CITIPOWER	**ELECTRICITY NETWORKS** **Asset Strategy & Performance** **Functional Scope**	Powercor AUSTRALIA

Executive Summary

North Richmond (NR) Zone Substation (ZSS) is a fully operational ZSS with three 66/11kV transformers operating approximately 2.3km from the CBD boundary, it currently supplies approximately 31,659 customers including the Epworth Hospital, Bethesda Hospital, Carlton & United Brewery's, MMTB (Melbourne Metropolitan Tram Board), Ikea and the Richmond town hall, five of these customers are listed as "Do not shed" in the contingency plans for a 66kV feeder loss event.
The current asbestos register lists the roof, expansion joints, wall vents, 11 kV cables, doors and pipe penetrations in Tx bay's No 1 & 2 and beams to the ceiling in Tx No 2 bay as containing asbestos.
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 asbestos and PCB's at this site.

Project Summary:

Replace the 66/11kV No. 1 and No.2 Transformers at North Richmond (NR) Zone substation. The scope of work includes primary and secondary design, associated civil structural works including enclosure replacement, 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

Replacing the aged 66/11kV No.1 and No.2 Transformers at NR Zone substation with CP-5 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 NR No 1 & No.2, 23/28MVA Transformers with new 20/27/33MVA ONAN /ODAN / ODAF / ODAF(E) transformers - type CP-5 as per ZD101 specification.

Undertake civil structural design for full enclosure replacement required to suit new transformers, primary and secondary electrical works, installation, including testing and commissioning to bring the new transformers into service.

It is expected no changes are necessary to the current network configuration the No.1 and No.2 transformers other than required secondary works to bring the protection schemes up to current relay standard.

3. Detailed Functional Scope of Work

3.1 Primary Plant Required

The 66/11kV transformers are currently installed within covered sound- proof bund enclosures. These bund enclosures will be replaced to accommodate the replacement transformers.

The 66/11kV replacement transformers will be procured in accordance with CitiPower transformer specification ZD101 for a CP-5 type unit with a rated capacity of 20/27/33 MVA. The transformer cooling radiators will remain detached due to the sound-proofing arrangements.

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 20/27/33 MVA, 66/11kV, ONAN/ODAN/ODAF/ODAF(E), DYn1 vector grouping with detached radiators.
- Decommission and remove the existing No.1 and No.2 transformers.
- Rebuild bund enclosures with roofs to accommodate new transformers 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 1,000mm2 cables.
- Determine the need to retain the 11kV transformer reactors.
- Assessment of the transformer cable terminations at the 11kV switchboard.
- Assess and modify transformer earthing arrangement as necessary.
- Provide conduits 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

Existing transformer enclosures are to be replaced with new bund enclosures taking into account noise and vibration suppression for both new transformers and radiators.

The enclosures shall be compliant with relevant building code regulations including but not limited to passive fire suppression equipment.

The bunding system of No.1 & No.2 transformer bays shall comply with CitiPower/Powercor standard. The bund installation shall make provision to future oily water treatment installation.

Install as necessary additional cable ducts for secondary wiring from control room to new No.1 & No.2 transformers and between transformers.

Oil separation system will need to be installed/upgraded.

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 rooms on site are to accommodate all the new secondary equipment and wiring.

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.
- 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 KVCH differential protection relay, along with associated CTs, resistors and cabling.

Transformer No.1 & No.2 Y protection:

- Retire the existing 2 x HT overload KCGG relay and replace with 2 x GE T-60 Y Transformer Differential Protection relays

Notes:

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

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

GPS Clock, Ethernet and Comms

There are changes to the Ethernet and Comms connectivity. These changes are required to ensure redundant internal communications as well as adding the new relays to provide SCADA and engineering access. The following is required:

- Install two new RST2228 Sub-LAN switches. These can be installed in the existing Ethernet Cubicle in the No2 control room – Cubicle 1.
- Install one new FortiGate 60E firewall. This can be installed in the existing Ethernet Cubicle in the No1 control room.
- Install two 48 core multimode fibre cables between the No1 & No2 control room
- Install two new optical fibre cable termination rack (48 port). These can be installed in the existing Ethernet Cubicle in the No1 control room.
- Install two new optical fibre cable termination rack (48 port). These can be installed in the existing Ethernet Cubicle in the No2 control room.
- Devices and relays as specified in appendices to be connected to sub-LAN switch.
- Refer to Appendix D: Station Ethernet connectivity diagram.

SCADA

- The Control System Pages for NR 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.
- Configure new SEL RTAC HMI and HMI (to be displayed on two HMI PCs)

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	✓	-	-

Summary of key new equipment

Function	QTY	Existing Relay (Function)	New Relay	SAP ID
No.1 Transformer 'X' Differential and REF protection relay	1	KVCH	Schweitzer - SEL-787-3	391378 (240V)
No.2 Transformer 'X' Differential and REF protection relay	1	KVCH	Schweitzer - SEL-787-3	391378 (240V)
No.1, 2 & 3 Transformer 'Y' Differential protection relay	2	HT overload KCGG	GE – T60	390737
Firewall	1	-	Fortinet – FortiGate 60E	390623
Ethernet switch	1	-	Ruggedcom - RST2228	391393
Single-Mode 1G LC Fibre SFPs	2	-	-	391361
Multi-Mode 1G LC Fibre SFPs	2	-	-	391383
10dB LC-LC SM Attenuator	4	-	-	391382

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

Vehicle and heavy load access is significantly restricted around the NR site and may require extended planning time with council and local residents etc.

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 **$7,208,078** in line with the following breakdown.

CITIPOWER	ELECTRICITY NETWORKS Asset Strategy & Performance Functional Scope	Powercor AUSTRALIA

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	2,885.1
	Labour costs associated with primary equipment installation	348.4
	— 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	610.2
Civil Construction Works		
	Transformer bay construction labour	28.3
	Transformer bay construction subcontractor costs	1,521.9
Construction Sec/Test/Commission		

	Secondary equipment installation & testing labour costs	432.7
	Material costs for secondary equipment	156.9
Closeout	Project closeout labour costs	55.0
Total		**7,208**

Appendix 1 – Current NR Single Line Diagram