Options Evaluation Report (OER)

Substation Capital Spares RP3
OER- **N2617** revision **7.0**

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Capability - Improved Asset Management

Project category: Prescribed - Asset Renewal Strategies

Approvals

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Date submitted for approval	14 October 2022	

Change history

Revision	Date	Amendment
0	28/09/2021	Initial version
1,2	10/11/2021	Minor formatting updates
3,4,5	13/11/2021	Re-issue pdf version
6	14/10/2022	• Added two 330kV power transformers after recent failures • Updated evaluation to FY22 values
7	31/10/2021	Version history added

Executive summary

Spare components and assets are required to enable the effective restoration of equipment following failure. Spares requirements are documented in TransGrid's Spares Policy (All Asset Streams) and substation spares requirements are in the Substation Spares Plan. Where the required spares meet TransGrid's capital expenditure policy the purchase of the spares is classified as replacement expenditure (repex). These items usually have significant lead-time to procure and are required to mitigate the impact of a failure of network equipment.

For substation assets, high voltage (HV) equipment such as power transformers, circuit breakers, current transformers, voltage transformers or major components of HV equipment (e.g., bushings, tap changer, circuit breaker interrupters and poles) are classified as capital spares. Capital spares will be required in 2023-2028 regulatory period due to following reasons:

- Asset failures and consumption of existing spares based on historical consumption,
- Spares required based on identification of gaps in holdings based on ongoing spares analysis and data improvements, and
- New spares required to support new asset types installed into the network.

The option evaluation summary for the recommended 179 capital spare items as shown in **Error! Reference source not found.**. An NPV is not calculated for this investment because they are needed to comply with the spares plan.

Additionally, the risk quantification for all HV assets is dependent on the availability of these spares in order to restore assets after failure in order to mitigate the impact of expected unserved energy.

Table 1 - Evaluated options

Option	Description	Direct capital cost ($m)	Network and corporate overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A	Allowance for substation capital spares	$16.77	Nil	$16.77	N/A	1

It is recommended to proceed with allowance of $16.77 million for substation capital spares. The detailed breakdown of spares list is provided in Table 2.

The cost of spares includes equipment supply and install cost only, therefore overhead cost component is nil.

[1] Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

1. Need/opportunity

The “Substation Spares Plan” and “In-Service and Spare Power Transformers and Reactors” documents determine spares holdings to minimise total cost whilst maintaining required levels of system reliability. Capital Spares are those spares that are required by these documents and that meet the criteria set down in the Expenditure Capitalisation procedure. They are recorded and capitalised with TransGrid’s financial systems. HV Plant items such as power transformers, circuit breakers, auxiliary transformers, current transformers, voltage transformers, or major components such as bushings, circuit breaker interrupters and poles are classified as capital spares.

There is an ongoing need to purchase capital spare and the expected amount required in the 2023-2028 regulatory period is included under this need.

Capital spares are required to respond effectively to equipment failure or impending failure as indicated by condition monitoring results. Asset management programmes, refurbishment programmes for equipment such as circuit breakers and emergency plant replacement due to failure or breakdown depend on the availability of spare major assemblies and plant. Failure of equipment and delay in the restoration due to the non-availability of spares would lead to an increase in the expected unserved energy following an asset failure. Inability to respond appropriately to developing plant issues is certain to increase the failure rate dramatically over time.

To continue effective management of equipment, appropriate capital spares will need to be purchased over the 2023–2028 regulatory period in accordance with the “Substation Spares Plan” and “In-Service and Spare Power Transformers and Reactors” documents.

The capital spares program will also cater for spares required for new plant items being installed on TransGrid’s high voltage network and replacement spares where these have been used on existing installations during maintenance refurbishment or emergency replacement.

2. Related needs/opportunities

There are no related needs identified.

3. Options

3.1. Base case

Operation of the transmission network relies on safe and effective high voltage plant within substations. Failure of equipment and delay in the restoration due to the non-availability of spares can lead to unreliable network, contradicts with best asset management practices and would also cost business in STIPS penalties. Inability to respond appropriately to developing plant issues is certain to increase the failure rate dramatically over time.

The ‘do nothing’ option – i.e.: no future purchase of plant spares is not consistent with the operation of the electricity network and asset management practices.

3.2. Options evaluated

Option A — Purchase appropriate capital spares to meet requirement of spares plan [OFS N2617A]

Capital spares are required to respond effectively to equipment failure or impending failure as indicated by condition monitoring results. Asset management programmes, refurbishment programmes for equipment such as circuit breakers and emergency plant replacement due to failure or breakdown depend on the availability of spare major assemblies and plant. To continue effective management of equipment, appropriate capital spares will need to be purchased over the 2024–2028 regulatory period in accordance with GM AS S1 012 – "Substation Spares Plan" and GM AS S1 009 – "In Service and Spare Power Transformers and Reactors".

The capital spares program will also cater for spares required for new plant items being installed on TransGrid's high voltage network and replacement spares where these have been used on existing installations during maintenance refurbishment or emergency replacement.

Based on last 5 year's capital spares consumption and the initial spares requirements from cyclic period agreements established for the supply of new high voltage plant, it is estimated that the total cost of the program during the 2024–2024 period will be $16.77m.

3.3. Options considered and not progressed

There are no other options considered.

4. Evaluation

The "Substation Spares Plan" and "In-Service and Spare Power Transformers and Reactors" documents provide guidelines in establishing appropriate minimum spares requirements for TransGrid to provide a High Voltage (HV) network that meets the required reliability standards. Option A is the only option that meets the guidelines stated in these documents.

It is estimated that the procurement of substation capital spares for the 2024–2028 period would cost $16.77m ± 25% in $2021-22 as per Table 2.

Table 2 Capital spare item list

Item	Forecasted Quantities	FY22 unit costs ($)	Total Estimate FY22 ($)
Power Transformer 330kV/132kV, 375MVA	2	$5,630,000	$11,260,000
Aux Transformer 11kV, 500/1000kVA	1	$129,600	$129,600
Bushing 33kV and below	3	$13,740	$41,220
Bushing 66kV	2	$13,740	$27,480
Bushing 132kV	3	$47,745	$143,235
Bushing 220kV	2	$89,601	$179,203
Bushing 330kV	3	$107,425	$322,276
Bushing 500kV	2	$129,357	$258,714
CB 66kV Interrupter/Pole (LHCB)	14	$16,493	$230,905

Item	Forecasted Quantities	FY22 unit costs ($)	Total Estimate FY22 ($)
CB 132kV Interrupter/Pole (LHCB)	18	$37,263	$670,741
CB 220kV Interrupter/Pole (LHCB)	1	$51,502	$51,502
CB 330kV Interrupter/Pole (LHCB)	13	$51,502	$669,526
CB 500kV Interrupter/Pole (LHCB)	2	$88,525	$177,049
CB 66kV Mechanism (LHCB)	6	$34,398	$206,386
CB 132kV Mechanism (LHCB)	8	$34,398	$275,181
CB 220kV Mechanism (LHCB)	1	$38,411	$38,411
CB 330kV Mechanism (LHCB)	7	$38,411	$268,880
CB 500kV Mechanism (LHCB)	1	$38,411	$38,411
CB 33kV Interrupter/Pole (DTCB)	4	$23,867	$95,469
CB 66kV Interrupter/Pole (DTCB)	5	$23,867	$119,336
CB 132kV Interrupter/Pole (DTCB)	8	$29,791	$238,326
CB 220kV Interrupter/Pole (DTCB)	3	$42,599	$127,797
CB 330kV Interrupter/Pole (DTCB)	3	$42,599	$127,797
CB 33kV Mechanism (DTCB)	2	$13,130	$26,260
CB 66kV Mechanism (DTCB)	2	$13,130	$26,260
CB 132kV Mechanism (DTCB)	3	$23,022	$69,065
CB 220kV Mechanism (DTCB)	1	$29,761	$29,761
CB 330kV Mechanism (DTCB)	2	$29,761	$59,522
Condition Monitoring Devices (Bushing Monitors)	2	$26,525	$53,050
Current Transformer 33kV and below	6	$7,587	$45,522
Current Transformer 66kV	6	$10,900	$65,400
Current Transformer 132kV	6	$13,800	$82,800
Current Transformer 330kV	9	$22,700	$204,300
Current Transformer 500kV	3	$34,756	$104,267
CVT 132kV	6	$9,400	$56,400
CVT 330kV	9	$12,900	$116,100
CVT 500kV	5	$17,300	$86,500
MVT 66 kV and below	4	$9,054	$36,216

Item	Forecasted Quantities	FY22 unit costs ($)	Total Estimate FY22 ($)
Magnetic Voltage Transformer (MVT) 132kV	1	$9,200	$9,200
Total	179		$16,768,069

The capex figures in this OER do not include any real cost escalation.

4.1. Commercial evaluation results

NA

4.2. ALARP evaluation

NA

4.3. Preferred option

Option A is the preferred option and the only option which meets the guidelines of the “Substation Spares Plan” and “In-Service and Spare Power Transformers and Reactors” documents. These documents have been developed to provide a minimum level of substation spares to allow response to equipment failure over the expected life of the equipment. The levels chosen balance factors including:

- Substation component criticality
- Numbers of a particular plant item
- The likelihood of failure of particular equipment components
- Minimising stores inventory and upfront costs
- The possibility/feasibility of component part repair
- The need to support the equipment over the design life period usually around 40 years for many substation assets, recognising that parts are cheaper when plant is originally purchased and may not be even available near end of life.

Capital and Operating Expenditure

There is no capex to opex trade-offs considered in this evaluation.

Regulatory Investment Test

It is not currently anticipated that a Regulatory Investment Test for Transmission (RIT-T) will be applied.

5. Recommendation

It is recommended to proceed with allowance of $16.77m for substation capital spares as stipulated under this need N2617 for the 2023-2028 regulatory period.

Approval Record

WF Ref:	Process Name	Actioned By	Action	Comments	Date
202563	Document Review	Lamplough Evan	Reviewed	Comments enclosed.	10-10-2021
203425	Document Review	Dutta Debashis	Reviewed		11-10-2021
203425	Document Review	Lamplough Evan	Reviewed		11-10-2021
203863	Document Approval	Wee Lance	Approve		18-10-2021
206092	Document Review	Lamplough Evan	Reviewed		10-11-2021
206160	Document Approval	McAlpine Andrew	Approve		11-11-2021
206400	Document Approval	Lamplough Evan	Approve		14-11-2021
206628	Document Approval	Lamplough Evan	Approve		17-11-2021
228917	Document Review	Lamplough Evan	Reviewed		19-10-2022
229278	Document Review	Dutta Debashis	Reviewed		21-10-2022
229352	Document Approval	Wee Lance	Approve		21-10-2022
229950	Document Review	Lamplough Evan	Reviewed		31-10-2022
229958	Document Approval	Wee Lance	Approve		31-10-2022