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Other Construction Cost Forecasting Methodology

2024-29 Revenue Proposal Waratah Super Battery Project (non-contestable)

30 June 2023

Contents

1. Purpose, scope and structure of this document

1.1. Purpose and scope of this document

The Waratah Super Battery (WSB) project is part of the NSW Electricity Infrastructure Roadmap and is critical to the affordability, reliability, security and sustainability of electricity supply in NSW, given the planned closure of Eraring Power Station. The battery will operate as part of a System Integrity Protection Scheme (SIPS) to increase the capacity of the existing transmission network, allowing electricity consumers in Sydney, Newcastle and Wollongong to access more energy from existing generators.

On 2 August 2022, the NSW Minister for Energy (Minister) identified the WSB Project as a priority transmission infrastructure project (PTIP) under the EII Act.

On 14 October 2022, the Minister published an Order directing Transgrid as the Network Operator to carry out the WSB project, which comprises:[1]

- two contestable components being a battery service, otherwise known as the SIPS service, and
- paired generation services, and
- a non-contestable component, which involve augmentation of our existing transmission network and the installation of a control and communications system (SIPS control).

This document sets out our other construction costs forecasting methodology for the non-contestable works and forms part of our WSB non-contestable Revenue Proposal.

The purpose of this document is to overview:

- the nature and scope of the other construction costs associated with delivering the WSB non-contestable works
- our approach to WSB non-contestable other construction costs, and
- how we forecast WSB other construction costs.

Unless otherwise stated, all values in this document are presented in real 2022-23 dollars.

1.2. Document structure

The remainder of this document is structured as follows:

- section 2 overviews WSB non-contestable other construction costs
- section 3 outlines our approach to forecasting other construction costs
- section 4 details each of the WSB non-contestable other construction costs.

[1] The Minister directs Transgrid to carry out the WSB project in accordance with section 32 of the EII Act

1.3. Structure of the Revenue Proposal

There are several other attachments and models that support, and form part of, our non-contestable Revenue Proposal. This Other Construction Costs forecasting methodology document references these attachments, models and other supporting documents and should be read in conjunction with them.

2. Overview of WSB non-contestable other construction cost

This section provides an overview of WSB non-contestable other construction costs (OCC).

We have identified 40 WSB non-contestable OCCs with a total anticipated capex forecast of $2.34 million (Real 2022-23). These OCCs are summarised in Table 2-1 for each asset class. Details on these OCCs are further discussed in section 4.

Table 2-1: Overview of WSB non-contestable OCCs ($, Real 2022-23)

OCC Type	Transmission Lines	Substations	SIPS control	TOTAL
Design	$78,959	$88,870	$483,589	$651,418
Procurement	-	$294,709	-	$294,709
Construction	-	[redacted]	$714,263	[redacted]
Contract Management	-	[redacted]	-	[redacted]
TOTAL	**$78,959**	**$1,062,310**	**$1,197,853**	**$2,339,122**

3. Approach to forecasting WSB non-contestable OCCs

A risk assessment has been undertaken for the Project to consider OCCs for the delivery of the project. We have identified OCCs that are not:

- covered by contract terms or insurance, and
- are not included in the tender costs.

For each OCC, we consider:

- the likelihood of the OCC occurring, which is based on experience from similar projects and subject matter expert assessment, and
- the cost consequence if the OCC occurs, which is based on the expected increase in costs under the best, most likely and worst case scenario.

The likelihood of the OCC occurring and the expected cost consequence if the OCC occurs allows us to calculate the expected OCCs. Our capex forecasts (without OCCs costs) assume that these OCCs do not occur.

Table 3-1 provides further explanation of how OCCs are calculated.

Table 3-1: OCC calculation inputs

Input	Description
Likelihood of OCC occurring	This represents the likelihood that a OCC occurs. The expected cost of the OCC is multiplied by the likelihood of the OCC occurring. For example, if the consequence should it occur is $10 and the likelihood of the OCC is 50%, then $10 x 50% = $5 is the expected OCC.
Best case scenario	This represents the situation where the event occurs but has a best-case (least cost) cost impact
Most likely case scenario	This represents the situation where the event occurs and results in the most likely cost impact
Worst realistic case scenario	This represents the situation where the event occurs but has a worst reasonable cost impact
Expected OCCs	This is calculated assuming that there is a triangular distribution of cost outcomes, where: • the best-case scenario is the lower limit • the worse-case scenario is the upper limit, and • the most likely scenario is the mode. This uses the formula: [2] $Expexted\ costs\ (P50) = B - \sqrt{50\%\ \times B\ \times (B - C)}$ *Where:*

[2] Note this formula changes to $A + \sqrt{50\%\ \times B\ \times (C - A)}\ when\ A - C > B - C$

	A = Best-case scenario ($) B = Worst-case scenario ($) C = Most likely scenario ($)
P50 OCC	The P50 OCC is calculated as the likelihood of OCC occurring multiplied by expected costs if the evebnt occurs, given by the formula: $Risk\ costs\ (P50) = Expected\ costs\ (P50) \times Likelihood\ of\ OCC\ occuring$

We have elected to quantify expected OCCs that are material to the project and add them to the base cost of the project rather than inflate the base costs.

4. WSB project OCCs

This section sets out the following for the OCCs we have identified for:

- transmission lines augmentation works
- substations augmentation works, and
- SIPS control implementation works.

4.1. Transmission lines augmentation

There is one transmission line augmentation OCC identified in relation to design.

4.1.1. Design

The transmission lines 3L/4 and 5 being uprated in this project were original commissioned between 1959 and 1962, respectively. This makes them 61 to 64 years old presently. As a result, these transmission lines have localised condition issues identified on 15 of the towers being modified under this Project.

Localised rust on the footings of these 15 towers may require treatment when the footings of these towers are modified as part of the upgrade works, however the full extent of the rust and required treatment cannot be assessed until works are occurring on site (i.e. excavation works around the base of the towers). Therefore the cost to remediate each of the 15 towers is expected to vary depending on the extent of remediation required. Table 4-1 summarises the transmission line design OCC.

Table 4-1: Transmission line design OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
Condition issues require remediation to facilitate augmentation works	50%	$105,000 ($7,000 x 15 towers)	$150,000 ($10,000 x 15 towers)	$225,000 ($15,000 x 15 towers)	$78,959

4.2. Substations augmentation

There are four types of substation augmentation OCC identified:

- design
- contract
- procurement, and
- construction.

4.2.1. Design

The substation augmentation works will occur at 22 separate sites meaning that Zinfra's nominated design partner will be required to develop an understanding of the design interface and legacy issues across each of these sites. The quantity or interface and legacy issues across these 22 sites means that additional design reviews by Transgrid are expected to be required to resolve these interface issues. Without these reviews the project risks higher additional costs during construction.

The substation augmentation design works by Zinfra will also require coordination with the SIPS control design work being undertaken by Transgrid at the same substation sites. Additional internal design effort will be required to coordinate the augmentation works design with the SIPS control design works.

Table 4-2: Substations augmentation design OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
Additional Transgrid design review required	90%	$30,508.80 (1 design engineer and 1 senior design engineer for 2 weeks)	$105,907.20 (1 design engineer and 1 senior site manager for 6 weeks, 1 senior design engineer for 3 weeks)	$126,611.80 (1 design engineer and 1 senior site manager for 8 weeks, 1 senior design engineer for 2 weeks)	$81,630.19
Design coordination between SIPS control and substation contractor required	25%	$0 (Nil)	$28,957.60 (1 designer for 4 weeks)	$57,915.20 (1 designer for 8 weeks)	$7,239.40
Total					**$88,869.59**

4.2.2. Contract

[redacted]

Table 4-3: Substations augmentation contract OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

4.2.3. Procurement

The substation augmentation works require the procurement of substantial equipment and material. Given the inflationary environment and market volatility, we need to pay a higher price than forecast to secure equipment and material to meet the delivery dates in the Minster's Direction.

Table 4-4 outlines the substation procurement OCC. The likelihood of the procurement OCC is based on current discussions with suppliers. The consequence costs are based on anticipated costs to secure the equipment and material and additional resource requirement expected. The details below are aligned with recent uplifts in costs related to procurement of substation equipment.

Table 4-4:Substations augmentation procurement OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total					**$294,708.65**

4.2.4. Construction

The substation augmentation works require upgrades of equipment at 22 substations, requiring outages on in-service equipment across each of these substations. These outages will be required on our main 330kV network, and in particular on the transmission lines which transfer power between NSW, Queensland and Victoria. Network constraints are therefore likely to mean that outages are cancelled and rescheduled at short notice in order to maintain power system security and reliability. Short notice cancellation and rescheduling of outages will result in disruption costs payable to the contractor. The subsequent closure of Liddell Power Station has resulted in a higher frequency of Lack of Reserve (LoR) conditions across our network leading to a highly constrained network regarding outage availability and outage recalls.

Table 4-5: Substations augmentation construction OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

4.3. SIPS control

There are two types of SIPS control OCC have been identified:

- design, and
- construction.

4.3.1. Design

The complex nature of the SIPS control which must monitor and interface with many sites across the network means that the design is expected to require:

- additional costs for integrating paired generators not allowed for in the base capex
- rework due to technical issues
- rework following consultation with AEMO on operation of the scheme and interface with AEMO's NEM Dispatch Engine, and
- design delays associated with not receiving timely external third-party inputs.

Note that at time of submission the designs are only at concept stage with detailed designs progressing. As detailed design is completed this may affect scope and hance additional works required.

Table 4-6: SIPS control design OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
Additional scope being discovered during detailed design phase	15%	-	$375,000	$1,500,000	$87,216
Additional works required to integrate future Paired Generators than allowed for in base case, e.g. additional communications links	15%	$0	$150,000	$1,500,000	$74,065
Technical issues discovered at detailed design requiring a change to design/philosophy	45%	$0	$125,000	$250,000	$56,250
Difficulties in access to EDMS drawings (many projects trying to work on the same drawing).	40%	-	$20,000	$40,000	$8,000
Test bench resources under utilised (stand-by) waiting for design inputs	70%	-	$50,000	$100,000	$35,000
[redacted]	[redacted]				
[redacted]	[redacted]				
[redacted]	[redacted]				

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
AEMO consultation requires changes to SIPS design specification and design rework	20%	$0	$50,000	$100,000	$10,000
Design delays delay in Paired Generation contract execution	30%	$0	$50,000	$150,000	$19,019
Additional design effort to incorporate paired generation from second tender round	20%	$0	$25,000	$100,000	$7,753
Total					**$483,589**

4.3.2. Construction

Construction of the SIPS control OCC relate to:

- SIPS control encounters technical issues or third party delays preventing commissioning
- equipment or resources are unavailable leading to delays
- environmental approvals are not available leading to delays
- rock is encountered during the installation of the underground fibre optic link.

Table 4-7: SIPS Construction OCC ($, Real 2022-23)

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
SIPS hardware or software is defective causing delays and requiring investigation	5%	-	$50,000	$2,500,000	$37,500
Extended project close-out process and unforeseen asset handover requirements.	50%	-	$25,000	$50,000	$12,500
SIPS control 'Ready for Load' gate not successful requiring rework	10%	-	$50,000	$150,000	$6,340

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
SIPS scheme does not operate as intended during commissioning requiring extensive rework and resulting in delays	5%	-	$2,500,000	$10,000,000	$193,814
Delay to commissioning tests due to spot market price being high	30%	-	$100,000	$250,000	$33,921
Resources unavailable resulting in commissioning delays	30%	-	$50,000	$100,000	$15,000
Disconnection tests for paired generators cannot occur at agreed time (e.g. out of hours).	30%	-	$100,000	$250,000	$33,921
Loss of critical skilled resources	40%	-	$100,000	$250,000	$45,228
Outages for installation being denied at short notice	60%	-	$100,000	$250,000	$67,842
Outages being cancelled at remote sites due to Distributor Load requirements	20%	-	$50,000	$100,000	$10,000
Paired generator outages to make connections (terminations etc) not available/rescheduled	40%	-	$100,000	$200,000	$40,000
Impact of other projects not being completed as anticipated (e.g. Ingleburn Secondary Replacement)	25%	-	$100,000	$250,000	$28,267
Rock encountered during construction of fibre optic communications link	20%	-	$100,000	$500,000	$36,754

OCC	Likelihood	Best case	Most Likely	Worst Realistic Case	P50 costs
Delays in receiving long lead time equipment result in project delays	20%	-	$75,000	$150,000	$15,000
Environmental approvals for not available resulting in delay costs	2%	-	$50,000	$100,000	$1,000
Environmental approvals for fibre optic cable link is delayed resulting in a delay to paired generator commissioning	5%	-	$50,000	$100,000	$2,500
[redacted]	[redacted]				
Site Covid outbreak meaning outages are missed (causing delayed construction)	15%	-	$100,000	$200,000	$15,000
Additional SIPS equipment procurement required	10%	-	$30,000	$100,000	$4,084
[redacted]	[redacted]				
[redacted]	[redacted]				
TOTAL					**$576,086**