S)		Existing CN BU Negative Sequence Relay
		Existing CN BU Instantaneous Overcurrent Relay
	Install	- Install new two-off BU Instantaneous Overcurrent & Negative Sequence Relay
EPN FDR (Bay A)	Remove	Existing EPN 66kV Feeder Auto Reclose Relay
	Install	- Install new EPN 66kV Feeder Auto Reclose Relay
NH/NEI FDR (Bay B)	Remove	Existing NH/NEI BU Instantaneous Overcurrent
	Install	- Install new NH/NEI BU Instantaneous Overcurrent
TT No.1 FDR (Bay D)	Remove	Existing TT No.1 BU CB Current Check Relay
	Install	- Install new TT No.1 BU CB Current Check Relay
TT No.2 FDR (Bay J)	Remove	Existing TT No.2 BU CB Current Check Relay
	Install	- Install new TT No.2 BU CB Current Check Relay
66kV Bus 1 Zone	Remove	Existing No. 1 66kV X Instantaneous Current Relay
		Existing No. 1 66kV Y Instantaneous Current Relay
		Existing 1-2 66kV Bus Undervoltage Relay
	Install	- Install new No.1 66kV Bus X Protection Scheme
		- Install new No.1 66kV Bus Y Protection Scheme
66kV Bus 2 Zone	Remove	Existing No. 2 66kV Y Instantaneous Overcurrent Relay
		Existing No. 2 66kV X Instantaneous Overcurrent Relay
	Install	- Install new No.2 66kV Bus X Protection Scheme
		- Install new No.2 66kV Bus Y Protection Scheme
66kV Bus 3 Zone	Remove	Existing No. 3 66kV Bus X High Impedance Protection
		Existing No. 3 66kV Bus X Undervoltage Protection
		Existing No. 3 66kV Bus Y High Impedance Protection
	Install	- Install new No.3 66kV Bus X Protection Scheme
		- Install new No.3 66kV Bus Y Protection Scheme

66kV Bus 4 Zone	Remove	Existing No. 4 66kV X High Impedance Bus Protection Relay
		Existing No. 4 66kV Y High Impedance Bus Protection Relay
	Install	- Install new No.4 66kV Bus X Protection Scheme
		- Install new No.4 66kV Bus Y Protection Scheme
No.2 Cap BK (Bay G)	Remove	Existing No. 2 66kV Capacitor Bank X Overcurrent & Earth Fault
		Existing No. 2 66kV Capacitor Bank X Instantaneous Overcurrent
		Existing No. 2 66kV Capacitor Bank X Current Balance Relay
		Existing No. 2 66kV Capacitor Bank X DC Timer Relay
		Existing No. 2 66kV Capacitor Bank Y Instantaneous Overcurrent
		Existing No. 2 66kV Capacitor Bank Y Overcurrent Relay
		Existing No. 2 66kV Capacitor Bank Y DC Timer Relay
	Install	- Install new No.2 Capacitor X & Y Protection & Control Scheme
No.4 Cap BK (Bay T)	Remove	Existing No. 4 66kV Capacitor Bank X Overcurrent Relay
		Existing No. 4 66kV Capacitor Bank X Backup Timer Relay
		Existing No. 4 66kV Capacitor Bank Y Overcurrent Relay
		Existing No. 4 66kV Capacitor Bank Y CB Backup Timer Relay
		Existing No. 4 66kV Capacitor Bank BU Current Check Relay
		Existing No. 4A 66kV Capacitor Bank X Current Balance Relay
	Install	- Install new No.4 Capacitor X & Y Protection & Control Scheme
No.4B Cap BK (Bay B)	Remove	Existing No. 4B 66kV Capacitor Bank X Current Balance Relay
		Existing No. 4B 66kV Capacitor Bank Y Current Balance Relay
		Existing 4A/4B 66kV Capacitor Bank Voltage Control
		Existing 2 & 4 66kV Capacitor Bank Voltage Control Relay

	Install	- Install new No.4B Capacitor X & Y Protection & Control Scheme
Common Panels	Remove	Existing 66kV Feeders Under Frequency Check Relay
		Existing 66kV Feeder Load Shedding Timer
	Install	- Install new 66kV Auto Load Shedding Control Scheme
	Remove	Existing 1 & 2 66kV Bus Potential Selector
		Existing 3 & 4 66kV Bus Potential Selector
		Existing 66kV Bus Metering Potential Selector
		Existing 66kV Synchro check Aux Relay
	Install	- Install new 1 & 2 66kV Bus Potential Selectors Scheme
		- Install new 2 & 3 66kV Bus Potential Selectors Scheme
		- Install new 66kV Bus Metering Potential Selectors Scheme
		- Replace and Install new 66kV Synchro check Aux Relay

Backup Generator	**Activity**	**Description (Secondary Equipment)**
Diesel Generator	Remove	Existing 415V Diesel Generator Overcurrent Protection
	Install	- Install new 415V Diesel Generator Overcurrent Protection Relay to Existing Panel