Jemena Electricity Networks (Vic) Ltd

2021-26 Electricity Distribution Price Review Regulatory Proposal

RIN supporting document

AECOM - ZSS Asset Replacement Programs Benchmark Report

Jemena Cost Estimation Services

ZSS Asset Replacement Programs Benchmark Report

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ZSS Asset Replacement Programs Benchmark Report

Client: Jemena Asset Management Pty Ltd

ABN: 20 093 846 925

Prepared by

AECOM Australia Pty Ltd
Level 10, Tower Two, 727 Collins Street, Melbourne VIC 3008, Australia
T +61 3 9653 1234 F +61 3 9654 7117 www.aecom.com
ABN 20 093 846 925

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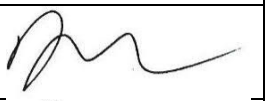
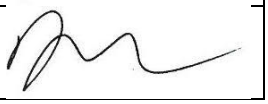
0	21-Jan-2020	Client Review	Jane Northey Associate Director	
1	24-Jan-2020	Final Report	Jane Northey Associate Director	

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Executive Summary

Jemena have engaged AECOM to prepare independent estimates and benchmark six zone station projects.

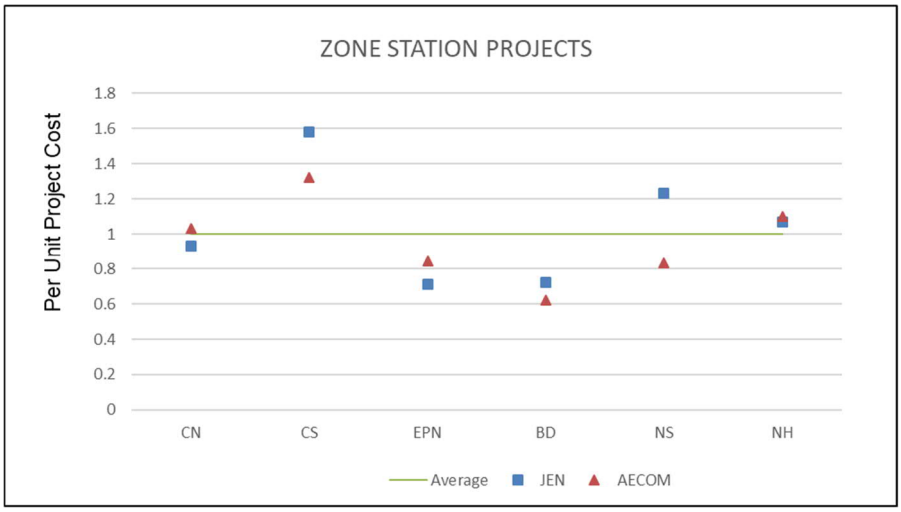
The estimates have been developed based on high level scopes, Jemena standards, specifications and normal industry practice. AECOM have considered local conditions and assumed network requirements as a component of the estimate.

Station Projects estimated include:

- The replacement of the Coburg North (CN) Zone Substation (ZSS) HV switchgear and secondary equipment.
- The replacement of the Coburg South (CS) ZSS HV switchgear and secondary equipment.
- East Preston (EPN) ZSS additional transformer and 22kV switchboard for Stage 6 of the conversion program.
- Broadmeadows (BD) ZSS transformer replacement.
- North Essendon (NS) ZSS secondary equipment replacement.
- North Heidelberg (NH) ZSS secondary equipment replacement.

AECOM has used industry information including actual costs and cost estimates to establish bench-marks for projects based on typical industry installations which have been used to establish a range of costs for the various projects and average costs. The cost estimates in this report are based on a per unit cost. The average cost for each type of project is one. This base is then used to compare the Jemena estimate with the AECOM estimate and the industry range.

AECOM has developed a Class 4 Estimate for each of these projects and provides the following comparisons to the benchmarks:



CN and NH estimates are similar to the average costs within the accuracy range of the estimate.

CS is considerably higher than the benchmarked average but within the range of costs for these works. Factors attributing to the higher cost include the modular capacitor bank, high feeder costs and high building costs for this multi-level indoor zone station.

EPN and BD are below the industry average due to the simple nature of the projects.

NS is above the expected range of costs.

Overall, AECOM considers that Jemena estimates for the ZSS program of works is within the industry range and in accordance with expectations for projects of this type given the particular requirements and constraints of each of the projects.

The estimates exclude Jemena overheads, GST, contingency and risk allowances amongst others.

1.0 Introduction

Jemena have engaged AECOM to prepare independent estimates and benchmark six zone station projects.

The estimates have been developed based on high level scopes, Jemena standards, specifications and normal industry practice. Due to the lack of a detailed scope of work for each estimate, a more specific scope of work has been assumed. This will require further investigation and adjustments as the projects are further developed. Changes in the content of the specific scopes, the mix of the various components of the scopes of work, latent conditions, contractor overhead and margin may impact on the estimates considerably.

AECOM have considered local conditions and assumed network requirements as a component of the estimate.

Station Projects estimated include:

- The replacement of the Coburg North (CN) Zone Substation (ZSS) HV switchgear and secondary equipment.
- The replacement of the Coburg South (CS) ZSS HV switchgear and secondary equipment.
- East Preston (EPN) ZSS additional transformer and 22kV switchboard for Stage 6 of the conversion program.
- Broadmeadows (BD) ZSS transformer replacement.
- North Essendon (NS) ZSS secondary equipment replacement.
- North Heidelberg (NH) ZSS secondary equipment replacement.

AECOM has established and maintains a comprehensive library of industry costs, templates and component modules that is used throughout Australia to estimate the cost of projects and other tasks in the electrical distribution industry. These costs have been developed from bottom up elements based on standard industry designs and current contractor practices. These are updated annually and compared to actual industry costs.

AECOM has used industry information including actual costs and cost estimates to establish benchmarks for projects based on typical industry installations, such as a distribution transformer, a number of high voltage switching bays, etc. These have been used to establish a range of costs for the various projects and average costs. The cost estimates in this report are based on a per unit cost. The average cost for each type of project is one. This base is then used to compare the Jemena estimate with the AECOM estimate and the industry range.

2.0 Specific Work Scope

Jemena has provided preliminary scope documents for each of these projects. AECOM has undertaken a visit to each site. These scopes of works are based on the information provided and normal industry processes and arrangements only. No design has been undertaken to develop these scopes.

2.1 Coburg North (CN) ZSS Redevelopment

- Demolition of the existing spares shed adjacent the entry gate, relocation of feeder CH1 to an alternative bay in parallel to an existing feeder.
- Relocation of the western boundary fence to the property boundary to allow sufficient space for the new control building.
- Construction of new 280m^2 switchroom building adjacent the main entry gate including building support, wall, piers, platforms & stairs.
- Construction of up to 200 metres of cable trenches including an allowance for road crossings and cable pits and trench crossings

- Supply and install a 22kV switch board comprised of two-off bus ties, three-off transformer circuit breakers, 15-off 630A feeder circuit breakers, a metering panel including earthing, spares, primary and secondary connections.
- Modify the TTS 66kV exit with the installation of one-off dead tank circuit breaker (DTCB), two-off 2500A motorised rotary disconnects, a set of surge diverters and relocation of the existing exit voltage transformers including footings, earthing, primary and secondary connections.
- Replacement of the existing 66kV bus tie circuit breakers with two-off 66kV DTCBs, replacement of the CS isolator with a 2500A motorised rotary disconnect, replacement of the existing transformer isolators with three-off 66kV 800A Motorised Rotary Disconnects including footings, earthing, primary and secondary connections.
- Modification of the existing CS exit 66kV circuit breaker including replacement of the motor drive, trip coils, close coils and auxiliary switches.
- Replace up to 51-off existing earth receptacles with spherical earthing receptacles in the 66kV switchyard.
- Replacement of secondary cables from the retained 66kV circuit breaker and adjacent current transformer to enable connection to the new protection and control schemes.
- Replacement of the existing transformer 66kV turrets and CTs, secondary cabling to connect to the new protection and control schemes plus an allowance of $25,000 per transformer to convert the transformers for operation at 110VDC.
- Replacement of the existing earth and NER switches on the existing transformers including supply and installation of CTs.
- Replacement of No 2 Transformer oil seal between the OLTC diverter switch, selector switch and drive mechanism. We have included an allowance to clean the existing transformers, transformer bund areas and touch up the paint on the existing transformers. We have excluded repair of other oil leaks on the existing transformers.
- Supply and installation of new transformer 22kV primary connections comprised of three-off 22kV 630mm^2 cables per phase installed direct buried.
- We have allowed for recommissioning of the transformers after the above modifications and connection to the new protection and control schemes.
- Modify No 1 Capacitor Bank with replacement of the existing earth switch, step switch, earth receptacles, primary and secondary connections.
- Replacement of No 2 & 3 Capacitor Bank earth switches, earth receptacles, primary and secondary cables.
- Progressive relocation of 12-off feeders to the new switchboard including an allowance for each of up to 100 metres of 300mm2, three-core aluminium conductor XLPE cables, direct buried including a termination pole in the existing 22kV switchyard and high voltage connections to the existing feeder exits. It has been allowed to relocate the feeders as transformers are transferred to the new switchboard. No temporary connection between the existing 22kV switchyard and the new switchboard has been allowed.
- Supply and installation of two 100kVA kiosk transformers, primary connections, changeover board and main AC switchboard.
- Supply and installation of duplicate 110VDC 100Ah Battery Banks, chargers, isolators and two-off DC Distribution Boards including primary and secondary connections.
- Supply, installation and commissioning of two-off 66kV Duplicate Line Differential Protection and Control Schemes, two-off high impedance Duplicate Bus Zone Protection and Control Schemes and four-off CB Management Schemes arranged as two schemes on one panel.
- Supply, installation and commissioning of twelve-off Feeder Protection Schemes arranged as four schemes on each panel, three-off Duplicate Transformer Protection & Control Schemes, three-off

Duplicate Bus Zone Schemes, five-off CB Management Schemes, Master & Back-up Earth Fault Protection Schemes and three-off Capacitor Bank Protection & Control Schemes.

- Supply, install, configure and commission a SCADA System including connection to all IEDs.
- Supply and install engineering workstation, one-off Local Alarm Panel, and one-off Power Quality Meter.
- Supply and installation of communication services including a Digital Communications Cabinet and Data Interface Cubicle.
- Replacement of up to four existing fire hydrants, twenty 400W halogen fittings with equivalent LED units and installation of up to seven-off Spector CCTV cameras.
- Demolition of the 22kV switchyard including disposal of all equipment and demolition of footings to 300mm below surface and make good.
- Allowance to modify existing control room including floor make good, install single roller door, cable handling equipment, strip out of existing buildings and make good including an allowance for asbestos removal and disposal.

2.2 Coburg South (CS) ZSS Redevelopment

- Supply and install modular 22kV Capacitor Bank, 6Mvar, including footings, earthing, primary and secondary connections. It is allowed to install this with a new protection and control scheme.
- Demolish and dispose of existing capacitor bank no 1 and make good the room for use as a relay room. Supply and installation of cable tray and earthing facilities for the room. We have allowed to recertify the crane hoist and to, supply and install a one tonne electric hoist to assist the project implementation.
- Replace existing 66kV bus tie circuit breaker with a 66kV DTCB including structure, earthing, primary and secondary connections.
- Modify the TTS exit including the replacement of the isolator with a 66kV 2500A Motorised Rotary Disconnect including Earth Switches, replacement of the VTs with three-off 66kV MVTs mounted on stands and replacement of the surge diverters with three-off 66kV surge diverters mounted on the wall above the cable head. This includes replacement of the structures, earthing, primary and secondary connections as applicable to all equipment.
- Modify the CN exit including the replacement of the isolator with a 66kV 2500A Motorised Rotary Disconnect including Earth Switches, replacement of the VTs with three-off 66kV MVTs and replacement of the surge diverters with three-off 66kV surge diverters mounted on the wall above the cable head. This includes replacement of the earthing, primary and secondary connections as applicable to all equipment.
- Replacement of the transformer disconnects with three-off 66kV 800A Motorised Rotary Disconnects including 2 Earth Switches including structure, earthing, primary and secondary connections.
- Replace eight-off existing overhead feeders from the transformers and Cat banks with the 22kV Cable of 300mm^2, 3 Core, Al Conductor Underground Cable and Direct Buried to the new building including termination equipment and allowance for connection and disconnection.
- Replacement of up to sixty cone earthing receptacles with spherical earthing receptacles on the 66kV equipment.
- Replacement of the existing transformer 66kV turrets and CTs, secondary cabling to connect to the new protection and control schemes plus an allowance of $25,000 per transformer to convert the transformers for operation at 110VDC.
- Replacement of the existing earth and NER switches on the existing transformers including supply and installation of CTs.

- An allowance to clean the existing transformers, transformer bund areas, repair identified surface rust and touch up the paint on the existing transformers. We have excluded repair of other oil leaks on the existing transformers.
- Supply and installation of new transformer 22kV primary connections comprised of three-off 22kV 630mm^2 cables per phase installed in conduits.
- We have allowed for recommissioning of the transformers after the above modifications and connection to the new protection and control schemes.
- Modifications to existing main transformers include, and allowance to modify transformer controls for 110VDC, replace transformer HV turrets and CTs, Clean transformers and transformer bund areas, touch up paint, oil leak rectification excluded, replace existing earth and NER switches on transformers and testing & commissioning Labour.
- We have allowed for building works to progressively install the two new 22kV switchboards including for No 3 Bus:
    - Erection of a temporary wall between No 2 Bus and the demolition site.
    - Concrete cutting of the floor and non-destructive digging (NDD) of an 8 x 4 x 1.9 metres pit including disposal of the spoil;
    - Construction of a cable pit up to 3.5 metres wide including steel supports for the 22kV switchboard and trench covers. It is allowed to backfill around the pit, make good the concrete floor and install trafficable covers around the switchboard aperture.
    - Supply and install ten-off 150mm conduits from the pit to the area outside of the western wall including boring through the existing building footing. We have allowed for concrete cutting, NDD and reinstatement of the concrete floor after conduit installation.
    - Supply and install three-off 150mm conduits from the pit to the No 3 transformer enclosure including boring through the existing building footings. We have allowed for concrete cutting, NDD and reinstatement of the concrete floor after conduit installation.
    - Supply and installation of No 3 22kV Switchboard including one-off transformer circuit breaker, one-off bus tire circuit breaker and joggle, four-off feeder circuit breakers and one-off capacitor bank circuit breaker including earthing, spares, primary and secondary connections.
    - Temporary connection of the No 2 Transformer to the No 3 Bus by installing a temporary 22kV cable arrangement comprised of two-off 630mm^2 copper cored XLPE cables from the existing No 2 Transformer 22kV transformer bushings, along the surface of the ground with mechanical protection to the No 3 transformer enclosure and using the existing conduits to connect to the No 3 22kV Bus incomer.
    - Transfer of four feeders from No 2 Bus to No 3 Bus. We have allowed for supply and installation of new 22kV 300mm^2 cables of up to 200 metres each, direct buried in road or footpath easements including pavement removal and reinstatement and up to 30 metres of boring for each cable. These have been allowed to be connected to existing poles.
- We have allowed for building works to progressively install the two new 22kV switchboards including for No 2 Bus:
    - Erection of a temporary wall between No 1 Bus and the demolition site.
    - Disconnection and disposal of the existing No 2 Bus Switchboard including existing primary connections to the No 2 Transformer Bay. Note that no allowance has been made for temporary connection between the existing No 1 22kV Bus and the new No 3 22kV Bus.
    - Concrete cutting of the floor and non-destructive digging (NDD) of an 8 x 4 x 1.9 metres pit including disposal of the spoil;
    - Construction of a cable pit up to 3.5 metres wide including steel supports for the 22kV switchboard and trench covers. It is allowed to backfill around the pit, make good the concrete floor and install trafficable covers around the switchboard aperture.

  - Supply and install ten-off 150mm conduits from the pit to the area outside of the western wall including boring through the existing building footing. We have allowed for concrete cutting, NDD and reinstatement of the concrete floor after conduit installation.
  - Supply and installation of No 2 22kV Switchboard including one-off transformer circuit breaker, one-off bus tire circuit breaker and joggle, four-off feeder circuit breakers and one-off capacitor bank circuit breaker including earthing, primary and secondary connections.
  - Removal of the temporary wall between No 2 and No 3 Bus.
  - Temporary connection of the No 1 Transformer to the No 2 Bus by installing a temporary 22kV cable arrangement comprised of two-off 630mm^2 copper cored XLPE cables from the existing No 1 Transformer 22kV transformer bushings, along the surface of the ground with mechanical protection to the No 2 transformer enclosure and using the existing conduits to connect to the No 2 22kV Bus incomer.
  - Transfer of four feeders from No 1 Bus to No 2 Bus. We have allowed for supply and installation of new 22kV 300mm^2 cables of up to 200 metres each, direct buried in road or footpath easements including pavement removal and reinstatement and up to 30 metres of boring for each cable. These have been allowed to be connected to existing poles.

- We have allowed for building works to progressively install the two new 22kV switchboards including for No 1 Bus:
  - Disconnection and disposal of the existing No 1 Bus Switchboard including existing primary connections to the No 1 Transformer Bay.
  - Concrete cutting of the floor and non-destructive digging (NDD) of an 8 x 4 x 1.9 metres pit including disposal of the spoil;
  - Construction of a cable pit up to 3.5 metres wide including steel supports for the future 22kV switchboard and trench covers. It is allowed to backfill around the pit, make good the concrete floor and install trafficable covers around and across the switchboard aperture. We have allowed for a sump and automated sump pump including alarms to the SCADA.
  - Supply and install ten-off 150mm conduits from the pit to the area outside of the western wall including boring through the existing building footing. We have allowed for concrete cutting, NDD and reinstatement of the concrete floor after conduit installation.
  - Rerouting of the No 1 Transformer connection through the No 1 Transformer Bay conduits and the new cable pit to connect to the No 2 22kV Bus incomer. We have allowed for mechanical protection of the HV cable in the cable pit.
  - Rerouting of the No 2 Transformer connection through the No 2 Transformer Bay conduits and the new cable pit to connect to the No 3 22kV Bus incomer. We have allowed for mechanical protection of the HV cable in the cable pit.
- Supply and installation of two 100kVA kiosk transformers, primary connections and changeover board to connect to the existing main AC switchboard.
- Supply and installation of duplicate 110VDC 100Ah Battery Banks, chargers, isolators and two-off DC Distribution Boards including primary and secondary connections. We have allowed to temporary locate one battery bank to enable refurbishment of the existing battery room. We have allowed to remove the existing battery banks and accessories, make good the room, repaint and replacement of ventilation.
- The protection and control schemes will be located in two rooms. We have allowed for supply and installation of cable tray and up to 1200m of 12-core 2.5mm2 cables and 400m of 12-core fibre installed on tray between the two rooms. This is additional to the normal cabinet interconnection cabling allowed with each control and protection scheme.
- Supply, installation and commissioning of two-off 66kV Duplicate Line Differential Protection and Control Schemes using the existing relays and one-off 66kV CB Management Scheme.

- Supply, installation and commissioning of eight-off Feeder Protection Schemes arranged as four schemes on each panel, two-off Duplicate Transformer Protection & Control Schemes, two-off Duplicate Bus Zone Schemes, three-off CB Management Schemes and Master & Back-up Earth Fault Protection Schemes.
- We have allowed for each IED to be connected to the existing SCADA system including provision installation, configuration and commissioning of new communications modules.
- Supply and install one-off Local Alarm Panel, and one-off Power Quality Meter.
- Extension of the existing earth grid for the No 1 Capacitor Bank and the new earthing equipment.
- Allowance to dress the surface, replace the entrance gates with palisade gates, replace the timber fence on the northern side, the security fence on the eastern side and external signage.
- We have allowed to replace all windows on the first floor, brick up ground floor windows, replace all external doors, improve lighting at ground floor, emergency lighting upgrade and epoxy coat the switchroom floor. We have not included the repair of the 66kV switchgear room ceiling as this would require complete substation shutdown. We have included an allowance of $100,000 for assessment and repair of unspecified building defects.
- Replacement of up to twelve external 400W halogen fittings with equivalent LED units, replacement of up to 120 internal light fittings with equivalent LED units and installation of up to seven-off Spector CCTV cameras.

2.3 East Preston (EPN) ZSS Conversion Program, Stage 6

The works have been staged as outlined below to enable the works to be undertaken without substantial outages of the existing plant.
It has been allowed to replace transformer No. 1 by extending the existing new 66kV switchyard to the south and then the installation of a new transformer to the south of the latest transformer:

- Retire and relocate feeders from No 1, 2 & 3 6.6kV Bus to No 4 & 5 Bus:
  - Retire EP4 EP11 and EP18 feeders by rearranging pole top connections.
  - Transfer feeders EP7, EP9 & EP16 to EP32, EP33 & EP28 by recommissioning the circuit breakers and protection schemes and installing 300mm^2 Al 3-cored XLPE cables from the circuit breakers to the respective pole tops.
- Decommission Cap Bank 1 by switching out, removing final primary connections and marking out of service.
- Remove and dispose of all 6.6kV switchgear from Switch House A and demolish the building. The adjacent relay house will be retained. We have allowed to make good walls and roof.
- Construction of new 150m^2 switchroom building adjacent the existing EPN building including building support, wall, piers, platforms & stairs.
- Installation of a 66kV bypass from the No 3 66kV EPN Transformer the EP No 2 66kV Bus by the installation of two poles and primary connections. We have allowed for rework of the protection and control systems to enable this bypass to operate during the replacement of the EP No 1 Transformer.
- Demolition of Transformer No. 1 plus 66kV equipment including an allowance for excavation of up to two metres deep and disposal of contaminated and non-contaminated soil.
- We have allowed to excavate up to two metres deep to remove contaminated soil to Category B from the site immediately below and adjacent the removed transformer. We have allowed for the excavation to be backfilled with suitable crushed rock.
- Supply and installation one-off 66kV DTCB including footings, earthing, primary and secondary connections.

- Supply and installation of three-off 66kV 2500A Rotary Disconnects including earth switches, footings, earthing, primary and secondary connections.
- Supply and installation of one-off 66kV 800A Rotary Disconnect including earth switches, footings, earthing, primary and secondary connections.
- Supply and install new EPN No 2 Transformer, 66/22kV 20/33MVA, including footings, three-sided noise enclosure, oil containment, drainage, earthing, primary and secondary connections.
- Supply and install a new 22kV switchboard including:
  - One-off 22kV Indoor Switchgear, Bus Tie
  - One-off 22kV Indoor Switchgear, Transformer
  - Four-off 22kV Indoor Switchgear, Feeder
  - One-off 22kV Indoor Switchgear, Capacitor Bank
  - Supply and install additional bus joggle to connect to existing switchboard
- We have allowed to connect to the existing EPN switchboard by cable. We have allowed for one-off 22kV bus riser to connect to existing switchboard and a bus tie cable comprised of two-off 630mm^2 copper XLPE cables per phase.
- Supply and installation of one-off transformer 22kV cable comprised of 80 metres of 2 x 630mm^2 copper XLPE Cables per phase, direct buried and an NER cable comprised of one-off single cored 185mm^2 copper XLPE cable, direct buried.
- No feeders have been allowed to connect to the new switchboard. We have allowed for the installation of six-off conduits up to 10 metres from the new switchgear building to the adjacent boundary fence only.
- We assume that the existing earth grid is in good condition. We have allowed for the provision of new switching and earthing equipment in the new switchroom.
- We have allowed to redress all switchyard surfaces.
- We have allowed for the reinstatement of roadway and surfaces external to site that have been damaged by the project works.
- Allowance to augment outdoor lighting with two additional lighting towers for the new transformer.
- Supply, installation and commissioning of a duplicate high impedance bus protection scheme and circuit breaker management scheme for the new circuit breaker.
- Supply, installation and commissioning of a duplicate transformer protection and control scheme, four-off feeder protection and control schemes on one panel, duplicate bus protection and control and two-off 22kV circuit breaker management schemes to be mounted on the above protection panels.
- Supply, installation and commissioning of Master & Back-up Earth Fault Schemes.
- We have allowed for each IED to be connected to the existing SCADA system including provision installation, configuration and commissioning of new communications modules.
- Supply, installation and commissioning of a local alarm panel and power quality meter.
- Supply and installation of an additional 22/0.4kV 100kVA kiosk transformer, AC Changeover Board and AC Distribution Board including primary and secondary connections.
- Supply and installation of duplicate 110VDC 100Ah Battery Banks, chargers, isolators and two-off DC Distribution Boards including primary and secondary connections.
- Supply, install and commission one-off Data Interface Cubicle, IEC 61850 Compliant.
- Allowance to relabel existing equipment in EP.
- Site testing including soil, earth resistance, etc.

2.4 Broadmeadows (BD) Transformer Replacement

We have allowed for No 2 Transformer to be taken out of service during the low load period and a new transformer enclosure and transformer to be installed in its place:

- Disconnection and demolition of No 2 Transformer for transport.
- Construction of a concrete pad and bund walls at AW Zone Station including underground pipework to the existing network.
- Transport and delivery including cranage of the existing No 2 Transformer to the pad prepared at AW.
- We have allowed for excavation up to two metres deep to remove Category B contaminated soil from the site immediately below and adjacent the removed transformer. We have allowed for the excavation to be backfilled with suitable crushed rock.
- Supply and Install new No 2 Transformer, 66/22kV 20/33MVA, including footings, three-sided noise enclosure, oil containment, drainage, earthing, primary and secondary connections to the existing protection schemes in the new control building.
- Supply and installation of a 66kV 800A Rotary Disconnect including primary connections.
- Supply and installation of a 22kV dead tank circuit breaker installed in an outdoor enclosure, a set of underslung disconnects, earthing, primary and secondary connections.
- Supply and installation of transformer 22kV cables comprised of two off 630mm^2 single core, Cu conductor XLPE cables per phase, installed in conduit.
- Allowance for dressing of the surface with crushed rock.
- Allowance to modify the existing SCADA for new equipment interface.
- Allowance for site testing.
- CCTV camera installation is excluded.
- Lighting improvements are excluded.

2.5 North Essendon (NS) ZSS Secondary Equipment Replacement

- Replacement of secondary cables from the existing 22kV circuit breakers including:
  - 12 off feeder circuit breakers
  - Two-off bus tie circuit breakers and
  - One-off metering panel.
- Remove redundant panels and fit inserts to enable the installation of 19” panels into the existing tunnel board.
- Supply, install and commission three HV feeder protection panels with four feeders per panel
- Supply, install and commission three duplicate bus zone protection and control schemes.
- Supply, install and commission main earth fault and back-up earth fault protection schemes.
- Allowance for each IED to be connected to the existing SCADA system including provision installation, configuration and commissioning of new communications modules.
- Supply and install new RSG2488 Ethernet Switch

2.6 North Heidelberg (NH) Secondary Equipment Replacement

- At NH, replacement of the existing TTS-NEI-NH 66kV pilot protection scheme with a current differential protection scheme. This replacement includes an allowance to rework the existing

cabinets for the new scheme and installation of a new multiplexer in the existing communications cabinet.

- At NEI, replacement of the existing TTS-NEI-NH 66kV pilot protection scheme with a Current Differential Protection Scheme. This replacement includes an allowance to rework the existing cabinets for the new scheme and installation of a communications cabinet including multiplexers to connection to the remote schemes.
- At TTS, all works to be done by others. No allowance has been provided for any works at TTS.
- Replace the existing No 2 66kV Bus overcurrent protection relay.
- Replacement of the GPS clock at NH.
- Replacement of three-off protection multiplexers in the existing cabinet at NH.
- Replacement of the No 1 Transformer overcurrent relay and install a new inter-trip relay.
- Replace the existing No 1 & 2 22kV Bus overcurrent protection relays and high impedance differential relays.
- Replace the existing No 3 22kV Bus high impedance differential relay.
- Replacement of the existing SCADA system including connection to all existing IEDs and IO.
- Replacement of two-off RSG2488 switches.

3.0 Comparison of Project Costs

3.1 Benchmarks

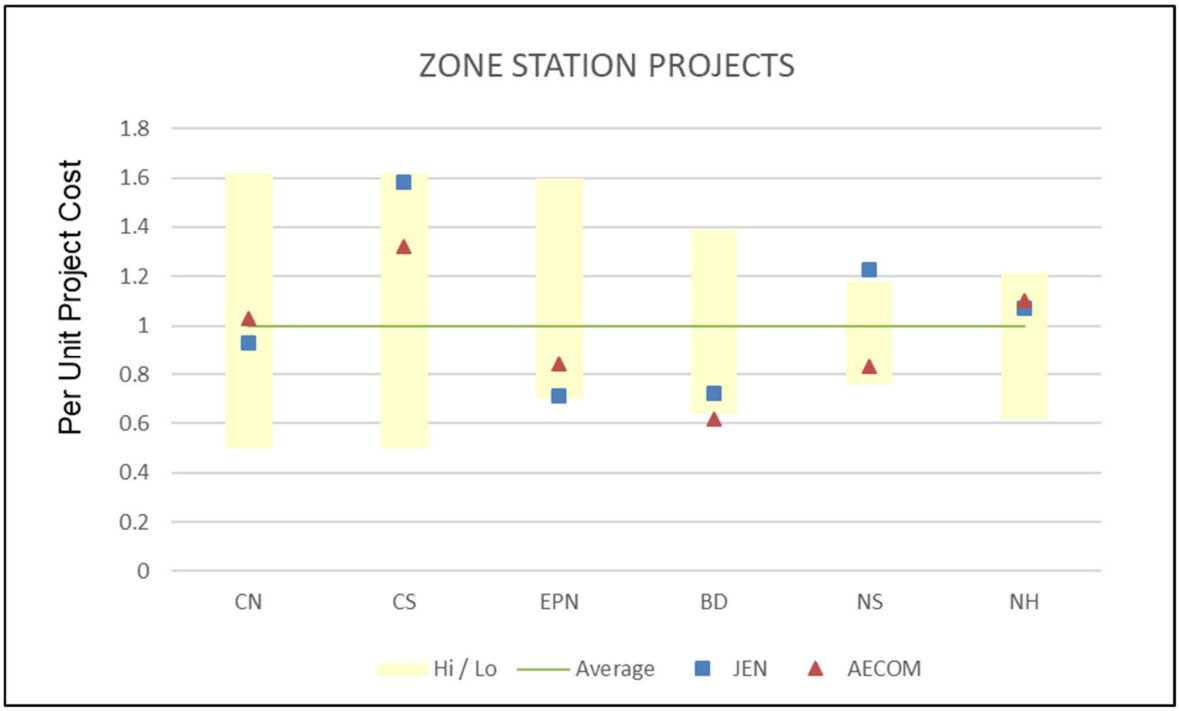
Benchmarks have been established by AECOM based on actual project costs and cost estimates.

ITEM	DESCRIPTION	BENCHMARK	LOW	HIGH
1	Coburg North	Replacement of 3-Bus HV Switchboard	$5.5M	$18.0M
2	Coburg South	Replacement of 2-Bus HV Switchboard	$3.7M	$12.0M
3	East Preston	Replacement of 66/22kV Transformer and 1-Bus HV Switchboard	$5.4M	$12.4M
4	Broadmeadows	Replacement of 66/22kV Transformer	$3.0M	$6.4M
5	North Essendon	Replacement of 19-off protection schemes	$1.11M	$1.7M
6	North Heidelberg	Replacement of 11-off protection schemes & RTU	$1.09M	$2.3M

The projects range from projects with minor additional works to construction of new switch gear / control buildings and major works in the sub-transmission switchyards.

The AECOM cost includes the direct cost of using an approved contractor to undertake all works. Jemena direct labour and plant costs to undertake the project is included. We have not included Jemena overheads or fixed costs. No risk component has been included in the estimates or costs represented in this report. The AECOM guidelines indicate that a nominal contingency of 15-20% should be applied to cost estimates of this class.

3.2 Comparison of Projects



Coburg North:

The Coburg North project includes the establishment of a new control / switchgear building and replacement of all auxiliary supply and secondary equipment. The scope includes replacement of three 66kV circuit breakers and minor works on the existing transformers.

The Jemena estimate is 9% below the AECOM estimate and 7% below the average cost of replacement. These estimates are close to the average cost of HV switchboard installations and within the margin of error for a Class 4 estimate.

Coburg South:

Coburg South is a multi-level indoor station using outdoor 66kV switchgear. The project includes the replacement of the existing two-bus switchboard in the existing building. Due to restrictions in the existing building the scope includes the demolition of the existing 6 MVAr capacitor bank with a modular outdoor unit to develop a second relay room and rework of the existing switchroom. Jemena have elected to retain the existing protection and control room and provide interfacing cabling from the new relay room.

The Jemena estimate is 20% above the AECOM estimate and 58% above the average cost of HV switchboard installations. It is 2% below the highest recorded cost for HV switchboard replacements. The AECOM estimate is 32% above the average cost which reflects the additional works required in an indoor substation.

The cost deviation from the average cost is due to the high cost of replacement of each of the feeder cables to the existing cable head poles, the modular capacitor bank and building modifications.

East Preston

The East Preston Zone Station is currently being modified from a 66/6.6kV station to a 66/22kV station. This stage includes the replacement of an existing transformer, construction of a new switchgear building and single bus 22kV switchboard to be connected by cable to the existing 22kV switchboard.

The Jemena estimate is 15% below the AECOM estimate and 29% below the average cost of replacement.

The estimate is below the average cost as this project is part of a staged upgrade of the zone station with much of the infrastructure replacement completed in previous stages. Also, this project does not include feeder modifications for connection of the existing feeders to the new 22kV switchboard.

Broadmeadows

This is a simple replacement of a 66/22kV transformer in situ with the replacement of the immediate 66kV isolator and 22kV outdoor circuit breaker only. The protection and control schemes have recently been upgraded and integration only is included in this project.

The Jemena estimate is 16% above the AECOM estimate and 28% below the average cost of replacement. This deviation is to be expected given the simple nature of the replacement and within the margin of error for a Class 4 estimate.

North Essendon

North Essendon Zone Station has been upgraded over the last few years including replacement of primary equipment. This project includes the replacement of the remaining protection and control schemes.

The Jemena estimate is 48% above the AECOM estimate and 23% above the average cost of replacement. It is 4% above the highest recorded cost for protection scheme replacements. The AECOM estimate is 17% below the average cost which reflects the relative simple nature of these replacements.

AECOM has been unable to determine the reasons for the Jemena estimate being above the expected range.

North Heidelberg

This project includes the replacement of the existing RTU and 12 protection and control schemes.

The Jemena estimate is 3% below the AECOM estimate and 7% above the average cost of replacement. It is 4% above the highest recorded cost for protection scheme replacements. These estimates are close to the average cost of these replacements and within the margin of error for a Class 4 estimate.

Overall, AECOM considers that Jemena estimates for the ZSS program of works is within the industry range and in accordance with expectations for projects of this type given the particular requirements and constraints of each of the projects.

3.3 Basis of Estimate

- These estimates comply with the requirements of AECOM Estimate Class 4, Pre-Feasibility (see Appendix B).
- The estimate has been compiled on the basis that the contract is let to the market as a design and construct lump sum contract with a detailed scope of work.
- Costs have been prepared using a mix of current and historical information from similar projects, adjusted to reflect the requirements of the proposed scheme, location and market conditions.
- The costs are based on the works being undertaken in 2018/19. No allowances for price escalations or potential exchange rate fluctuations have been included.
- Direct labour and supervision cost for Jemena staff has been included.
- No Jemena overhead or profit is included.
- No contingency / risk allowance has been allocated to these estimates.

4.0 Assumptions / Clarifications

Scope of Work:	The scope has been developed based on the reference documents listed in Appendix A of this report. No design works have been undertaken.
Working Hours:	The costs are based on works being undertaken during normal working hours unless otherwise noted. Allowance has been provided for transformer and feeder transfers to be undertaken out-of-normal-hours. Line rates include allowances for out-of-hours works as listed.
Access to the Sites:	The estimates are prepared on the basis that the contractor can gain reasonable access to sites and that remobilisation is not required to perform the works. It is assumed that all sites have access to heavy transport routes for transformer delivery. Traffic control has been included for each site in accordance with the expected requirements.
Outages:	The estimates are prepared on the basis that outages are available to undertake the works described. Unless specifically outlined in the scope of work, it is assumed that temporary works to enable outages to be provided are not required. During construction works the network may operate in a non-standard configuration.
Contaminated Soil:	Unless specifically included in the scope in Section 2, it has been allowed to retain any contaminated soil found during construction or demolition on the sites.

Asbestos Removal:	It has been allowed to demolish and remove asbestos from site where it is indicated in the scope of works in Section 2 only. It has been allowed to remove redundant protection and control panels that contain asbestos.
General Building Works:	Site assessment of works has been undertaken by limited site inspections only. We have indicated works expected to be undertaken based on this initial information and additional works may be required to prepare the stations for building and other modifications. We understand that the existing buildings are sound and do not require remediation works other than those detailed in Section 2 to undertake the works.
Feeder Connections:	Where feeders are to be relocated or reconnected to a new switchboard, etc. we have made an assessment of the local area and included the detail of this assessment in the scope of works.
Secondary Works:	It is assumed that all protection and control schemes will be mounted in cubicles or on inserts in existing protection scheme structures. It is assumed that circuit breaker management schemes will generally be mounted on the protection and control panels for the relevant lines. Where specific panels are allowed these are detailed in the scope of works.
Communications Works:	The communications works include the provision of an IEC61850 compliant scheme. This includes the provision of network connections and local area network capability within the control building only and connection to a WAN provided by others.
Geo-technical:	It is assumed that the sites are free from contaminated soils, other than the expected oil contamination in the existing transformer enclosures. An allowance of 10% of the excavated volume has been made to enable excavation and removal of friable rock from the site utilising the rock bucket on a 20 tonne excavator to enable installation of footings and cable trenches. It is assumed that the ground is of standard bearing capacity and does not require over-size footings. Unless otherwise stated, it has been allowed to retain contaminated soils on site.
Demolition & Disposal:	In general disposal is included in the cost above. For demolition and removal of transformers it is assumed that the cost of lifting and removal of transformers from site is a cost for the salvage company. It has been allowed to disconnect, drain oil and provide clear access for removal only. No allowance has been made for the disposal of asbestos contaminated building debris or equipment contaminated by PCBs.
Traffic Control:	It is assumed that local controls can be managed by the works crew for most works unless otherwise listed.

5.0 Exclusions

The following items have been excluded from this cost plan:

- Temporary works to enable outages to be provided.

- Works by AusNet Services.
- Feeder and other network modifications other than those listed in the scope of work.
- Excavation and disposal of hard rock unless otherwise noted.
- Disposal of contaminated soils or materials unless included in the scope of work.
- Handling or disposal of PCB contaminated materials.
- Changes to the SCADA master system and WAN infrastructure.
- Structural or repair works to buildings unless specifically included in Section 2.
- Controlled stormwater release from sites.
- Costs of rail easement closures or occupations.
- Statutory approvals or permits.
- Relocation of services such as Telstra, sewerage, water, drainage.
- Pre-order works including the development of detailed scopes and tendering processes.
- Jemena overheads and profit.
- Cost of land or easements.
- Cost of rectification works due to contingent events that would normally be covered by the proceeds of all works, public liability and/or professional liability insurance.
- GST.
- Escalation.
- Delay of works requiring compression costs.
- Future proofing requirements.
- Diversions to existing below ground services.

6.0 Risk

The estimates have been developed based on a high level scope, limited site inspections and information available in the public forum. During the development of the projects and design costs may vary due to various factors. The following risks outline the factors that may have major impact on the estimates:

- This estimate is based on high level information. Changes due to detailed design and analysis may vary the scope considerably.
- Network modifications to enable the works.
- Line routes.
- Latent conditions.
- Positions of buildings.
- Relocation of assets to enable stations modifications.
- Contaminated soils, asbestos and PCBs.
- Community concerns.

Appendix A

Information Provided

Document name	Revision	Date
EDPR 2021-25 HL SoW - EP Conversion Stage 6_Draft V0.1.doc	First issue	28/08/2018
SoW - Replace aged relays NS v1.0.docx	First issue	31/08/2018
ZSS BD SoW Replace Transformers SB.docx	First issue	15/10/2018
ZSS CN SoW Relay replacement_dy.docx	First issue	28/8/2018
ZSS CN SoW Replace 22kV Switchgear SB.docx	First issue	24/8/2018
ZSS CS SoW Relay replacement final.docx	First issue	20/8/2018
ZSS CS SoW Replace 22kV Switchgear SB.docx	First issue	13/8/2018
ZSS NH SoW Relay replacement.docx	1.0	31/08/2018

Appendix B

AECOM Estimate Guidelines

AECOM Estimate Class Guidelines

Purpose

The AECOM Classes of Estimate procedure has been developed to consolidate industry best practice in the classification of Project Cost Estimates. The procedure provides guidance on the typical capital cost estimate class definitions and details the typical estimate input requirements.

Scope

This procedure shall be used for the production of all capital cost estimate types across the project life cycle independent of the project delivery method undertaken by AECOM. Where Client requirements are more stringent and/or more detailed they should be used and compliance with this procedure recorded in the AECOM Estimate Plan.

Estimate Intended Level of Accuracy

Project cost estimates shall be classified according to their accuracy range. AECOM uses five estimate classes, each class being purposely aligned to standard project life cycle development phases.

Estimate accuracy is a measure of confidence in the final cost outcome for a given project being within a range expressed as a ± percentage range around a central cost estimate number.

Cost estimate accuracy is dependent on the quality and maturity of the variables available to develop an estimate. Estimate accuracy is able to be improved in parallel with the development of these variables which include such things as project scope, design development and site specific data.

Accuracy is to be applied only after contingency is included within the central cost estimate. Contingency is a calculated allowance based upon an assessment of “known unknowns” generally using risk management principles. Contingency is not the same as accuracy in cost estimating.

The key control variables for cost estimate accuracy include:

- Level of scope definition – this is the primary determinant
- Reliability and quality of pricing sources – supply and install components
- Project implementation plan including procurement strategy and master development schedule
- Available time, skill and resources to prepare the estimate
- Available time for appropriate quality of quotations from vendors and contractors.

Estimate Classes

All cost estimates prepared by AECOM shall be described as one of the following estimate classes:

- ***Class 5 (Order of Magnitude Estimate - Conceptual):*** intended level of accuracy ± 50%. Based on limited project scope definition. Generally used to determine indicative end cost values for comparison of scope or delivery method options and for initial evaluation of project economic viability. Also used for long range planning and project screening.
- ***Class 4 (Pre-Feasibility Estimate):*** intended level of accuracy ± 25%. Based on preliminary engineered project definition where the driving components of the scope are definable in terms of capacity and quantity. Used to determine indicative end costs for pre-feasibility studies, strategic planning; budget approvals and confirm project economic viability.
- ***Class 3 (Feasibility Estimate):*** intended level of accuracy ± 15%. Based on a detailed level of project documentation of both scope and project delivery methodology and where meaningful budget quotations of contractor/vendor pricing may be sourced. Represents the minimum standard for client funding requests and bankable feasibility studies.
- ***Class 2 (Detailed Estimate - Control):*** intended level of accuracy ± 10%. Based on a detailed level of project documentation where the majority of commitments have been formally tendered or

already in place. Generally used to determine final cost control baseline, supplier negotiation support, claims and dispute resolution.

- ***Class 1 (Definitive Estimate):*** intended level of accuracy ± 5%. Based on a highly detailed level of project documentation and the majority of commitments have been formally tendered and or already awarded. Virtually all engineering and design documentation, project execution and commissioning plans of the project are complete. Generally referred to as the current control estimate and becomes the new baseline for cost/schedule control of the project and also used for evaluation and /or dispute claims.

The accuracy bands of each estimate class are shown diagrammatically in Figure 1 with indications of the typical magnitude of contingency as well as probability spread.

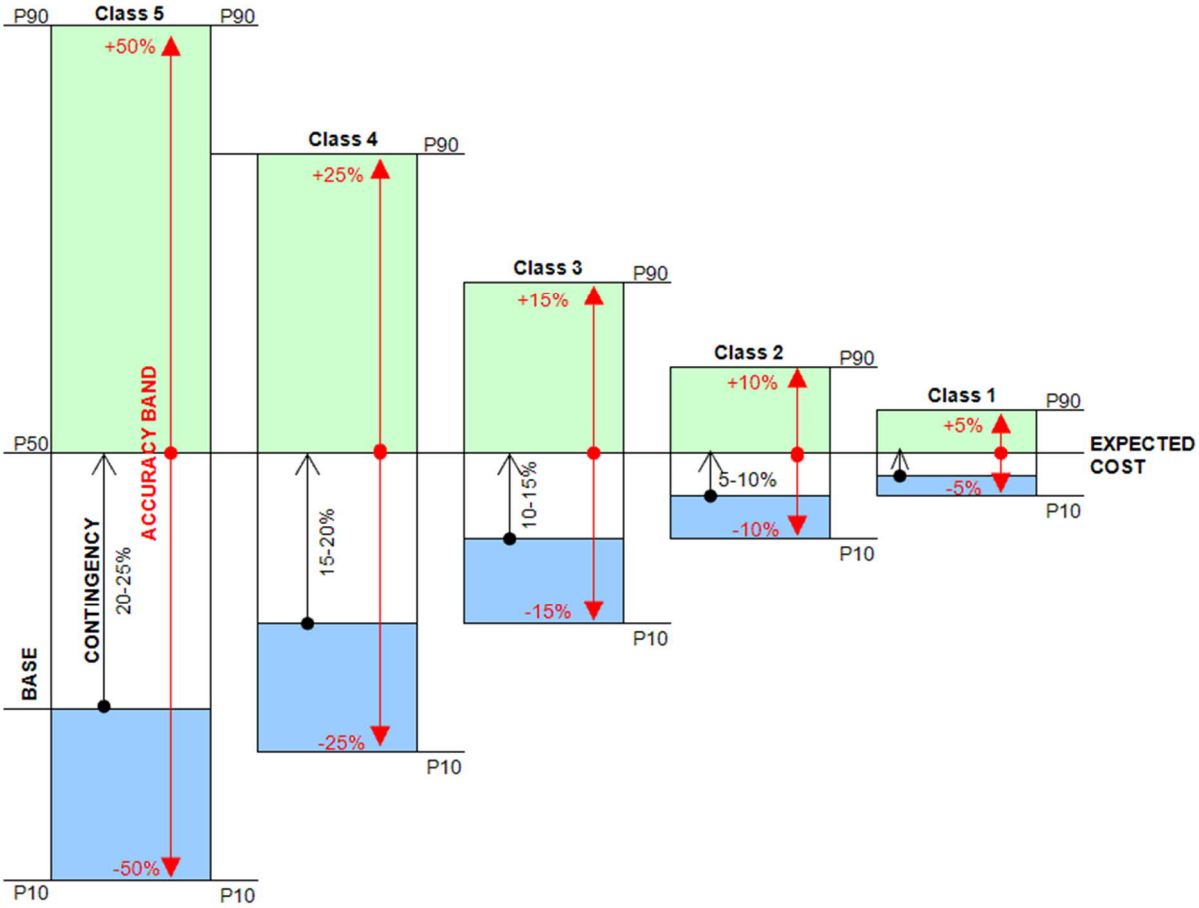


Figure 1 Accuracy Bands for Estimate Classes

Although the graphic demonstrates symmetry around the expected cost value as scope is progressively defined, experience shows that there is a tendency towards the P90 value over time.

Further definition and explanation of these estimate classes is provided in Table 1 .

For the production of capital and operating cost estimates for industrial resource type projects, detailed input requirements for each class of estimate are given in Table 2.

Table 1 Definition of Estimate Classes

Estimate Class	**5**	**4**	**3**	**2**	**1**
Name	**Order of Magnitude (Conceptual)**	**Pre-feasibility**	**Feasibility**	**Detailed/ Control**	**Definitive**
Expected accuracy range	± 50	± 25%	± 15%	± 10%	± 5%
Usage	• Indicative costs • Compari-son of options • Early economic viability • Long range planning	• Pre-feasibility studies • Strategic planning • Budget approval • Economic viability	• Feasibility Studies • Client funding • Bankable Feasibility Studies • Bidding	• Cost control final baseline • Bidding • Bid checking • Supplier negotia-tion • Claims & dispute support	• Owner's estimate check • Subcontra ctor's bid • New baseline for cost control / schedule • Evaluate and / or dispute claims
Characteri stics	• May utilises a "top down" or "bottoms up" approach • Project site not known • Based on minimal scope informa-tion • Reliance of past project data relation-ships • Minimal time & effort to prepare • Minimal cost break-downs unavailabl e	• Mostly utilises a "bottoms up" approach with many parts factored from the "driving" component • Project site located but minimal investigation • Based on limited scope information but driving items defined in terms of capacity and/or quantity • Preliminary implementatio n plan developed • Reliance on previous price knowledge plus budget quotes for major equipment and major bulk items • Project indirects are factored	• Mostly utilises a "bottoms up" first principles approach • Project site located and field investiga-tion complete • Based on preliminary design data with partial details • All equipment and major bulks identified and sized • Implementa -tion plan developed • Quotes received for all direct costs • Project indirects are mostly calculated	• Fully based on a "bottoms up" first principles approach • Scope definition detailed • Design optimised and "frozen" for driving elements • Implemen tation plan in effect • Major commit-ments formally quoted or awarded • Project field constructi on experi-ence available • Project indirects	• Fully based on a "bottoms up" first principles approach • Scope definition highly detailed • Design document ation complete • Complete project execution and commiss-ioning plans in effect • Major commit-ments awarded • Project field constructi on experi-ence available • Project indirects

Estimate Class	5	4	3	2	1
Name	Order of Magnitude (Conceptual)	Pre-feasibility	Feasibility	Detailed/ Control	Definitive
				fully calculated	fully calculated
Scope Definition	0-5 %	5-10 %	25-40 %	50-75 %	75-100 %

Selection of Estimate Class

As part of the estimate planning process, the class of estimate must be selected and agreed between AECOM and the client. This may require project specific input tables to be prepared to document the agreement.

The following should be considered when determining the class to which an estimate will belong:

- Client requirements and purpose of the estimate
- The maturity of base project criteria including design criteria and site investigations
- The level of scope definition available
- Availability of project delivery methodology and implementation plan
- Availability of appropriate pricing sources
- Available time to prepare the estimate

It must be noted that every line item in the cost estimate does not have to be estimated to the class range. The estimate accuracy range should be able to be demonstrated as being achieved on a cost weighted basis across the entire estimate. In this way the level of effort can be directed to the cost significant items which will be most effective for the project. The estimate input requirements shall be established by estimating, and be documented as a set of deliverables from the engineering, procurement and other project team members as appropriate.

Table 2 Input Requirements for Industrial Resource Projects

Estimate Class	5	4	3	2	1
Name	**Order of Magnitude (Conceptual)**	**Prefeasibility**	**Feasibility**	**Detailed/ Control**	**Definitive**
Expected accuracy range	**± 50%**	**± 25%**	**± 15%**	**± 10%**	**± 5%**
Use of estimates	**Comparison/ rejection**	**Pre-Feasibility**	**Funding**	**Control / Tender**	**Close-out**
Site Data					
Geographical Location	Assumed	General	Actual	Actual	Actual
Maps and surveys	None	If available	Available	Detailed	Detailed
Soil and foundations tests	None	Preliminary	Essential	Final	Final
Site visits by project team	Possibly	Recommended	Essential	Essential	Essential
Process					
Process flow sheets	Assumed	Preliminary	Optimised	Finalised	Finalised
Bench-scale tests	Not needed	Recommended	Essential	Essential	Essential
Pilot plant tests	Not needed	Recommended	Recommended	Essential	Essential

Estimate Class	5	4	3	2	1
Name	**Order of Magnitude (Conceptual)**	**Prefeasibility**	**Feasibility**	**Detailed/ Control**	**Definitive**
Expected accuracy range	**± 50%**	**± 25%**	**± 15%**	**± 10%**	**± 5%**
Use of estimates	**Comparison/ rejection**	**Pre-Feasibility**	**Funding**	**Control / Tender**	**Close-out**
Energy and matl balance	Not needed	Preliminary	Optimised	Finalised	Finalised
Equipment list	Not essential	Preliminary	Finalised	Finalised	Finalised
Facilities Design					
Nature of facilities	Conceptual	Possible	Probably	Actual	Actual
Plant capacity	Preliminary	Preliminary	Optimised	Finalised	Finalised
Equipment selection	Hypothetical	Preliminary	Optimised	Finalised	Finalised
GA's, mechanical	None	Preliminary	Optimised	Complete	Complete
GA's, structural	None	Preliminary	Optimised	Complete	Complete
GA's, other	None	Preliminary	Optimised	Complete	Complete
Piping drawings	None	One-line	One-line	Detailed	Detailed
Electrical drawings	None	One-line	One-line	Detailed	Detailed
Specifications	None	Performance	General	Detailed	Detailed
Basis for Capital Cost Estimating					
Quantification (MTO's):					
Civil work	Factored	Prelim drawing	Detailed	Detailed	Detailed
Structural work	Factored	Prelim drawing	Detailed	Detailed	Detailed
Mechanical work	Approx qty	Equipment list	Equipment list	Equipment list	Equipment list
Piping work	% of equipment	% of equipment	Approx quantities	Detailed incl. fittings	Detailed incl. fittings
Electrical work	% of equipment	% of equipment / $ per kW	Prelim schedules	Detailed	Detailed
Instrumentation	% of equipment	% of equipment	Prelim list	Detailed list	Detailed list
Pricing					
Equipment costs	Factored / Previous	Single budgetary	Multiple budgetary	Competitive	Actual
Bulk material costs	Factored / Previous	Single budgetary	Multiple budgetary	Competitive	Actual
Installation costs	Factored / Previous	Previous	Budgetary	Competitive	Actual
Services costs	% of directs	% of directs	Calculated	Competitive	Actual
Other indirect costs	% of directs	% of directs	Calculated	Competitive	Actual
Contingency	% of total	Calculated	Calculated, Monte Carlo	Calculated, Monte Carlo	Calculated, Monte Carlo
Project programme	Simple bar chart	Bar chart, CP	CP network	CP network	CP network
Basis for Operating Cost Estimate					
Labour quantities	Factor on previous	Calculated	Calculated	Actual	Actual
Labour rates	Factor on previous	Investigate	Current	Actual	Actual
Power costs	Factor on previous	Previous	Budget quote	Actual	Actual

Estimate Class	5	4	3	2	1
Name	**Order of Magnitude (Conceptual)**	**Prefeasibility**	**Feasibility**	**Detailed/ Control**	**Definitive**
Expected accuracy range	**± 50%**	**± 25%**	**± 15%**	**± 10%**	**± 5%**
Use of estimates	**Comparison/ rejection**	**Pre-Feasibility**	**Funding**	**Control / Tender**	**Close-out**
Fuel costs	Factor on previous	Previous	Budget quote	Actual	Actual
Process consumables	Factor on previous	Previous	Budget quote	Actual	Actual
Contracted operations	Factor on previous	Previous	Budget quote	Actual	Actual
Maintenance	Factor on previous	% of capital	% of capital	Calculated	Calculated
Administrative	Factor on previous	% of OpEx	Calculated	Calculated	Calculated
Expected contingency range	20–25%	15–20%	10–15%	5–10%	0-5%

For the production of capital and operating cost estimates for commercial building projects, detailed input requirements for each class of estimate is given in
Table 3.

Table 3 Input Requirements for Commercial Building Projects

Estimate Class	**5**	**4**	**3**	**2**	**1**
Name	**Order of Magnitude (Conceptual)**	**Prefeasibility**	**Feasibility**	**Detailed/ Control**	**Definitive**
Expected accuracy range	**± 50%**	**± 25%**	**± 15%**	**± 10%**	**± 5%**
Use of estimates	**Comparison/ rejection**	**Pre-Feasibility**	**Funding**	**Control / Tender**	**Close-out**
Site					
Geographical location	Assumed	General	Actual	Actual	Actual
Maps and surveys	None	If available	Available	Detailed	Detailed
Soil and foundation tests	None	Preliminary	Essential	Finalised	Finalised
Site visits by project team	Possibly	Recommended	Essential	Essential	Essential
Facilities Design					
Nature of facilities	Conceptual	Possibly	Probably	Actual	Actual
Architect's concept	Sketch	1:500	1:200	Finalised	Finalised
Mechanical services	None	Preliminary	Optimised	Detailed	Complete
Structural concepts	None	Preliminary	Optimised	Detailed	Complete
Finish schedules	None	Preliminary	Optimised	Detailed	Complete
Equipment selection	Hypothetical	Preliminary	Optimised	Finalised	Finalised
Piping drawings	None	One-line	One-line	Detailed	Detailed
Electrical drawings	None	One-line	One-line	Detailed	Detailed
Specifications	None	Performance	General	Detailed	Detailed
Site infrastructure	None	Preliminary	Optimised	Detailed	Detailed
Basis For Capital Cost Estimating					
Quoted unit rates	Previous	Single source	Multiple	Competitive	Competitive
Civil work	Rough sketch	Drawing	Take-off	Take-offs	Take-offs
Structural work	Rough sketch	Preliminary drawings	Take-off	Take-off	Take-off
Mechanical services	$ per SM	$ per SM	Take-off	Take-off	Take-off
Electrical work	$ per kW	$ per kW	Take-off	Take-off	Take-off
Indirect costs	% of total	% of total	Calculated	Calculated	Calculated
Project programme	Simple bar chart	Bar chart, CP	CP network	CP network	CP network
Expected contingency range	20–25%	15–20%	10–15%	5–10%	0-5%

Records

The records that are to be retained relating to estimate classes are the project Estimate Plan which will state the Class of Estimate to be used and any project specific estimate input requirements that deviate from this procedure.

References

The key reference document used is the “Project and Cost Engineers Handbook”, 4th Edition, Kenneth K. Humphreys, Association for the Advancement of Cost Engineering (AACE), 2005.

This procedure when followed will ensure that cost estimates are intended to be prepared in accordance with the guidelines of the following associations:

1. Association for the Advancement of Cost Engineering (AACE)
2. The Australian Cost Engineering Society (ACES).

Other documents that should be referenced for project estimating include the following procedures:

CPGH005	Capital Cost Estimating (CapEx) Guideline
CPGH006	Operating Cost Estimating (OpEx) Guideline
CPGH007	Services Cost Estimating Guideline