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| Assets Planning and Delivery GroupEngineering |

DESIGN STANDARD DS 26-05

Type Specifications

Electrical Type Specification

for Stand Alone Generating Set

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| version 3revision 1 |
| August 2024 |

**FOREWORD**

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning, and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction, and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

[Overview of Western Australia’s Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)](https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf)

Enquiries relating to the technical content of a Design Standard should be directed to the Principal Engineer, Electrical (Power) Section, Infrastructure Design Branch. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Head of Engineering

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The revision status of this standard is shown section by section below.

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**DESIGN STANDARD DS 26-05**

**Type Specifications – Electrical**

**Type Specifications for a Stand Alone**

**Generating Set**

**CONTENTS**

*Section Page*

[1. General 12](#_Toc175224532)

[2. Standard Classifications 12](#_Toc175224533)

[2.1. Generating Set 12](#_Toc175224534)

[2.2. Mode of Operation 12](#_Toc175224535)

[2.3. Performance Class 13](#_Toc175224536)

[2.4. Installation Features 13](#_Toc175224537)

[2.5. Emissions 13](#_Toc175224538)

[2.6. Site Conditions 13](#_Toc175224539)

[2.7. Power Ratings 14](#_Toc175224540)

[2.8. Operating Performance 14](#_Toc175224541)

[3. Work by the Principal 14](#_Toc175224542)

[4. Information to be provided by the Contractor 14](#_Toc175224543)

[5. Drawings 14](#_Toc175224544)

[6. Standards 15](#_Toc175224545)

[6.1. General 15](#_Toc175224546)

[6.2. Particular Standards 15](#_Toc175224547)

[6.3. Type Specification 16](#_Toc175224548)

[7. Quality Assurance 16](#_Toc175224549)

[8. Electrical Work 16](#_Toc175224550)

[9. Engine 16](#_Toc175224551)

[9.1. General 16](#_Toc175224552)

[9.2. Rating 17](#_Toc175224553)

[9.3. Governing 17](#_Toc175224554)

[9.4. Fuel 17](#_Toc175224555)

[9.5. Lubrication 17](#_Toc175224556)

[9.6. Cooling Fan Bearings 17](#_Toc175224557)

[9.7. Exhaust System 17](#_Toc175224558)

[9.8. Air Cleaners 18](#_Toc175224559)

[9.9. Extra Low Voltage Electrical Equipment 18](#_Toc175224560)

[9.10. Batteries 18](#_Toc175224561)

[9.11. Nameplate and Markings 18](#_Toc175224562)

[10. Alternator 19](#_Toc175224563)

[10.1. General 19](#_Toc175224564)

[10.2. Coupling 19](#_Toc175224565)

[10.3. Type 19](#_Toc175224566)

[10.4. Rated kVA 19](#_Toc175224567)

[10.5. Rated Power Factor 19](#_Toc175224568)

[10.6. Number of Phases 19](#_Toc175224569)

[10.7. Rated Output Voltage 19](#_Toc175224570)

[10.8. Frequency 19](#_Toc175224571)

[10.9. Voltage Variation 19](#_Toc175224572)

[10.10. Voltage Waveform 20](#_Toc175224573)

[10.11. Windings 20](#_Toc175224574)

[10.12. Class of Insulation 20](#_Toc175224575)

[10.13. Temperature Rise 20](#_Toc175224576)

[10.14. Enclosure 20](#_Toc175224577)

[10.15. Type of Construction 20](#_Toc175224578)

[10.16. Type of Cooling 20](#_Toc175224579)

[10.17. Alternator Rotor 20](#_Toc175224580)

[10.18. Bearings 21](#_Toc175224581)

[10.19. Direction of Rotation 21](#_Toc175224582)

[10.20. Excitation System 21](#_Toc175224583)

[10.21. Short Circuit Withstand Capability 21](#_Toc175224584)

[10.22. Voltage Regulation 21](#_Toc175224585)

[10.23. Automatic Voltage Regulator 21](#_Toc175224586)

[10.24. Automatic Voltage Regulator Power Supply 22](#_Toc175224587)

[10.25. Sub-Transient Reactance 22](#_Toc175224588)

[11. Controlgear and Switchgear 22](#_Toc175224589)

[11.1. General 22](#_Toc175224590)

[11.2. Switchboard 22](#_Toc175224591)

[11.3. Neutral Earthing 22](#_Toc175224592)

[11.4. Circuit Breaker Neutral 22](#_Toc175224593)

[11.5. Modes of Control and Controller 23](#_Toc175224594)

[11.5.1 Modes of Control 23](#_Toc175224595)

[11.5.2 Controller Type 23](#_Toc175224596)

[11.6. Battery Charger 23](#_Toc175224597)

[11.7. Monitoring Control and Protection Functions 23](#_Toc175224598)

[11.8. Control Power Supply 24](#_Toc175224599)

[11.9. Remote Indications 24](#_Toc175224600)

[12. Kiosk 24](#_Toc175224601)

[12.1. General 24](#_Toc175224602)

[12.2. Base Plate and Skid Base 25](#_Toc175224603)

[12.3. Lifting Points 25](#_Toc175224604)

[12.4. Fuel Tank 25](#_Toc175224605)

[12.5. Fuel Bund 25](#_Toc175224606)

[12.6. Radiator 26](#_Toc175224607)

[12.7. Sound Proofing 26](#_Toc175224608)

[12.8. Safety Guards 26](#_Toc175224609)

[12.9. Enclosure 26](#_Toc175224610)

[13. Corrosion Mitigation 27](#_Toc175224611)

[14. Protective Coatings 27](#_Toc175224612)

[14.1. Mild Steel Fabricated Components 27](#_Toc175224613)

[14.2. Aluminum Kiosk Enclosure 27](#_Toc175224614)

[15. Testing 28](#_Toc175224615)

[15.1. General 28](#_Toc175224616)

[15.2. Engine Type Tests 28](#_Toc175224617)

[15.3. Engine Routine Tests 28](#_Toc175224618)

[15.4. Alternator Type Tests 28](#_Toc175224619)

[15.5. Alternator Routine Tests 28](#_Toc175224620)

[15.6. Switchboard Design Verification 28](#_Toc175224621)

[15.7. Switchboard Routine Tests 29](#_Toc175224622)

[15.8. Generating Set Noise Type Tests 29](#_Toc175224623)

[15.9. Kiosk Routine Temperature Rise Test 29](#_Toc175224624)

[15.10. Routine Test Certificates 29](#_Toc175224625)

[16. As Constructed Information 29](#_Toc175224626)

[17. Manuals 29](#_Toc175224627)

[18. Delivery Instructions 30](#_Toc175224628)

[19. Installation at Site 30](#_Toc175224629)

[20. Post Installation Requirements 30](#_Toc175224630)

[21. Spare Parts 30](#_Toc175224631)

[22. Technical Support 30](#_Toc175224632)

[23. Training 30](#_Toc175224633)

# General

This Specification covers the requirements for the design, manufacture, assembly, factory testing and delivery of kiosk mounted diesel-powered Low Voltage generating set in the range 15 kW to 500 kW for stand-alone outdoor operation. The generating set shall be a self-contained transportable unit suitable for shifting from site to site depending on operational requirements or a permanently installed generator which will remain at site.

The generating set shall consist of a diesel engine, a direct coupled alternator, an associated electrical switchboard and ancillary equipment all mounted on a suitable base frame and enclosed in a weatherproof kiosk, all as specified hereunder.

The generating set shall be supplied complete and shall include all necessary accessories and miscellaneous material, minor parts and other such items to complete assembly, testing and commissioning of the equipment.

# Standard Classifications

The generating set shall be defined in respect to the various classifications for application, rating and performance in accordance with ISO 8528-1 as further defined hereunder.

## Generating Set

1. The prime mover shall be a compression ignition engine as further specified section 9 of this Specification
2. The generator shall be a synchronous alternator as further specified section 10 of this Specification
3. The generating set shall be provided with control and switchgear as further described section 11 of this Specification
4. The generating set shall be self-contained without external auxiliary equipment
5. The generating set shall be a self-contained weatherproof unit
6. The generating set shall have a service interval of not less than 250 running hours. Maintenance attendance for topping up engine oil, changing filters, and the like shall not be required outside the normal service schedule
7. The design service life of generating set shall be not less than 30,000 hours before any major servicing is required

## Mode of Operation

1. The generating set shall be suitable for the mode of operation specified in the Annexure power operation
2. The generating set shall be suitable for single operation with the generating set being the sole source of electrical power

The generating set shall be equipped for operation as further specified section 11 of this Specification

## Performance Class

The generating set performance class, in accordance with ISO 8528-1, clause 8, shall be class G2 or G3 as specified in the Annexure.

## Installation Features

The generating set shall be a type D configuration in accordance with ISO 8528-1 clause 9.3 suitable for mounting on an inflexible mount as further described clause 12 of this Specification.

## Emissions

1. Unless a lower value is specified in the Annexure, the airborne noise A weighted power level emitted by the generating set at prime power load, measured as per ISO 8528-10, shall be determined as follows:

LWA = 95 dB + log PRP

where LWA = maximum allowable sound power level dBA

 PRP = generating set prime power level

The maximum permissible sound pressure level shall be determined as follows:

Lp = LWA- 10\*log(2 \* 3.14 \* d2)

where Lp = sound pressure level at distance d from the generating set

 e.g. for a 400 kW generating set the maximum allowable sound power level and maximum allowable sound pressure level at a distance of 7 metres from the generating set would be:

 LWA = 95 + 2.6 = 97.6 dBA

 Lp = 97.6 - 25.9 = 72.7 dBA at 7 metres

1. The vibration levels, produced by the generating set at both no load and full rated load shall be not more than Value 1 levels in accordance with ISO 8528-9 Table C.1 in respect to displacement, velocity and acceleration
2. The electromagnetic emissions from the generating set shall not exceed the limits specified in IEC 61000.6.3 for residential, commercial and light industrial areas

The generating set shall be approved by the Australian Communications Authority in respect to electromagnetic compatibility

1. The generating set shall be immune to electromagnetic interference not more than the limits specified in IEC 61000.6.2 for industrial areas

## Site Conditions

1. The generating set shall be suitable for operation at ambient temperature of 50 deg. C unless a different temperature is specified in the Annexure
2. The generating set shall be suitable for operating outdoors in heavy rain or with a humidity level of up to 95%
3. The generating set shall be suitable for operating in an atmosphere having an atmospheric corrosivity category specified in the Annexure in accordance with AS 2312
4. Access to some sites may be over rough roads

## Power Ratings

Operating in its kiosk enclosure, the generating set shall have power rating in accordance with ISO 8528-1 clauses 14.3.2, 14.3.3 and 14.3.5 as specified in the Annexure when operating in the ambient temperature.

## Operating Performance

The operating performance of the generator set shall be determined in accordance with ISO 8528-1, section 15 and as further specified in sections 2.3, 9 and 10 of this Specification.

# Work by the Principal

 The work to be performed by the Principal shall be as detailed in the Annexure.

# Information to be provided by the Contractor

The Contractor shall provide the following documentation in respect to the generating set within the listed number of days after receipt of the Principal’s order.

1. General Arrangement Drawings 28 days
2. Electrical Wiring and Schematic Drawings 28 days
3. External Connection Diagrams of the terminals

and control signals 28 days

1. Manufacture and Delivery Schedule 14 days
2. Specification Data Sheets 35 days
3. Inspection and Test Plan 35 days
4. Test Certificates On delivery
5. Operating and Maintenance Manual On delivery

# Drawings

1. All drawings provided by the Contractor shall be in accordance with the latest issue of the Water Corporation Design Standard DS24 – Electrical Drafting
2. All drawings shall be prepared in AutoCAD format, Release 2018 or later software
3. Drawings shall be prepared on the “Electrical” A1 metric drawing sheet and title block provided in the Water Corporation eXternal (WCX) package (available for download) in accordance with the Water Corporations Design Standard DS80
4. The drawings shall provide within the title block, the details to identify the drawing, including but not limited to its title, plan number, revision status, date of issue, Corporate project number, contractor’s name and reference number (if applicable)
5. Drawings detail shall include, but not limited to, the general arrangement, panel layout, power and control circuit diagrams and equipment specifications, as required
6. The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings

# Standards

## General

The workmanship, equipment and materials provided in accordance with this Specification shall comply in design, construction, rating and performance with the current relevant Australian Standards and Codes. In their absence, relevant international and other national standards, together with the requirements of competent Authorities having jurisdiction over all or part of the manufacture, installation and operation of the equipment shall be adhered to.

## Particular Standards

Except as specified otherwise in this Specification, the generating set shall comply with all relevant

parts of ISO 8528.

The following particular standards are referenced in this Specification:

AS 1019 Internal Combustion Engines – Spark Emission Devices

AS 1554 SAA Structural Steel Welding

AS/NZS 3000 Wiring Rules

AS 3010 Electrical installations - Generating sets

AS 3570 Automotive Diesel Fuel

AS 4506 Metal Thermoset Powder Coatings

AS 4680 Hot Dip Galvanised Coatings on Fabricated Ferrous Articles

AS/NZS 2312 Guide to the protection of structural steel by the use of protective coatings - Paint coatings

IEC 60034-1 Rotating electrical machines - Ratings and performance
(AS 60034-1 is modified version)

IEC 60034-6 Rotating electrical machines - Methods of cooling (IC code)

IEC 60529 Degrees of protection provided by enclosures (IP Code)
(AS 60529 identical)

IEC 61000-6-2 Electromagnetic compatibility (EMC) - General standards - Immunity for industrial environments (AS/NZS 61000.2 identical)

AS/NZS61000-6-3 Electromagnetic compatibility (EMC) – General standards - Emission Standard for Residential, Commercial and Light Industrial Environments

AS/NZS 61439.1 Low Voltage switchgear and controlgear assemblies - General rules (AS 61439.1 is modified version)

ISO 281 Rolling bearings - Dynamic load ratings and rating life

ISO 1940-1 Mechanical vibration - Balance quality requirements for rotors in constant (rigid) state - Specification and verification of balance tolerances

ISO 3046-1 Reciprocating internal combustion engines – Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods

ISO 3046-4 Reciprocating internal combustion engines – Part 4: Speed governing

ISO 8528-1 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets – Specification for Application, Ratings and Performance (BS 7698.1)

ISO 8528-2 Reciprocating internal combustion driven alternating current generating sets - Engines

ISO 8528-3 Reciprocating internal combustion driven alternating current generating sets - Alternating current generators for generating sets

ISO 8528-4 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets – Specification for Controlgear and Switchgear (BS 7698.4)

ISO 8528-10 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets – Measurement of airborne noise by the enveloping surface method.

AS/NZS/ISO 9001 Quality management systems – Requirements (AS/NZS ISO 9001 identical)

ISO 15550 Internal combustion engines - Determination and method of measurement of engine power - General requirements

DS 80 WCX CAD Standard

WA Legislation Electricity (Licensing) Regulations 1991

Energy Safety Code of Practice for persons working on or near energised electrical installations

Worksafe WA Occupational Safety and Health Act WA

## Type Specification

DS26-45 Type Specification – Battery Charger for Diesel Engine Battery System.

# Quality Assurance

The generating set shall be manufactured under a Quality System certified by an Accredited Authority in accordance with AS/NZS/ISO 9001 or an approved equivalent.

# Electrical Work

All electrical work shall be performed by appropriately qualified and experienced personnel who shall hold a current electrical workers license to perform such work.

# Engine

## General

The engine shall be a solid injection, cold starting, 4 stroke diesel engine in accordance with ISO 8528-1 and ISO 8528-2inclusive and shall comply with the further requirements listed hereunder and detailed in the Annexure.

## Rating

The ISO standard power rating of the engine shall be defined as the rating of the engine tested a under ISO 15550 standard reference conditions.

The Contractor shall provide the Principal with a test certificate verifying the claimed ISO standard power rating.

## Governing

The engine of the generating sets specified in the Annexure as Class G3 shall be provided with an electronic governing system providing proportional, integral and differential (PID) control with ISO 3046-4 Class M3 accuracy, so as to enable a generating set ISO 8528-1 Class G3 operating performance.

The engine of the generating sets specified in the Annexure as Class G2 shall be provided with an electronic governing system providing PID control with ISO 3046-4 Class M2 accuracy, so as to enable a generating set ISO 8528-1 Class G2 operating performance. (Clause 2.8 refers).

## Fuel

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

The engine shall be fitted with replaceable cartridge type fuel and an upstream water separating fuel filters, with a dry contact alarm.

## Lubrication

The engine shall incorporate a forced oil lubrication system and shall be fitted with a full flow replaceable cartridge type lubricating oil filter. The engine shall be suitable for continuous operation using lubricants.

The capacity of the lubricating oil sump shall be such that topping up of the lubricating level shall not be required between routine servicing.

On turbocharged engines, lubrication of the turbocharger shall be maintained during engine shut down.

## Cooling Fan Bearings

The bearings for the engine cooling air fan and jockey pulley shall be enclosed in water and dust proof housings.

## Exhaust System

1. The engine shall be fitted with an exhaust pipe and heavy-duty residential type muffler. The exhaust system shall be fitted with a spark arrester or a combination spark arrester/muffler in accordance with AS 1019
2. Provide a fitting to extend the exhaust pipe 1 metre past the end of the kiosk if specified in the Annexure
3. The exhaust system shall direct exhaust gases away from the control panel end of the generating set enclosure and shall be fitted with a rain flap
4. The exhaust outlet shall be located so that fumes are not induced into the air cleaner or into the cooling fan intake
5. The muffler shall be constructed of aluminised steel
6. The exhaust pipework shall be steel with dimensions in accordance with the manufacturer’s requirements
7. Exhaust manifold, turbo, and exposed exhaust pipe to be covered with heat resistant exhaust blanket, to avoid operator injury

## Air Cleaners

The engine shall be fitted with an engine inlet air cleaner of the dry dual life element with bowl type pre-cleaner.

## Extra Low Voltage Electrical Equipment

The engine shall be suitable for electric starting and shall be provided with suitable batteries for this purpose. The nominal voltage rating of the battery bank may be either 12 V or 24V and all Extra Low Voltage DC equipment fitted to the engine shall be suitable for operation from such a supply.

The engine shall be equipped with the following Extra Low Voltage DC electrical equipment:

1. Belt driven alternator capable of replacing, within 30 minutes, the battery charge used by two engine start sequences
2. Electric starter motor and associated control equipment
3. Fuel rack solenoid arranged to shut down the engine if de-energised

## Batteries

1. Batteries shall be lead acid type AGM with temperature compensated chargers and shall have sufficient capacity to power six (6) consecutive sets of starting sequences without recharging. Batteries shall be capable of providing power for all control and indicating equipment
2. Batteries shall be housed so that these are readily accessible for service and removal
3. Battery carriers shall be fabricated of corrosion resistant material, shall be mounted securely and shall be positioned well clear of the alternator cooling air intakes. Battery to starter motor cables shall be as short as practical so as to minimise voltage drop on starting
4. The battery bank terminals shall be fitted with insulating shrouds. A battery isolator shall be provided at a convenient location within the kiosk

## Nameplate and Markings

The engine shall be fitted with an engraved nameplate, secured with drive screws and located in an easily read position.

The nameplate shall show the following information:

1. Manufacturer’s name
2. Engine model
3. Engine serial number
4. Governed speed
5. ISO standard power rated output (continuous power and/or prime power and/or emergency standby power)

# Alternator

## General

The alternator shall comply with the requirements of ISO 8528-1, ISO 8528-3 andIEC 60034-1 and shall comply with the further requirements listed hereunder and detailed in the Annexure.

## Coupling

1. The alternator shall be direct driven from the engine
2. The coupling shall incorporate radial, angular and longitudinal flexibility
3. Both halves of the coupling shall be dynamically balanced individually with half keys in accordance with ISO 1940-1
4. The coupling shall have a minimum service factor of 1.5 times the maximum rated engine power at operating speed

## Type

The alternator shall be of the brushless, salient pole type with fully interconnected damper windings.

## Rated kVA

1. The alternator shall be rated for duty S1 and shall have a maximum continuous kVA power rating as specified in the Annexure
2. Under the specified operating conditions, the temperature of all alternator components shall remain within safe limits and all alternator winding temperatures shall remain below the limits specified IEC 60034-1

## Rated Power Factor

The alternator rated power factor shall be 0.8 lagging. The alternator shall be capable of operating from no load to rated load over the power factor range of 0.8 lagging to 0.95 leading.

## Number of Phases

The alternator shall be a 3 phase, 4 wire, star connected machine with the neutral being brought out to be grounded solidly.

## Rated Output Voltage

The alternator rated output voltage shall be 415 Volts phase to phase.

## Frequency

The alternator shall be rated for operation at 50 Hz.

## Voltage Variation

The alternator shall be capable of continuous operation at rated current, frequency and power factor at any terminal voltage in the range 95% to 105% of rated voltage.

## Voltage Waveform

With the alternator operating into a linear load, the output voltage waveform shall not include any individual harmonic greater than 3% of the fundamental and the total harmonic content shall not exceed 5% of the fundamental.

## Windings

1. Windings shall be designed to have an even temperature distribution free of hot spots and shall be suitably braced to give adequate rigidity under short circuit and short duration overload conditions
2. The stator winding shall be star connected with all six ends brought out and insulated to full line voltage
3. The alternator stator winding shall be double layer 2/3rd pitch
4. Phase ends of windings shall be marked in order of their phase sequence
5. The alternator rotor shall be equipped with fully interconnected damper windings

## Class of Insulation

The class of insulation used throughout the alternator shall not be less than Class F, i.e. Class 155 in accordance with IEC 60085.

## Temperature Rise

1. If the alternator is insulated to Class F, temperature rises at various locations within the alternator when operating under full load in a test ambient temperature of 40oC shall not exceed those specified in IEC 60034-1 for machines with Class B insulation, e.g. the winding temperature rise shall not exceed 80oC
2. Alternatively, if the alternator is insulated to Class H, temperature rises at various locations within the alternator when operating under full load in a test ambient temperature of 40oC shall not exceed those specified in IEC 60034-1 for machines with Class F insulation e.g. the winding temperature rise shall not exceed 105oC

## Enclosure

The alternator shall be of the drip proof construction protected to IEC 60529 classification IP23. Guards shall be provided on all moving parts.

## Type of Construction

The alternator shall be either foot mounted or flange mounted onto the engine.

## Type of Cooling

The alternator shall be air cooled to IEC 60034-6 code IC01.

## Alternator Rotor

1. The alternator rotor shall be of the salient pole type of construction
2. The rotor shall be dynamically balanced in accordance with ISO 1940-1
3. The rotor shall be capable of operating at 125% rated speed for two minutes without damage

## Bearings

1. The alternator shall be fitted with ball or roller type bearings having a rated operating life in accordance with ISO 281 of not less than 40,000 hours under the specified operating conditions
2. Bearings shall be high-grade selected industrial bearings with balls and rollers retained in metallic cages. Ball bearing retainers shall be of the one-piece pressed steel or bronze construction. Riveted retainers shall not be acceptable
3. Bearings shall conform to ISO standard metric dimensions
4. Bearings shall be grease lubricated
5. Unless bearings are of the sealed for life type, bearings shall utilise lithium based mineral oil grease, Shell Alvania EPLF2 or equivalent, and shall be fitted with grease nipples and automatic grease pressure relief and venting systems

## Direction of Rotation

The alternator’s direction of rotation shall be marked clearly, preferably by an arrow cast into the alternator casing.

## Excitation System

1. Excitation of the alternator field shall be provided by a direct driven AC main and permanent magnet pilot exciter. The permanent magnet pilot exciter output shall power the field of the main exciter via a static automatic voltage regulator. The main exciter AC output shall power the alternator main field via full wave rotating diode rectifiers
2. The rotating rectifiers shall be capable of withstanding surge voltages not greater than 300% nominal voltage without damage and shall be fitted with appropriate surge suppression
3. Removable covers shall be provided to provide easy access to connections and rotating diode assemblies

## Short Circuit Withstand Capability

The alternator shall be capable of sustaining, without damage, at least 300% full load rated current for 10 seconds when a three-phase short circuit is applied at the alternator terminals.

## Voltage Regulation

1. The automatic voltage regulator shall be continuous acting, have three phase sensing and shall respond to the root mean square of the alternator’s output voltage
2. The automatic voltage regulator shall maintain the alternator terminal voltage within +/- 1.0% of its set point value when at full load
3. The generator maximum allowable voltage drop is 20% and, the voltage recovery time is 1.5 seconds to +/-5%

## Automatic Voltage Regulator

The automatic voltage regulator shall:

1. Employ solid state components
2. Be encapsulated to protect it against moisture and dust
3. Be mounted onto the alternator using anti-vibration mounts or mounted within the control panel
4. Be provided with the protection functions listed at paragraph 11.6

## Automatic Voltage Regulator Power Supply

If the alternator is rated greater than 40 kVA it shall be fitted with a permanent magnet generator which shall power the automatic voltage regulator.

## Sub-Transient Reactance

The alternator’s sub-transient reactance shall be consistent with the requirements specified in clause 10.22 of this Specification and shall be the value specified by the Contractor on the Tender Technical Response Schedule.

# Controlgear and Switchgear

## General

The Controlgear and switchgear shall comply with the requirements of ISO 8528-1 and ISO 8528-4 except that the references therein to IEC 60439-1. which is superseded, shall be deemed to be to IEC 61439-1, which is the current replacement.

## Switchboard

Switchgear including manual controls shall be mounted in a switchboard located within the generating set kiosk. The switchboard shall be constructed in accordance with IEC 61439-1. The switchboard enclosure shall provide the switchgear assembly with a degree of protection of IP53 in accordance with IEC 60529.The main circuit breaker shall have a lock out and tag facility.

Note:

Electrical Design Standard DS29, sets out arc flash design standards and engineering practice to follow on switchboards connected to permanent and portable gensets.

The switchboard installed inside a generating set is required to be arc flash assessed by others, and generally that work is responsibility of a Design Manager.

The Design Manager/project team will engage a Consultant to carry out an arc flash assessment.

## Neutral Earthing

Separate neutral and earth bars shall be provided on the switchboard panel.

## Circuit Breaker Neutral

The main circuit breaker shall switch the neutral if the generator is to be permanently installed.

## Modes of Control and Controller

### 11.5.1 Modes of Control

The mode of control of the generating set shall be selectable by a lockable three position physical control selector switch located on the switchboard.

The three positions shall have the following functions:

1. Manual
2. Placing the control selector switch into the “manual” position, shall put the generating set into “local electric start/electric stop” as defined by ISO 8528-4.
3. Off

Switching the control selector switch to the “off” position shall shut down the engine.

1. Remote/Auto

Placing the control selector switch into the “remote” position, shall put the generating set into “remote start/electric stop” as defined by ISO 8528-4.

Placing the control selector switch into the “remote” position shall enable the initiation of engine starting only by the energization of a switchboard mounted “remote run” relay via a remote set of voltage free contacts. The “remote run” relay shall be powered from the engine started batteries.

### 11.5.2 Controller Type

The controller shall be a ComAP MRS16, and it will form an internal part of the generating system.

## Battery Charger

1. The generating set shall be provided with a 240 AC powered constant potential battery charger in accordance with DS26-45 Type Specification for Battery Charger for Diesel Engine Battery System. With the diesel engine inoperative, the battery charger shall be capable of replacing, within 8 hours, the battery charge taken by six engine starts.

The battery charger shall be located within the switchboard.

The battery charger shall include a manually selectable boost charge facility and automatic isolation during engine start and run periods.

The battery charger shall be supplied via an RCD type circuit breaker connected to the load side of the alternator main circuit breaker.

1. If specified in Annexure supplementary solar charger system shall be provided

## Monitoring Control and Protection Functions

Monitoring, control and protection functions shall be provided in accordance with the following table.

If a particular monitored parameter value exceeds its set high limit, the control system shall take the action indicated in the table for that particular monitored parameter.

Similarly, if a particular monitored parameter value falls below its set low limit, the control system shall take the action indicated in the table for that particular monitored parameter.

|  |
| --- |
| Generating Set Monitoring and Control Devices |
| No | Parameter | Monitored Limit Value | ShutDown | Indication | Comments |
| High | Low | Local | Remote |
| 1 | Overspeed | 🟋 |  | 🟋 | 🟋 | 🟋 | Only for sets > 100kW |
| 2 | Failure to Start |  |  |  |  | 🟋 |  |
| 3 | Battery Voltage |  | 🟋 |  | 🟋 | 🟋 |  |
| 4 | Fuel Level |  | 🟋 |  | 🟋 | 🟋 |  |
| 5 | Fuel Level |  |  |  | 🟋 | 🟋 | Analogue valueOnly for sets > 100kW |
| 6 | No start attempts | 🟋 |  | 🟋 |  | 🟋 |  |
| 7 | Mode od Control Selector Switch  |  |  |  | 🟋 |  | Hand control required |
| 8 | Frequency |  |  |  | 🟋 |  | Analogue value |
| 9 | Frequency Protection | 🟋 | 🟋 | 🟋 |  | 🟋 | AVR function |
|  |  |  |  |  |  |  | Only for sets >100 kW |
| 10 | Voltage |  |  |  | 🟋 |  | Analogue value |
| 11 | Voltage Protection | 🟋 | 🟋 | 🟋 |  | 🟋 | AVR function |
|  |  |  |  |  |  |  | Only for sets >100 kW |
| 12 | Voltage Setting |  |  |  | 🟋 |  | Screw driver adjustment |
| 13 | Speed Setting |  |  |  | 🟋 |  | Screw driver adjustment |
| 14 | Operating hours |  |  |  | 🟋 |  | Analogue value |
| 15 | Current |  |  |  | 🟋 |  | Analogue value in 3 phases |
| 16 | Active power (kW) |  |  |  | 🟋 |  | Analogue value  |
|  |  |  |  |  |  |  | Only for sets > 100 kW |
| 17 | Short Circuit Current | 🟋 |  | 🟋 | 🟋 | 🟋 | By circuit breaker |
| 18 | Time Delayed Overcurrent | 🟋 |  | 🟋 | 🟋 | 🟋 | By circuit breaker |
| 19 | Lub. Oil Pressure |  | 🟋 | 🟋 | 🟋 | 🟋 |  |
| 20 | Lub. Oil Pressure |  |  |  | 🟋 |  | Analogue value |
| 21 | Lub. Oil Level |  | 🟋 | 🟋 | 🟋 | 🟋 |  |
| 22 | Coolant Temperature | 🟋 |  | 🟋 | 🟋 | 🟋 |  |
| 23 | Coolant level |  | 🟋 | 🟋 | 🟋 | 🟋 |  |
| 24 | Fan Belt Failure |  |  | 🟋 | 🟋 | 🟋 |  |
| 25 | Air Cleaner Pressure Drop | 🟋 |  |  | 🟋 |  |  |
| 26 | Engine Running |  |  |  |  | 🟋 |  |
| 27 | Generating set tank high level fuel alarm and auto shut-off | 🟋 |  | 🟋 | 🟋 |  |  |

## Control Power Supply

Monitoring control and protection devices requiring an external power supply shall be powered from the generating set starter batteries.

## Remote Indications

The generating set monitoring and control system shall provide a serial communication link to enable signaling of specified fault indications and analogue values to remote sites as indicated in the above table. Modbus and Profibus are the preferred communications interfaces.

A connection socket(s)/terminals shall be in a readily accessible location to secure field cabling.

# Kiosk

## General

1. The engine, alternator, switchboard and all ancillary equipment shall be enclosed in a weatherproof transportable kiosk as described further hereunder
2. The kiosk itself and the arrangement of equipment within the kiosk shall be such as to provide convenient access to all items requiring periodic maintenance
3. A sealed storage box inside enclosure for manuals and service history shall be provided

## Base Plate and Skid Base

1. The engine and alternator shall be mounted onto a common base plate. Switchboard shall be mounted separate to engine and alternator. All equipment shall be mounted using appropriate anti-vibration mountings
2. The base plate shall either be integral with the skid base or mounted directly onto it
3. The base plate and skid base shall be fabricated from mild steel sections and shall be of a welded construction in accordance with AS 1554 or a similar international or national standard
4. The base plate shall be fully seal welded and adequately braced to prevent misalignment and flexing under load
5. If the alternator is foot mounted, individual mounting pads shall be provided for the engine and alternator
6. The base plate and fasteners shall be hot dip galvanised
7. Anti-vibration elastomeric waffle pad shall be provided if specified in the Annexure

## Lifting Points

1. Generating sets with a prime power rating up to and including 400 kW, shall be fitted with a steel lifting eye which shall be attached to the skid base, extend through the kiosk roof and terminate above the centre of gravity of the generating set with a full fuel tank. Provision shall be made to unscrew this lifting eye if it is necessary to lift off the kiosk enclosure
2. Generating sets with a prime power rating greater than 400 kW shall be provided with four lifting points outside the kiosk at suitably located positions on the skid base

## Fuel Tank

1. The generating set shall be provided with a fuel tank located in the skid base and having a capacity to fuel the engine at full load for the maximum attendance interval specified in Annexure
2. The fuel tank shall be of steel construction and shall incorporate suitable baffles so as to allow the generating set to be transported safely with fuel in the fuel tank
3. The fuel tank shall not be painted or coated internally
4. The fuel tank shall be fitted with a filler pipe extended to a convenient location within the kiosk, and over the fuel bund. The filler pipe shall be such as to allow the entry to the suction pipe on a portable fuel pump to the bottom of the fuel tank
5. A fuel supply 3-way valve with a single operating handle, to connect an auxiliary fuel tank, shall be installed in location easy to access if specified in the Annexure

## Fuel Bund

1. The generating set shall be provided with a bund built into the skid base to capture and contain any fluids which may leak from the fuel tank or the engine
2. The capacity of the bund shall equal 110% of total amount of all fluids contained within the generator kiosk, including fuel oil, lubricating oil and cooling water

## Radiator

1. A radiator cap with integral relief latch shall be provided to prevent personal being scalded
2. A radiator fill point shall be fitted with an accessible overflow bottle to allow ease of refilling

## Sound Proofing

1. The kiosk enclosure and engine muffling system shall be such as to reduce the sound power emitted from the generating set at full load to not more than the maximum allowable sound power level specified in clause 2.5(a) of this Specification
2. All sound proofing materials shall be compatible with lubricating oil and diesel fuel
3. Where hot exhaust ducts or heated components pass through sound proofing panels, special precautions shall be taken to prevent thermal damage to sound proofing materials

## Safety Guards

Safety guards shall be provided in accordance with the requirements of AS/NZS 3010 and such safety guards shall not affect cooling air flow adversely.

## Enclosure

1. The generating set kiosk enclosure design shall be of a heavy construction and shall not restrict the cooling of the engine or alternator adversely, or in any way prevent the generating set from meeting the specified performance requirements
2. The generating set kiosk enclosure, apart from the base plate, shall be of a folded and welded metallic sheet type construction and shall be bolted onto the base plate

The sheet material shall be either marine grade aluminum not less than 3mm thick, or zinc or zinc alloy coated steel not less than 1.5mm thick

1. At rated prime power load, the ambient temperature rise within the kiosk in the vicinity of the switchboard and alternator cooling air inlet shall not exceed 10oC
2. Lifting facilities shall be provided to allow the kiosk enclosure to be lifted off the generating set proper
3. The kiosk shall be weatherproof to IP23 as defined in AS 60529 (IEC 60529), shall be provided with gutters at each opening and shall provide a weatherproof shield for the bund.

 In respect to accessibility, the enclosure design shall include the following features:

Access to the engine for servicing and maintenance shall be via large access doors on each side

Ready accessibility and convenience for routine engine maintenance shall be provided

Doors hinged to open vertically shall be fitted with gas struts to hold these in the open position. Other doors shall be fitted with restraining devices to hold these in the open position

A system to drain the engine sump and fuel bund conveniently outside the engine compartment shall be provided

Access to any part of the engine, alternator, switchboard, batteries, and any exposed fill points shall incorporate lockable security features

All doors and hinged panels shall be lockable with Lockwood Night Latches fitted with an EM1 key bilock cylinder or Lockwood 8474 Handles fitted with an EM1 key bilock cylinder, except the door of the switchboard which shall be fitted with an EL2 key bilock cylinder

All doors shall be fitted with security switches, each wired to provide a voltage free contact, closed when the door is closed

Any viewing windows in the kiosk shall be of clear vandal proof polycarbonate UV sun protection

# Corrosion Mitigation

 Components shall be constructed so as to minimise the risk of corrosion.

The following principles shall be taken into account in the design of the enclosure and the base plate and skid base:

1. Corrosion resistant materials shall be used to the maximum extent practical and where the use of corrosion resistant materials is not practical, such materials shall be fully and effectively coated following proper pretreatment
2. The design shall be free of any crevices or water trapping pockets i.e. should be free draining
3. Any lap joint shall be sealed along all sides
4. The use of dissimilar metal contact shall be minimised. Where dissimilar metal contact is unavoidable, the materials shall be selected so as to minimise the difference in corrosion potential

# Protective Coatings

## Mild Steel Fabricated Components

1. The base plate shall be hot dip galvanised in accordance with AS 4680 or a similar international or national standard
2. Mild steel fabricated components other than the base plate, but including the kiosk if of mild steel construction, shall be protected against corrosion as detailed hereunder
3. All exposed steel surfaces, including both inside and outside of the kiosk, shall be pretreated and powder coated as per materials and durability specification G1 so as to provide the coating system long term durability (i.e. 10-15 years to first maintenance rating) to the environment specified in clause 2.6 and the Annexure (A8) of this Specification

## Aluminum Kiosk Enclosure

1. If the kiosk enclosure is aluminum, all aluminum surfaces, including both inside and outside of the kiosk, shall be pre-treated and powder coated as per materials and durability specification G1 so as to provide the coating system long term durability (i.e. 10-15 years to first maintenance rating) to the environment specified in clause 2.6 and the Annexure (A8) of this Specification

# Testing

## General

1. The generating set shall be subjected to the testing to verify conformance to the Specification and in particular shall be submitted to the tests specified hereunder
2. For the purposes of this Specification “type tests” shall be deemed to mean those tests carried out to verify correct design of the item and which are carried out on the item being supplied under the Contract or on an item of the identical design
3. For the purposes of this Specification “routine tests” shall be deemed to mean those tests carried out to verify correct manufacture of the type tested item and which are carried out on the item being supplied under the Contract
4. All routine tests specified in this Specification shall be carried on the completed generating set assembly

## Engine Type Tests

The engine shall be of a design which has been type tested at the original engine manufacturer’s works in accordance with ISO 3046-1 and the Contractor shall provide the Principal with a copy of the type test certificate.

## Engine Routine Tests

The Contractor shall subject the engine to acceptance tests in accordance with ISO 3046-1 Table 7 Test B1 and Table 8 Tests C1 to C5 inclusive.

With respect to Test B1, the generating set shall be tested for 2 hours at rated prime power.

With respect to Test C1, the overspeed protection system shall be tested by running the generator at 110% prime power load and then tripping the generating set circuit breaker.

Tests B1, C1 and C2 shall be witnessed by the Contract Superintendent’s Representative.

## Alternator Type Tests

1. The alternator shall be of a design which has been type tested at the original alternator manufacturer’s works in accordance with ISO 8528 and the Contractor shall provide the Principal with a copy of the type test certificate
2. Further, the alternator shall have been type tested to verify the alternator’s performance in respect to motor starting loads

## Alternator Routine Tests

The Contractor shall subject the alternator to the following acceptance tests which shall be witnessed by the Contract Superintendent’s Representative:

1. Temperature rise test at engine prime power load at unity power factor
2. Insulation resistance tests

## Switchboard Design Verification

1. The switchboard shall be of a design which has been verified in accordance with the requirements of IEC 61439-1, Table D1 except that verification of short circuit strength shall not be required as per clause 10.11.2 of IEC 61439-1
2. The Contractor shall provide the Principal with a copy of the design verification test certificate

## Switchboard Routine Tests

The Contractor shall subject the switchboard to the routine tests detailed in IEC 61439-1.

## Generating Set Noise Type Tests

The generating set shall be of a design which has been type tested at prime power or emergency standby power level specified in Annexure in accordance with ISO 8528-10 so as to verify sound power levels generated.

## Kiosk Routine Temperature Rise Test

1. The generating set as a whole shall be run at rated prime power or emergency standby power load for 2 hours and temperature measurements taken to verify the ambient temperature rise within the kiosk in the vicinity of the switchboard and the alternator cooling air inlet
2. This test shall be witnessed by the Contract Superintendent’s Representative

## Routine Test Certificates

The Contractor shall submit, to the Contract Superintendent’ Representative, a copy of the test certificate for each and every routine test for his/her approval and certification.

# As Constructed Information

The Contractor shall provide the Principal with an as constructed arrangement drawing of the generating set showing overall critical dimensions, weight, circuit diagrams (power and control) and cable entry locations. These drawings shall be provided in A3 hard copy form as well as in electronic form.

# Manuals

The Contractor shall supply one copy of comprehensive instruction manuals for the generating set, written in English and covering the complete operation and maintenance requirements of all equipment supplied under the Contract.

The manuals shall be printed on high grade A4 size paper and shall be bound in a high grade A4 size loose leaf binder.

There shall be an additional set of instruction manuals in a digital format.

Information included in the manuals shall include:

1. Operating instructions
2. Safety instructions and warnings
3. Maintenance instructions and schedules
4. Recommended spare parts and special tool list
5. As constructed drawings
6. Test reports and test certificates

# Delivery Instructions

 Delivery instructions are as detailed in the Annexure.

# Installation at Site

 If it is specified in the Annexure the connection of the generating set will be carried out by others after any on site assembly and positioning has been completed by the Contractor. Once connection of the generating set is complete, the Contractor shall return to the site to commission the generating set under the overall direction of the Principal.

Installation instructions are as detailed in the Annexure.

# Post Installation Requirements

Inspection, site testing and commissioning shall be carried out by the contractor if required as detailed in the Annexure.

# Spare Parts

The Contractor shall recommend essential spare parts for the generating set.

# Technical Support

The Contractor shall maintain an adequate level of technical support within Australia.

# Training

If requested in the Annexure, the Contractor shall supply as part of the Contract training for the number of Water Corporation electrical technicians specified in the Annexure. Such training shall cover first line fault finding and first line servicing.

**Annexure to Specification**

**for**

**Stand Alone Generating Set**

**This Specification shall be used for projects that follow the Engineering Design Process only. The specific generating set requirements will be defined by a Project Manager/Designer**

**A1. Project:**

**A2. Work by the Principal**:

**A3. Location**: ……………………………………………………………………………………………..

**A4.** **Mode of Operation** (Continuous/Prime Power/Emergency Standby Power in accordance with ISO8528-1) ……………………………………..........................................................................

**A5. Performance Class** (G2 or G3) ……………………………………………………………………..

**G2** (General light and power, fixed speed motors, fans and hoists type of loads) ………… Yes/No

 **G3** (VSC/thyristor-controlled loads, UPSs type of loads) …………...…………...………..Yes/No

**A6. Maximum Sound Power Level** *[if lower than clause 2.5 (a)]:*

**A7. Site Maximum Ambient Temperature** *[if lower than clause 2.6 (a)]*………………………… °C

**A8. Atmospheric Corrosivity Category** *[select from the following options]……………... C3/C4/C5/Cx*

 **C3:** medium/ covers coastal areas with low salinity, or

 **C4**: high, wastewater treatment plants along the coast, damp environments, around sheltered bays, or

 **C5**: very high, beachfront in regions of rough seas and surf beaches, or

 **Cx**: extreme, such as Burrup or Cocos Island, regions with very high salt deposition

**A9. Engine requirements**

 (a) Naturally Aspirated or Turbocharged

 (b) Water or Air cooled

 (c) Governed speed r.p.m.

**A10. Minimum Power Requirements**

 (a) ISO 8528-1 Continuous Power rating …………………………………………………… kW

 (b) ISO 8528-1 Prime Power rating kW

 (c) ISO 8528-11 Emergency Standby Power rating … …………………………………………kW

**A11. Routine service interval**  hrs

**A12. The exhaust pipe extended 1 metre past the end of the kiosk** ………………………..……Yes/No

**A13. Supplementary Solar Charger System**………………………………..…………………….Yes/No

 ……………………………………………………………………………………………………..

**A14. Fuel supply 3-way valve with a single operating handle** ……………………………..……Yes/No

**A15. Principal’s drawing numbers**

**A16. Load Details**

**A17. The exhaust pipe extended 1 metre past the end of the kiosk** ………………………..……Yes/No

**A18. Anti-vibration elastomeric waffle pad** ……………………………..…………………..……Yes/No

**A19. Principal nominated coating system (MS1/MS2/AL1/AL2, details as per Appendix A** … Yes/No ………………………..…………………..……………………………………………………………………

**A20. Training for** *[specify number]* **Electrical Technicians, on fault finding and servicing** ….…Yes/No

**A21. Steel bund with forklift points** ………………………..………………………………………Yes/No

**A22. RCD outlets** ……………………………………………………..………………………..……Yes/No

**A23. Lockable battery isolator (red) ………………………………...**………………………..……Yes/No

**A24. Lockable starting isolator (yellow) ……………………………** ………………………..……Yes/No

**A25. Fire extinguisher ……………………………………………….** ………………………..……Yes/No

**A26. Pre-filter on engine intake …………………………………….** ………………………...……Yes/No

**A27. Water separating fuel filter** ……………………………………………………………..….…Yes/No

**A28. All threaded fuel fittings sealed with a sealant** …………………….………………….. ……Yes/No

**A29. Belly fuel tank** **wired to genset controller** …………………………………..…………..……Yes/No

**A30. Internal led lighting** ………………………………………………..……………………..……Yes/No

**A31. Bund level switch** ………………………………………………………..………………..……Yes/No

**A32. Fire valve** ………………………………………………………………...………………..……Yes/No

**A33. Oil level switch** …………………………………………………..………………………..……Yes/No

**A34. Mechanical fuel shut off on fire detection in canopy** ….………………………………..……Yes/No

**A35. Smoke/fire sensor** ………………………………………………..………………………..……Yes/No

**A36. The 12V Anderson plug** …………………………………………………………………..……Yes/No

**A37. Battery cable terminal covers** ……………………………………………………..……..……Yes/No

**A38. Quick connect fittings** …………………………………………...………………………..……Yes/No

**A39. Other accessories** ……..…………………………………………...………………………..……

|  |
| --- |
| **Type Specification for Stand Alone Generating Set Tender Technical Response Schedule** |
| Clause | **Subject** | **Noted** | Compliance | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| **1.** | **General** |  |  |  |  |
| **2.** | **Standard Classifications** |  |  |  |  |
| 2.1 | Generating Set |  |  |  |  |
| 2.2 | Mode of Operation |  |  |  | Continuous/Prime Power/Emergency Standby Power |
| 2.3 | Performance Class |  |  |  | Performance class = |
| 2.4 | Installation Features |  |  |  |  |
| 2.5 | Emissions |  |  |  | LWA = ……………………….dBA |
| 2.6 | Site Conditions |  |  |  | **Ambient Temperature =**  |
| 2.7 | Power Ratings |  |  |  | Continuous Power kW =  |
|  |  |  |  |  | Prime Power kW = |
|  |  |  |  |  | Emergency Standby Power kW = |
| 2.8 | Operating Performance  |  |  |  |  |
| **3.** | **Work by Principal** |  |  |  |  |
| **4.** | **Information from Contractor** |  **2** |  |  | 1 Digital set + 1 Manual Set |
| **5.** | **Drawings** | **2** |  |  | 1 Digital set + 1 Manual Set |
| **6.** | **Standards**  |  |  |  |  |
| 6.1 | General |  |  |  |  |
| 6.2 | Particular Standards |  |  |  |  |
| 6.3 | Type Specifications |  |  |  |  |
| **7.** | **Quality Assurance** |  |  |  |  |
| **8.** | **Electrical Work** |  |  |  |  |
| **9.** | **Engine** |  |  |  |  |
| 9.1 | General |  |  |  |  |
| 9.2 | Ratings |  |  |  |  |
| 9.3 | Governing |  |  |  | ISO 8528 performance class = |
| 9.4 | Fuel |  |  |  |  |
| 9.5 | Lubrication |  |  |  |  |
| 9.6 | Cooling Fan Bearings |  |  |  |  |
| 9.7 | Exhaust System |  |  |  |  |
| 9.8 | Air Cleaners |  |  |  |  |
| 9.9 | Extra LV Electrical Equipment |  |  |  |  |
| 9.10 | Batteries |  |  |  |  |
| 9.11 | Nameplate and Markings |  |  |  |  |

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| **Type Specification for Stand Alone Generating Set Tender Technical Response Schedule** |
| Clause | **Subject** | **Noted** | Compliance | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| **10.** | **Alternator** |  |  |  |  |
| 10.1 | General |  |  |  |  |
| 10.2 | Coupling |  |  |  |  |
| 10.3 | Type |  |  |  |  |
| 10.4 | Rated kVA |  |  |  | Rated kVA = kVA |
| 10.5 | Rated power factor |  |  |  | Rated lagging PF = |
|  |  |  |  |  | Rated leading PF = |
| 10.6 | Number of phases |  |  |  |  |
| 10.7 | Rated Output Voltage |  |  |  |  |
| 10.8 | Rated Frequency |  |  |  | Rated frequency, Hz = |
| 10.9 | Voltage Variation |  |  |  |  |
| 10.10 | Voltage Waveform |  |  |  |  |
| 10.11 | Windings |  |  |  |  |
| 10.12 | Class of Insulation |  |  |  | Insulation class = |
| 10.13 | Temperature Rises |  |  |  | Winding temp. rise = deg. C |
| 10.14 | Enclosure |  |  |  | Enclosure IP rating = |
| 10.15 | Type of Construction |  |  |  |  |
| 10.16 | Type of Cooling |  |  |  | Cooling IC code = |
| 10.17 | Alternator Rotor |  |  |  |  |
| 10.18 | Bearings |  |  |  |  |
| 10.19 | Direction of Rotation |  |  |  |  |
| 10.20 | Excitation System |  |  |  |  |
| 10.22 | Voltage Regulation |  |  |  |  |
| 10.23 | Automatic Voltage Regulator |  |  |  |  |
| 10.24 | A.V.R. Power Supply |  |  |  |  |
| 10.25 | Sub-Transient Reactance  |  |  |  | Xd” = % |
| **11.** | **Controlgear and Switchgear**  |  |  |  |  |
| 11.1 | General |  |  |  |  |
| 11.2 | Switchboard |  |  |  | IP rating =  |
| 11.3 | Neutral Earthing |  |  |  |  |
| 11.4 | Circuit Breaker Neutral |  |  |  |  |
| 11.5 | Modes of Control and Controller |  |  |  |  |
| 11.5.1 | Modes of Control  |  |  |  |  |
| 11.5.2 | Controller Type |  |  |  | ComAP MRS16 Controller |
| 11.6 | Battery Charger |  |  |  |  |
| 11.7 | Monitoring and Protection |  |  |  |  |
| 11.8 | Control Power Supply |  |  |  |  |
| 11.9 | Remote Indications  |  |  |  |  |

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| **Type Specification for Stand Alone Generating Set Tender Technical Response Schedule** |
| Clause | **Subject** | **Noted** | Compliance | **Comments** |
| **No.** |  |  | **Yes** | **No** |  |
| **12.** | **Kiosk** |  |  |  |  |
| 12.1 | General |  |  |  |  |
| 12.2 | Base Plate and Skid Base |  |  |  |  |
| 12.3 | Lifting Points |  |  |  |  |
| 12.4 | Fuel Tank |  |  |  | Fuel Tank Capacity = L |
| 12.5 | Fuel Bund |  |  |  |  |
| 12.6 | Radiator |  |  |  |  |
| 12.7 | Sound Proofing |  |  |  | Max. Sound Power = dBA |
| 12.8 | Safety Guards |  |  |  |  |
| 12.9 | Enclosure |  |  |  | Max. ambient temp. inside kiosk deg. C |
|  |  |  |  |  | Near alternator = ……………… deg. C |
| **13.** | **Corrosion Mitigation** |  |  |  |  |
| **14.** | **Protective Coatings** |  |  |  |  |
| 14.1 | Mild Steel Fabricated Components and coating system as per Specification G1 |  |  |  | C3/C4-5/Other coating details:…………………………………….. |
| 14.2 | Aluminum Kiosk Enclosure and coating system as per Specification G1 |  |  |  | C3/C4-5/Other coating details:…………………………………….. |
| **15.** | **Testing** |  |  |  |  |
| 15.1 | General  |  |  |  |  |
| 15.2 | Engine Type Tests |  |  |  |  |
| 15.3 | Engine Routine Tests |  |  |  |  |
| 15.4 | Alternator Type Tests  |  |  |  |  |
| 15.5 | Alternator Routine Tests |  |  |  |  |
| 15.6 | Switchboard Type Tests |  |  |  |  |
| 15.7 | Switchboard Routine Tests |  |  |  |  |
| 15.8 | Generating Set Noise Type Tests |  |  |  |  |
| 15.9 | Kiosk Special Temperature Rise Test  |  |  |  |  |
| 15.10 | Routine Test Certificates |  |  |  |  |
| **16.** | **As Constructed Drawings** |  |  |  |  |
| **17.** | **M**anuals |  |  |  |  |
| **18.** | **Delivery Requirements** |  |  |  |  |
| **19.** | **Installation Requirements** |  |  |  |  |
| **20.** | **Post Installation Requirements** |  |  |  |  |
| **A39.** | **Other accessories** |  |  |  | List all other accessories: |

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