ELECTRICITY NETWORKS

Asset Strategy & Performance

Functional Scope

Executive Summary	Celestial Ave (WA) Zone Substation (ZSS) is a fully operational ZSS with three 66/11kV transformers operating within the CBD. The current asbestos register notes the presumed presence of asbestos used as packing and bungs on Tx 1 & 2 and within the CB room, it appears a nominal amount. The current PCB register lists Tx No 1 & 2 as containing PCB along with feeder CB's. Taking the above into account, there is the potential for contaminated soil containing PCB's at this site.
Project Summary:	Replace the 66/11kV No. 1 and 2 Transformers at Celestial Avenue (WA) Zone substation. The scope of work includes primary and secondary design, associated civil & structural works, and procurement of two new transformers, installation and commissioning.

Comments:

Associated Projects:

There are no other known projects associated with this project. Other tasks in the vicinity may be carried out concurrently including repairs and maintenance.

PROJECT REQUIREMENTS

1. Project Objective

Replace the aged 66/11kV No. 1 and 2 Transformers at WA Zone substation with CP-2 type power transformers, complying with the CitiPower and Powercor Material and Technical specification for Zone Substation Power Transformers (ZD101 version 10).

2. Broad Functional Requirements

Replace existing WA No 1 & 2, 20/27MVA Transformers with new 20/27MVA ONAN/ODAF transformers (CP-2 type as per ZD101 specification) undertaking civil structural, primary and secondary electrical works, installation, including testing and commissioning to bring the new transformers into service.

There shall not be a change to the current network functional aspect of the No. 1 and 2 transformers other than the additional requirements raised due to the introduction of new two transformers in to the network and their upgraded control and protection philosophy requirements.

3. Detailed Functional Scope of Work

3.1 Primary Plant Required

The current WA ZSS transformers are Wilson 66/11kV, 20/27 MVA, rated with an ONAN/ODAF cooling arrangement and DY1 vector grouping. They are located on the ground floor of a multi-level building between Celestial Avenue and Heffernan Lane.

The 66kV cables enter the building through underground PVC conduits encased in concrete and terminate onto a tubular busbar which is installed above the transformers. Flexible dropper connections are used to between the busbar and transformer HV terminations.

The 11kV exits the transformer enclosures into a cable tunnel which traverses under the building to the 11/6.6kV switchroom. The 11kV cables enter the switchroom underneath their respective switchboards.

The 66/11kV replacement transformers will be procured in accordance with CitiPower transformer specification ZD101 for a CP-2 type unit with a rated capacity of 20/27 MVA. The transformer cooling radiators will remain detached due to the building arrangement.

The 66kV connections are via overhead strung conductors onto exposed HV transformer bushing which penetrate through the enclosure roof. The 11kV connections are via underground cables to the adjacent 11kV series reactors and to the 11kV switchboard.

The following detailed design works required are:

- Procure two 20/27 MVA, 66/11kV, ONAN/ODAF/ODAF(E), DYn1 vector grouping with detached radiators.
- Decommission and remove the existing No.1 and No.2 transformers.
- Assess current bunded enclosure to determine suitability of accommodating the new transformer and provide safe entry and egress. Ensure all clearances comply with standards.
- Modify the overhead 66kV transformer connections to align with the new HV bushings.
- Replace existing 11kV transformer cables with 2x 1,000mm2 cables per phase.
- Assessment of the transformer cable terminations at the 11kV switchboard.
- Assess and modify transformer earthing arrangement as necessary.

- Provide conduit/cable ladder or trays for all cabling from the transformer enclosures to various locations for transformer operation.
- Ensure Factory and Site Acceptance Testing results comply with CitiPower requirements.
- Arrange earth grid testing to ensure existing earth grid is compliant.
- Create/modify associated labels to meet CitiPower standards.
- Prepare ordering documentation for parts and material.
- Provide construction support.
- Provide noise assessment support for sound-proofing

The design shall confirm the oil volume and ensure appropriate discharge into the existing oil containment system.

Verification of the new conductors and cables are suitably rated for the transformer operational capabilities.

Ensure sufficient lighting in accordance with operational health and safety requirements in and around the transformer enclosure.

3.2 Civil Works Required

Civil design is to provide detailed design for the installation of both new 20/27MVA ONAN/ODAF transformers. Transformer No 2 design shall be completed in parallel to transformer No 1 design work.

Access arrangements:

- Provide necessary access to mobilise the old and new transformers from and to the site.

New Transformers:

- Modify indoor foundation for new No1 & 2 Transformers as necessary.
- Modify indoor foundation for new No1 & 2 Transformer radiator banks as necessary. Design and positioning of the new radiators to gain the maximum benefit of natural convection to be reviewed to avoid the use of forced ventilation.
- Connection throughout the installations and attachments to the building to be reviewed to minimise propagation of vibration and resulted increased noise.
- Review and modify the bunding system of No1 & 2 transformer bays to comply with CitiPower/Powercor standard SA051. The bund installation shall make provision to future oily water treatment installation.
- The fire deluge system structure is to be reviewed and modified including correct positioning of fire detection and spray arrangement to suit to the new transformers.
- Install, as necessary, additional cable ducts for secondary wiring from control room to new No1 & 2 Transformers.
- Structural assessment of cable tunnels
- Structural assessment of structures being modified/reused.

3.3 Switchyard Lighting

Conduct a lighting study in and around the vicinity of the transformer enclosure to assess any impact and update as required.

3.4 Building & Property Considerations

The existing control room on site is to accommodate all the new secondary equipment and wiring.

The existing indoor building arrangement for the old transformers is known to cause ventilation issues. This needs to be considered by introducing proper ventilation system for new transformers to function at their designed efficiencies.

3.5 Recoveries

All primary and secondary equipment removed from the existing installation shall be assessed for serviceability and adequacy for spares holding requirements. Where equipment is returned to the spare equipment store, it shall be clearly labelled as to where they originated and details regarding its serviceability and condition.

The existing transformers shall be reviewed and assessed. Where parts such as tap changers, HV bushings, radiators and fans, monitoring devices are determined to be in a serviceable condition and able to be used as spare parts, these shall be retained in the equipment stores. Any unserviceable equipment shall be disposed in the appropriate manner.

As soon as practical after shutdown, the transformers are to be condition assessed by taking oil and paper samples prior to scrapping. This will help establish the internal condition of the transformers with same age, duty and condition for benchmarking purposes on similar transformer in the network.

3.6 Secondary Works Required

General

- All works in the control room shall make allowance for future expansion including additional 11kV feeders and capacitor banks.
- Ensure DC battery capacity is appropriate for any new equipment. Calculations to be conducted.
- A protection review shall be carried out, new settings to be applied to all relevant relays and tested into service.
- All protection settings, calculations, setting files, coordination plots are to be attached in PRISM.
- Any modifications made to AC distribution board to be AS3000 compliant.
- A site visit with the RO and a tester is required to determine possible panel location for the new relays prior to DDS development.
- All serviceable secondary equipment removed shall be returned to the Spare Equipment Store and shall be used to boost spare stock levels as required.

Transformer Protection

Transformer No.1 X protection:

- Install a new SEL-787-3 X Transformer Differential and Restricted Earth Fault Protection relay.
- Retire the existing 1 x D21Se3-2195 differential protection relay, along with associated CTs, resistors and cabling.

Transformer No.2 X protection:

- Install a new SEL-787-3 X Transformer Differential and Restricted Earth Fault Protection relay.
- Retire the existing 1 x D21Se3-2195 differential protection relay, along with associated CTs, resistors and cabling.

Transformer No.1 Y protection:

- Install a new GE T-60 Y Transformer Differential Protection relay.
- Retire the existing 1 x DT2-577 differential protection relay, along with associated CTs, resistors and cabling.

Transformer No.2 Y protection:

- Install a new GE T-60 Y Transformer Differential Protection relay.

- Retire the existing 1 x DT2-577 differential protection relay, along with associated CTs, resistors and cabling.

Transformer No.1 & No.2 HT and LT Protection:

- Replace existing HT and LT over current protection relays (CDG11-520 and PCD 676) with new SEL-351A protection relays.

Notes:

- No change to TX parallel control.
- Upgrade Gas and Tap Changer prot to include 3 position selector switch ON – TEST - OFF.

Application Manuals

- Refer to below application manuals. **Latest version to be confirmed with EN Protection and Control at design commencement**
- SEL-787-3 Transformer Differential Protection - Application manual Version 1.4
- GE-T60 Transformer Protection - Application manual Version 1.3
- SEL-351A Selective Bus Overcurrent Protection - Application manual Version 5.0

SCADA

- The Control System Pages for WA shall be modified within the existing SCADA system and all new relevant controls, statuses, analogues and alarms are to be remotely monitored via the substation RTU.

Time Synchronisation connectivity

Time synchronisation shall be established to the following devices as summarised in the table below:

Equipment	Functionality	Qty	SNTP	IRIG-B P2	IRIG-B P3
SEL-787-3	X Trans Differential	2	✓	-	-
GE T60	Y Trans Differential	2	✓	-	-
SEL-351A	Bus Overcurrent Protection	4	✓	-	-

Summary of key new equipment

Function	QTY	Existing Relay (Function)	New Relay	SAP ID
No.1 Transformer 'X' Differential and REF protection relay	1	D21Se3-2195	Schweitzer - SEL-787-3	391378
No.2 Transformer 'X' Differential and REF protection relay	1	D21Se3-2195	Schweitzer - SEL-787-3	391378
No.1 Transformer 'Y' Differential protection relay	1	DT2-577	GE – T60	390737
No.2 Transformer 'Y' Differential protection relay	1	DT2-577	GE – T60	390737
No.1 & No. 2 Transformer HT over current protection	2	CDG11-520	Schweitzer - SEL-351A	390292
No.1 & No. 2 Transformer LT	2	PCD 676	Schweitzer -	390292

over current protection			SEL-351A	

3.7 Other Work External to the Zone Substation

Nil

4. Environmental Considerations

Oil Containment Risk Assessment is to be conducted as per Powercor Standard SA051 throughout the oil handling processes.

Further consideration to be given regarding the following:

- Visual, noise, vibration, EMF considerations.
- Access, traffic, obstructions and working hours.
- Potential soil contamination, Soil testing and management if required during oil handling.
- Standard work practices to apply regarding traffic, noise, pollutants, dust, debris, and water run-off and oil containment.

5. Liaison and Coordination of Works

The Project Manager is responsible for:

- Contact with Local Councils, obtaining any permits and approvals etc.
- Community consultations where applicable.
- Road management to apply.
- Communicating project status and issues to the stakeholders and arrange meetings.

6. Known Issues Specific to this Location or Project

Nil

7. Health and Safety Concerns

All H & S issues relating to this project must be as per Citipower & Powercor health & safety standards.
The following should be also considered:

- Non-standard work practices
- Any other matters of importance
- Site inductions and site conditions

8. Test and Commissioning Plans

The project manager shall coordinate and arrange Test and Commissioning Plans:

- Inspection and Test Plans
- Contingency Plans
- Pre-Commissioning Meeting Agendas
- Commissioning Plan

9. Cost Estimate

The estimate based on this scope is **$5,984,634** in line with the following breakdown.

Task Name	Description of cost breakdown	Cost ($ 000)
Project Management		260.3
Initiation and Scope		64.8
Design		
	Design and drawing update labour costs	632.3
	External subcontractor costs for design confirmation (contaminated soil, oil testing, soil resistivity testing)	78.0
Construction		
	Construction management & supervision (on site)	134.3
	Transformer material costs	2,312.2
	Labour costs associated with primary equipment installation	343.9
	— Subcontractor costs for asbestos removal — Transformer bay demolition — Heavy haulage & crane hire to skate transformer into position — Scissor lift, boom lift and smaller on site crane for material handling	605.4
Civil Construction Works		
	Transformer bay construction labour	28.3
	Transformer bay construction subcontractor costs	706.8
Construction Sec/Test/Commission		
	Secondary equipment installation & testing labour costs	577.5
	Material costs for secondary equipment	183.1

Closeout	Project closeout labour costs	57.8
Total		**5,985**

Appendix 1 – Current Single Line Diagram