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Pr9913 - Specification for Acoustic Enclosed Generators at Unitywater Sites (Supply and Installation)

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References	Refer to Appendix B – References of this document

Version Review

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Pr9913 - Specification for Acoustic Enclosed Generators at Unitywater Sites (Supply and Installation)

Contents

1. Purpose

The purpose of this Specification is to define Unitywater requirements to achieve functional performance, time objectives and cost objectives for the supply, design, installation and testing of diesel generators.

This Specification defines the minimum requirements for the strategic planning, design, technical aspects and maintenance of all generator components and assets directly associated with generators.

2. Scope

This Specification outlines/applies to:

- The design, supply, testing and installation of generators and associated assets at Unitywater's sites.
- The general intent of the generating sets are to provide standby power during a mains power failure and/or for load shedding requirements of the electricity Supply Authority or Unitywater's electricity retailer.
- But is not limited to, the minimum requirements and standards for the design, materials fabrication, construction, installation, commissioning and performance testing.
- Works being constructed directly for Unitywater or other authority or for an owner who will hand over the ownership of the constructed works to Unitywater or who will retain ownership.
- Three-phase generators only and does not apply to single phase generators.

The scope allows for access to a broad pool of technological opportunities beyond the minimum acceptable requirements for components associated with a generator, including the diesel engine, alternator, enclosure, fuel systems, battery systems, cable requirements and earthing and bonding. Design innovation is encouraged to provide newer designs within the diesel generator space. All new designs are to be presented for review by Unitywater Engineering.

3. Planning

The minimum standard for planning intends to prescribe an essential method for deciding whether a generator is required at a site and develop a work plan for implementing the scope of requirements. Planning shall consider the application requirements in deciding whether a permanent generator or a mobile generator is selected for a site.

3.1. Location

During planning stages of projects, sufficient space may need to be allowed for the installation of a permanent or mobile generator for the site and/or as per scope of works. Considerations should include:

- Location of generator in relation to switchboard i.e. to prevent long cables runs, location of connection point for mobile generators etc.
- Set down area for mobile generators.
- Ease of access from the road for mobile generators.
- Ease of access for equipment required to maintain the generator.

3.2. Permanent Generator

For a permanent generator installation, planning shall consider sizing the generator such that it can service the plants electrical capacity for the duration of its design life.

If a generator is sized to match the plant's transformer rating, there is the possibility that the generator might be oversized for the plant's capacity. The plant capacity must be at least 40% of the generator rating otherwise load banks will be required to prevent generator engine glazing.

In this instance, it might be optimal to size the generator to match the plant's capacity, with due consideration for future plant capacity and appropriate allowances made.

Planning shall consider the size and type of generator enclosure to be installed.

It may be necessary to consider the proximity to the switchboard to reduce long cable runs.

3.3. Mobile Generator

For a mobile generator installation, planning shall consider the size and type of mobile generator (i.e. skidmount, trailer etc) required for the site.

A slab may be required for generator placement.

4. Design

4.1. General Design Aspects

The design shall be carried out in conjunction with the Scope of Work or the Principal's Project Requirements, Pr9380 - Specification for Electrical Installation at Network Sites and/or Pr9835 - Specification for Electrical Installation at Treatment Plants or any other overarching document that details the specific requirements for the work.

The design of assets shall sufficiently address the optimal balance of the cost to operate, lifecycle of the asset, safety and the reliability of plants.

4.2. General Site, Service Conditions, Design Life Aspects

Generating sets shall be designed to operate as a standby generating set and be available to run 24 hours per day 365 days per year with a design life of 40 years for mechanical components and 20 years for electrical components.

Generating sets shall be designed operate within the power supply requirements nomintated at the site it is intended to operate at. In the absence of these details being provided the site will typically operate on 3 phase + neutral system at nominated voltage 50Hz 400V AC +10%, -6%.

Particular attention shall be paid to high corrosion resistance for all externally mounted equipment to achieve corrosion resistance and protection that ensures the life expectancies listed are achieved or bettered.

Generating sets shall be sized such that it is capable of supplying the entire load for the site, including planned future capacity, for periods of time during mains power outages or for load shedding requirements when agreed with the Electricity Supply Authority or the electrical retailer. Generating sets shall be sized for a Standby application. Unitywater may, at its discretion, select a generator for a particular site that does not meet these requirements.

4.3. Arc Flash Risk Mititation

The arc flash risk rating for the generator shall be based upon the load side rating of the generator onboard circuit breaker. This value shall be used for the production of arc flash labels.

The incident energy must be reduced as far as practicable, however design must not inhibit defined operational requirements.

There is no requirement for the onboard circuit breaker panel at the generator to be arc fault contained to AS61439. Unitywater has procedural control measures to mitigate the risk presented by the lineside of the generator onboard circuit breakers.

4.4. Equipment and Fault Coordination

The design shall ensure that every item of equipment is suitable for operation at the required fault level.

Protective equipment shall be fully coordinated so that no item is called upon to break fault current in excess of its fault rating. This shall include control circuit breakers if 230 Vac control is used. Control circuit shall be fault limited to less than 5 kA.

Power and control cable protection shall be such that the energy let through by the protective device does not exceed the level permitted for that cable by AS/NZS 3008.1.1.

If fault limiting devices or coordinated circuit breakers are used, then these shall be fully rated for the fault level specified and be labelled as per Arc Flash Assessment.

Protective devices must comply with the approved Arc Flash Assessment completed as per Pr10618 - Power System Analysis and Arc Flash Studies.

4.5. Design for Safety

Systems shall be designed and constructed as far as practicable to protect against foreseeable misuse and damage to the facilities and equipment and to extend the safe operation and maintenance of the installations over the duration of the nominated asset life without need of rehabilitation.

Due consideration shall be made in the design of the equipment to simplify installation and termination of field cables.

All necessary safety facilities and mechanisms shall be installed to assure that there are no exposed live conductors when any door is open. This is to prevent accidental contact with otherwise exposed live circuits behind doors or hinged panels that may be opened without special tools and also when specifically directed within the Scope of Works or the Principal's Project Requirements or any other overarching document that details the specific requirements for the work.

4.6. Preferred Equipment and Standardisation

The preferred equipment list for automation, electrical and instrumentation equipment is outlined in F10678 - Accepted Electrical Equipment List.

All equipment supplied to Unitywater shall be strictly in accordance with this preferred equipment list.

4.7. Access to Equipment

All equipment shall be located and installed so that it will be readily and safely accessible for operation and maintenance (sufficient space for full door open servicing activities and emergency egress). Special care shall be taken to ensure this requirement is met for all doors and that the door can be fully opened and access gained to the required equipment.

AS3000 clearances will be required for all opening doors or access panels.

The equipment layout shall provide adequate access for operation with all indicators and instrumentation in easy to read locations.

All electrical and instrumentation equipment that requires scheduled or unscheduled maintenance or periodic access, shall be located to allow unobstructed, easy and safe access for maintenance, removal and replacement of items. Operator interfaces and shall be mounted between 500mm and 1600mm above working floor height at final installation. Therefore it may be necessary to take into consideration site installation requirements during design.

4.8. Design Review and Verification

Unitywater will carry out a design review for general compliance with this specification and relevant Australian Standards.

As a minimum, the following components shall be reviewed for compliance:

- Generator sizing against maximum site loading, including load shedding scenarios.
- Prospective fault current and device fault ratings.
- Protective device coordination between generator onboard circuit breaker and switchboard generator circuit breaker.
- Populated Vendor generator datasheet - refer to F11280 - Generator Datasheet Template.

The design check or verification shall be undertaken by a Registered Professional Engineer of Queensland (RPEQ) from the Board of Professional Engineers Queensland, in the category appropriate to the item being design checked or verified.

4.9. Environmental Design Aspects

All designs, plant and equipment shall be arranged and implemented as far as practicable to achieve the following:

- ensuring that regulatory requirements to which Unitywater is obligated to are complied with sustainably
- ensuring that life cycle management aspects and related environmental consequences can be sustainably addressed
- contributing to carbon footprint and energy cost minimisation.

5. Construction

5.1. General

Construction details are generally as shown in the following sections.

An engineered slab is required at site for all permanent generators.

Where provision is made for temporary generators, an enginnered slab and/or lay down area may be required as part of the project.

6. Technical Requirements

6.1. General Requirements

The following general requirements are supplementary to the requirements of the generator datasheet (refer F11280 - Generator Datasheet Template). This datasheet shall be used in the design review process and tender submission/evaluation. The datasheet shall be used for specifying generator requirements.

All equipment and materials shall be new and comply with the relevant specifications, regulations, codes and standards.

Each generator set shall include the following unless specified otherwise on any Project Data Sheet:

- Diesel engine including pumps, fans, radiator, piping, control system, governor, etc.
- Main alternator and auxiliaries including excitation system and automatic voltage regulator.
- Main circuit breaker.
- Weather-proof acoustic enclosure for generator set with inlet and outlet noise attenuators.
- Exhaust system including muffler and silencers.
- Electric starting system with on board cranking battery and charger.
- Engine instrumentation and engine control panel.
- Interconnecting cabling for auxiliary equipment and panels.
- Flexible coupling between engine and generator.
- Baseplate with anti-vibration mountings.
- Lifting points.
- Integrated fuel tank (day tank) and fuel system.
- Bunded base frame to contain oil and fuel spillage.
- Provision for draining the bund.
- Special tools required for maintenance of the generator.
- Terminal boxes for connecting all external power and control cables.

Prime Rating: The power the generating set shall produce when operating continuously as the primary power source. The generating set shall also be capable of producing 10% in excess of the prime rating for 1 hr in every 12 hr consecutive running. It is to be noted that UW do not generally use Prime rated generators unless it is required for specific projects.

Standby Rating: The power of the generating set shall produced when operating as a back-up power source. The power the generating set shall produce for 1 h in 12 h of continuous operation. The generating shall also be capable of producing at least 90% of the standby rating when operating continuously.

The rating of the generating sets shall be produced at the Alternator terminals when the set is operating under the specified site and service conditions.

Radiator ‘approach-air’ temperatures should be given considerable attention.

Datasheets shall also state the minimum loads at which each engine can operate with satisfactory behaviour without requiring excessive or abnormal maintenance and preventing engine-glazing.

The power output and fuel consumption of each engine shall comply with AS 4594.

The engine, generator and engine control panel, circuit breaker panel, batteries and fuel tank shall be mounted on a common base frame/plate, which shall be sufficiently rigid to be self-supporting.

The base frame/plate shall include minimum of four lifting lugs for lifting the entire package as one unit. All skid mounted equipment shall be suitable to withstand any lift and lifting deflection.

6.2. Diesel Engine

6.2.1 General

The engine shall be of multi-cylinder, direct injection diesel type, suitable for driving a flexible-coupled alternator to provide the rated output at the site conditions.

The diesel engine shall be in accordance with AS 4594.

The generator engine shall be designed and rated for unattended start-up and normal operation. It shall be designed to prevent deterioration during long periods (up to 3 months) of non-operation.

The engine shall be fitted with all protection devices necessary to ensure safe operation of the engine under the specified operating conditions. Such devices shall, where applicable, be integrated with other protection devices specified.

All driving belts and rotating parts shall be adequately guarded. Belt guards shall be designed in accordance with AS 4024 (all applicable parts).

6.2.2 Lubricating Oil

The engine shall be supplied with lubrication oil sufficient for the initial fill of the engine and any anticipated usage during test running and commissioning. The oil shall be replaced after commissioning.

Pipework shall be provided for the discharging of used lubrication oil to a location accessible from outside the enclosure. A suitable valve shall be installed in the pipework. A ramp shall be provided over the pipework inside the enclosure.

6.2.3 Lubricating Oil Pump

The lubricating oil pump shall be of the positive displacement type and shall be driven from the engine by gears.

6.2.4 Lubricating Oil Cooler

The engine shall be fitted with a direct engine-mounted full-flow oil cooler with an automatic by-pass valve. A switch shall provide indication to the control system of by-pass operation.

6.2.5 Air Intake Filter

The air intake filter systems shall provide clean, dry and dust free air to both the diesel engine and the alternator.

A two-stage filter system shall be installed. The first stage shall filter outside air into the acoustic enclosure and shall be mounted in the end wall of the enclosure closest to the alternator. The second stage shall comprise individual air cleaners mounted on the air intakes on each of the engine's turbo chargers.

Both filters shall be of the dry type with disposable paper elements.

Both filters shall have differential pressure gauges marked with clean/dirty zones to indicate when the filters should be replaced.

6.2.6 Exhaust Piping and Silencer

All exhaust pipework within the acoustic enclosure shall be insulated and lagged to prevent heat build-up within the enclosure. Pipework shall be connected to the engine via a flexible section arranged so that no weight is taken by the engine manifolds.

The exhaust system components supplied shall include the engine exhaust manifold(s), extension unit(s) and silencer.

The exhaust system shall include an extension pipe so the exhaust outlet is minimum 2.5m above finished ground level. A wall or roof enclosure transit flange and exhaust rain cap outlet suitable for outside duty shall be supplied.

The exhaust system shall be vented to air with adequate clearance from structures and other equipment to prevent damage or fouling of the items from the exhaust fumes.

The exhaust system shall be designed such that there are no exposed hot surfaces accessible to personnel at ground level. This may be achieved via thermal insulation or guards designed in accordance with applicable parts of AS 4024.

6.2.7 Engine Cooling System

A water-cooled radiator (cooled by an engine driven fan) shall be provided on the generating set unit. The system shall be sized to provide engine operation within the temperature limits specified by the engine manufacturer for the specified site conditions. The system shall be closed circuit with the necessary gauges, piping, ductwork and louvers.

For a installation within a building, the radiator shall be mounted near the end wall of the acoustic enclosure and shall be ducted to exhaust louvers to prevent hot air returning to the enclosure.

Any water treatment chemicals or additives necessary for the initial fill of the radiator shall be provided.

6.2.8 Engine Speed Control

An electronic governor shall be provided for generating sets above 110kVA.

Where mechanical, the governor shall be provided with a manual means of adjustment for the purpose of setting operating speed and an approved means of locking the adjustment after setting.

6.2.9 Engine Fuel System

The engine shall be suitable for running on automotive diesel fuel in accordance with AS 3570.

The engine fuel system shall be suitable to accept and return supply from and to the engine header pipe.

Fuel lines shall be fitted with a water separation filter.

The engine shall be fitted with a self-lubricated, positive displacement engine driven fuel pump.

The engine shall be supplied with diesel sufficient for the anticipated usage during test running and commissioning.

Where the engine has a high fuel recirculation (i.e. > 20%) a fuel cooler shall be installed. The fuel cooler shall be installed between the return fuel line and the fuel day tank. An allowance for not less than 20% reduction in heat transfer capacity shall be made for fouling.

6.2.10 Engine Starting System

The engine shall be started electrically using batteries and starter motor(s) with lockable battery isolators. The batteries shall be provided with lockable isolators.

At the minimum ambient temperature specified for the project the cranking battery shall have the capacity to maintain required engine cranking speed through three (3) consecutive cycles of the manufacturer's recommended starting operation.

The automatic cranking cycle shall lock out after three (3) unsuccessful cranking cycles. Upon completion of the cranking cycles, the engine shall accelerate to rated speed within 10 seconds.

The overall start-up of the engine from detection of power failure to attaining full speed shall not exceed 10 seconds and shall be able to supply load within 12 seconds.

See Section 6.10 Batteries and Battery Chargers for further details.

6.3. Alternator

6.3.1 General

The alternator and regulator shall be of the solid state self-excited brushless type and shall be single bearing type.

The alternator shall be enclosed to a minimum of IP22 in accordance with AS 60529.

The alternator datasheet with transient performance technical details shall be provided by the supplier.

The maximum level of the total harmonic voltage and current distortion produced shall not exceed 5% of the fundamental, while the maximum of any individual harmonic voltage or current frequency shall not exceed 3% of the fundamental.

6.3.2 Excitation System and Performance

Excitation systems shall consist of permanent magnet generating sets for generators rated 250kVa and above, coupled to electronic Automatic Voltage Regulators (AVRs). The AVR outputs shall be fed to the rotors via brushless exciters. Generators rated below 250kVA shall be self-excited.

Under short circuit conditions, the alternator shall be adequately protected from overheating.

6.3.3 Cooling

The alternator shall have a standard screen-protected, drip-proof fan ventilated enclosure and shall draw its cooling air from within the generator acoustic enclosure. The exhausted cooling air shall preferably be ducted through louvers to the outside of the enclosure. This exhaust to the outside shall be designed to minimise entry of dust. Alternatively, an exhaust filter may be used.

6.3.4 Windings

Stator and rotor windings shall be braced to withstand engine overspeed and electrical short circuits. Overspeed shall be 130% of normal rating, and short circuit shall be the full symmetric short circuit of the machine for a period of 1 s.

Windings shall be tropicalised or coastal ingress protected.

Stator winding temperature detectors shall be provided as RTD type only. RTDs are required for generating sets rated 250kVA and above.

RTDs shall be wired directly to the generator controller RTD input modules.

Operation of one set of detectors shall initiate an ‘over temperature’ alarm at an appropriate temperature and operation of the other set shall initiate the opening of the generating set feeder circuit breaker in the switchboard.

Indication of individual or average temperatures measured by the detectors shall be displayed on the generator controller.

6.4. Fuel System

6.4.1 General

Fuel will be stored in a day tank located within the generating set unit. From the day tank the engine fuel pump will draw fuel for the engine. A separate fuel storage tank, may be utilised when requested by Unitywater. Details for an external fuel tank can be found in Appendix C – External Storage Tank (where required).

6.4.2 Day Tank

The day tank shall have a minimum capacity for 8 hours while running the generating set at 75% of full load without refueling. Where this is unachievable with the storage limits of the day tank, further clarification shall be sought from Unitywater.

The day tank shall be double bunded and include an analog fuel level sensor with input back to the Plant control system via the controller.

The day tank shall be provided with at least two independent overfill shut-off devices arrangement so that each will continue to function to prevent overfilling in the event of failure of the other.

The method of filling the day tank and the fuel level indication and control shall comply with AS 1940 and AS 1692.

A low level switch shall be provided to cause an alarm when there is less than 60 minutes running time of fuel remaining in the tank. A very low level switch shall initiate an engine shutdown.

Top level of tank shall not be higher than the engine injectors.

The interior of the tank is to be cleaned of all scale and oxide formation prior to filling. The exterior is to be cleaned and painted.

6.5. Generating Set Control System

6.5.1 Control System Requirements

Each generating set shall be provided with a complete control, instrumentation and protection system necessary for the safe and reliable operation of the generating unit.

The generating set control system shall be based on Deep Sea Electronics 8000 series of generating set controllers with expansion module(s) where required. It shall be provided with interposing relays to interface with control devices. For complex (non-standard) installations (eg. grid synchronisation or complex protection schemes), alternate generator controllers may be considered, however these are subject to Unitywater approval based on the specific project requirements.

The control system shall allow complete local operation of the generating set and shall interface with the Plant control system via a communications link for the remote control and monitoring of the generating unit operation parameters, alarm and trip conditions. The communications link must be Ethernet/Modbus TCP.

Power supplies for the generating set control system and associated input and output circuits shall be provided by the onboard batteries. The batteries will be charged by a battery charger which shall be supplied from an external source. Refer Section 6.10 Batteries and Battery Chargers for further details.

Unitywater may request the generating set control system be capable of synchronising the generating set to the mains power supply to allow seam-less changeover and testing. This will be detailed in the data sheet and Unitywater may not implement synchronisation on all sites.

The operating mode of the generator shall be determined generating set controller.

The modes of operation for the generator shall be:

- Automatic Start-up Mode
- Manual Start/Stop Mode.

The generator shall be capable of starting and running without an external power source.

The Auto and Manual modes shall be integrated with the plant control system including the operation of the ATS (if permanent generator).

The generator control panel shall enable automatic start with cranking control in the event of an external contact closure signal for loss of normal plant power supply (if permanent generator).

The generator control panel shall allow a manual start and stop of the generator via local controls of the generating set controller.

6.5.2 Control Panel

The following controls shall be provided on each generating set control panel:

- Key switch stop/run/start control switch.

Emergency stop suitably located on the perimeter of the engine/alternator set. The generating set control panel shall be mounted on the enclosure where the generating set is enclosed. Control panels within the enclosure shall be accessible from outside of the enclosure.

As a minimum the following shall be able to be displayed on the generating set controller:

- Voltage of all phases including phase-to-phase and phase-to-neutral
- Current of all phases
- Frequency
- Engine run hours
- Fuel pressure
- Fuel level
- Shaft speed
- Synchronisation status (where implemented)
- Jacket water temperature
- Jacket water pressure
- Lube oil temperature
- Lube oil pressure.

Where an ATS is installed, the generating set controller shall be set to ‘slave’ with the ‘master’ controller residing with the ATS in the switchboard.

Terminal strips shall be provided for all wiring between input and output modules and all devices internal and external to the control panel.

When the controller is set to local, operation shall be possible only from the local controls. Synchronising with the mains and closing of the external switchboard circuit breaker will be inhibited if synchronising capability is specified.

When the controller is set to remote, all local controls, except for the emergency stop pushbutton shall be inoperative. The generating set shall only be capable of being started remotely. Remote initiation of generating set shutdown will not stop the engine immediately but will cause the engine to be stopped after an adjustable programmed delay.

An emergency stop pushbutton shall be provided on door of the control panel or some other easily accessible location on the generator. Operation of an emergency stop pushbutton shall shut down the generating set immediately irrespective of the mode and shunt trip the onboard circuit breaker. The generator shall not automatically restart in any mode until the emergency stop has been reset at the control panel.

Generating set voltage and current sensing devices will be provided in the onboard circuit breaker panel and signals from these devices will be made available at terminals in each generating unit control panel for use with local metering.

All wiring shall comply with the requirements set out in the switchboard section of Pr9835 - Specification for Electrical Installation at Treatment Plants if not specifically detailed within this specification.

6.5.3 Alarm and Trip Conditions

All alarm and trip conditions shall be monitored by the generating set control system and shall be displayed on the generating set controller.

The alarm conditions shall include but not limited to the following:

- Low control voltage
- Battery charger failure
- Air inlet pressure
- Fuel pressure
- Coolant pressure
- Engine oil pressure
- Engine oil level
- High water temperature
- Water level
- Low Fuel level
- Alternator over-temperature.

The trip conditions shall include but not limited to the following:

- Emergency Stop
- Generator onboard circuit breaker tripped
- Controller failure
- Engine overspeed
- Very Low fuel level
- Very low oil pressure
- Very high water temperature.

Engine overspeed trip shall be via a fuel shut-off valve in addition to governor fuel cut off. All other trips shall be by operation of the governor to the no-fuel position.

All engine trips shall simultaneously provide a trip signal for the external switchboard circuit breaker wired to terminals.

6.6. Onboard Circuit Breaker Panel

The onboard circuit breaker panel will be used to house the onboard circuit breaker.

It should be separate from the generator control system panel.

The generating set shall have an onboard circuit breaker for protection. The number of poles required, neutral switching and MEN connection shall explicitly comply with the requirements of AS3010.

The following feedback signals are required from the generator onboard circuit breaker and appropropriate provisions (auxiliary contacts etc) are required to facilitate these signals

- Onboard circuit breaker open
- Onboard circuit breaker closed
- Onboard circuit breaker tripped.

These signals shall be wired to the controller and to terminals within the control panel to allow inputs to the the plant control system (PLC or RTU).

The door shall be hinged with 1/4 turn 8mm solid square lock drive. Where there is insufficient space for a hinged door, then a removable door with acorn nuts may be used.

All cable entries must be from the bottom.

If the circuit breaker trips, it must be able to be reset locally and from the generator control panel.

6.7. Generator Electrical Works

All electrical works and equipment supplied and installed shall be in accordance with Pr9380 - Specification for Electrical Installation at Network Sites and/or Pr9835 - Specification for Electrical Installation at Treatment Plants.

The following is a non-exhaustive list of key items to note in the above specifications:

- SDI cables may be flexible
- Cable/conductor entry to all enclosures within the generating set must be bottom entry
- Conduit may only be rigid or non-metallic liquid tight flexible PVC with non-metallic uPVC reinforcing
- Cable ladder/tray may be used within the acoustic enclosure
- Wire colour coding is detailed in the above specifications.

6.8. Earthing and Bonding

All non-current carrying parts of mounted equipment on board the generator skid and skid frame shall be earthed by welding, bonding or direct connection to the main earth bar.

Moving parts and door joints shall be earth bonded and have a flexible earth cable installed across the joint to ensure continuity.

6.9. Labelling

6.9.1 Name Plates

A large name plate shall be attached to the front of each generating set enclosure.

Name plates shall be stainless steel with black lettering.

Name plates shall be fixed with stainless steel screws.

The name plates shall display the following details (as a minimum):

- Tag Number
- Name
- Voltage
- Power Rating (Prime and Standby)
- Switchboard Connection Circuit Breaker.

6.9.2 Arc Flash Label

An arc flash label plate shall be fitted to the generator, adjacent to the protective device (onboard circuit breaker).

The label shall be in accordance with Pr10618 - Specification for Power Systems Analysis and Arc Flash Studies. The Power System Analysis and Arc Flash Study may be by others and will be defined in the scope of works.

6.9.3 Rating Plates

A rating plate shall be attached to the front of each generating set enclosure. The rating plate shall be fixed on the generator frame.

Rating plates shall be stainless steel with black lettering.

All information required by the applicable standards shall be included on each rating plate.

The Manufacturer's standard rating plate plus a supplementary plate where necessary will be acceptable providing the following additional information is captured:

- Manufacturer's name
- Applicable standard
- Model Number
- Serial Number, type and Frame reference
- Rated output in kVA and kW
- Duty
- Rated power factor
- Overload rating
- Rated frequency
- Rated voltage
- No. of Phases and type of connection

- Rated stator current
- Rated speed in Rev/Min
- Direct axis sub transient, transient and synchronous reactances (in %)
- Class of insulation (Stator)
- Temp. Rise (Stator)
- Phase Rotation (CW or CCW) viewed from DE
- Excitation current and voltage at rated output
- Year of manufacture
- Weights in kg of rotor and stator
- Alternator bearing type/No (DE/NDE)
- IP rating of generator (unprotected by the acoustic enclosure)
- Fuel Capacity in litres
- Overall Weight (with full fuel tanks).

6.9.4 Equipment and Component Labels

All other labelling requirements are detailed in Pr9835 - Specification for Electrical Installation at Treatment Plants.

Labels within the generating set enclosure may be considered ‘indoor’ labels.

6.9.5 Label Schedule

A label schedule showing details of each label shall be submitted for approval prior to manufacture of the labels.

6.10. Batteries and Battery Chargers

6.10.1 General

The generating set shall have a single set of batteries and battery charger to provide all internal control power to the generator. The system will be based of 24V DC and will be used for the 6.2.10 Engine Starting System and the 6.5 Generating Set Control System. Where required it will also supply power to the onboard circuit breaker for trip and control functions (Section 6.6 Onboard Circuit Breaker Panel).

The batteries and the charger shall be located inside the acoustic enclosure in a dedicated battery box.

The battery charger shall be powered by a 230V AC external auxiliary power supply. This must ensure that the battery is maintained in an optimum fully charged state.

For permanent generators, the battery charger shall be wired to an external 230V AC supply.

For mobile generators, the battery charger shall be wired to 230V AC 10A IP56 screwed lock fitting suitable for connection to a standard socket.

The battery shall be capable of supplying the engine’s specified crank cycles under all operating conditions.

6.10.2 Battery Chargers

Battery chargers shall be of the smart charger type that are suitable for use with the selected battery, with mains failure indication and a common alarm contact and individual indication for:

- Battery voltage high
- Battery voltage low
- Loss of AC
- Battery ground
- Charger fault.

The common alarm contact shall be wired to the generating unit controller and display 'Battery Charger fault' alarm on controller and Plant Control System. The battery charger shall have AC mains circuit breaker and DC MCBs.

The batteries shall be installed with easy access to the batteries for maintenance purposes.

6.10.3 Batteries

Batteries shall preferably be AGM type, however they must be compatible with the battery charger.

Batteries shall be of sufficient capacity to enable three (3) consecutive engine starts from cold.

The batteries shall be positioned to minimise cabling to the starter motor.

The batteries will be a 24V DC system for cranking and engine starting.

A separate battery cover with easy access for maintenance purposes shall be provided and fixed in place prior to any operation.

Batteries shall be provided with a lockable isolator to isolate from load, mounted adjacent to the batteries.

6.11. Painting

The enclosures and control panels, engine, alternator, radiator and internal structural surfaces may be painted in accordance with the manufacturer's recommended coating system and colour, subject to approval by Unitywater.

All preparation and painting shall be carried out strictly in accordance with the paint system manufacturer’s recommendation.

The surface of the metalwork shall be degreased and cleaned with solvent, then coated with electrostatically applied powder coat in accordance with paint manufacturers' recommendations.

Metal finishing, the preparation and pre-treatment of surfaces shall comply with the AS 1627 series of standards or equivalent standards.

The complete acoustic enclosure shall be surface protected to suit the site environmental conditions.

Surface preparation and paint systems shall be selected to give a life of not less than 15 years to first maintenance.

Primers based on zinc chromate or red lead and topcoats utilising polyurethane shall not be used under any circumstances. Isocyanide based materials also shall not be used under any circumstances.

Preferred colour for acoustic enclosure is powder coated mist green (AS 2700 colour G54).

Preferred colour for electrical panels within the acoustic enclosure is powder coated orange (AS2700 colour X15).

Preferred colour for the escutcheons and equipment within panels shall be powder coated white (AS 2700 colour N14).

Additional touch up paint shall be supplied for any damage caused during transport and installation and left on site.

7. Permanent Generator

All permanent generators shall have an Automated Transfer Switch arrangement as outlined in Pr9380 - Specification for Electrical Installation at Network Sites and/or Pr9835 - Specification for Electrical Installation at Treatment Plants.

7.1. Outdoor Generating Set Enclosures

7.1.1 Description

The following are required for outdoor generating sets:

- Acoustic enclosure
- Shade shed.

7.1.2 Acoustic Enclosure

A fully enclosed weatherproof acoustic enclosure shall be provided. The enclosure shall be designed and constructed to prevent water pooling and to prevent ingress of moisture and rain whilst permitting adequate airflow for cooling and ventilation. This may be achieved by having a sloped or peaked roof, however it is the designer/constructor's responsibility to ensure water pooling and moisture ingress does not occur. Drains shall be provided where needed to divert any water which may enter the enclosure to grade. All vents and drains shall be fitted with screens to prevent the entry of vermin.

The enclosure shall be mechanically robust and shall allow good maintenance access to all equipment requiring servicing and inspection, particularly air, oil and fuel filters, fuel and oil pumps, starter motors, oil dipsticks, sensor connections, batteries and chargers.

A general arrangement drawing of the enclosure set shall be provided by the supplier.

Construction material type for specific locations shall be as nominated below.

a. Locations 0 km to 5.0 km from Coastline:
    i. Stainless Steel Grade 316 of minimum thickness 1.5 mm, (under galvanised shade shed outdoors)
    ii. Marine Grade Aluminium 5251 or 5083 of minimum thickness 3.0 mm, (enclosed within a sealed building with low atmospheric contaminants).

b. All other locations:
    i. Marine Grade Aluminium 5251 or 5083 of minimum thickness 3.0 mm, (under galvanised shade shed outdoors)
    ii. Zinc Anneal minimum thickness 2.0 mm (enclosed within a sealed building with low atmospheric contaminants).

Doors and removable panels shall be constructed with double returned edges and additional stiffeners where necessary to prevent distortion. Doors should open freely and have no sharp edges or burs.

All doors shall be installed on lift-off hinges. The doors, handles and locks need to be suitable for Unitywater applications. The vendors standard hands/locks must be approved by Unityater prior to acceptance. Where specifically requested by Unitywater, hasp and staple style latches that will fit Unitywater locks may be supplied in addition and/or as an alternative.

For doors in excess of 1200 mm high the latches shall engage at three points; top, centre and bottom.

Doors shall be arranged to open by at least an angle of 110°. Positive stops shall be provided to ensure that doors cannot open so far that they will come into contact with adjacent equipment and cause damage. Door stays shall be provided to allow the doors to be latched in the open position.

All doors and removable panels shall be provided with gaskets consisting of neoprene-covered foam rubber or equivalent. Gaskets shall be securely retained in a recess within the door. Gaskets shall bear on a flat sealing surface at least as wide as the gasket.

Lock barrels are to be mounted so that the lock pins are towards the top.

All fixings shall be minimum Grade 316 Stainless Steel.

Stainelss steel acoustic enclosures do not need to be painted unless specifically requetsd by Unitywater.

All other acoustic enclosures shall be powder coated in accordance with Section 6.11 Painting.

The preferred external colour of acoustic enclosures is Mist Green (AS2700 G54).

7.1.3 Shade Shed

Where the acoustic enclosure cannot prevent water/moisture ingress to the satisfaction of Unitywater a shade shed shall be installed.

A shade shed shall be shall be installed to provide additional weatherproofing. All shade sheds shall have peaked/sloped roofs to prevent the pooling of moisture.

The shade shed shall be structurally designed and installed which includes any council approvals /certification /other approvals.

The shade shed shall be constructed of galvanised steel with appropriate fixings.

There shall be a clearance of 1.5m from the generator to the shade shed on all sides to ensure adequate access to open /remove doors for maintenance purposes.

Special consideration is required to ensure the generator exhaust is vented outside of the shade shed.

Depending on the installation location, gates and walls may be required on the shade shed. Unitywater will advise where this is required.

The shade shed shall be design and installed for Cyclone Regions as per AS/NZS 1170.2.

7.1.4 Acoustic Performance

The generating set shall be installed in a way that minimises the noise level external to the enclosure or building. All penetrations through the walls of the enclosure or building, the access doors and the interface between the enclosure and the footing shall be treated to minimise the escape of noise. Cooling air intakes and outlets shall be equipped with acoustics attenuators.

Where the enclosure consists of sheet metal that is otherwise not acoustically treated the inside of the cladding shall be lined with sound absorbing foam to minimise the radiation of sound. Where installed inside a room the building ventilation louvers shall be designed to provide the required acoustic performance.

Noise emissions from the generator installed in its enclosure, with the generator running at full load, shall not exceed 85 dB(A) at 1 m or 5dBA above the surrounding environment noise level measured at the boundary, whichever is lower.

When installed near sensitive environments, such as residential properties, noise shall not exceed 30 dBA at the property boundary consistent with the Acoustic Quality Objectives in the Environmental Protection (Noise) Policy 2019.

7.2. Indoor Generating Set Enclosure

For indoor generating sets, an acoustic enclosure is still required, however the building may still require further noise suppression.

All other requirements of Section 7.1.4 Acoustic Performance above shall be met with regards to the enclosure.

For building requirements see Pr9903 - Specification for Building and Structural Works.

8. Mobile Generator

Where a trailer is required for a portable generator then Unitywater's Fleet team must be engaged to ensure trailers are fit for purpose. Design of trailers is outside the scope of this specification.

9. Testing, Commissioning and Documentation

Commissioning tests shall be undertaken in accordance with AS/NZS 3000, AS/NZS 3010 activities shall be carried out in conjunction with the requirements of Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets.

The following testing activities shall be undertaken during FAT and SAT, but not be limited to:

- detailed mechanical inspection
- eetailed electrical inspection
- verification of correct labelling
- review of setup parameters for all digital control systems (if applicable)
- functional testing of all control, indication, measurement, safety systems and protection circuits
- functional testing of all interfaces to the Plant control system for remote monitoring and control (this may be simulated)
- performance testing to demonstrate the equipment meets the specified performance requirements including noise measurements
- insulation resistance tests (before dielectric withstand tests)
- dielectric withstand tests (power frequency tests)
- insulation resistance tests (repeated after dielectric withstand tests)
- load tests (4 hours minimum duration) using resistive load banks (for SAT plant load may be used)
- load step tests (to verify transient voltage and frequency performance) for load steps of 0-50%, 50-100%, 100-50% and 50-0% of full load using resistive load banks
- harmonic voltage distortion tests for open circuit, 25%, 50%, 75% and 100% of full load conditions using resistive load banks
- inspection of all loose-supplied equipment
- review of manufacturing inspection and test documentation and records
- review of manufacturing defect lists/punchlists.

Instruments calibrated by authorities accredited by National Association of Testing Authorities (NATA) of Australia must be used for the testing activities.

A comprehensive Site Test Report shall be provided at completion of the respective site tests. The Site Test Report shall include as a minimum:

- results of all tests
- copies of any test oscillograms, graphs, printouts, etc.
- copies of site defect lists/punchlists
- copy of the completed Site ITP
- statement confirming compliance with all specified and legislated requirements.

9.1. Quality Assurance and ITPs

9.1.1 Quality Assurance

The Supplier shall implement a quality system that complies with the requirements of AS ISO 9001 for all work on the diesel generating sets.

Quality records shall be provided by the Supplier in accordance with Documentation and Deliverables Section 9.2 of this Specification.

9.1.2 Inspection and Test Plans

Inspection and Test Plans (ITPs) for the generating sets must include the following as a minimum:

- Factory ITP - Covering all off-site activities i.e. engineering, design, supply, manufacture, factory assembly, factory testing, resolution of factory defects/punchlists, release for delivery, preparation for transport, etc.
- Site Testing ITP - Covering all on-site testing, resolution of site defects/punchlists, handover, etc.

The ITPs shall identify the standards and/or procedures as well as the acceptance criteria that shall apply for each stage in the ITPs. All standards, procedures and acceptance criteria included in the ITPs shall comply with the requirements defined in this Specification and the requirements of Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets.

Commissioning work on the generating sets shall be in accordance with the ITPs.

Additional witness points and/or hold points may apply on various stages of the ITPs and may be carried out by third party inspectors.

9.2. Documentation and Deliverables

9.2.1 General

Documentation for the generating sets and their housings shall comply with Unitywater's Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets and AS 1101 and AS/NZS 1102 Parts 101-111.

A complete, detailed and fully customised set of drawings shall be provided for each system.

The datasheet (F11280 - Generator Datasheet Template) shall be fully populated at the as constructed stage and is a deliverable as part of generator handover requirements.

9.2.2 Warranties

Major components shall have warranties in accordance with Unitywater purchasing requirements or, if these are unavailable, industry standards.

9.2.3 Spare Parts and Tools

Any tools required for the operation of the equipment shall be supplied.

A priced list of all spare parts and/or tools for routine and scheduled maintenance shall be provided. Prices shall include delivery to site and packing suitable for long-term storage.

9. Appendices

Appendix A – Definitions/Acronyms

The following definitions, abbreviations and acronyms are used throughout this specification.

Term	Meaning
AC or ac	Alternating current
Acoustic Enclosure	Generator enclosure for all in one type unit
AVR	Automatic Voltage Regulator
CB	Circuit Breaker
Control panel	On board the generator – a control panel where the generator may be controlled locally
DC or dc	Direct current
IEC	International Electrotechnical Commission
ITP	Inspection and Test Plans
MEN	Multiple Earth Neutral
Prime rating	The power rating of a generating set when operating as the primary power source.
PVC	Polyvinyl Chloride
RPEQ	Registered Professional Engineer of Queensland
RTD	Resistance Temperature Detector
SCADA	Supervisory Control and Data Acquisition
Standby rating	The power rating of a generating set when operating as a back-up power source.

Appendix B – References

General

All design, equipment and workmanship shall conform to the most recent requirements of relevant statutory local, state and Commonwealth requirements and applicable, current Australian Standards.

Where no Australian Standard exists, work shall conform to the most applicable, current IEC Standard.

Where conflicts exist between this specification and any statutory requirement, the statutory requirement prevails.

In the event of ambiguity, discrepancy, divergence or inconsistency of technical requirements in or between this specification and other documents, this specification shall prevail over all other technical engineering documents.

If the requirements of this Specification do not articulate the minimum requirements of the statutory regulations and standards, the regulatory requirements are taken to apply. If the requirements of this Specification are more exacting than the minimum requirements of the statutory regulations and standards, the former shall apply.

The following legislation, Regulation and Codes apply to this specification:

- *Electricity Act 1994* (Qld)
- *Electrical Safety Act 2002* (Qld)
- *Electrical Safety Regulation 2013* (Qld)
- *Electricity Regulations 2006* (Qld)
- *Work Health and Safety Act 2011* (Qld)
- *Work Health and Safety Regulation 2011* (Qld)
- *Renewable Energy (Electricity) Act 2000* (Cth).

Pr9913 - Specification for Acoustic Enclosed Generators at Unitywater Sites (Supply and Installation)

Relevant Unitywater documents that relate to this specification

All designs and equipment shall comply with the current edition of the following standards:

Document No.	Title
Asset information and handover	
Pr8843	Specification for Drawing, Document and Equipment Tag Numbering
Pr10360	Project Information Requirements
Pr10382	Digital Engineering Execution Plan
Pr9080	Specification for CAD BIM Drafting and Modelling Standards
Pr8701	Specification for Asset Information
Pr11211	Specification for Commissioning and Handover of Active and Passive Assets
Pr10883	Safety in Design Guidelines
SEQ AIS	SEQ Asset Information Specification
Electrical	
Pr9380	Specification for Electrical Installation at Network Sites
Pr9835	Specification for Electrical Installation at Treatment Plants
Pr10618	Specification for Power Systems Analysis and Arc Flash Studies
F11280	Generator Datasheet Template
Control Systems	
Pr9833	Specification for SCADA and PLC Architecture
Pr9834	Specification for SCADA Standard
Pr9844	Specification for SCADA and PLC Device Type - Siemens
Pr10699	Treatment Plant PLC and SCADA Specification - Device Type Schneider PLC
Pr10434	Specification for SCADA and PLC Device Type Siemens OPC - PID Controller
Pr9845	SCADA and PLC Implementation Specification
Pr9846	SCADA and PLC Historian and Reporting Specification

International and Australian Standards referenced within this specification

All designs and equipment shall comply with the current edition of the following standards:

Standard	Title
General	
AS ISO 1000	The international system of units (SI) and its application
AS 1101	Graphic symbols for general engineering
AS/NZS 1102	Graphical symbols for electrotechnical documentation
AS 1375	Industrial fuel-fired appliances
AS 3570	Automotive diesel fuel
Structural	
AS 1074	Steel tubes and tubulars for ordinary service
AS/NZS 1170 series	Structural design actions
AS 1627	Metal finishing – Preparation and pre-treatment of surfaces
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS/NZS 1664 series	Aluminium structures
AS 1665	Welding of aluminium structures
AS 1692	Steel tanks for flammable and combustible liquids
AS/NZS 1866	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
Electrical	
AS 1081	Acoustics – Measurement of airborne noise emitted by rotating electrical machinery
AS/NZS 1768	Lightning protection
AS/NZS 2053	Conduits and fittings for electrical installations – General requirements
AS/NZS 2373	Electric cables – Twisted pair for control and protection circuits
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008.1.1	Electrical installations – Selection of cables – Cables for alternating voltages up to 0.6/1 kV – Typical Australian installation conditions
AS/NZS 3010	Electrical Installations – Generating Sets
AS/NZS 3013	Electrical installations – Classification of the fire and mechanical performance of wiring system elements
AS/NZS 3017	Electrical installations - Verification guidelines
AS/NZS 3100	Approval and test specification - General requirements for electrical equipment
AS/NZS 5000.1	Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 kV
AS/NZS 5139	Electrical installations – Safety of battery systems for use with power conversion equipment.
AS 60034	Rotating Electrical Machines
AS 60044.1	Instrument transformers – Current transformers
AS 60529	Degree of protection provided by enclosures (IP code)
AS/NZS IEC 60947	Low-voltage switchgear and control gear
AS/NZS 61439	Low-voltage switchgear and control gear assemblies

Appendix C – External Storage Tank (where required)

Note additional storage tanks are no longer required by default. By default, the generator supplied shall only have an onboard day tank (refer to Section 6.4.2).

Where an external storage tank is required, the following may be used as the basis for requirements.

The fuel storage tank shall be located close to the generating set with adequate allowance for maintenance access and inlet/exhaust air. It shall have a minimum capacity for 24 hours of continual operation at 75% of full load of the generating unit without refuelling and shall be of the above-ground type on a steel support structure. The minimum capacity storage required should be determined as part of the project scope. The storage tanks shall be double wall and shall comply with the AS 1692 standard.

Where multiple generating sets are installed on site, storage tanks may be combined. However, the 'resulting' tank must be able to supply each generating set it supplies for the time specified.

Each tank shall have at least the following fittings:

- One screwed inlet with stop valve and standard filling coupling accessible from ground level
- One screwed outlet with isolating valve
- One vent socket and insect proof vent
- One 800 mm diameter access opening
- One sight glass type level gauge with flanged or screwed connections
- One drain line and valve from the lowest end
- Lifting lugs
- External level indicator.

The tank shall be installed with a maximum fall of 1:600 towards the drain end; the outlet being at the opposite bottom end.

All necessary valving to allow the transfer of storage tank to the day tanks shall be provided.

All tank auxiliaries, including contents gauges, fill and dip points, ladders and platforms, support cradles, overflows, vents, and drains shall be provided.

Interconnecting pipe work shall be installed on top of the slab in an enveloping pipe and fixed to the structures elsewhere. This system shall feature flexible connections and isolation valves to each skid tank.