CITIPOWER	**ELECTRICITY NETWORKS** **Network Planning & Development** **Functional Scope**	Powercor AUSTRALIA

Functional Scope Created	**9/08/2019**	**By**	Chris McCallum		
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Project RO		**Ex:**			
Project Title	Torquay (**TQY**) zone substation				
Network No. and F/C					
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Project Engineer					
System Planning Engineer	Chris McCallum				
Protection and Control Engineer	Vikram Hadya				
Plant and Stations Engineer					
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Version	Date	Changes	Responsible Officer
0.1	9/08/2019	Initial scope	C.McCallum
1.0	16/01/2020	Finalised scope	C.McCallum

1 Project overview

This project scope covers the installation of a new zone substation at Torquay (TQY). The TQY zone substation is to be built with two (2) 25/33MVA transformers, a 66kV outdoor bus with three (3) 66kV circuit breakers, two (2) 66kV lines from Waurn Ponds (WPD) zone substation, a 22kV switch room with thirteen (13) 22kV circuit breakers, a 4 x 3.0MVar capacitor bank and two (2) ground fault neutralisers (GFN). As part of these works a fibre optic loop is to be constructed between TQY zone substation and WPD zone substation.

To connect the new TQY zone substation into the existing WPD zone substation at WPD the WPD011 feeder exit will need to be underground for a 66kV bus extension which will relocate CB 'A', and install three (3) new 66 kV Circuit Breakers.

The GFNs are required as the new TQY system will be a resonant earthed network. The GFNs change the electrical operating characteristics of a zone substation and its distribution network as follows:

- full voltage displacement occurs on the system for operation of the GFN;
- this significantly stresses equipment on the system and may lead to failure;
- this equipment has been identified and included in this scope for replacement as part of the GFN installation; and
- other limitations will dictate part of the operational protocols that will be developed by Electricity Networks.

The GFN provides potential benefits to single-phase-to-ground faults on the 22kV three phase system. It provides no benefit on the following:

- the 12.7kV Single Wire Return System (**SWER**);
- the 66kV sub-transmission system; and
- the low voltage (**LV**) system.

Note that this scope is for estimation purposes and must be reviewed closer to the construction date.

1.1 Background

There are two drivers to the installation of the TQY zone substation, load at risk due to Waurn Ponds operating above its N-1 capacity and the Victorian Government Bushfire Mitigation Regulations performance standards.

To meet the Victorian Government Bushfire Mitigation Regulations performance standards for detection and limiting of arc fault energy on high voltage (**HV**) overhead assets in high bushfire consequence, rapid earth fault current limiters (**REFCLs**) can be used.

A REFCL is a network protection device, normally installed in zone substations that significantly reduce the arc fault energy generated during a phase to ground fault to mitigate against fire ignition.

The Bushfire Mitigation Regulations mandate the following performance criteria (for a phase-to-ground fault on a polyphase electric line with a nominal voltage between 1 kV and 22 kV):

- to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for high impedance faults to 250 volts within 2 seconds; and
- to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for low impedance faults to:
  - 1900 volts within 85 milliseconds; and
  - 750 volts within 500 milliseconds; and
  - 250 volts within 2 seconds; and
- during diagnostic tests for high impedance faults, to limit:

- fault current to 0.5 amps or less; and
- the thermal energy on the electric line to a maximum I^2t value of 0.10;

The solution with the highest net benefits is to install three (3) GFNs at WPD on the existing three transformers and build a new zone substation at TQY with two (2) GFNs on land reserved for this purpose near the corner of Ghazeepore Road and Coombes Road.

This option meets the Victorian Government Bushfire Mitigation Regulations performance standards, reduces the load at risk at WPD for both the N and N-1 capacities and also increases the constrained 22kV feeder capacity for the Surf Coast area.

Approximately 35 MVA of load is to be transferred away from WPD to the new zone substation by cutting into existing feeders. Four (4) new 22kV feeders will be created which will supply the Torquay, Jan Juc, and Anglesea townships, as well as the surrounding Surf Coast area. The new zone substation will be supplied from two (2) 66 kV lines from WPD, and there will also be provision created for a future third 66 kV line from another zone substation or a potential wind farm.

2 ZSS requirements

This functional scope sets out the TQY zone substation requirements, including the following:

- Install two (2) 66/22 kV, 25/33 MVA zone substation transformers.
- Install a new 66kV outdoor ring bus comprising of three (3) 66 kV circuit breakers (CB) and two (2) 66kV line exits.
- Install a new indoor 22kV switch room containing the GFN inverters and associated equipment, and a switchboard with two (2) 22 kV buses, with thirteen (13) 22kV circuit breakers (two 22kV bus tie CBs, two transformer CBs, eight 22kV feeder CBs, one capacitor bank CB), two (2) bus risers, two (2) bus earth switches, two (2) bus VTs and two (2) transformer VTs.
- Install one (1) 12 MVAr capacitor bank with 4 x 3 MVAr module steps and VAR control.
- A new control room.
- Install two (2) new station service supply 750kVA kiosk transformers with an AC distribution board.
- Install amenities facilities.
- Install new zone substation earth grid.
- Establish ASC bunds for two (2) REFCLs.
- Installation of two (2) Swedish Neutral GFN Arc Suppression Coils (ASC).
- Modification of the 66/22kV transformer earthing arrangement
    - Installation of Transformer Neutral Isolators and Direct Earth Switches
    - Installation of 19kV surge diverters on transformer neutrals
    - Installation of two (2) Neutral Bus Systems
        - Bus CB's
        - ASC terminations
        - Neutral VT Installation
- Install a new fibre optic communications hut.

Also included are the following WPD zone substation requirements to establish the TQY zone substation:

- Underground the existing overhead 22kV WPD011 feeder exit.
- Extend the WPD 66kV ring bus by relocating CB 'A', installing two (2) new 66kV Bus Crossover modules, three (3) new underground 66 kV line entry structures and three (3) new 66 kV Circuit Breakers.
- Modify Station Earth Grid as required.
- Install additional switchyard lighting as required.

Secondary Requirements

This functional scope sets out the TQY zone substation requirements, including the following:

- New Comms equipment including station RTUs, firewalls, modem, Ethernet switches and SubLAN switches.
- New REFCL equipment.
- New 66kV WPD No1 Line X & Y Protection.
- New 66kV WPD No2 Line X & Y Protection.
- New 66kV X & Y CB Management.
- New 66kV No.1 & No.2 Trans Protection.
- New 22kV No.1 & No.2 Bus Protection.
- New 22kV X CB Management & X CB Fail.
- New Station Earth Fault and Neutral Bus Management.
- New Backup Earth Fault.
- New Disturbance Fault Recorder.
- New 22kV Feeder Protection.
- New PQM.
- New VRR.
- New VAR control.
- New Capacitor Bank Protection.

- New GPS Clock.
- New Station HMI.

This functional scope sets out the WPD zone substation requirements, including the following:

- New 66kV TQY No1 Line X & Y Protection.
- New 66kV TQY No2 Line X & Y Protection.
- New 66kV X & Y CB Management.
- Update 66kV GTS Line X & Y Protection.
- Update 66kV BCG Line X & Y Protection.
- Update 66kV VT standby supplies.
- Install a new Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation.

2.1 Primary plant requirements at TQY

2.1.1 Zone substation transformers

- Install and commission two (2) 66/22 kV, 25/33MVA transformers (Dyn1, 25% boost, 5% buck) as per Powercor Transformer Specification ZD101. The transformer shall be installed complete with 66 kV station class 10kA surge arresters and 22kV continuous station class (class 2) voltage arrestors (ABB MWK22 or equivalent).

The current transformers required are as follows (as per Tech Standard ZD101):

- 66 kV Side –
  - Four (4) three phase sets 900/500/300/5A; Class 0.35PX100 R0.15 Ohm on 300/5A.
- 22 kV Side –
  - One (1) three phase set 1200/700/5 Class 1.0M 20 VA on 700/5 (Metering).
  - One (1) single phase (w ph) 1200/700/5 Class 1.0M 20 VA on 700/5 (Control).
  - One (1) single phase (w ph) 1200/700/5 Class by Supplier (WTI).
- Neutral CT in each transformer 22 kV Star-point earth connection -
  - Two (2) dual winding 300/5 0.25PX50 R0.15 Ohm.
- REF Neutral CT in each transformer 22 kV Star-point earth connection.
  - One (1) single winding 1600/1500/1200/900/5 0.2PX75 R0.40 Ohm on 900/5.

2.1.2 Zone substation 66kV circuit breakers

Install three (3) 66 kV Circuit Breaker with isolators to Tech Standard ZD011. Dead-tank CB's with integral CT's are required. The CB's and CT's shall be rated 72.5kV, with a minimum continuous current rating of 1600A and fault rating of 25kA. 66kV Circuit Breaker module as per Tech Standard SJ221.

The 66 kV circuit breaker current transformers required are as follows:

- Four (4) three phase sets 1600-1200-900-600/5A; 0.25PX100R0.15 Ohm on 300/5A (Preferably 2 sets on each side of CB).

2.1.3 Zone substation 66kV bus

Install two (2) 66 kV line entry structures (Tech Standards SJ 201 & SJ 361) including:

- Two (2) 66 kV ganged operated disconnect switches (Min rating 1250 A) complete with earthing switch for the WPD No.1 and No.2 66 kV Lines mounted at the line entry isolator structures.
- Two (2) sets of three (3) 66 kV station class surge arresters directly connected at the line entry structure.
- Two (2) sets of three (3) 66 kV/110V single phase Magnetic Voltage Transformers (72.5kV) as line voltage transformers. (66 kV/√ 3: 110V/√ 3: 110V/√ 3 Class 0.5M/1.0P 100VA).

Install appropriate bus work in the same footprint as equipment for the possible ultimate design. Refer To Section 14 Appendix – TQY SDS attached.

- Five (5) 66kV Bus Crossovers Modules (2 for transformers and 3 for termination bus as per SJ231 Tech Standard).
- Ultimate thirty six (36) 66 kV single blade underslung isolators (min. rating 1250A) to enable proposed and future CB isolation. Designer to consider methods to install minimum isolators for 66 kV CB works as per Section 12 Appendix - Proposed TQY General Arrangement.
- Install two (2) Transformer modules (Tech Standard SJ 361 Discon Switch and Tech Standard SJ 933A 22 kV cable support Structure modified for 66 kV tube bus support overhead).

Install two (2) Transformer modules (Tech Standard SJ 361 Disconnect Switch and Tech Standard SJ 933A 22 kV cable support Structure modified for 66 kV tube bus support overhead) including:

- Two (2) 66 kV gang operated disconnect switches (Min rating 1250A) complete with earthing switch. The purpose of each switch is to earth the 66 kV windings of each transformer.

Install new 32mm Cu tube Bus sections with tubular bus expansion joints to Standard SJ541 for 66 kV Disconnect Switch and 22 kV U/G cable connections to the new Transformers.

Construct outdoor 66 kV Yard with Strung 66 kV bus – 37/3.75 AAC.

2.1.4 Zone substation capacitor bank

Install one (1) 12 MVAr capacitor bank with 4 x 3 MVAr module steps and VAR control on the No.1 22kV Bus.

The new No.1 capacitor bank is to be un-earthed and is to have the following specifications to make this new capacitor bank meet resonant network requirements:

- Neutral (star-point) structure must provide sufficient insulation to allow for continuous neutral displacement (12.7kV + 10%) under system earth fault conditions.
- Neutral point is fit for continuous operation at 13.97kV.
- CTs on capacitor bank are REFCL compliant CTs.

2.1.5 Zone substation 22kV switch board

Install a new 22 kV indoor switchboard with CB's that shall preferably have 150kV LIWL rating (or 125kV by approval) and shall be suitable for resonantly earthed network and shall comprise a minimum:

- Two (2) 22kV buses with two (2) bus risers. Provision for the third 22kV bus is required.
- Eight (8) 22 kV feeder circuit breakers (Min 630A, 25kA) with four (4) 22 kV feeder circuit breakers on each bus. Feeder CB's shall have the capability for terminating single core/phase of up to 630 sq mm Al XLPE cable and a station service cable using 3/c 95m2 22 kV XLPE.
- One (1) 22 kV circuit breaker (Min 1250 A, 25kA) for the capacitor bank on 22 kV Bus No1. The breaker must be capable of switching of 12MVAr capacitor banks. (4 x 3 MVAR modules).
- Two (2) 22 kV circuit breakers (Min 1600A, 25kA) for the bus-ties.
- Two (2) 22 kV circuit breaker (Min 1600A, 25kA) for the transformers. The transformer CBs shall have the capability for terminating 2 x single core/phase 630 sq mm Al single core XLPE cables.
- All 630A CBs shall be interchangeable.
- All 1600A CBs shall be interchangeable.
- The switchboard shall include separate lockable bus & cable shutters, voltage indicators and separate earthing facilities.
- The bus fault rating shall be a minimum 25kA.
- The current rating of the bus is to be a minimum 1600A at system highest voltage of 24kV.
- The 22kV switchboard shall have 25kA for 1 second Arc Fault Containment with AFC cladding through building flashed aperture. AFC cladding to be terminated by an approved pressure relief vent cover. AFC bus

segregation to be between the joggle and BT CB. Aperture openings will be confirmed (ZD103 Powercor Tech Standard).

- The switchgear shall be extendable i.e. have the provision to add a future second and third bus (as per Section 14 Appendix – TQY SDS).

Two (2) of three (3) x 630mm^2 1/c 22 kV Cu XLPE underground cables are to be installed between the zone substation transformer 22 kV bushings and the transformer CBs on the 22 kV Buses, and one (1) of three (3) x 630mm^2 1/c 22.a.x.hc.h. underground cable between the No.1 22 kV bus and the Cap Bank CB.

2.1.6 22kV Bus VTs

Install two (2) new bus VTs to be incorporated in the bus of the switchboard for the No.1 and No.2 22kV buses with the following specification:

- Frequency: 50Hz
- Ratio: 22,000/110/110V
- Connection: Star/Star/Star
- Vector Group: YNyn0yn0
- Neutral for HV and 2 LV Windings: Solidly Earthed
- Output: 100VA Per Phase Per Secondary Winding
- Accuracy: Class 0.5M1P per secondary winding at the specified voltage factor
- Voltage Factor: 1.9 for 8 Hours
- Category B

Install two (2) new transformer VTs to be incorporated in the in the transformer circuit breaker positions of the switchboard for the No.1 and No.2 22kV transformers with the following specification:

- Frequency: 50Hz
- Ratio: 22,000/110/110V
- Connection: Star/Star/Star
- Vector Group: YNyn0yn0
- Neutral for HV and 2 LV Windings: Solidly Earthed
- Output: 100VA Per Phase Per Secondary Winding
- Accuracy: Class 0.5M1P per secondary winding at the specified voltage factor
- Voltage Factor: 1.9 for 8 Hours
- Category B

2.1.7 22kV Bus CTs

Install the following 22 kV current transformers in the switch board for the feeders and transformers circuit breakers:

Each Feeder CB CT's shall have;

- One (1) Three Phase set 600/5A, 0.2PX100 R0.3 Ohm (Bus side)
- One (1) Three Phase set 1500/5A, 0.2PX100 R0.5 Ohm (Feeder side)
- One (1) Three Phase set of core balance CTs 600-300/5A 40-20VA class 0.1 (Feeder side, preferably in the switchboard)
  Note: CT's on feeder CBs may all be on the feeder side of the CBs.

Transformer incomer CB CT's shall have:

- Two (2) Three Phase sets 1200/5A, 0.2PX100 R0.3 Ohm (Bus side).
- Two (2) Three Phase sets 1500/5A, 0.2PX100 R0.5 Ohm (Transformer side)
  Note: CT's on transformer CB may all be on the transformer side of CB.

Bus-Tie CB CT's shall have:

- Two (2) Three Phase sets 1500/5A, 0.2PX100 R0.5 Ohm (Bus No 2 side).

- Two (2) Three Phase sets 1500/5A, 0.2PX100 R0.5 Ohm (Bus No 1 side).

Capacitor Bank CB CT's shall have:

- One (1) Three Phase set 600/5A, 0.2PX100 R0.3 Ohm (Bus side).
- One (1) Three Phase set 1500/5A, 0.2PX100 R0.5 Ohm (Capacitor Bank side).
  Note: CT's on capacitor back CB may all be on the capacitor bank side of the CB.

2.1.8 Station Service Transformers

Install two (2) new 750kVA 22kV/415V Station Service Kiosk Transformers

- The new kiosk substations are to be connected to 22 kV Feeder CBs (one on 22kV Bus No.1 and one on Bus No.2) using 95mm^2 3/c 22.a.x.hc.h. underground cable. The transformer and fusing is to be fault rated to a minimum of 13.1kA
- Connect the new station service transformers to the No.1 and No.3 22kV buses, protected by HV fuses on the bus.

2.1.9 Zone substation surge arrestors

In a non-effectively earthed system, the voltage displacement caused under earth fault conditions results in the healthy phases experiences full line-to-line voltage on a line-to-ground basis. Surge arrestors used in non-REFCL Powercor substations do not have the Temporary Overvoltage Capability required for these conditions.

- Install only zone substation surge arresters with a station class (class 2) 22kV continuous voltage arrestor (ABB MWK22 or equivalent).

2.1.10 Amenities shed

Install one (1) new amenities shed, including appropriate toilet and washing facilities.

2.1.11 TQY design for future works

The design of the station is to allow for the ultimate configuration of three transformers and three 22 kV buses.

2.1.12 Zone Substation Earth Works and Earthing

New zone substation earth works as per Tech Standard SJ041:

- Complete earth fill works as required on the site to create a compacted, raised level area on the site for construction of the HV enclosure and access roadway required for establishment of the new TQY ZSS. Install site drainage and a triple interceptor pit.

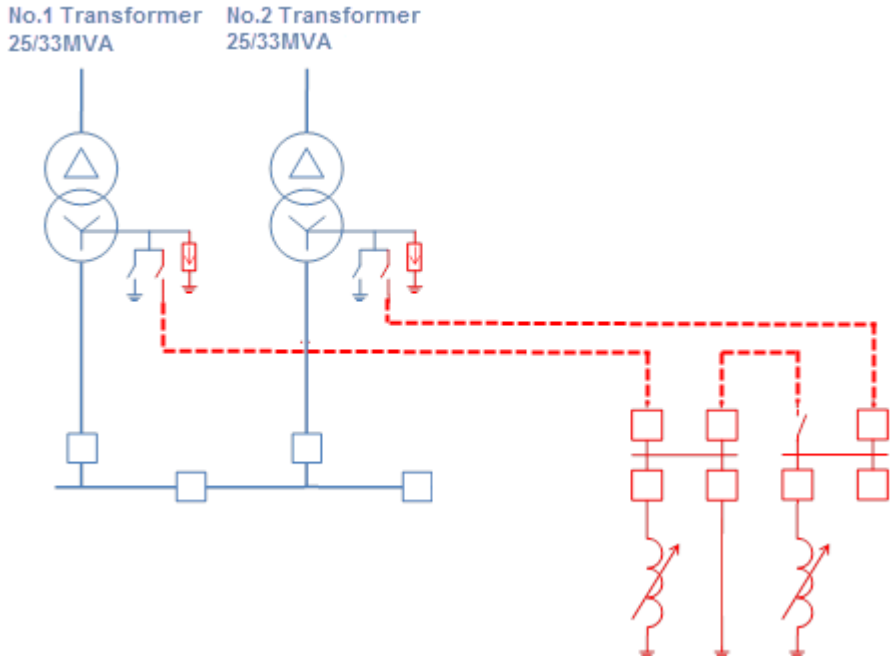
Install a HV earth grid within the substation to Powercor Tech Standards with an earth grid impedance as low as possible, as the earth grid impedance impacts negatively on REFCL operation. The following should be carried out:

- Site survey, earth grid and soil resistivity testing
- Detailed analysis and modelling of earth grid and soil conditions

2.1.13 TQY REFCL installation

The works associated with the installation of the TQY ASC arrangement is summarised in the following single line diagram.

Figure 3 TQY Proposed Neutral Diagram



2.1.14 Arc suppression coil

Install two (2) x Swedish Neutral – Ground Fault Neutraliser's Arc Suppression Coil (ASC) components. The arc suppression coil is a paper wound copper coil wrapped around a solid iron core and immersed in oil. This arc suppression coil is of fixed reluctance but contains an array of capacitors in parallel that are switch as part of the tuning process of the coil. The coil also features an LV winding for coupling of these capacitors and the Residual Current Compensator.

Primary neutral and earth connections are via elbows.

As oil filled device, it shall be installed in a bunded area in accordance with current standards.

The GFN ASC's are to be installed in a yet to be determined location of the yard (see Section 12 Appendix - Proposed TQY General Arrangement, subject to a design review);

- install Ground Fault Neutraliser comprising of two (2) x 17-200A ASC and residual current compensation modules with maximum available tuning steps onto the provided pad mount within a newly established bunded area;
- the footing of the ASC shall reside on the installed 150mm steel beams fixed to the concrete pad; and
- install cable connections to and from the Neutral System.

2.1.15 GFN inverters

The switch room is to also house the GFN inverters and associated equipment.

2.1.16 Neutral system arrangement

- Two (2) new kiosk type ground mounted modules as per ZD081 -
  - One (1) module is to be Type A comprising of four (4) circuit breakers.
  - One (1) module is to be Type B1 comprising of three (3) circuit breakers and one (1) switch.
- Transformer neutral connection assets -
  - HV neutral cable.
  - Neutral bus connection isolator.

- System earth connection.

The Neutral Bus system facilitates simple use of the different earthing methodologies and permits isolation of the transformer neutral in case of access or internal fault.

- The Neutral Bus system and all connection assets shall be continuously rated to 13.97kV.
- The Type A neutral bus module has CTs on two (2) of the CBs. Connection to one (1) transformer neutral and to the Type B1 neutral bus module is to be via a CB with CT at the neutral bus module end.
- The Type B1 neutral bus module has CTs on two (2) of the CBs. Connection to one (1) transformer neutral and to the future neutral bus module is to be via the spare CB with CT at the neutral bus module end.

Neutral Bus

The connection to the neutral bus module shall be via elbow connections. Four (4) elbows are required per module for; Type A neutral bus:

- Transformer neutral connection (1 x transformer).
- ASC connection.
- Solid ground connection.
- Neutral bus tie connection.

Type B1 neutral bus:

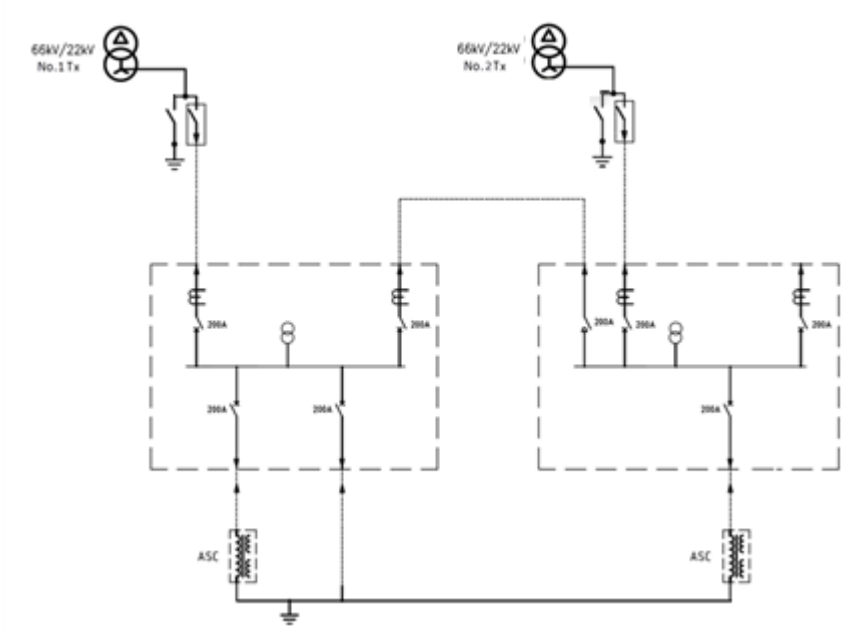
- Transformer neutral connection (1 x transformer).
- ASC connection.
- Neutral bus tie connection.
- Spare connection.

Neutral Voltage Transformer

A neutral VT shall be included in each of the Neutral Bus modules, connected directly to the bus as shown in ZD081.

- $22000\sqrt{3} / 110\sqrt{3}$
- Class 0.5M1P
- Output: 15VA
- Frequency: 50 Hz
- Voltage Factor: 1.9 for eight (8) hours
- Dielectric Insulation Level: 24/50/150kV
- Australian Standard: AS 60044.2.

Figure 4 Proposed TQY neutral system single line diagram



2.1.17 Transformer Earthing and Ground Bypass Isolators

The neutral earthing arrangement for each transformer shall permit connection to the Neutral Bus system. For each transformer neutral connection point;

- Insulate the neutral conductor and install independent Neutral Bus/Direct Ground isolators
  - This is required so that if the neutral bus is to be taken out of service the transformer neutrals can be earthed by closing these ground by-pass isolators.
- Install single phase HV cable and cable terminations between the Transformer Neutral Bus Isolators and the relevant Neutral Bus CB via elbow connections on the Neutral Bus RMU

2.1.18 Neutral surge diverter

Install a Station Class (Class 2) 19kV surge diverter between the transformer neutral bus and the substation earth grid, as close to the transformer neutrals as possible (ABB MWK19 or equivalent).

2.2 Civil works requirement at TQY

Civil works should include what's required for the installation of two transformers initially and for the ultimate configuration of three transformers and three GFNs. Furthermore, the civil works include the following:

- The TQY site to be graded from the security fence to exclude the ingress of any offsite stormwater, and internally from the security fence to channel stormwater on site via concrete spoon drains through an internal stormwater system. This system would include a sump pit, station isolation valve, and triple interceptor pit.
- Primary oil spill containment, in the form of a bund wall to is to be installed around the main transformers (including radiators) to accommodate 110% of the total oil volume of the plant. The floor of the bund area should be impermeable and be graded to one corner to enable stormwater to be drained via a valve (normally closed) installed in the bund and shall be incorporated into the existing station drainage system.
- Secondary oil spill containment, in the form of a Separation Pit/ Triple Interceptor Pit (TIP) system shall be incorporated into the design with drainage from the transformer bunded area. Inclusion of a station isolation valve is required in the drainage system before the TIP, located near an access gate (for emergency services access). The design should have the ability to allow for future transformer equipment requirements.

- TIP and drainage design is required for the metal enclosed outdoor Capacitor Bank. Must provide appropriate oil containment for failure of capacitor can/s. Any oil containment used shall be incorporated in the station stormwater management system & TIP.
- The Switch Room and/or Control Room and foundations shall be to local council building requirements.
- Supply and install station outdoor nameplates on primary equipment in accordance with "Powercor Zone Substation Equipment Labelling Standard".
- An enclosed control cable system comprising cable trenches and PVC cable conduits to be laid between major plant items and the control room so that entry by vermin is prevented. The cable trenches shall be of concrete construction, cast on site, be fitted with galvanised steel checker-plate covers and shall be as shown on drawing VX10/44/8.
- Cable brackets to be provided to support cables above ground for maintenance staff safety.

For Neutral System

- Install concrete foundation pad for neutral system module.
- Install neutral cable conduit, control cable conduit and provision for solid earth grid connections.
- Install neutral cable conduits from transformers to neutral system module.
- Install conduits to ASC and solid earth grid connection.
- Install conduits for secondary circuits.

For ASC

- Install neutral cable conduit, control cable conduits and solid earth grid connections.
- Pour concrete foundation.
- Install steel beam, 150mm high at a width designed to accommodate the placement of the GFN Arc Suppression coil.
- Install bunding to EPA requirements.

For Station Service Supplies

- Install concrete foundation for new station service transformers.

2.3 Switchyard Lighting at TQY

Install 240 V AC Yard Lighting to achieve a minimum level of 10 Lux at electrical equipment and operating locations within the HV enclosure.

2.4 Building & Property Considerations at TQY

Include the following considerations for the switch room:

- Construction of the 22kV switching room may include solid brick, brick veneer, tilt concrete slab, colour-bond clad low profile with a concrete floor with cast cable ducts and cable conduits or be an elevated type with adequate space beneath to run cables [Such construction will require an aesthetically pleasing, removable plinth between switch-room base and ground level]. The switching room is to enable the ultimate 3 x 22kV busses and possibly the station service transformers (Design to consider similar to TNA ZSS on cost & practicality basis). Refer to Powercor specification ZD091.
- If elevated the building must be secured to the concrete foundations as per the appropriated regulations. The building will have suitable access ways to enable equipment installation. A flat roof or pitched roof construction is acceptable provided that eaves are provided and the building and all doors are sealed to prevent ingress of water.
- The switch room shall be designed and constructed with tunnel vents such that it shall be capable of withstanding the pressure wave resulting from an arcing switchgear fault without suffering any damage and such that any operational personnel in the switch room at the time of the fault are not injured. This design feature is to be reviewed if arc fault cladding and venting is installed on the 22kV switchboard as per section 2.1.5 Zone substation 22kV switch board.

- The building shall be designed for a life span of more than 50 years, be aesthetically pleasing and blend naturally with the surrounding environment.

Include the following considerations for the control room:

- The control room may be incorporated into the switch room building or may be a separate building. [The requirements for the control room building are as for the switch room building.] The control room shall have a thermostatically controlled air-conditioner / heating system.
- The control room dimensions shall be such that all secondary protection, control, monitoring and remote control equipment required for the ultimate development of TQY substation shall be able to be readily accommodated without the need for any further control room expansion.
- The protection/control panels and switchgear are to be located within the Control Room building to allow ready access for the installation of additional equipment to future possible ultimate – at a later stage. Refer to Section 14 Appendix – TQY SDS attached.
- The building shall be designed for a life span of more than 50 years, be aesthetically pleasing and blend naturally with the surrounding environment.

The building designs for the switch room and control room shall be submitted to PCN for approval.

Include the following considerations for the zone substation site:

- All operational requirements from Operations group to be provided e.g. desk/phones, earthing equipment, first aid kit, fire extinguishers etc. The intention is to provide a fully functioning ZSS to PCA Network for immediate operation during commissioning.
- A vehicle access track adequate for heavy moving equipment such as crane and low loaders etc. shall be provided. The track must allow for the turning circles of cranes, load loaders etc.
- An adequate security fence will be required to encompass the HV equipment and the 'possible ultimate' 66 kV switchyard. Appropriate entry points (minimum of 1 gate) shall be provided for access by personnel, cranes and low loaders etc. The entry point(s) will need to enable the final positioning of possible ultimate equipment without station outages. Yard surface within the security fence shall be 100 mm F.C.R.
- No vegetation is to remain within the security fence. A landscape plan for plantings/screening is required to be submitted to PCN for approval.
- Fire fighting compliance to the relevant authorities requirements will be provided by PCS (this will include consideration of any water tanks or hydrants etc).
- A new fibre optic communications hut at is to be built at TQY to terminate the fibre optic loop between WPD zone substation and TQY zone substation.

2.5 Secondary works at TQY

The following outlines the Protection and Control requirements at TQY.

- Latest version of application manuals are to be confirmed with EN Protection Solutions at design commencement.
- 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 RESIS.
- A site visit with the RO and a tester is required to determine possible panel location for the new relays prior to DDS development.

2.5.1 Uplink Communication & SubLAN Control Loop Cubicle

Install:

- Standard 23" protection cubicle
- Two (2) Fortigate 60E firewalls
- One (1) MDS SD9 radio device
- One (1) 3G modem
- One (1) EKI-2525 Ethernet switch
- Two (2) RST-2228 SubLAN switches

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- MDS radio unit device type and part no. is to be confirmed by the comms group.
- The SubLAN switches in this cubicle are to be ordered with 4x RJ45 ports.

2.5.2 Station RTU Cubicle

Install:

- Standard 23" protection cubicle
- Three (3) SEL-3505-4 RTACs for RTAC A, B & NVD
- One (1) Tekron GPS Clock
- Station I/O Controllers for HW connections to non-DNP devices

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- RTAC A to be used for establishing DNP session to 66kV relays.
- RTAC B to be used for establishing DNP session to 22kV relays.
- RTAC NVD to be used for new neutral displacement blocking scheme for 22kV connected generators.

2.5.3 SubLAN X & Y Protection A Loop Cubicle

Install:

- Standard 23" protection cubicle
- Three (3) RST-2228 Ethernet Switches for
    - X RST-2228-21 SubLAN
    - X RST-2228-22 SubLAN
    - Y RST-2288-31 SubLAN

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.4 SubLAN X & Y Protection B Loop Cubicle

Install:

- Standard 23" protection cubicle
- Three (3) RST-2228 Ethernet Switches for
    - X RST-2228-41 SubLAN
    - X RST-2228-42 SubLAN
    - Y RST-2228-51 SubLAN

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.5 REFCL Cubicles

Install:

- Two (2) Standard Swedish Neutral GFN cubicles with associated devices for GFN control

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.6 HMI Inverter Cubicle

Install:

- One (1) SEL-3505-4 RTAC with HMI for dedicated station HMI
- One (1) DC-AC inverter for supply to station HMI PC
- One (1) DC-DC converter for 24V DC distribution
- Emergency lighting controls
- Audible Controls

Design Notes:

- Establish red GPO on operator desk for connection of station HMI.

2.5.7 66kV WPD No1 Line X & Y Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-311L Relay for
  - WPD No1 Line X Differential protection
- One (1) RS400 for
  - DNP communication and engineering access to SEL-311L & 7SD522
- One (1) SEL2411 for
  - WPD No1 Line Management
- One (1) 7SD522 Relay for
  - WPD No1 Line Y Differential protection

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- 2 serial connections are to be established to the SEL311L & 7SD522 from the RS400

  (One for DNP3 and the other for Engineering access).

2.5.8 66kV WPD No2 Line X & Y Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-311L Relay for
  - WPD No2 Line X Differential protection
- One (1) RS400 for
  - DNP communication and engineering access to SEL-311L & 7SD522
- One (1) SEL2411 for
  - WPD No2 Line Management
- One (1) 7SD522 Relay for
  - WPD No2 Line Y Differential protection

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- 2 serial connections are to be established to the SEL311L & 7SD522 from the RS400

  (One for DNP3 and the other for Engineering access).

2.5.9 66kV X CB Management Cubicle

Install:

- Standard 23" protection cubicle
- Three (3) SEL-351S X CB Management and X CB Fail relays for
  - 66kV CB A
  - 66kV CB B
  - 66kV CB E

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.10 66kV Y CB Management Cubicle

Install:

- Standard 23" protection cubicle
- Three (3) GE-C60 Y CB Management and Y CB Fail relays for
  - 66kV CB A
  - 66kV CB B
  - 66kV CB E

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.11 66kV No1 Trans Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-787 relay for
  - No1 Trans X Differential and X REF Protection
- One (1) GE-T60 relay for
  - No1 Trans Y Differential and Y REF Protection
- One (1) SEL-2414 relay for
  - No1 Transformer Mechanical Protection and monitoring

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- A SEL-2440 I/O relay should already be in the Zone Substation 66kV/22kV Transformer specification.

2.5.12 66kV No2 Trans Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-787 relay for
  - No2 Trans X Differential and X REF Protection
- One (1) GE-T60 relay for
  - No2 Trans Y Differential Protection

- One (1) SEL-2414 relay for
    - No2 Transformer Mechanical Protection and monitoring

Design Notes:

- Refer appendix B for proposed Ethernet connectivity to Section 17 Appendix - for proposed Ethernet connectivity.
- 2440 I/O relay should already be in the Zone Substation 66kV/22kV Transformer specification.

2.5.13 22kV No1 Bus Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) GE-B90 relay for
    - No1 22kV X Low Impedance Bus Protection (LIBP)
- One (1) SEL-311C-1 relay for
    - No1 22kV Y Bus Distance protection

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- A GE-60 relay for Switchboard Management and Incomer CB Fail should already be in the 22kV Switchboard specification.

2.5.14 22kV No2 Bus Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) GE-B90 relay for
    - No2 22kV X Low Impedance Bus Protection (LIBP)
- One (1) SEL-311C-1 relay for
    - No2 22kV Y Bus Distance protection

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- A GE-60 relay for Switchboard Management and Incomer CB Fail should already be in the 22kV Switchboard specification.

2.5.15 22kV X CB Management & X CB Fail Cubicle

Install:

- Standard 23" protection cubicle
- Four (4) SEL-351S relays for
    - No1 Transformer X CB Management & X CB Fail
    - No1-2 Bus Tie X CB Management & X CB Fail
    - No2 Transformer X CB Management & X CB Fail
    - No2-3 Bus Tie X CB Management & X CB Fail

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- Serial to Fibre converters to be installed for Mirrored Bits communication to switch-room.
- An appropriate number of SEL-2506 I/O relays should already be in the 22kV Switchboard specification.

2.5.16 Station Earth Fault and Neutral Bus Management Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-451 relay for
  - Station Earth Fault Management (SEFM)
- One (1) GE-F35 relay for
  - Neutral Bus Management & X MEF

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.17 Backup Earth Fault and Disturbance Fault Recorder Cubicle

Install:

- Standard 23" protection cubicle
- One (1) GE-F35 relay for
  - Backup Earth Fault (BUEF) protection
- One (1) Elspec G5 Black Box for
  - 22kV Disturbance Fault Recorder (DFR)

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.18 No1 Bus 22kV Feeder Protection Cubicle

Install:

- Standard 23" protection cubicle
- Two (2) SEL-351S relays for:
  - TQY11 Feeder protection & management
  - TQY12 Feeder protection & management

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- Space to be reserved for future TQY13 & TQY14 feeder protection relays.
- Neutral CT ratio to be considered in relay setting.
- Serial to Fibre converters to be installed for Mirrored Bits communication to switch-room.
- An appropriate number of SEL-2506 I/O relays should already be in the 22kV Switchboard specification.

2.5.19 No2 Bus 22kV Feeder Protection Cubicle

Install:

- Standard 23" protection cubicle
- Two (2) SEL-351S relays for:
  - TQY21 Feeder protection & management
  - TQY22 Feeder Protection & management

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- Space to be reserved for future TQY23 & TQY24 feeder protection relays.
- Neutral CT ratio to be considered in relay setting.
- Serial to Fibre converters to be installed for Mirrored Bits communication to switch-room.

- An appropriate number of SEL-2506 I/O relays should already be in the 22kV Switchboard specification.

2.5.20 PQM, VRR & VAR Control Cubicle

Install:

- Standard 23" protection cubicle
- One (1) ION-9000 relay for:
  - No1 Transformer PQM
- One (1) ION-7400 relay for:
  - No2 Transformer PQM
- One (1) SEL-451 relay for:
  - Station 22kV voltage regulation
- One (1) SEL-2411 relay for:
  - No1 Cap Bank VAR Control

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.

2.5.21 Capacitor Bank Protection Cubicle

Install:

- Standard 23" protection cubicle
- One (1) SEL-351S relay for:
  - No1 Capacitor Bank OC, EF & Management

Design Notes:

- Refer to Section 17 Appendix - for proposed Ethernet connectivity.
- Space to be reserved for future No3 Cap Bank OC, EF & Management relay.
- Neutral CT ratio to be considered in relay setting.
- Serial to Fibre converters to be installed for Mirrored Bits communication to switch-room.
- An appropriate number of SEL-2506 I/O relays should already be in the 22kV Switchboard specification.

2.5.22 IEC61850 Configuration

IEC61850 Design Integration Spreadsheet

- Add new relays as per Section 14 Appendix – TQY SDS.
- Map and Re-configure signals to new relays as per relevant Scheme Documents.

IEC61850 Architect & GE UR Setup

- Configure CID files as per Design Integration Spreadsheet.

IEC61850 TQY Scheme document drawings

- Produce TQY scheme document drawings to match configured Design Integration Spreadsheet.

2.5.23 GPS Clock

- Establish time synchronisation to new relays.

2.5.24 SCADA works

- Create TQY Single Line Diagram to accommodate new SLD.
- Create Alarm Pages to include new relays.
- New configurations required for SEL RTACs.

2.5.25 Fibre Optic works

- Establish new Fibre connections from new feeder relays to existing CB Remote I/O SEL2506 relays in switch-room.
- X & Y Fibre paths are to be diverse.

2.5.26 DC Distribution

- Install X & Y DC Distribution Wall boxes as per current standard.

2.5.27 AC Station service supplies

- Install AC station service, AC changeover & AC distribution as per current standard.

2.5.28 Building access control system

- Install building access control system and intrusion detection as per current standard.

2.5.29 Fire System & Indication

- Install fire system as per current standard.

2.5.30 AC Charger & DC System

- Install X & Y Battery Charger as per current standard.
- Install X & Y DC Systems as per current standard.
- Load calculation for DC System to be attached in RESIS.

2.5.31 Fibre Patch Panel

- Install X fibre patch panel/wall box.
- Y fibre patch box to be installed at rear of any Y protection cubicle.
- Fibre paths are to be diverse and Multimode OM3 (Aqua) fibre to be utilised.

2.5.32 Operator Desk

- Install Station HMI PC, mouse, keyboard, monitor on operators desk.
- Refer Protection & Control group for procurement and setup of these device.

2.5.33 Station HMI works

- Create SLD and control pages.
- Create IEC61850 status pages.

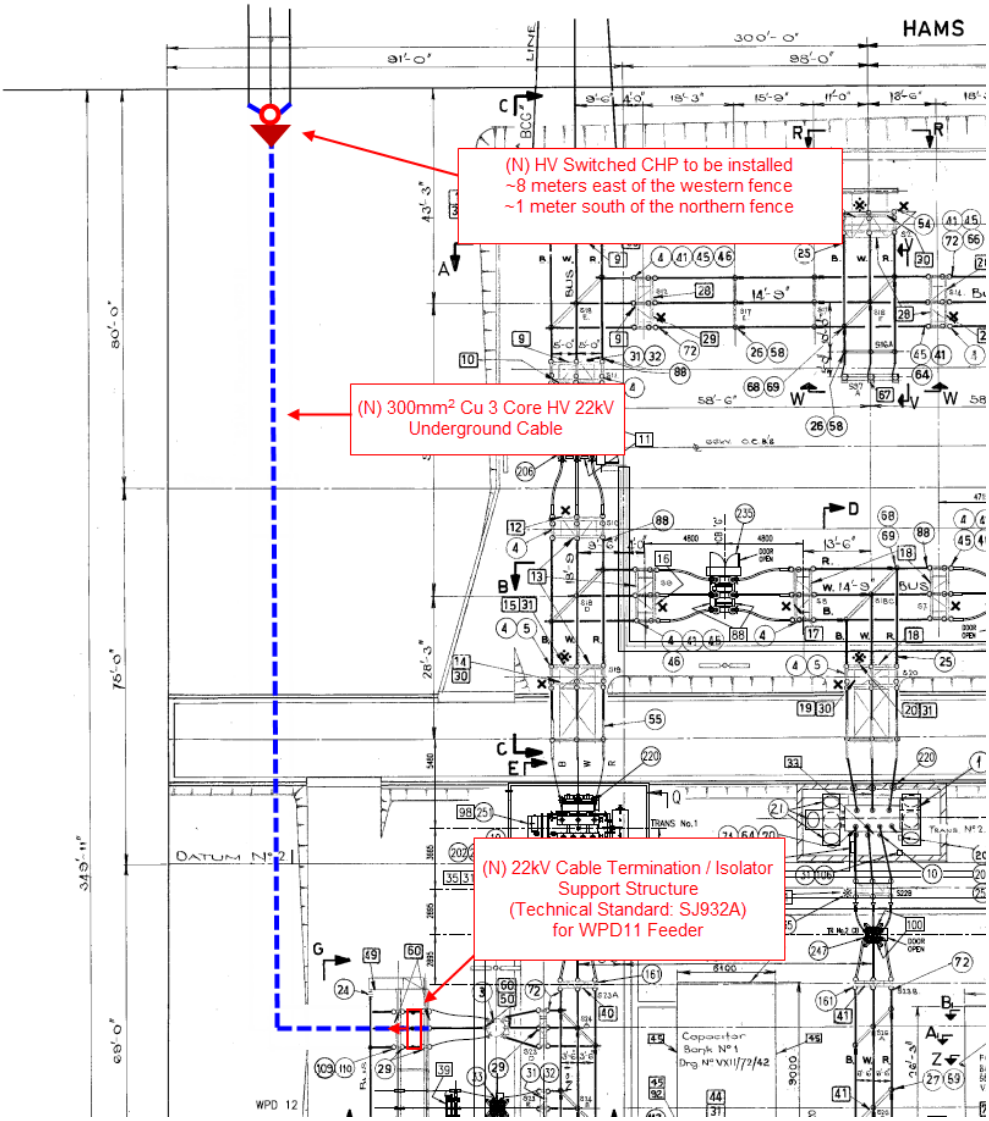
2.6 Primary plant requirements at WPD

2.6.1 Underground the existing overhead 22kV WPD011 feeder exit

The existing overhead feeder exit for WPD011 must be relocated underground to make way for the 66kV ring bus extension.

- Install a new 22kV cable termination/isolator support structure (Technical Standard SJ932A) for the new WPD011 underground cable exit.
- Install a new HV Switched CHP approximately 8 meters east of the western fence and 1 meter south of the northern fence of the WPD Zone Substation and tie in the existing overhead conductors running south from the existing pole 3 Hams Rd East (LIS 11831).
- From the existing WPD011 overhead exit to the new Switched CHP, retire approximately 80 meters the existing overhead conductor
- From the new termination/isolator support structure, extend approximately 80 meters of new 300mm^2 3/c 22.c.epr.hc.v. underground cable north and tie the cable in at the new Switched Cable head pole.

Figure 5 Underground the existing overhead 22kV WPD011 feeder exit



2.6.2 Zone substation 66kV Bus

Extend the WPD 66kV ring bus to accommodate the new 66kV line exits to the TQY zone substation by including the following:

- Relocate CB 'A' from it's current position to a position as part of the western extension of the 66kV bus beside the No.1 transformer.
- Install two (2) new 66kV Bus Crossover modules (one located between CB 'A' and future CB 'F', and one between new CB 'E' and future CB 'F') with one (1) new double break rotary disconnect switch.

  Note: a bus termination structures will be required as detailed in Technical Standard: SJ231.

- Install new 32mm Cu Tube ring bus sections with expansion joints for the new 66kV ring bus extensions.

- Install three (3) new underground 66 kV line entry structures (Technical Standard: SJ211) with disconnect switches and earthing switches for the new WPD – TQY No.1, new WPD - TQY No. 2 66kV line and the future WPD - CMT 66kV lines.
- Retire the existing and obsolete line entry structure located between CB's 'C' and 'D' to make way for the new WPD – TQY No.1 line entry structure.
- One (1) set of three (3) 66 kV/110V single phase magnetic voltage transformers (72.5kV) as line voltage transformers for the WPD-TQY No.2 line. (66 kV/√ 3: 110V/√ 3: 110V/√ 3 Class 0.5M/1.0P 100VA).

Note: the WPD-TQY No.1 line is to utilise the existing single phase magnetic voltage transformers on the 66kV bus.

See Section 13 Appendix – Proposed WPD Site General Arrangement for a diagram of the WPD zone substation 66kV bus works.

2.6.3 Zone substation 66kV circuit breakers

Install three (3) new 66 kV Circuit Breakers with isolators to Tech Standard ZD011. Dead-tank CB's with integral CT's are required. The CB's and CT's shall be rated 72.5kV, with a minimum continuous current rating of 1600A and fault rating of 25kA. 66kV Circuit Breaker module as per Tech Standard SJ221.

The 66 kV circuit breaker current transformers required are as follows:

- Four (4) three phase sets 1600-1200-900-600/5A; 0.25PX100R0.15 Ohm on 300/5A

  (Preferably 2 sets on each side of CB)

The new CB 'C' will be located between the existing GTS Line and the new TQY Line No.1 and include:

- One (1) set of isolators are required as the existing Duo Roll Switch can act as one isolation point for the new CB module.

The new CB 'D' will be located between the existing BCG Line and the new TQY Line No.1 and include:

- One (1) set of isolators are required as the existing Duo Roll Switch can act as one isolation point for the new CB module.

The new CB 'E' will be located between the existing BCG Line and the future Charlemont (CMT) Line.

Relocate the existing Dead Tank Type CB 'A' to the new position between the No.1 Transformer and the new TQY Line No.2, as part of the extended ring bus and include:

- One (1) set of isolators are required as there are existing isolators on one side of the relocated CB module.

Install two (2) sets of isolators and a new 66kV Circuit Breaker Dead Tank Module (Ref: Technical Standard: SJ221) in preparation for future CB 'F'.

Note: CB 'F' to be installed at a later stage when the new WPD – CMT 66kV line is installed.

2.6.4 Zone Substation Earth Works and Earthing

- Construct modifications / extensions and new connections to the existing Station Earth Grid as required for the new plant ring bus extensions, but try to minimise the earth grid resistance due to the presence of the REFCLs at WPD.

2.6.5 22kV Bus Nomenclature

Any large scale changes to the 22kV yard require that consideration is given to the naming of plant in the substation from an operational perspective. This is critical from a healthy and safety perspective as well as from an operational

Nameplates in the 22kV Yard must be reviewed and any that do not conform with the new naming of primary plant must be replaced.

- Review nameplates of all 22kV Circuit Breakers, Buses, Isolators, Disconnect Switches, Earth Points and Cables.

All Primary and Secondary drawings must be reviewed and any that do not conform with the new naming of primary plant must be updated.

- Review all drawings with references to 22kV Circuit Breakers, Buses, Isolators, Disconnect Switches, Earth Points and Cables.

Particular attention shall be given to the naming of primary plant items in the operational systems to ensure that any naming changes in the field are updated in the operational software such that switching instructions are correct when printed. This requires coordination between the field works, the SCADA group and network operations.

2.7 Civil works requirement at WPD

The civil works are to include the following:

- Construct new foundations as required for the new 66kV ring bus extension and additional CB's.
- All equipment and foundations shall be to local council building requirements.
- Utilise existing cable ducts for new secondary wiring between major plant items and the station control room as far as possible. If an additional control cable system is required, it shall be enclosed so that entry by vermin is prevented. Some cable trenches may need to be relocated due to the installation of new plant and bus bay structures.
- Supply and install station outdoor nameplates on the new primary equipment in accordance with "Powercor Zone Substation Equipment Labelling Standard". Nameplates are required for any existing equipment that will be renamed as well as for new equipment.

2.8 Switchyard Lighting at WPD

Install additional 240 V AC Yard Lighting to achieve a minimum level of 10 Lux for the relocated 66kV CB 'A' and new 66kV CB's 'C', 'D' and 'E'.

2.9 Building & Property Considerations at WPD

Not applicable.

2.10 Secondary works at WPD

The following outlines the Protection and Control requirements at WPD.

- Latest version of application manuals are to be confirmed with EN Protection Solutions at design commencement.
- All secondary drawings shall be in the wiring schematic format consistent with the existing suite of drawings for the station.
- 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 RESIS.
- A site visit with the RO and a tester is required to determine possible panel location for the new relays prior to DDS development.

2.10.1 66kV TQY No1 Line X & Y Protection

Install:

- One (1) SEL-311L Relay for
  - TQY No1 Line X Differential protection

- One (1) RS400 for
  - DNP communication and engineering access to SEL-311L & 7SD522
- One (1) SEL2411 for
  - TQY No1 Line Management
- One (1) 7SD522 Relay for
  - TQY No1 Line Y Differential protection

Design Notes:

- 2 serial connections are to be established to the SEL311L & 7SD522 from the RS400

  (One for DNP3 and the other for Engineering access).

2.10.2 66kV TQY No2 Line X & Y Protection Cubicle

Install:

- One (1) SEL-311L Relay for
  - TQY No2 Line X Differential protection
- One (1) RS400 for
  - DNP communication and engineering access to SEL-311L & 7SD522
- One (1) SEL2411 for
  - TQY No2 Line Management
- One (1) 7SD522 Relay for
  - TQY No2 Line Y Differential protection

Design Notes:

- 2 serial connections are to be established to the SEL311L & 7SD522 from the RS400

  (One for DNP3 and the other for Engineering access).

2.10.3 66kV X CB Management

Install:

- Three (3) SEL-351S X CB Management and X CB Fail relays for
  - 66kV CB C
  - 66kV CB D
  - 66kV CB E

2.10.4 66kV Y CB Management

Install:

- Three (3) GE-C60 Y CB Management and Y CB Fail relays for
  - 66kV CB C
  - 66kV CB D
  - 66kV CB E

2.10.5 66kV GTS Line X & Y Protection

- Update the existing GTS Line X & Y distance protection due to the new 66kV CB ‘C”.
- Update the standby 66kV VT supplies.

2.10.6 66kV BCG Line X & Y Protection

- Update the existing BCG Line X & Y current diff protection due to the new 66kV CBs ‘D’ and ‘E’.
- Update the standby 66kV VT supplies.

2.10.7 Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation

A new Fibre Optic loop is to be installed between WPD zone substation and the new TQY zone substation and include the following:

- From the existing communications hut at WPD, extend two (2) new optic fibre cables in one (1) new 63mm Ø conduits south east and under the fence of the WPD zone substation and continue the optic fibre cables south through one (1) existing 63mm Ø conduit.
- One (1) fibre optic cable is to exit the conduit adjacent to the existing pole 1 WPD – TQY No.2 (LIS 993910) and then continue overhead under WPD – TQY No.1 66kV Sub-Transmission Line to the proposed TQY ZSS (route along Ghazeepore Road, Whites Road, Anglesea Road and Coombes Road).
- One (1) fibre optic cable is to exit the conduit adjacent to the proposed pole 7 WPD to TQY No2 (LIS 786166, in GIS) and then continue overhead under the WPD – TQY No.2 66kV Sub-Transmission Line along Ghazeepore Road to the proposed TQY ZSS.

Note that new overhead fibre optic cables are to be designed so that a subsidiary 22kV circuit can be installed on the 66kV pole line, if there is not one already.

3 LV line requirements

Not applicable.

4 66kV sub-transmission requirements

4.1 TQY zone substation site requirements

Two new 66kV Sub-Transmission Lines (WPD-TQY No.1 and WPD-TQY No.2) are required to run from the existing WPD zone substation to the TQY zone substation. This will form a new 66kV loop between the existing WPD Zone Substation and the TQY Zone Substation. In the event of the loss of one of the WPD-TQY 66kV lines during peak load periods, the other WPD-TQY 66kV line will be able to supply the entire TQY station load; this eliminates the load at risk under this contingency.

One new 66 kV line section has been completed in 2006, from the existing WPD zone substation to the TQY site (WPD to TQY No.2), which runs along Ghazeepore Road. At the corner of Ghazeepore Road and Dillwynia Lane, the WPD to TQY No.2 66kV line is to tee off along Dillwynia Lane and into the southern end of the TQY zone substation site. The WPD to TQY No.2 line is currently operating at 22 kV (as WPD032). The second new 66 kV line section from the existing WPD zone substation to the TQY site (WPD to TQY No.1), was completed in 2013, which runs along Anglesea Road. From the end of the 66kV construction in Anglesea Road, new 66kV overbuild will be established along Coombes Road to tie into the existing WPD to TQY No.1 line conductors off Coombes Road (near the intersection of Ghazeepore Road) that run into the north end of the TQY zone substation site. The WPD to TQY No.1 line will operate at 22 kV until the new TQY zone substation is built (as WPD021).

- The two line sections will terminate at strain poles with stays (one outside the southern site fence in the Pettigrove Lane road reserve, and one outside the northern site fence but still within the subdivision for the Torquay zone substation site).
- The new line sections within the TQY station yard are to be wood pole lines designed for 66 kV only, with pole top cruciform construction and 1250mm creepage post type insulators. The 66 kV conductor required is 19/4.75 AAC. It is proposed that the construction will be mostly short spans with slack stringing onto station rack structures.
- Creation of both WPD to TQY No 1 & No 2 circuit data sheets is required.

4.1.1 WPD-TQY No.1 works

The following works are required to establish the WPD-TQY No.1 line at the TQY 66kV line entry to Anglesea Road:

- From existing pole 108 Anglesea Road (LIS 786299), tie in and extend new 3-19/4.75 AAC overhead conductor (100°C/+75°C design temperature) overbuild of the existing 22kV conductor to pole 1 Coombes Road spur (LIS 786300) – approximately 50m.
  Note that there is existing 3-19/4.75 AAC overhead conductor between pole 1 Coombes Road spur and pole 2 Coombes Road spur (LIS 786301).
- From existing pole 2 Coombes Road spur to pole 127 WPD to TQY No1 (LIS 778430) along Coombes Road, install new 3-19/4.75 AAC 66kV overhead conductor (100°C/+75°C design temperature) and new 3-19/3.25 AAC subsidiary 22kV overhead conductor (65°C/+30°C design temperature) for the new TQY011 feeder – approximately 1,400m each.
  Note that the new 3-19/4.75 AAC overhead is to be tied into the existing 3-37/3.75 AAC between pole 127 WPD to TQY No1 and pole 130 WPD to TQY No1 (LIS 778433).
- From pole 130 WPD to TQY No1 extend new 3-19/4.75 AAC 66kV overhead conductor (100°C/+75°C design temperature) into the TQY zone substation to the 66kV line entry for the WPD-TQY No.1 line on the new 66kV bus – approximately 50m.
- Retire the top circuit (existing WPD021 feeder) span of 3-19/3.25 AAC overhead conductor between pole 108 Anglesea Road and pole 108A Anglesea Road (LIS 827820).

All new sections of overhead 66kV sub-transmission construction are to be designed to accommodate a new optical fibre see Section 2.10.7 Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation.

4.1.2 WPD-TQY No.2 works

The following works are required to establish the WPD-TQY No.2 line at the TQY 66kV line entry to Ghazeepore Road:

- Install a new 66kV and 22kV anchor pole on the intersection of Ghazeepore Road and Dillwynia Lane.
- From the new 66kV and 22kV anchor pole extend new 3-19/4.75 AAC overhead conductors (100°C/+75°C design temperature) west and tie the conductors into the existing 3-37/3.75 AAC overhead conductors that run west from pole 105 WPD to TQY No2 (LIS 778425) to pole 109 WPD to TQY No2 (LIS 778429) along Dillwynia Lane – approximately 20m.
- From pole 109 WPD to TQY No2 extend new 3-19/4.75 AAC 66kV overhead conductor (100°C/+75°C design temperature) into the TQY zone substation to the 66kV line entry for the WPD-TQY No.2 line on the new 66kV bus – approximately 80m.
- Retire the span of 19/4.75 AAC overhead conductor from the new 66kV and 22kV anchor pole to pole 5 Barwon Water Ghazeepore S (LIS 987598).

All new sections of overhead 66kV sub-transmission construction are to be designed to accommodate a new optical fibre see Section 2.10.7 Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation.

4.2 WPD zone substation site requirements

The new WPD-TQY #1 66kV sub-transmission Line is to run along Anglesea Road. The 66kV section of this line is currently terminated approximately 300m south of the WPD zone substation. To tie-in the planned WPD-TQY No.1 66kV sub-transmission Line into the planned WPD 66kV ring bus, new 66kV underground cable must be installed to a new 66kV cable head at this termination point off Ghazeepore Road. A rearrangement then occurs at the corner of Ghazeepore Road and Whites Road to get the line to Anglesea Road.

The existing WPD-TQY #2 66kV sub-transmission Line has been built adjacent to Ghazeepore Road and the majority of it is presently operating at 22kV as the WPD032 feeder. The planned section of this line is currently terminated at the fence of the WPD Zone Substation (which is presently the WPD021 feeder). To run the WPD-TQY #2 66kV sub-transmission line at 66kV, new 66kV sub-transmission cables and 66kV overhead conductor must be installed to connect the existing 66kV section of the WPD-TQY #2 66kV sub-transmission Line in Ghazeepore Road to the 66kV ring bus in the WPD Zone Substation. A rearrangement then occurs at the corner of Ghazeepore Road and Whites Road to kepp the line running along Ghazeepore Road.

4.2.1 WPD-TQY No.1 works

The following works are required to establish the WPD-TQY No.1 line at the WPD 66kV line entry to Anglesea Road:

- Install a new 66kV cable head pole (Technical Standard GE141) on existing pole 1 WPD to TQY No2 (LIS 993910) for the WPD-TQY No.1 66kV sub-transmission line.
- From the new 66kV cable head on pole 1 WPD to TQY No2, extend new 3 x 630mm^2 1/c 66.c.xlpe. 66kV underground cables through existing 125mm Ø conduit that runs east to Ghazeepore Road and then north along Ghazeepore road to the south eastern boundary of the WPD zone substation - approximately 350m.
  Note: an appropriate earthing conductor is to be installed along the route in the existing 63mm Ø conduit, design to confirm.
- From the south eastern boundary of the WPD zone substation, extend new 3 x 630mm^2 1/c 66.c.xlpe. 66kV underground cables into the zone substation in new 150mm Ø conduit to the new 66kV line entry on the 66kV bus between new 66kV CB's 'C' and 'D' - approximately 150m.
  Note: an appropriate earthing conductor is to be installed along the route in the existing 63mm Ø conduit, design to confirm.

- Install a new 66kV anchor pole (proposed pole 12 WPD to TQY No1, LIS 786185 in GIS) on Whites Road between existing pole 11 WPD to TQY No2 (LIS 993921) and pole 12 WPD to TQY No2 (LIS 993922).
- From the new anchor pole 12 WPD to TQY No1 (LIS 786185) on Whites Road, extend a new 3-19/4.75 AAC overhead conductors (100°C/+75°C design temperature) west to the proposed 66kV pole 30 WPD to TQY No1 (LIS 786202) and tie the conductors in to the proposed 19/4.75 AAC overhead conductors that will run south along Anglesea Road - approximately 1,600m.
  Note: this section of new 66kV construction is to be designed for 22kV subsidiary.
- Retire one span of 3-19/4.75 AAC overhead conductors between new anchor pole 12 WPD to TQY No1 (LIS 786185) and existing pole 12 WPD to TQY No2 (LIS 993922).
- Rename poles 1 (LIS 993910), poles 2 (LIS 993911), poles 3 (LIS 993912), poles 4 (LIS 993914), poles 5 (LIS 993915), poles 6 (LIS 993916), poles 7 (LIS 993917), poles 8 (LIS 993918), poles 9 (LIS 993919), poles 10 (LIS 993920), poles 11 (LIS 993921), from WPD to TQY No2 to WPD to TQY No1.

All new sections of overhead 66kV sub-transmission construction are to be designed to accommodate a new optical fibre see Section 2.10.7 Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation.

4.2.2 WPD-TQY No.2 works

The following works are required to establish the WPD-TQY No.2 line at the WPD 66kV line entry to Ghazeepore Road after Whites Road:

- Install a new 66kV cable head pole (Technical Standard GE141) in the vicinity of existing pole 1 Ghazeepore Road (LIS 16296) for the WPD-TQY No.2 66kV sub-transmission line (in the WPD zone substation yard).
- From the new 66kV cable head on pole 1 Ghazeepore Road, extend new 3 x 630mm^2 1/c 66.c.xlpe. 66kV underground cables within the zone substation yard to the new 66kV line entry on the 66kV bus between relocated 66kV CB 'A' and future CB 'F' - approximately 100m.
- Retire poles 1, (LIS 16296), 1A (LIS 16297) and 2 (LIS 16298) Ghazeepore Road to rebuild the line.
- From the new 66kV cable head in the vicinity of pole 1 Ghazeepore Road, extend new 3-19/4.75 AAC overhead conductors (100°C/+75°C design temperature) east to pole 3 WPD to TQY No2 (LIS 786160) - approximately 70m.
  Note: see Section 5.2.2 as the WPD021 feeder exit is to be retired, and new poles are to be installed with the WPD022 feeder exit to be relocated so that it is run as a subsidiary to the WPD-TQY No.2 66kV sub-transmission line.
- From pole 3 WPD to TQY No2 (LIS 786160), augment the existing 3-19/.128 AAC overhead conductor to new 3-19/4.75 AAC overhead conductor (100°C/+75°C design temperature) to pole 23 Ghazeepore Road (LIS 15720) - approximately 1,500m.
  Note the existing WPD022 conductor is to be subsidiary to the WPD-TQY No.2 66kV sub-transmission line.
- Extend new 3 – 19/4.75 AAC overhead conductor (100°C/+75°C design temperature) between pole 23 Ghazeepore Road (LIS 15720) and pole 12 WPD to TQY No2 (LIS 993922) – approximately 60m.

All new sections of overhead 66kV sub-transmission construction are to be designed to accommodate a new optical fibre see Section 2.10.7 Fibre Optic Communication Ring between the WPD zone substation and the TQY zone substation.

5 22 kV distribution feeder requirements

5.1 REFCL 22 kV distribution feeder requirements

All REFCL 22kV distribution feeder requirements for TQY have been included in the related Waurn Ponds (WPD) ZSS REFCL Installation scope.

5.2 HV feeder rearrangements

Four (4) new feeders are to be initially established from the new TQY zone substation, TQY011, TQY012, TQY021 and TQY022. Works will also occur on existing WPD 22kV feeders as follows:

5.2.1 Existing WPD032 works

The existing WPD032 feeder exit is to be maintained and terminated at the cable head pole and reserved for future use as a 22kV feeder by the following works:

- The existing 300mm^2 3/c 22.c.epr.hc.v. high voltage underground cable between the WPD032 feeder exit and pole 1 WPD to TQY No2 (LIS 993910) is to be terminated at the cable head pole.

5.2.2 Existing WPD021 works

The WPD021 feeder will be retired as part of these works:

- Retire the existing 3-19/.128 AAC WPD021 overhead feeder exit to pole 3 WPD to TQY No2 (LIS 786160).
- Retire the existing 3-19/3.25 AAC overhead conductors between pole 23 Ghazeepore Road (LIS 15720) and proposed anchor pole 12 WPD to TQY No1 (LIS 786185).
- Ensure the Whites – Anglesea P40 pole substation is transferred to WPD014 by maintaining the 22kV conductors between pole 40 Whites Road (LIS 15955) and pole 30 WPD to TQY No1 (LIS 786201) and changing the bridging on pole 30 WPD to TQY No1.

5.2.3 New TQY011 works

New TQY011 feeder to supply the north west part of the TQY network, as well as down to Lorne in the south, works as follows:

- From the new TQY011 circuit breaker in the new TQY 22kV switch room extend new 300mm^2 3/c 22.c.epr.hc.v. high voltage underground cable in a 150mm Ø conduit to a new switched cable head (Tech Standard GE106) and tie in at pole 130 WPD to TQY No1 (LIS 778433) with the existing 3-19/3.25 AAC – approximately 130m.
- Replace the existing two (2) HV fuses on existing pole 6 Coombes Road spur (LIS 34732) with new 10A fault tamers.
- Retire the existing HV fuses on pole 112 WPD to TQY No1 (LIS 786304).
- Upgrade the existing Gevea Air Break Switch (Sw No.21041) to a new 400A ACR on pole 32A WPD to TQY No1 (LIS 786206) to be used as a new open point between TQY011 and WPD014.

Note that new 3-19/3.25 AAC (65°C/+30°C design temperature) overhead subsidiary is to be installed for the TQY011 feeder backbone as part of the WPD to TQY No.1 66kV sub-transmission line works and is to be tied at pole 125 WPD to TQY No1 (LIS 786323) with the existing 3-19/3.25 AAC to the zone substation site, see Section 4.2.1 WPD-TQY No.1 works.

5.2.4 New TQY012 works

New TQY012 feeder to supply the north east part of the TQY network, including northern part of Torquay itself, works as follows:

- From the new TQY012 circuit breaker in the new TQY 22kV switch room extend new 300mm^2 3/c 22.c.epr.hc.v. high voltage underground cable in a 150mm Ø conduit to a new switched cable head (Tech

Standard GE106) and tie in at pole 109 WPD to TQY No2 (LIS 778429) to the existing 3-19/3.25 AAC subsidiary to the WPD to TQY No.2 66kV line – approximately 30m.

- From pole 105 WPD to TQY No2 (LIS 778425), extend new 3-19/3.25 AAC (65°C/+30°C design temperature) eastwards along Dillwynia Lane to the new 66kV and 22kV anchor pole, then northwards along Ghazeepore Road to a new anchor pole on the corner of Coombes Road to be tied in with the existing WPD014 overhead conductor in Coombes Road (subsidiary to the WPD to TQY No.2 66kV line) – approximately 280m.
  Note that the two pole substations, "Barwon Water- Ghazeepore P6" and "Barwon Water- Ghazeepore P6" are to be re-terminated to the new TQY012 subsidiary 22kV line.
- From existing pole 125 No1 (LIS 786323), augment the 2-3/2.75 SC/GZ to new 3-19/3.25 AAC (65°C/+30°C design temperature) eastwards along Coombes Road to pole 12 Coombes Road spur (LIS 35845) – approximately 1,200m.
  Note: New tall poles will be required to accommodate these three phase conductors and a future 22kV 3-19/3.25AAC subsidiary.
- Install two (2) new 10A fault tamer fuses on pole 12 Coombes Road spur (LIS 35845).
- Install a new HV cable head on a new pole in Coombes Rd in the vicinity of pole 12 Coombes Road and extend new 240mm^2 3/c 22.a.x.hc.h. underground cable in the existing 150mm Ø spare conduit along Coombes Road and Frog Hollow Drive to a termination with the spare SW No.60700 at the triple switch 315kVA 'Frog Hollow Coombes' kiosk substation - approximately 400m.
- From existing pole 16 Coombes – Messmate Spur (LIS 33380) to existing pole 1 Coombes – Messmate Spur (LIS 34250) in Coombes Road augment the existing 3-7/3.0 AAC to new 3-19/3.25 AAC (65°C/+30°C design temperature) - approximately 1,400m.
- From pole 16 Coombes – Messmate Spur to pole 1 Messmate Coombes (LIS 949741) augment the existing 3-7/3.0 AAC to new 3-19/3.25 AAC (65°C/+30°C design temperature) - approximately 75m.
- Install three (3) new 20A boric acid fuses on pole 1 Messmate Coombes (LIS 949741).
- Retire the three (3) 63 Amp powder filled high voltage fuses at existing pole 1 Coombes – Messmate Spur (LIS 34250). Retain existing switch at this location SW No.47283).
- Install a new 400A ACR on pole 6A Coombes Road (LIS 786409) to be the new open point between TQY011 and TQY012.
- Upgrade the existing Gevea Air Break Switch (Sw No.22919) to a new 400A ACR on pole 205 Torquay Road (LIS 35232) to be used as a new open point between TQY012 and WPD022.

5.2.5 New TQY021 works

New TQY021 feeder to supply the south west part of the TQY network, including Anglesea and part of Jan Juc, works as follows:

- From the new TQY021 circuit breaker in the new TQY 22kV switch room extend new 240mm^2 3/c 22.a.x.hc.h. high voltage underground cable in a 150mm Ø conduit southwards then westwards along Dillwynia Lane in existing 150mm Ø spare conduit, then southwards along Lincoln Avenue to the spare switch (SW No.82902) at the 315kVA double switched kiosk substation 'Lincoln-Suffolk' – approximately 350m.
- Install a new 400A ACR on pole 33 Grossmans Road spur (LIS 35354) to be the new open point between TQY021 and TQY022.

5.2.6 New TQY022 works

New TQY022 feeder to supply the south east part of the TQY network, including Torquay's centre and part of Jan Juc, works as follows:

- From the new TQY022 circuit breaker in the new TQY 22kV switch room extend new 300mm^2 3/c 22.c.epr.hc.v. high voltage underground cable in a 150mm Ø conduit southwards then eastwards along Dillwynia Lane, then southwards along Ghazeepore Road to a new switched cable head (Tech Standard GE106) and tie in at pole 5 Barwon Water Ghazeepore S (LIS 987598) with the existing 3-19/4.75 AAC – approximately 350m.

5.2.7 TQY feeder exit spare conduits

- Install four (4) 150mm Ø spare conduits from the TQY 22kV switch room, southwards then eastwards along Dillwynia Lane to Ghazeepore Road for future TQY 22kV feeders.

5.2.8 New TQY feeder arrangements

The Network Solutions group will provide switching for the new TQY 22kV feeders closer to the construction period.

5.2.9 HV Fuse changes

A number of HV fuses will be required to be changed due to the increased fault level in the vicinity of the new TQY zone substation.

6 Other Work External to the Zone Substation

All works at TQY and WPD zone substations as well as works external of the zone substations to establish TQY have been included in this scope in Sections 3, 4 and 5.

7 Environmental Considerations

Preliminary Environmental Impact Assessment (EIA) to be completed at least a year before TQY scheduled construction.

Flora & Fauna as well as Cultural Heritage issues to be identified and all permits obtained.

Identify all requirements regarding the following:

- Effect of work location (Rural, CBD, Urban, Residential etc.),
- Visual, noise, EMF considerations.
- Access, traffic, pedestrians, obstructions and working hours.
- Pollutants, dust, debris and water run-off, oil containment.
- Contaminated soil area. Soil testing and management required.
- Standard work practices to apply regarding traffic, noise, pollutants, dust, debris and water run off.
- Trees, roots & pruning.

All works and installations are to comply with current EPA requirements.

8 Liaison and Coordination of Works

The PCS PM will provide the Responsible Officer with a work plan outlining the key steps and associated target dates needed to achieve the overall project completion target date. This will be used as an aid in determining how the project is progressing.

The PCS PM will submit a detailed commissioning plan, (addressing both sub-transmission and distribution issues as appropriate) to the Responsible Officer for discussion and identification of any system operational problems at least 5 weeks prior to commissioning. The PCS PM will be responsible for obtaining acceptance of the commissioning plan from Powercor's Operations Group (as appropriate).

If a major project (greater than $300,000), the PCS PM and RO will communicate on a fortnightly basis with a minimum reporting on:

- Work done – survey, design, drafting, construction, and closeout.
- Forecast target dates.
- Materials ordering & delivery progress
- Current project expenditure to-date vs. budget, and forecast cost to complete.

The PCS PM will submit a project Quality Plan to the Responsible Officer for approval.

<u>Construction:</u>

- At least one week before construction starts the PCS PM will submit to the Responsible Officer:
- A project specific Health and Safety Plan satisfying guidelines set out in Powercor document 08-F161 Guidelines for Review of H&S Plans.

- Plan drawings showing the locations of all new or modified structures, span lengths, angular changes in route, pole types, structure types, locations of stays, conductors, isolators, fuses, transformers, switches and any other equipment relevant to the work;
- General arrangement or erection drawings for each structure type used in the design, details of material components, locations of all components, major dimensions, electrical clearances, etc.

Commissioning:

- Plans provided will include a detailed Commissioning Plan, Contingency Plans, Pre-Commissioning Meeting Agendas, H & S plans, Inspections and Test Plans.

Close-out:

- As part of the "Close Out" process the Project Manager is to provide hard copy drawings and any ZSS Test & Inspection Reports to the Network RO.

Note: Final drawings to be submitted in A3 folder format to Powercor Network. Drawings shall include as a minimum as described in Section "9"

Any possible variations shall be processed in accordance with the "Powercor Network Engineering Project Variation Guidelines."

9 Known Issues Specific to this Location or Project

Liaison may be required with the adjacent retirement village, as construction works are likely to impact the area.

The project encompasses work though the Geelong – Warrnambool railway line, and multiple busy arterial roads (Anglesea Road, Bunyip Boulevard).

10 Health and Safety Concerns

Appropriate access permits and clearances shall be maintained throughout the works.

Appropriate traffic management shall be carried out where necessary.

All health & safety precautions are to be taken.

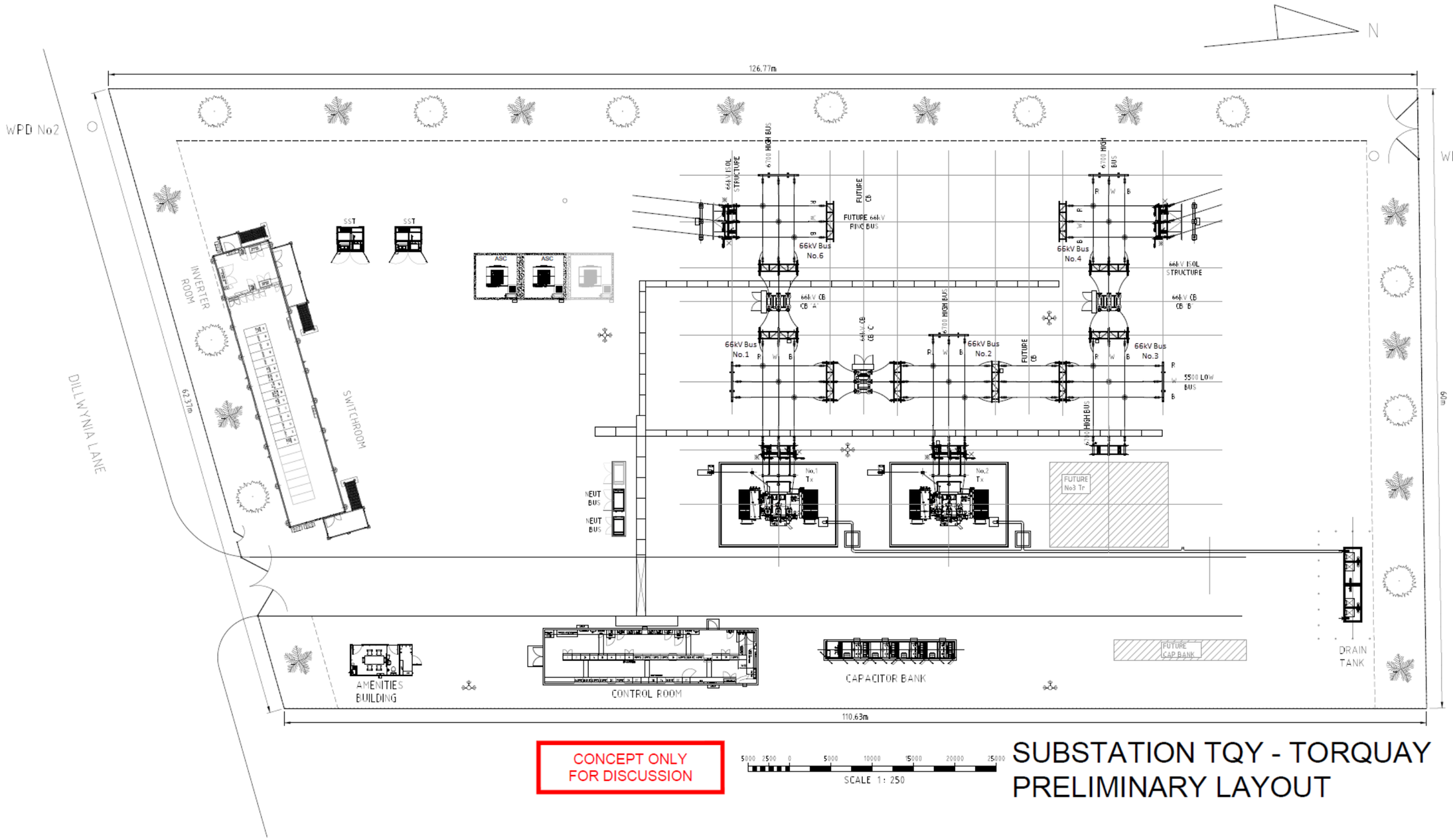
Retirement village residents entering the site.

11 Test and Commissioning Plans

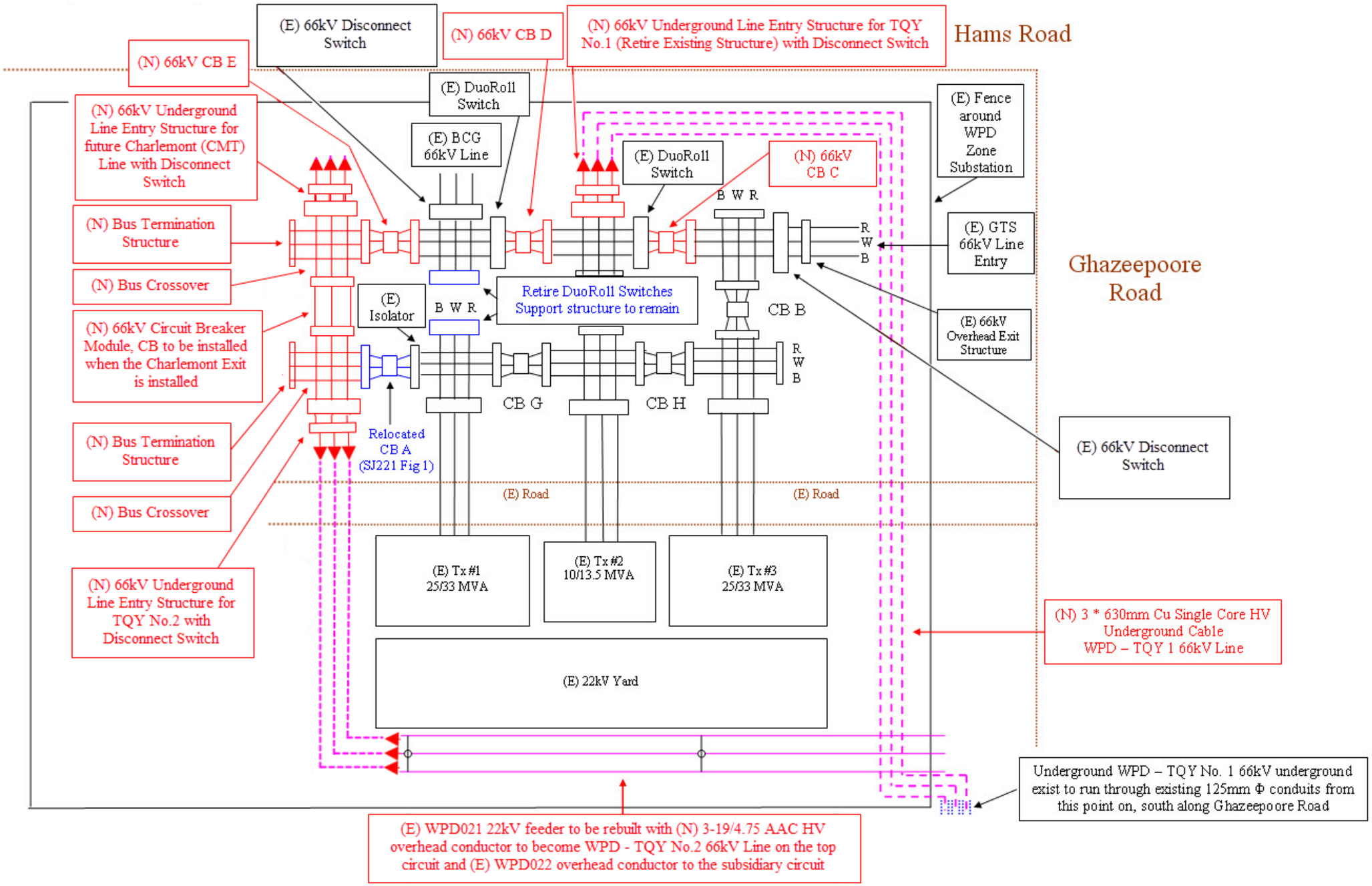
Network Services to prepare Test and Commissioning Plans:

- Inspection and Test Plans
- Contingency Plans
- Pre-Commissioning Meeting Agendas
- Commissioning Plan
- Any other drawings or plans required by the business

12 APPENDIX - Proposed TQY Site General Arrangement



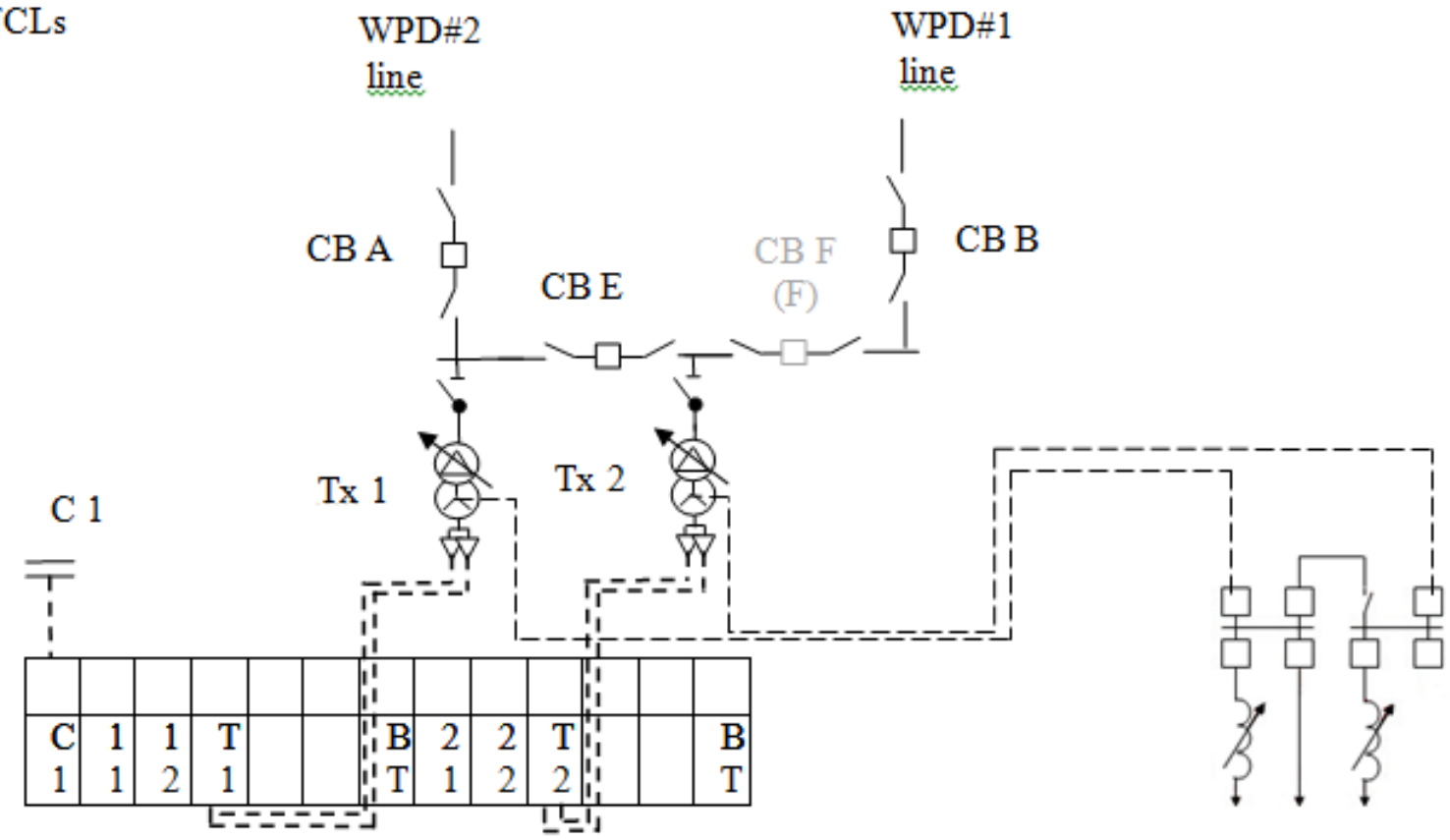
13 APPENDIX – Proposed WPD Site General Arrangement



14 APPENDIX - TQY System Design Sheets

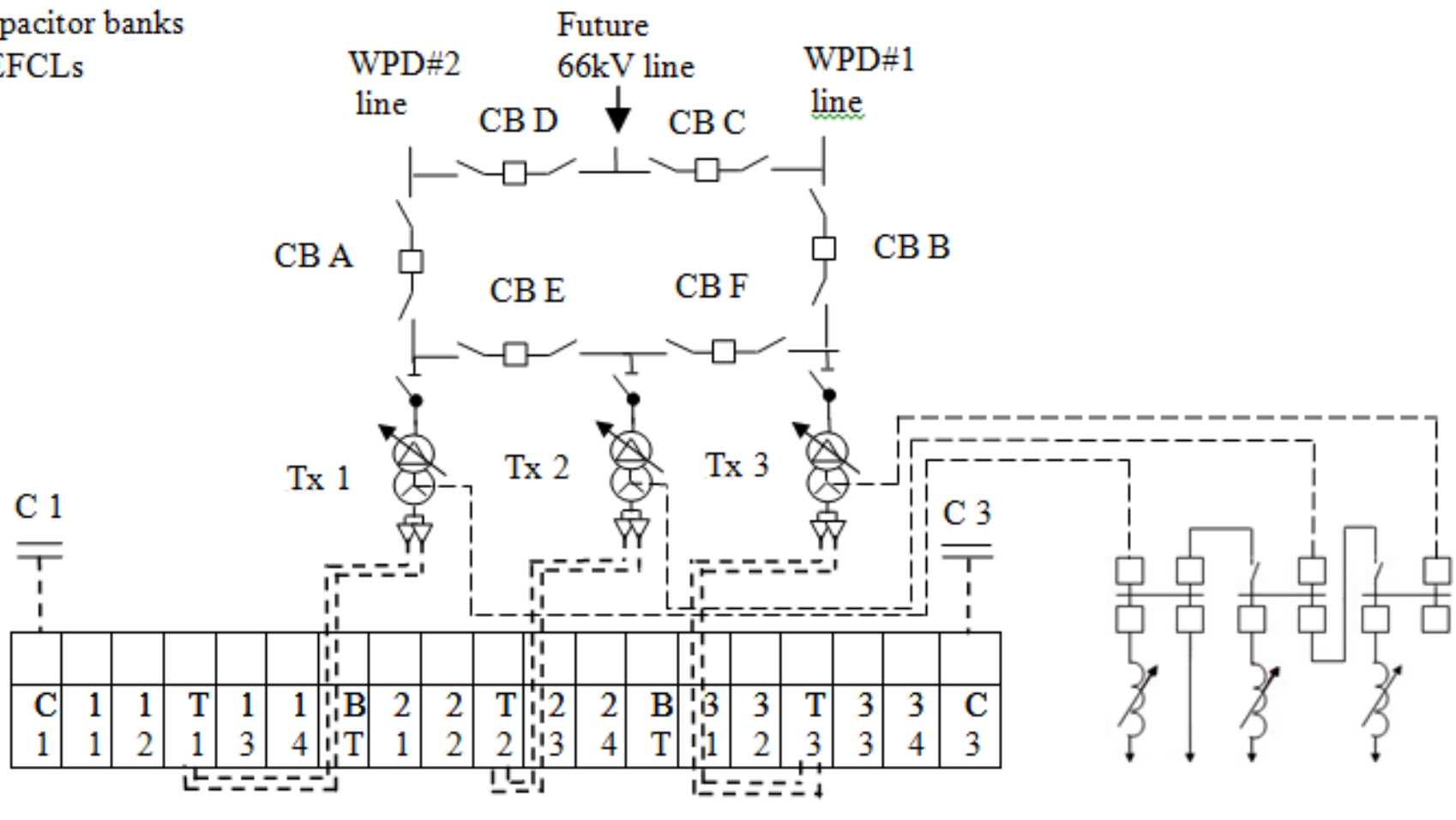
Proposed - 2022

- 2 – 25/33 MVA Transformers
- 2 – 66kV lines
- 3.- 66kV CBs
- 4 – 22kV feeders (2 * Bus Indoor Switchboard)
- 1 – 4 * 3 MVAr Capacitor Bank
- 2 – REFCLs



Possible - Ultimate

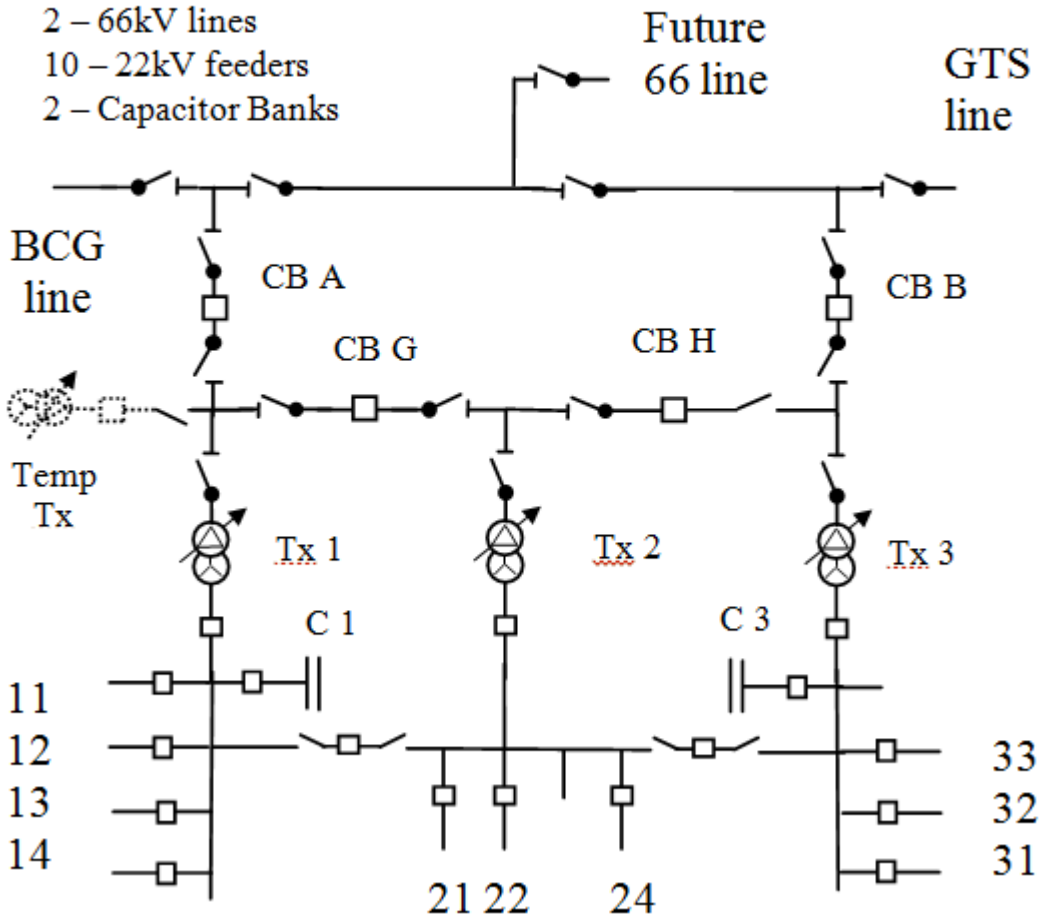
- 3 – 25/33 MVA Transformers
- 3 – 66kV lines
- 6.- 66kV CBs
- 12 – 22kV feeders (3 * Bus Indoor Switchboard)
- 2 – Capacitor banks
- 3 – REFCLs



15 APPENDIX - WPD System Design Sheets

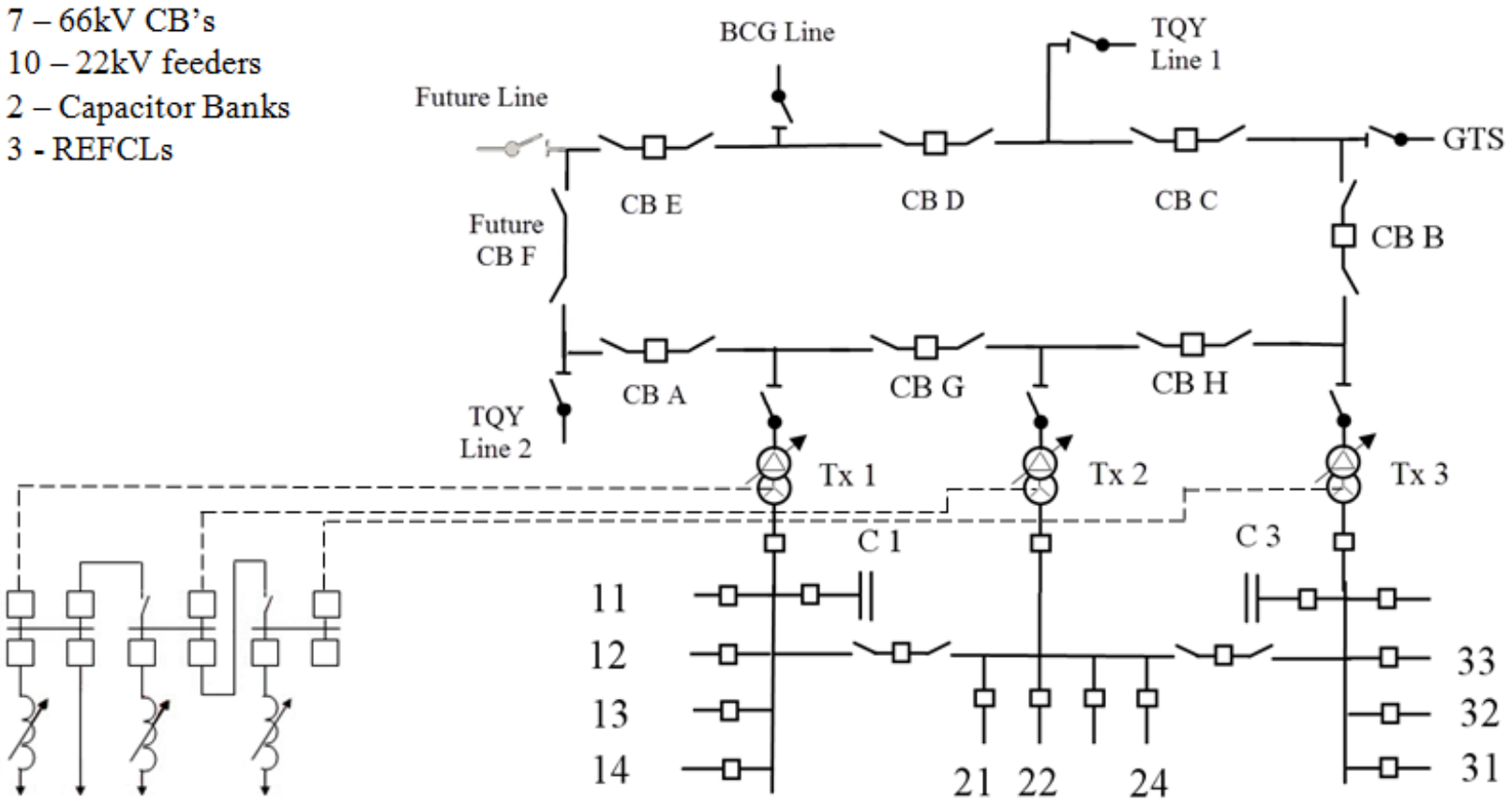
Existing – 2019

- 2 – 25/33 MVA Transformers(Tx1 & Tx3)
- 1 – 10/13 MVA Transformer (Tx2)
- 2 – 66kV lines
- 10 – 22kV feeders
- 2 – Capacitor Banks



Proposed – 2 x TQY Lines (2022)

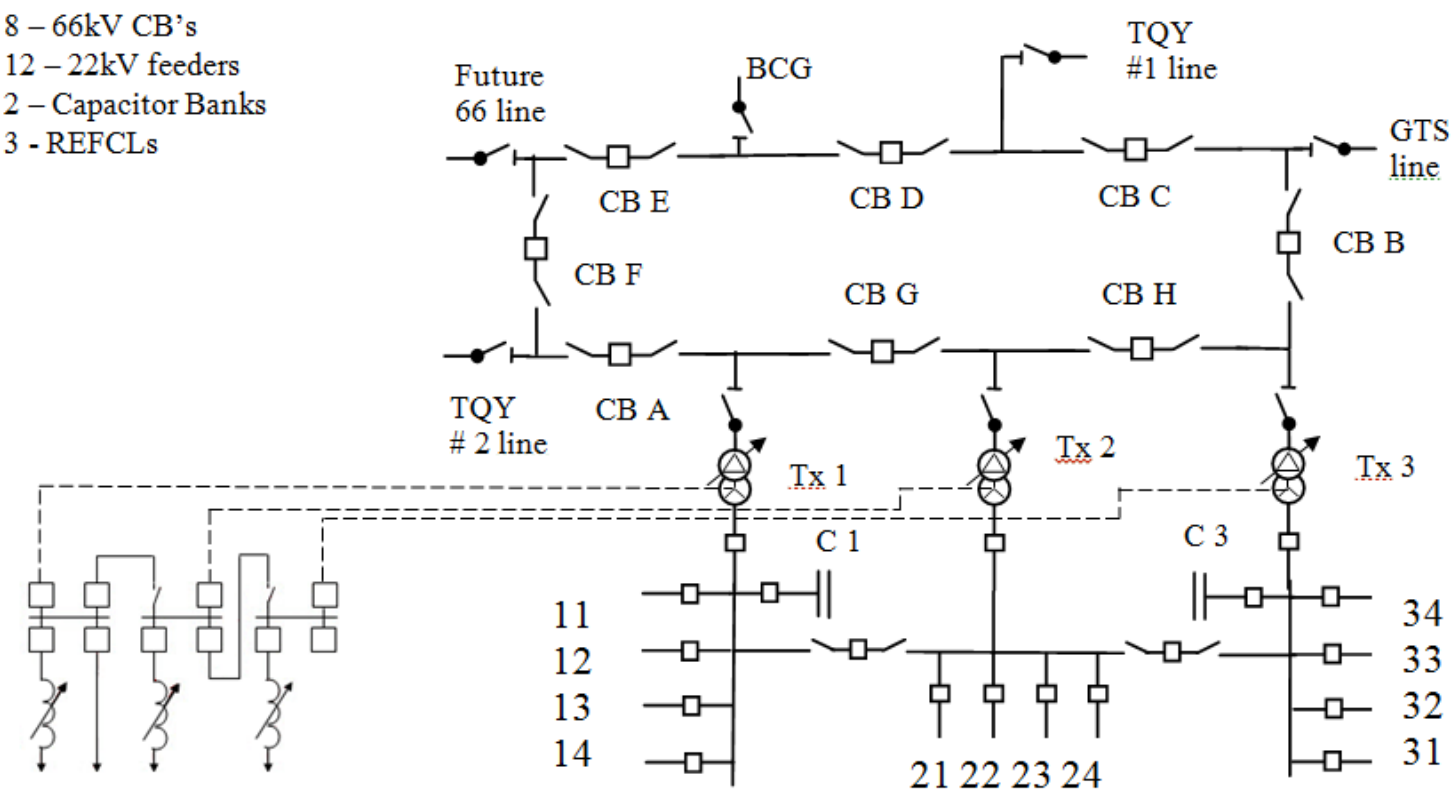
- 2 – 25/33 MVA Transformers(Tx1 & Tx3)
- 1 – 10/13 MVA Transformer (Tx2)
- 4 – 66kV lines
- 7 – 66kV CB's
- 10 – 22kV feeders
- 2 – Capacitor Banks
- 3 - REFCLs



15B APPENDIX - WPD System Design Sheets (continued)

Possible Ultimate

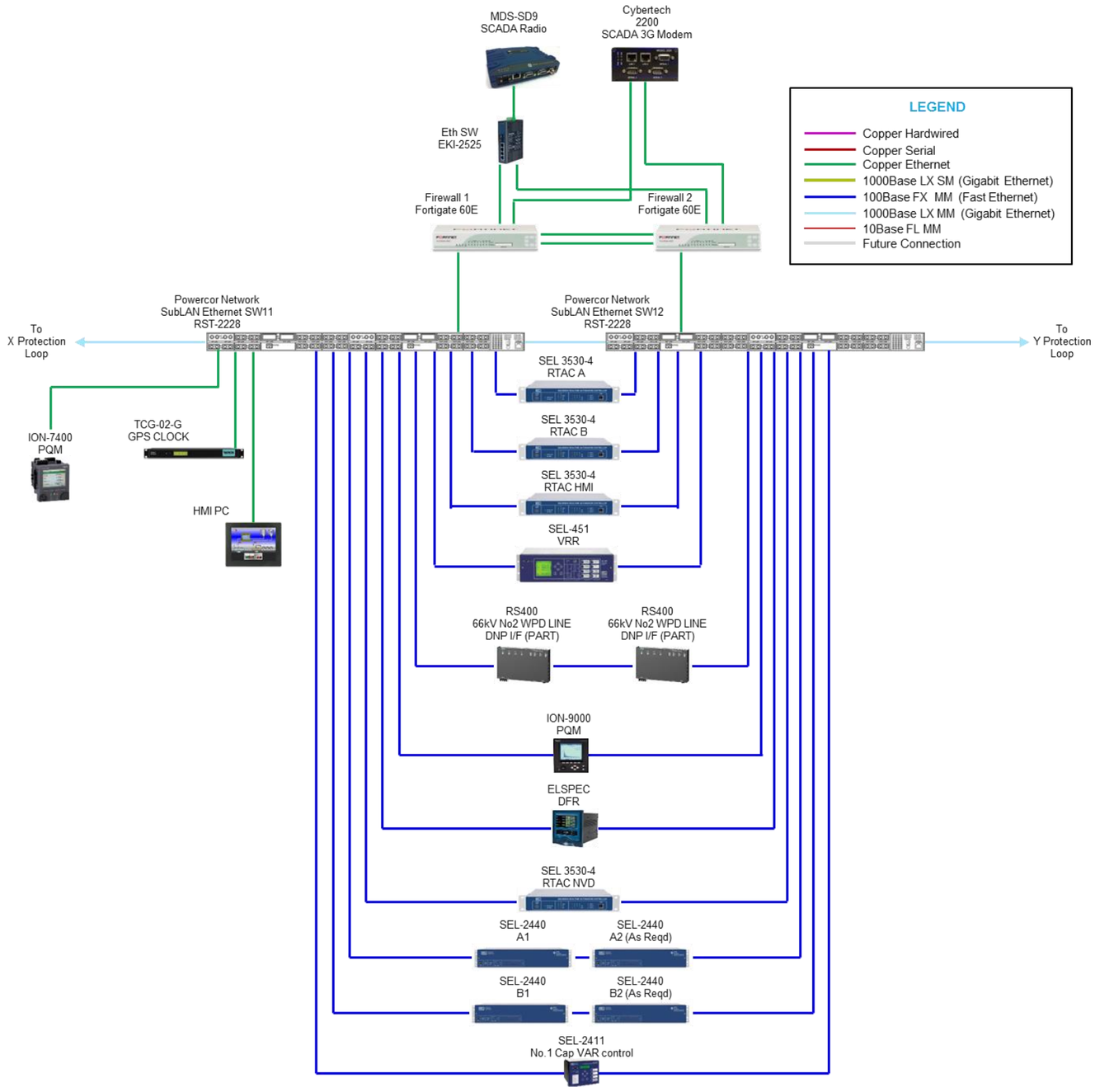
- 3 – 25/33 MVA Transformers
- 5 – 66kV lines
- 8 – 66kV CB's
- 12 – 22kV feeders
- 2 – Capacitor Banks
- 3 - REFCLs



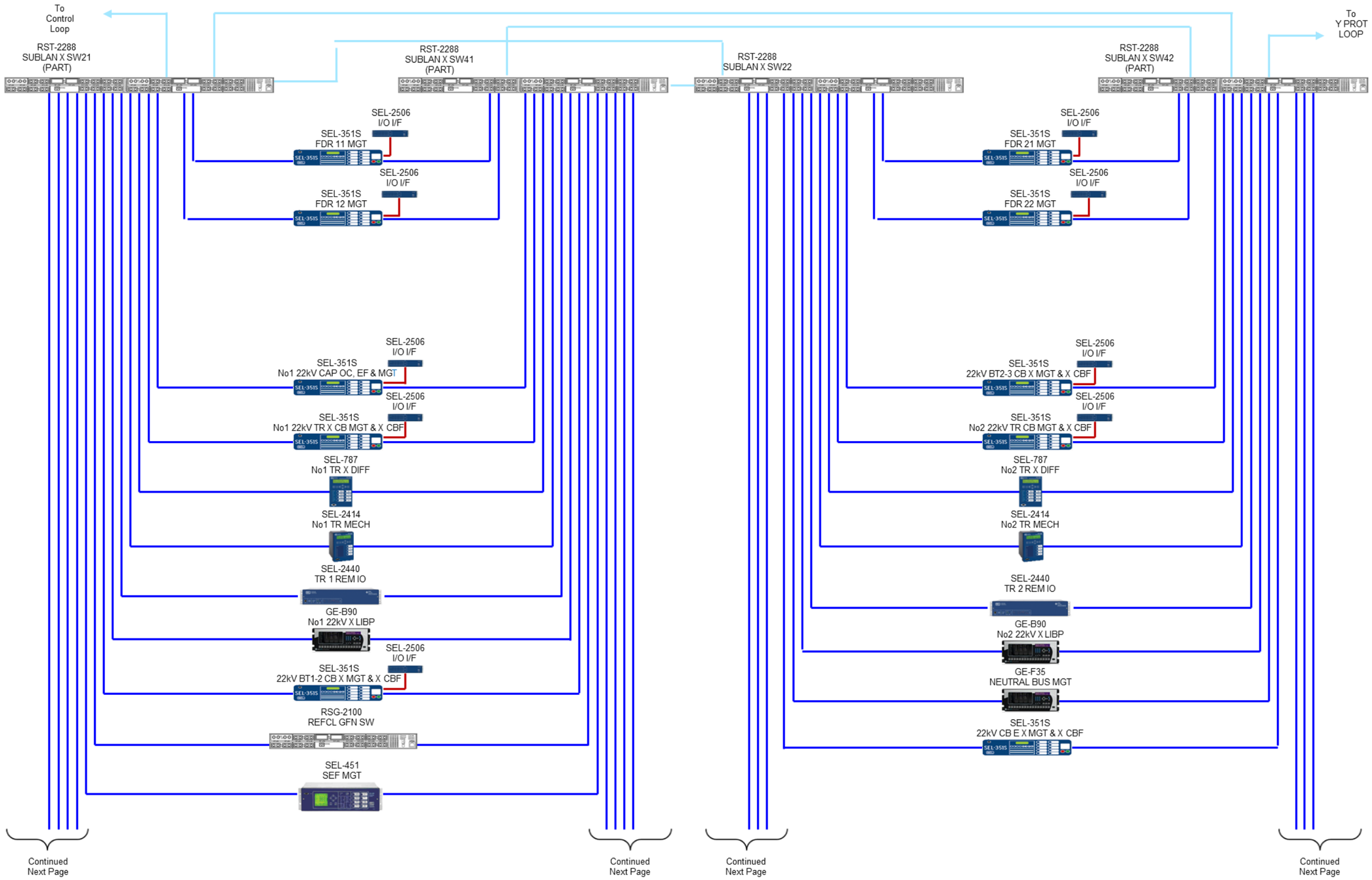
16 APPENDIX – Proposed Control Room Arrangement at TQY

CUB 1 WAN & CONTROL LOOP COMMS	CUB 2 X & Y A LOOP	CUB 3 RTAC A & B GPS, RTAC NVD STATION I/O	CUB 4 REFCL PC & HMI	CUB 5 REFCL PC & HMI	CUB 6 HMI RTAC, PC INVERTER, ALARMS	CUB 7 66kV WPD No1 LINE X & Y PROT	CUB 8 66kV WPD No2 LINE X & Y PROT	CUB 9 FUTURE	CUB 10 FUTURE	CUB 11 CB A, B, E X CB MGT & CB FAIL	CUB 12 CB A, B, E Y CB MGT & CB FAIL	CUB 13 FUTURE	CUB 14 FUTURE	CUB 15 COMMS X & Y B LOOP
CUB 16 No1 X & Y TRANS PROT	CUB 17 No2 X & Y TRANS PROT	CUB 18 22kV No1 BUS X & Y PROT	CUB 19 22kV No2 BUS X & Y PROT	CUB 20 22kV X CB MGT & X CB FAIL PROT	CUB 21 SEF MGT NEUT BUS MGT & X MEF	CUB 22 BUEF & Y MEF ELSPEC DFR	CUB 23 TQY11, TQY12 TQY13, TQY14 FDR MGT	CUB 24 TQY21, TQY22 TQY23, TQY24 FDR MGT	CUB 25 PQMs VRR CAP CONTROL	CUB 26 No1 CAP PROT No2 CAP PROT	CUB 27 FUTURE	CUB 28 FUTURE	CUB 29 FUTURE	CUB 30 FUTURE

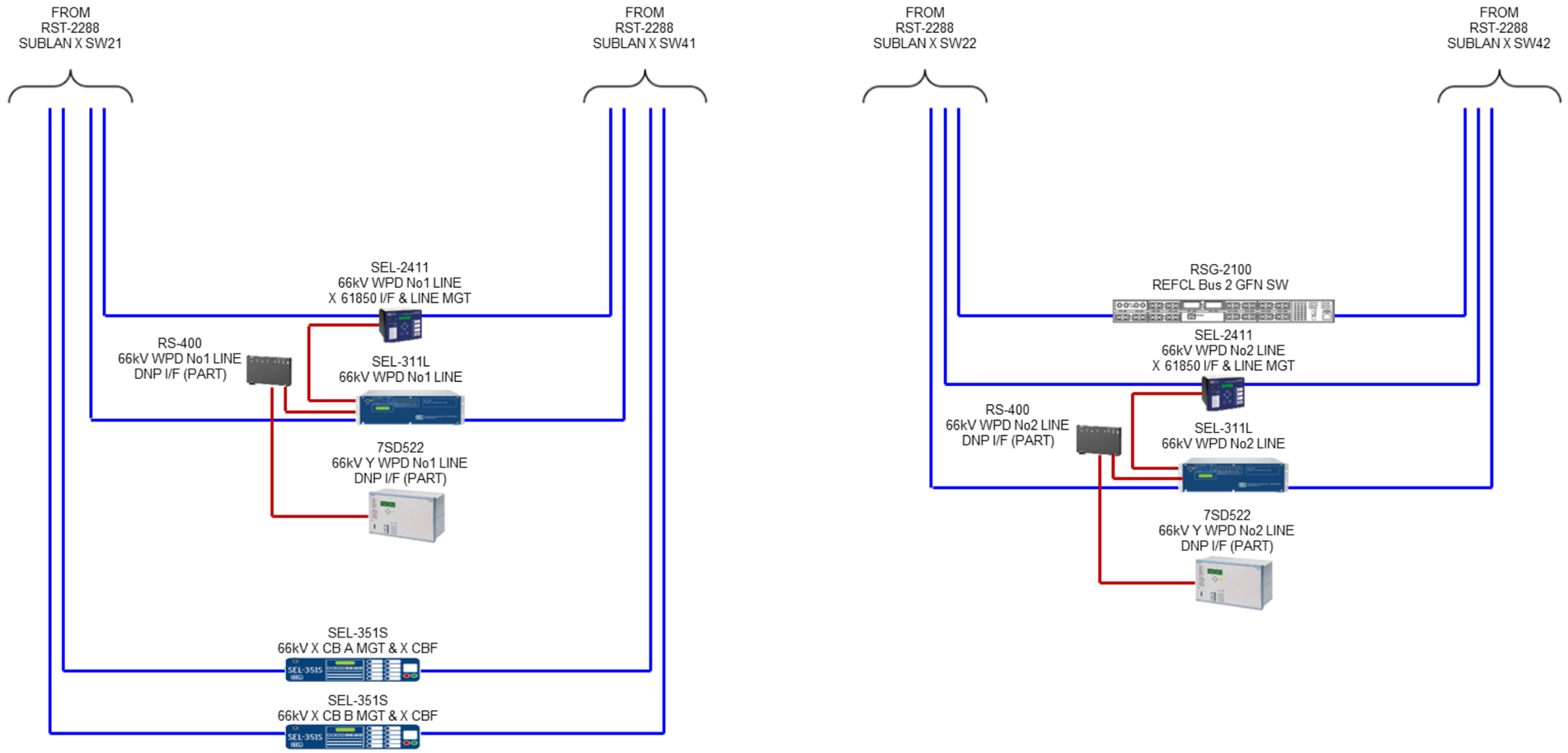
17 APPENDIX – Proposed Ethernet Connectivity – Uplink & SubLAN Control Loop at TQY



17B APPENDIX – Proposed Ethernet Connectivity – SubLAN X Protection Loop at TQY



17C APPENDIX – Proposed Ethernet Connectivity – SubLAN X Protection Loop at TQY (continued)



17D APPENDIX – Proposed Ethernet Connectivity – SubLAN Y Protection Loop at TQY