

Technical Specification – Permanent Gas Engine Driven Pump

Table of Contents

Revision details	3
Introduction	3
Copyright	3
Acronyms	3
1. General	6
1.1 Scope	6
1.2 Drawings	6
1.3 Scope of Work	6
1.4 Capacity	8
1.5 Operation.....	8
1.6 Gas leakage detection and interlocks	8
1.7 Testing and Commissioning	9
1.8 O&M Manuals and WAC Drawings	9
2. Standards, Codes and Regulations	10
2.1 General	10
2.2 Regulations	10
2.3 Standards	10
2.4 Sydney Water Specifications	11
2.5 Codes.....	12
3. Technical Requirements	13
3.1 General	13
3.2 Acoustic Enclosure	13
3.3 Engine.....	15
3.4 Starting System	16
3.5 Pump.....	17
3.6 Baseplate.....	19
3.7 Control Panel	20
3.8 Corrosion Protection.....	25
3.9 Earthing	25
3.10 Installation, Operation and Maintenance Manuals.....	25
4. Inspection and tests	26
Ownership	28
Ownership	28
Change history	28
Appendices.....	29
Appendix 1 Gas Pump Remote Interface Terminal Block	30
Appendix 2 Gas Pump Data Sheet	31
Appendix 3 Gas Pump System Curves	42

Revision details

Version No.	Clause	Description of revision
1	All	Complete revision, reformatting and publication.
0	All	Specification created. Not officially published

Introduction

This specification is for the design, fabrication and supply of a permanent emergency gas engine driven self-priming centrifugal sewage pumping unit for Sydney Water assets.

Appendix 2 - Gas Pump Data Sheet and Appendix 3 – Gas Pump System Curves of this specification provide site specific information and must be reviewed and completed by the Designer and filled out by the Supplier.

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Acronyms

Acronym	Definition
A	Ampere
AC	Alternating Current
AS	Australian Standard
ASTM	American Society for Testing and Materials
BMEP	Brake Mean Effective Pressure
BS	British Standard
DC	Direct Current
DIN	Deutsches Institut für Normung (German Standard)
FAT	Factor Acceptance Test
GPO	General Power Outlet
Hz	Hertz
I&C	Instrumentation and Control
IICATS	Integrated Instrumentation, Control and Telemetry System

Acronym	Definition
IP	Ingress Protection
ISO	International Organisation for Standardisation
ITP	Inspection and Test Plan
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt Hour
LED	Light-emitting Diode
LEL	Lower Explosive Level
NATA	National Association of Testing Authorities of Australia
NC	Normally Closed
NO	Normally Open
NPSHr	Nett Positive Suction Head required
NPSHa	Nett Positive Suction Head available
NZS	New Zealand Standard
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
Pre-FAT	Preliminary Factory Acceptance Testing
PVC	Polyvinyl Chloride
RCD	Residual Current Device
rpm	Revolutions per Minute
SAE	Society of Automotive Engineers
SCADA	Supervisory Control and Data Acquisition
SOC	Systems Operation Centre
SPS	Sewage Pumping Station
TOG	Telemetry Operations Group
USB	Universal Serial Bus
V	Volt
WAC	Work as Constructed
WSAA	Water Services Association of Australia

General Terms & Definitions

Term	Definition
Design life	The period adopted in design for which a product, equipment or component is required to perform its function within the specified parameters with periodic maintenance but without replacement or major overhaul.
Service life	The forecast life expectancy of a product based on operational experience and actual installed conditions during which it remains in use, which may include replacement of critical parts and major overhauls.
Supplier	The person or organisation responsible for the fabrication or manufacture and supply of products, materials, equipment and components described herein.

Term	Definition
Sydney Water	The nominated person or organisation that has written authority to act on Sydney Water's behalf.
WSAA Codes	Codes of Practice issued by Water Services Association of Australia

1. General

1.1 Scope

The scope of the specification is for the supply of a packaged emergency gas engine driven self-priming centrifugal sewage pumping unit (in further text 'gas pump') for permanent installation on a concrete plinth within Sydney Water's facilities. The specification covers the technical requirements of the gas pump and required associated items, including an acoustic enclosure, pump priming system and control equipment. The specific details are given in Appendix 1 – Gas Pump Remote Interface Terminal Block, Appendix 2 - Gas Pump Data Sheet and Appendix 3 – Gas Pump System Curves.

1.2 Drawings

The Supplier must provide a full set of certified construction drawings for the gas pump for Sydney Water's review prior to fabrication. Detailed equipment list / bill of materials must also be supplied prior to performing any work on the project. Additionally, WAC drawings must be supplied for Sydney Water review prior to delivery of the gas pump to site.

The construction drawings submitted must include plan, elevations and section views with item numbers, showing:

- major equipment such as the gas engine, centrifugal pump, pump priming system and acoustic enclosure,
- location and details of the pump suction and discharge flanges,
- location of all control and electrical panels and batteries,
- field interface cable entries and access locations,
- location of supply gas connection,
- acoustic louvre details,
- access doors (in open and closed positions),
- air filters and lubrication points,
- material list, and
- loads and foundation details, including anti-vibration mounds and holding down bolts.

1.3 Scope of Work

The extent of work covered by this specification includes the design, manufacture, factory testing and delivery to site of a complete gas pump. The gas pump must be suitable for outdoor installation.

As a minimum, the work must include:

1. Supply of:

- complete packaged gas pump,
- automatic pump self-priming system,
- steel skid baseplate,
- weatherproof acoustic enclosure,

- anti-vibration mounting pads,
 - holding down anchor bolts,
 - lifting lugs or eyebolts.
2. Integral closed-circuit radiator.
 3. Engine exhaust system including silencer and flashings.
 4. Gas distribution system within the engine compartment including:
 - gas filters
 - gas pressure regulators
 - gas pressure gauges
 - gas over pressure switch
 - gas low pressure switch
 - gas isolating valves
 - gas leakage detectors
 - gas emergency automatic shut off valves
 5. 230 V AC single phase load centre with separate circuit breakers for:
 - jacket water heater,
 - battery chargers,
 - LED lights mounted within the acoustic enclosure with an on/off switch,
 - two GPOs (RCD Protected),
 - 20 A spare capacity for future use.
 6. Local control panel with gas pump controller, protection devices, alarms, indicators and control switches.
 7. Electrical power supply isolation panel.
 8. Electric starting system (24 V DC) including batteries and battery charger.
 9. Batteries and battery charger for gas pump control circuits (separate to starting system batteries and battery charger).
 10. Termination panel for termination of outgoing cables from the gas pump.
 11. All power and control wiring internal to the package.
 12. Detailed template drawings of skid baseplate and loading information.
 13. Detailed drawings of control and power supply isolation panels with full equipment list for approval prior to manufacturing.
 14. All protective and final finishing painting.
 15. Pre-FAT and FAT in accordance with Sydney Water Specification Commissioning – transitioning assets into operation.
 16. Delivery to site.

17. Supply of installation, operating and maintenance manuals and other documentation in accordance with Sydney Water Specification: Commissioning – transitioning assets into operation.
18. Supply of all WAC drawings.
19. 12 months servicing and breakdown cover from the date of final commissioning on site.
20. Minimum 12 months warranty from the date of final commissioning on site.
21. Recommended critical spare parts and special tools if required for maintenance.

1.4 Capacity

The gas pump must meet the design capacity and pumping head and be capable of operating over the whole operating range specified and shown in Appendix 2 - Gas Pump Data Sheet and Appendix 3 – Gas Pump System Curves.

The unit must achieve this capacity and head when operating in the ambient temperature range and at an elevation specified in the Gas Pump Data Sheet.

1.5 Operation

The gas pump control system must be provided with three operating modes:

- Automatic,
- Manual, and
- OFF.

The required operating mode must be able to be selected by an operating mode selector switch on the gas pump control panel.

In automatic mode the gas pump must be able to be started and stopped remotely by a volt free contact interfaced to a pre-assigned digital input in the gas pump control system.

In manual mode the gas pump must have the ability to be operated from the gas pump control panel via start/stop push buttons and adjustable speed set-point.

When the gas pump operating mode selector switch is selected to OFF position, the gas pump must not be able to be started/stopped either remotely or manually.

1.6 Gas leakage detection and interlocks

An intrinsically safe gas detector must be mounted inside the enclosure at a location nominated by the manufacturer. The detector must detect the presence of natural gas.

If the gas level reaches 5% LEL, the following actions must take place:

- Gas supply to the gas engine must be switched off by the automatic gas shut-off valve.
- Gas engine operation to be inhibited.
- Except the intrinsically protected control and monitoring signals, all electrical power supplies to the gas pump enclosure must be isolated at a point external to the acoustic enclosure.
- The sparking mechanism for the gas engine must be disabled.
- Alarm must be sent to Sydney Water SOC and a warning light on the outside the enclosure must be switched off.

All of the above conditions must remain in place as long as the presence of gas in the enclosure is above its safe limit (5% LEL) and must only be reset manually. Remote or automatic resetting to enable gas engine operation must not be permitted.

With all specified controls in place the gas pump enclosure must be classified and sign posted as Class I Zone 2 hazardous area in accordance to AS 60079.10.1.

1.6.1 Electrical power supply isolation panel

All power supplies to the gas pump including auxiliary power supply, cranking battery supply and the control power battery supply to the gas engine must be automatically isolated when the gas level within the acoustic enclosure reaches 5%LEL. The isolation of power supplies must occur outside the acoustic enclosure to ensure there are no potential power sources within the enclosure.

The auxiliary power supply, cranking power supply batteries, control power supply batteries, battery chargers, and the control equipment required to facilitate the isolation must be housed in an external electrical power supply isolation panel. The power supply isolation panel must be free standing and must not be directly bolted onto the acoustic enclosure. The electrical conduits, channels or ducts between the panel and the gas pump acoustic enclosure must not be terminated directly on the power supply isolation panel.

The power supply isolation panel must be manufactured from 2mm Grade 316 stainless steel and must have a minimum ingress protection rating of IP54. The general construction including doors, door seals, door latches, door handles, equipment mounting plates, earthing, internal wiring, labelling, gland plates, surface treatment and painting must comply with the Sydney Water Technical Specification - Electrical. The panel must be positioned at eye height, i.e. between 1500 mm – 2000 mm above standing level.

All cabling between the power supply isolation panel and the gas engine must be bottom entry.

1.7 Testing and Commissioning

The Supplier must undertake factory testing of the gas pump in accordance with Sydney Water's Specification: Commissioning – transitioning assets into operation. The Supplier must provide site testing and commissioning support.

The Supplier must prepare and submit Inspection and Test Plans (ITPs) and Check Lists as part of the Supplier's Project Quality Plan detailing all testing required to satisfactorily complete the factory acceptance testing (Pre-FAT and FAT).

1.8 O&M Manuals and WAC Drawings

The Supplier must provide operation and maintenance (O&M) manuals and WAC drawings in accordance with this Specification and Sydney Water's Specification: Commissioning – transitioning assets into operation.

2. Standards, Codes and Regulations

2.1 General

All equipment, materials and accessories used for the completion of the scope of work must be new. Their design and construction must be in accordance with all legal regulations and latest editions of relevant standards, codes and Sydney Water's specifications including, but not limited to those stated below.

Where no Australian Standard or Code exists, relevant International Standards, subject to Sydney Water acceptance, must apply.

Proof of compliance with a Standard or specified test may be required. Where requested, such proof must comprise a test certificate from an independent testing authority.

Where a standard or specification requires reference to another standard or specification and that document has been amended, replaced or superseded or withdrawn, the reference must be taken to apply to the replacement of that standard or specification or, if withdrawn, to its latest revision. If necessary, the author of such document must be consulted for a determination of the appropriate replacement standard or specification.

2.2 Regulations

- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2017
- Dangerous Goods Act 1985 and Regulations
- National (NSW) Gas Act 2008
- NSW Electricity Supply Act 1995
- National Construction Code of Australia
- NSW Environmental Noise Control Manual
- EPA NSW Noise Policy for Industry (NPfI) 2017
- Service and Installation Rules of New South Wales
- Relevant Power Supply Authority Requirements
- Australian Communications and Media Authority Requirements
- Environmental Planning and Assessment Act 1979
- Protection of the Environment Operations Act 1997
- Protection of the Environment Operations (Clean Air) Regulation 2010
- Gas compliance requirements of New South Wales
- Gas and Electricity (Consumer Safety) Act 2017
- Gas and Electricity (Consumer Safety) Regulation 2018

2.3 Standards

- AS 1019: Internal combustion engines – Spark emission control devices

- AS 1055: Acoustics - Description and measurement of environmental noise
- AS 1081.1: Acoustics - Measurement of airborne noise emitted by rotating electrical machinery - Engineering method for free-field conditions over a reflective plane
- AS 1081.2: Acoustics - Measurement of airborne noise emitted by rotating electrical machinery - Survey
- AS/NZS 1269: Occupational noise management
- AS 1627: Metal finishing – Preparation and pre-treatment of surfaces
- AS 2317.1: Lifting points – Part 1: Collared eyebolts and collared eye nuts – Grade 4
- AS/NZS 2373: Electric cables - Twisted pair for control and protection circuits
- AS/NZS 3000: Electrical installations
- AS 4024: Safety of machinery
- AS 4041: Pressure piping
- AS 4044: Battery chargers for stationary batteries
- AS 4594: Internal combustion engines – Performance
- AS/NZS 5601.1: Gas installations – General Installations
- AS 60079.10.1: Explosive atmospheres – Classification of areas – Explosive gas atmospheres
- AS 60269.1: Low-voltage fuses - General requirements
- AS 60529: Degrees of protection provided by enclosures (IP Code)
- AS/ISO 9906: Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1, 2 and 3
- AS/NZS 61439: Low voltage switchgear and control gear assemblies
- AS/NZS CISPR 11: Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement
- AS/NZS CISPR12: Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of off-board receivers
- SAE J1349: Engine power test code - Spark ignition and compression ignition - As installed net power rating
- ISO 10816-6: Mechanical vibration – Evaluation of machine vibration by measurement on non-rotating parts – Reciprocating machines with power rating above 100 kW

2.4 Sydney Water Specifications

- TOG_TS01 Instrumentation and Control Standards (General) (HSS0009)
- I&C_SPS SPS Related Instrumentation and Control Standards (HSS0007)
- Treatment Plant SCADA Standards (D0000724)
- Commissioning – transitioning assets into operation (D0001441)
- Management specification (1041412)

- Technical Specification – Mechanical (BMIS0209)
- Technical Specification – Electrical (CPDMS0022)
- Sydney Water Supplement to Industry Standard for Submersible Pumps for Sewage Pumping Stations WSA 101 (D0000677)

2.5 Codes

- Water Services Association of Australia WSA 201 Manual for Selection and Application of Protective Coatings
- Water Services Association of Australia Industry Standard for Submersible Pumps for Sewage Pumping Stations WSA 101

3. Technical Requirements

3.1 General

All the equipment provided by the Supplier, including the details of which have not been covered by any specific rating or performance requirements in this specification, must be of an approved construction and suitable for the duty it must perform.

For any type of equipment or accessory, the same manufacturer and range must be used throughout the installation to maintain standardisation. The gas pump and all equipment in the control panel must be of a type commonly used within Sydney Water for standardisation purposes.

Any of the works, which would reasonably and obviously be inferred as necessary for the complete, safe and satisfactory operation of the supplied equipment, whether or not expressly described or specified, must be provided and such work executed as part of the supply Contract.

The whole of the work must be carried out by skilled qualified tradesmen under competent supervision.

When designing the enclosure and skid careful consideration must be given to providing suitable access to equipment for operation and maintenance. Access doors must be large enough and positioned in such a way that additional ladders or platforms are not required. The enclosure must be wide enough to accommodate any auxiliary equipment associated with the gas pump.

Auxiliary equipment and accessories must be mounted so as to be free of vibration from the gas pump. Adequate provisions must be made for the attachment of lifting slings and/or jacks for ease of handling.

Painting of stainless steel and non-metallic service parts such as hoses, clamps, wiring harness and others is not acceptable. Fasteners must be Grade 316 stainless steel, designed to minimise marring of the painted surfaces when removed for normal installation or service work.

The general design must provide easy access to all points requiring servicing, maintenance or regular inspection, including batteries, sensors, gas regulators, safety shut off system and isolators. The crankcase oil drain and cooling water system drain must be brought to the side of the unit so that a 200mm high receptacle may be used to drain the oil or water. Alternatively, if the oil and cooling water spill into a common collection sump, a provision for a suitable portable pump to empty the sump into a container may be considered.

The gas pump must be supplied with a suitably sized oil/coolant spill kit located within the acoustic enclosure.

Exposed moving parts must be protected by adequate guards complying with relevant part of AS 4024. The guards must not interfere with any controls or prevent normal operation or maintenance of the unit.

3.2 Acoustic Enclosure

The gas pump must be installed inside an acoustic enclosure. The pump must be installed in such a manner that the transmission of noise and vibration is kept to a minimum. Anti-vibration mountings for the skid baseplate must be provided to achieve the specified acoustic performance. The sound pressure level at 7m from the canopy must not exceed the noise level stated in the Gas Pump Data Sheet with the gas pump control panel door in open position and the gas pump operating at the rated speed.

The enclosure must be fabricated from structural steel and be of a vermin proof design. The enclosure must carry the necessary labels to indicate the presence of electricity, hot surfaces, noise, fumes and any other

hazardous conditions. The enclosure must be weatherproof with ingress protection rated to a minimum IP 22 as per AS 60529. Each access door must be fitted with Sydney Water locking system to suit CB-Y yellow keying.

The enclosure must be painted as per WSA 201 Manual for Selection and Application of Protective Coatings, coating system POW or PUR-A for high exposure class or PUR-B for moderate exposure class. The enclosure colour must be Dulux Ocean Mist 96183250 or European Colour Standard No. RAL9018, unless specified otherwise by Sydney Water (e.g. Environmental Green G66 may be more suitable if installed in parks or bush areas). Sheet metal must be primed for corrosion protection and finish painted to the specified colour. Surfaces of metal parts must be primed and painted to an approved paint system unless they are made from corrosion resistant materials.

The acoustic enclosure must house the gas pump, gas supply pipework and ancillary components. All equipment and cables must be neatly arranged within the enclosure such that they do not become a trip hazard. Access to the control panel must be possible without increasing the noise level as per the requirements in the Gas Pump Data Sheet.

Panels for air intake and exhaust must be of adequate size and robust construction such that air induced vibration does not add to the overall noise level. If the enclosure consists of a separate exhaust chamber, access must be provided to ensure debris can be cleaned. If no access is provided to this chamber, then the exhaust must be supplied with an appropriate hood to prevent debris or rainwater entering the chamber.

The enclosure must be fully removable from the installed gas pump assembly to enable major overhauls. No other equipment, including instruments, must be attached to or supported off the enclosure walls or roof. The enclosure must be constructed such that it can be removed with minimum disassembly and must retain the acoustic capability when reinstalled. The operation and maintenance manual must provide step by step details of its disassembly and re-installation. Adequate lifting points, certified to relevant Australian Standard, must be provided for that purpose.

The enclosure must reduce the sound level of the gas pump set while operating at full rated load to the maximum level specified in the Gas Pump Data Sheet. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustic material used must be oil, water and fire resistant. Foam materials must not be used unless it can be demonstrated that they have the same durability and life span as mineral wool.

The enclosure must include hinged doors for access to both sides of the engine, pump and ancillary equipment for routine maintenance and inspection. The doors must be double leaf with min. 2100 mm headroom. The height of the step at the entry points must not exceed 200mm measured from underside of the pump baseplate. The doors must be fitted with neoprene type seals installed within retaining channels. Seals fixed with adhesive only are not acceptable. Door hinges and fasteners must be Grade 316 stainless steel. Each door must be provided with a Grade 316 stainless steel latch to secure the door in the open position.

Each door must be provided with a limit or an industrial grade metal reed switch. The switch must be Grade 316 stainless steel, fastened to the door/enclosure with Grade 316 stainless steel fasteners, not glued. The volt free contact must CLOSE when the door is in fully closed position and must OPEN in any other position. Door limit switches must be terminated at the terminal block in the control panel.

One of the door leaves must include an inside pocket of suitable size to store one copy of A3-sized WAC drawings and data sheets.

The enclosure must be provided with an exhaust silencer, mounted inside the enclosure that allows the gas pump to meet specified sound level requirements. The silencer and exhaust must include a rain cap and rain shield, all manufactured from Grade 304 or 316 stainless steel. An exhaust guard is to be provided for protection against vandalism. All exhaust pipework must be lagged.

The Supplier must provide all anticipated noise level information required in the Gas Pump Data Sheet.

The complete gas pump assembly with enclosure must be factory tested for noise compliance. This must include the noise generated by the pump priming system. Equipment operating under normal conditions that does not meet the defined requirements for noise must be rectified and retested.

3.3 Engine

3.3.1 General

The engine must be a turbo-charged, after-cooled or normally aspirated 4 stroke type gas type of proven design.

Replaceable cartridge type filters must be provided for gas, lubricating oil and combustion air. The cartridge filters must be positioned in an easily accessible location to allow for periodic maintenance with no need to disassemble other engine parts within the enclosure.

The engine must be equipped with a radiator and cooling fan.

Crankcase ventilation pipes must be run to a point adjacent to the air intake filter to minimise contamination of the enclosure with oil and gas fumes.

Only engines with proven track record in Australia of reliability, provisions of local service facilities and local availability of spare parts will be considered. The engine and accessories must comply with AS 4594.

3.3.2 Rating

The power rating of the engine at its minimum tolerance level must be sufficient to drive the pump and all connected accessories with min. 15% safety margin required by the pump at 110% of the nominated pump duty flow rate and be non-overloading at maximum flow.

The engine rating must be based on the maximum ambient temperature stated in the Gas Pump Data Sheet. SAE J1349 engine power test code must be used as the baseline for rating the engine. If the engine is rated by any other standard, that rating must be converted to SAE J1349 standards by using the correcting formula adopted and published by the SAE Power Test Code Committee under the Engine Group.

3.3.3 Drip Tray

An easily removable drip tray must be provided under the engine. The drip tray must have sufficient capacity to capture oil or coolant leakage. Alternatively, a small accessible sump able to collect any leakages and spillages may be provided instead of the drip tray.

3.3.4 Jacket Water Heaters

Jacket water heaters must be installed to facilitate rapid starting and loading of the engine. The heaters must accept 230 V AC single-phase power and include thermostatic controls. Hoses to and from the heater must be industrial quality with long design life.

3.3.5 Radiator

The radiator and fan must be included in the package. The jacket water/radiator cooling circuit must be a closed water circuit. Air intakes and outlets must be weather, insect and vermin proof.

3.3.6 Pipework

Pipework and associated components must comply with AS 4041 and AS 1940, as well as with the requirements of Local Authorities.

Pipework must be carried out using seamless mild steel to ASTM A106 Grade B or BS 3601 Grade 27 or equivalent. The pipes must be pickled, descaled and externally painted or otherwise protected throughout. Grade 316 stainless steel seamless tubes to ASTM A269 must be used where installed in aggressive environment. All ends must be capped or plugged where not terminated at a piece of equipment.

Joints must be butt-welded, and all workmanship must be consistent with the requirements of AS 4041. Joints must be tested to AS 4041 before completion. Press fit ('crimped') pipe joints are not acceptable.

Bolted joints must be electrically bonded to protect against the effects of static electricity.

The pipework must be complete with valves and fittings necessary for functional operation. Pipe fittings must be malleable iron, steel or bronze.

Valves must be similar to Fire Safe socket weld ball valves.

All pipes must be fixed and supported to prevent rattling or vibration during operation. Where necessary, Grade 316 stainless steel thrust type anti-vibration bellows must be used.

3.4 Starting System

3.4.1 General

An electric starting system must be used. It must be:

- 24 V DC,
- closely regulated over current protected battery charger and batteries, and
- have an engagement mechanism incorporating a chamfered ring-gear and self-lubricated pinion.

The engagement mechanism must be activated through electromechanical engagement. The starter motor must operate on 24 V DC and must be rated for 30 seconds of continuous cranking.

3.4.2 Battery

The battery must be heavy duty and comply with AS 4044. The selection of battery must consider the risk of explosion and suitability for the standby gas engine starting application. The battery must have sufficient capacity to allow a minimum of 5 successive, 15 second starting attempts at 0°C. The number of charge-discharge cycles must not be less than 2400.

All necessary wiring, switches and purpose-made connections must be provided for a complete installation.

A lockable main battery isolator must be provided and mounted in the external power supply isolation electrical panel. The terminals must be numbered and DIN rail mounted. All wires must be numbered and pin connected. 230 V AC terminals must be segregated by a physical barrier from the 24 V DC terminal and have an appropriate warning label.

The battery must be located so that voltage drop to the starter motor is minimised.

The cells must be mounted in a rigid structure with an electrolyte resistant finish which:

- allows easy access to the terminals and vents for maintenance, and
- protects against falling tools touching the connectors or terminals

3.4.3 Battery Charger

A constant voltage automatic battery charger, complete with all necessary controls, fuses and alarms must be supplied for charging the battery. The battery charger must be suitable for the type of battery selected and suitable for standby gas engine starting application.

An engine driven automatic type alternator as the sole means for battery charging is not acceptable.

The battery charger must be a Type 3 with the battery connected in parallel in accordance with AS 4044.

The battery charger must supply 24 V DC to the battery system for engine starting and the alternator control system. Under normal circumstances when 230 V AC power is available the battery charger must charge the battery ensuring that it is always fully charged. Under emergency conditions where normal site power is not available during power failure, the alternator of the gas engine must charge the battery.

The battery charger must be capable of automatically restoring the battery to full charge within 12 hours, following a total of five successive start cycles of cranking.

The charger must include an analogue or digital DC voltmeter and ammeter, 12 hour equalise charge timer and AC and DC fuses.

3.4.4 Battery Charger Alarms

The system must include LED type lights to provide local indication for:

1. Supply mains on.
2. Charge fail.
3. Low battery volts.

Provision for remote indication at the control panel of a common fault alarm and a separate 'low battery volts' alarm must be made by means of voltage free changeover relay contacts. The 'low battery volts' alarm must be initiated if the battery voltage falls below a value required to ensure reliable starting and operation of the engine unit.

Alarms for DC output / charger failed and low battery voltage are to be provided and must be wired to the control panel. Alarms must be configured as fail-safe and must have volts free contacts. The alarms must reflect the true battery voltage and not the rectified voltage from the AC supply.

The alarms must be wired in series with the alarms for the gas pump control circuit battery charger alarms so that either will trigger the remote alarm input.

3.5 Pump

3.5.1 General

The pump must be of a single stage non-clog impeller centrifugal type capable of handling unscreened raw sewage containing rags and fibrous material. It must be of a horizontal, end suction design with replaceable front and rear wear plates and heavy-duty bearing housing, generally complying with Sydney Water

Technical Specification – Mechanical, WSA 101 and Sydney Water’s Supplement to WSA 101, and the requirements of this specification.

The pump must be fitted with a suitable priming system.

3.5.2 Pump performance

The pump must be capable of delivering the flow and total dynamic head and be suitable for suction lift as specified in the Gas Pump Data Sheet and shown on the Gas Pump System Curves. The pump NPSHr at all conditions must be at least 1.0 m less than the NPSHa.

3.5.3 Casing

The design must include provision to enable removal of blockages without dismantling the pump and preferably without the use of special tools. A DN25 drain with a Grade 316 stainless steel ball valve and a ‘Minsup’ hose connection must be fitted to the bottom of the pump casing.

3.5.4 Suction and discharge connections

The pump suction and discharge connections must be positioned in the horizontal plane at low level. The suction connection must be positioned at the pump front end (‘end suction’) and the discharge connection either on the left or right hand side of the pump when viewed from the drive (engine) end, as specified.

The suction and discharge connections must be fitted with flanges complying with AS 4087 PN16. Both flanges must be positioned outside the acoustic enclosure. The suction and discharge connections penetrations through the acoustic enclosure must be adequately sealed against the elements and vermin, prevent transfer of gas pump vibrations onto the enclosure and must not compromise the gas pump acoustic performances.

The pump must be supplied without non-return or stop valves installed on its discharge or suction branches.

3.5.5 Impeller

The impeller must:

- have low NPSHr characteristic,
- have large open free passages capable of passing solids as specified in WSA 101 and Sydney Water Supplement to WSA 101, and
- be designed to minimize the build up of ragging material on the vane leading edges.

3.5.6 Mechanical seals

Mechanical seals shall be designed to run dry for min. 5 minutes to withstand pump priming operation.

3.5.7 Priming system

The pump must be fitted with an automatic priming system. The priming system must be simple, with few moving parts and be easily repairable on site.

The system must be capable of fully priming the suction pipeline and pump casing enabling the pump to reach its full capacity in no more than 180 seconds, based on the specified size, length and profile of the suction pipeline. The priming system discharge point must be fitted with an anti-spit valve and located such that it can be easily piped back to the pump suction sump.

The priming system must be belt driven off the centrifugal pump shaft. The priming system must include an air separation chamber. The chamber must be attached to the pump suction nozzle or to the top of the pump casing.

The following types of priming systems may be considered, in the order of preference:

- Compressor venturi priming system,
- Diaphragm priming system, or
- Vacuum pump priming system.

3.5.8 Pressure gauges and tapping points

Pressure gauges (analogue) of min. $\Phi 100\text{mm}$ face dial must be provided on a Grade 316 stainless steel support secured to the pump baseplate near the access doors. They must be installed at eye height and clearly visible without having to enter the enclosure. One pressure gauge with a range from 0 to -100 kPa must be connected to the pump suction and the other with a range from 0 to 1000 kPa to the pump discharge side.

In addition, pump suction and discharge branches must have tapping points for pressure measurement during commissioning and testing. These tapping points must be fitted with DN15 block and bleed Grade 316 stainless steel two-part ball valves. The tapping points must be accessible for installation of portable pressure gauges. Alternatively, the tapping points may be provided off the pressure gauges tubing via suitable Tees and ball valves.

3.5.9 No-flow protection

In both operating modes, the gas pump control system must stop the pump if no flow is detected in the pump discharge pipeline. During pump start this protection must be delayed by a pre-set period of time (adjustable 60 – 300 seconds) to allow for pump priming.

The no flow in the pump discharge pipe will be detected by a 24 V DC three wire proximity switch fitted to the discharge non-return valve. Both the non-return valve and the proximity switch will be provided by others.

The proximity switch output contact will be NO when the flow in the discharge pipeline is below a pre-set value and will change over to a NC state when the discharge flow is at or above the pre-set value. The proximity switch output contact must be wired to operate a 24 V DC relay in the gas pump control panel and a NO contact of the relay must be used by the gas pump control system as the NO FLOW signal.

The 24 V DC power supply to the proximity switch relay and the 24 V DC interposing relay must be provided as part of the gas pump control system.

3.6 Baseplate

The engine, pump and all other ancillary equipment must be mounted on a rigid baseplate, fabricated from mild steel and hot dipped galvanised or painted in accordance with WSA 201. The baseplate must be substantial, suitable for installation on a concrete plinth and must ensure the engine and pump are correctly aligned.

Vibration isolators spring/pad type must be provided between the engine and pump skid and the baseplate.

The baseplate must be fitted with a minimum of three levelling screws to allow for a minimum 20 mm height adjustment and levelling.

The mounting surfaces for the engine and pump must be machined so that the pump mounting locations are in a common plane and the engine mounting locations are in a parallel plane to the pump mounting locations. The relative dimension of the two planes must provide adequate shimming allowance to achieve final alignment of the engine and pump after allowing for manufacturers' tolerances of centreline heights.

All holding down bolts must be of Grade 316 stainless steel and must be supplied by the gas pump Supplier. Holes drilled for holding down (anchor) bolts must not be obstructed by the equipment installed on the baseplate.

3.7 Control Panel

3.7.1 General

The gas pump local control panel must be located inside the gas pump acoustic enclosure at eye height. A separate lockable door to access the controls, indicating instruments and equipment within the control panel must be provided. The gas pump must be capable of operating at the rated capacity with the opened internal and external access doors of the control panel and must comply with the specified noise rating.

The external door of the control panel must be provided with lockable handle to accept Sydney Water key or Sydney Water standard padlock with 10mm shackle. The internal panel door must be provided with 7mm square pin latches. Control panel doors must be fitted with latches capable to retain the doors in 120° open position. The latches must be mechanical, heavy duty. Gas struts are not acceptable.

In the case of back access to the panels, rear doors or covers must be of the lift off type. Lift off doors or covers must be fitted with lifting handles and must be retained in their position when retaining nuts or bolts are removed. Covers must be held in place with chrome-plated captive knurled fixing nuts or screws.

Panels having access from the front only must be provided with lift off covers over cabling compartments.

Doors and covers must be fitted with neoprene type seals installed within retaining channels. Seals fixed with adhesive only are not acceptable.

Panel components and controls must be identified by engraved traffolyte labels fixed by self-tapping stainless steel screws or an equivalent approved system.

Incoming or outgoing cabling to the control panel must be bottom entry only. Each incoming or outgoing cable must be fitted with suitable glands such that the cables are adequately spaced and allow for required bending radius.

The panel must be a dead front folded sheet metal type and the general arrangement of equipment on the front panel must be such that an ordered and balanced appearance is provided.

The control panel, doors and covers must be manufactured from minimum 2 mm thick cold rolled zinc seal steel sheet, free of scale, rust or indentations. Special attention must be given to doors, which must be rigid and free from buckling. The sheet metal must be painted white in accordance with WSA 201.

Bolts, nuts and screws used must be cadmium plated or similar approved finish.

The degree of protection must be IP56.

3.7.2 Control Panel Layout

The control panel layout must comply with the following:

- 230 V AC wiring and control wiring must be suitably segregated within the control panel.

- Control relays, timers must be DIN rail mountable grouped and located on the same DIN rail. All control fuses must be DIN rail mountable grouped and located on the same DIN rail.
- Control input terminals to the gas driven pump controller must be grouped and located on the same DIN rail.
- Control output terminals from the controller must be grouped and located on the same DIN rail. All remote control signal terminals and remote monitored signals must be grouped and located on the same DIN rail.
- Components that are required to be accessible for maintenance must not be mounted higher than 2000 mm and all panel indicators, operating panels and switches must not be mounted higher than 1600 mm from the mounting floor of the control panel.
- Equipment, other than the engine controller, unless prior Sydney Water's approval is obtained must be the type currently used in Sydney Water to ensure standardisation. Information will be made available on request. A full equipment list with layout drawings must be supplied and approved prior to any manufacturing taking place.

3.7.3 Gas Pump Controller

The gas pump controller must be fascia mounted on the internal door of the control panel.

The gas pump controller must include but not be limited to the following, however some features such as alarms and indicators may be provided in proprietary integral solid state devices:

1. Gas pump Operation Mode Selection with the following modes:
 - Automatic Mode — gas pump started from remote start signal
 - Manual Mode — gas pump able to start and run
 - OFF Mode — gas pump set shutdown and both Automatic and Manual Modes disabled
2. Emergency stop pushbutton (red pushbutton with mushroom head, twist release)
3. Gas pump running indication
4. Not in auto mode indication
5. Common warning indication
6. Low oil pressure warning (latched)
7. Low oil pressure shutdown (latched)
8. High engine temperature warning (latched)
9. High engine temperature shutdown (latched)
10. Over-speed shutdown (latched)
11. Under-speed shutdown (latched)
12. Fail to start (latched)
13. Low/high battery voltage (latched)
14. 5% LEL shutdown, gas supply shut-off, electrical supply disabled, sparking disabled, alarm and warning light
15. No flow shutdown (latched)

3.7.4 Telemetry Remote Monitored Alarms

The gas pump must be capable of supplying but not limited to the following alarms and status:

1. Common alarm for all fault / alarm conditions identified by the gas pump controller / engine management system.
2. Gas pump suction safety.
3. Gas pump running.
4. Gas pump unavailable including but not limited to: emergency stop pressed, not in AUTO.
5. Gas pump fail to start.
6. Gas pump engine over-crank.
7. Engine cooling system fault including but not limited to:
 - low jacket water temperature shutdown
 - high jacket water temperature shutdown
 - low jacket water level shutdown
8. Engine low lubricating oil pressure shutdown.
9. Engine over speed shutdown.
10. Gas leakage detected.
11. Gas engine high gas pressure.
12. Gas engine low gas pressure.
13. Combined starting battery charger fault or control circuit battery charger fault, including loss of 230 V AC supply.
14. Combined starting battery voltage fault or control circuit battery voltage fault.
15. Gas engine alarm reset.
16. Gas pump enclosure doors security alarm.

See I&C_SPS Standards and Gas Pump Data Sheets for details.

All volt free alarm contacts must be wired to a set of terminals as shown in Appendix 1. The common for the alarm circuits must be supplied from the gas pump control voltage to interposing relays in the gas pump control panel supplied by the Supplier. This is required to ensure that faults within the gas pump do not jeopardise the Sydney Water's main switchboard control voltage power supply.

Unless agreed otherwise, all alarms must be fail-safe. The fail-safe alarm circuits must be configured to ensure that failure of any component, including primary devices, arising and/or de-energising of the circuit will open the volt-free contact and generate a remote alarm.

In addition, an engine running status signal must also be provided which must not be wired as fail-safe.

Where the gas pump controller is not capable of supplying volt free fail-safe relay contacts for all of the required remote monitored alarms as described above, they may be provided by alternative programmable devices or solid state devices. Alternative device/s must have the capability to communicate directly with the gas pump controller to extract all alarm and trip status generated by the gas pump controller. Where alternative programmable devices are proposed the following also applies:

1. Equipment must be approved by Sydney Water

2. Delivery of programming software and hardware
3. Delivery of manuals for hardware and software
4. Delivery of software program
5. Easily accessible within the control panel
6. Powered by the gas pump battery supply
7. Must be able to operate reliably within voltage variation caused during gas driven pump cranking at starting or use a separate battery supply system and must have:
 - Separate battery charger that has same alarm capability of the gas driven pump battery charger
 - Alarms wired in series with the alarms of gas driven pump battery charger.

3.7.5 Local gas pump alarms

In addition to the remotely monitored alarms specified, the engine must be fitted with all protective devices considered necessary by the manufacturer to protect it from damage in event of a malfunction and to provide warning of an impending malfunction. Pre alarms must be capable of being manually cancelled without shutting down the engine once the condition being monitored has returned to the manufacturer's limit.

All alarms must be indicated locally on the gas pump control panel and be capable of being reset from a remote signal via IICATS or plant SCADA. The remote signal must be a volt free relay normally open contact.

Alarm wiring must be secured to prevent vibration and must terminate on the remote control and alarm terminal block mounted in the local control panel.

3.7.6 Control Wiring

Unless otherwise approved control wiring must be carried out in minimum 16/0.2 PVC insulated wire rated at 0.6/1 kV. All ends must be terminated with approved type lugs or ferrules.

Colour coding of wiring must comply with the Sydney Water's Instrumentation and Control Standards.

Wiring within the control panel must be enclosed with grey slotted duct. Terminals must be spaced suitably from the ductwork allowing room for neatly separated wiring, identification, and terminations. The wiring must be identified with wire numbers within plastic sleeves at each end of the wire.

Terminals within the control panel must be an approved type where wiring is terminated on the top and bottom of the terminal, not into the front. All terminals must be numbered sequentially. Each terminal strip within the control panel must also be identified to differentiate between different terminal strips, i.e. X1, X2 etc.

Terminations and terminals exposed on the inside of hinged doors must be appropriately shrouded.

Harness bars or equivalent must be provided for wiring associated with hinged doors to suitably support the weight of the wiring and secured such that it is not affected by any vibration or movement. Wiring across hinged doors must be bound in spiral wrap unless otherwise approved.

3.7.7 Control Circuit Battery

A battery (or batteries) must be supplied, separate to the gas engine starting system batteries, dedicated to supplying the gas pump control circuits.

Heavy duty batteries must be supplied which comply with AS 4044. The selection of battery must consider the risk of explosion and suitability for standby gas pump application. The battery must have sufficient capacity to supply the gas pump control circuits for a period of 12 hours. The battery must be installed in the external power supply isolation panel.

All necessary wiring, switches and purpose-made connections must be provided for a complete installation.

A main battery isolator is to be provided. The terminals must be numbered, and DIN rail mounted. All wires are to be numbered and pin connected. 230 V terminals are to be segregated by physical barrier from the 24 V and appropriately warning labelled.

The battery must be located so that voltage drop to the control circuits is minimised and that it is unaffected by heat from the engine.

The cells must be mounted in a rigid structure with an electrolyte resistant finish which:

1. Allows easy access to the terminals and vents for maintenance.
2. Protects against falling tools touching the connectors or terminals.

3.7.8 Control Circuit Battery Charger

A constant voltage automatic battery charger, separate to the gas engine starting system battery charger, must be supplied, complete with all necessary controls, fuses and alarms for charging the gas pump control circuit battery. The selection of battery charger must be suitable for the type of batteries selected and for standby gas pump application.

An engine driven automatic type alternator as the sole means for battery charging is not acceptable.

The battery charger must supply 24 V DC battery system for the gas pump control circuits. Under normal circumstances when 230 V AC auxiliary power supply is available the battery charger will charge the batteries ensuring that they are fully charged. Under emergency conditions where normal site power is not available during power failure, the alternator of the gas engine must charge the battery.

The battery charger must be capable of restoring full charge to the battery within 12 hours, following supplying the control circuits for 12 hours. The charger must also be adjustable to compensate for the battery self-discharge rate and must be capable of recharging batteries to full potential within 4 hours.

Alarm for 24 V DC output power supply failed and low battery voltage are to be provided which are to be wired to the control panel. Alarms must be fail-safe and must have volt free contacts. Alarms must reflect the true battery voltage and not the rectified voltage from the AC supply. The alarms must be wired in series with the alarms for the starting system battery charger alarms so that either will trigger the alarm input.

The charger must include an analogue or digital DC voltmeter and ammeter, 12 h equalise charge timer and AC and DC fuses.

3.7.9 Control Circuit Battery Charger Alarms

The control circuit battery charger system must include LED type lights to provide indication for:

1. Supply mains on,
2. Charge fail, and
3. Low battery volts

Provision for remote indication at the control panel of a common fault alarm and a separate "low battery volts" alarm must be made by means of voltage free changeover relay contacts. The "low battery volts" alarm must be initiated if the battery voltage falls below a value required to ensure reliable starting and operation of the pumping unit.

3.7.10 Labelling

All components within the control panel must be physically labelled and identified on the gas pump WAC drawings. Labels must be engraved traffolyte type with black lettering on white background and to be installed in a clearly viewable position located above the component. No labelling must be installed directly onto any component nor on any ductwork.

3.7.11 Instruments, Meters and Accessories

Instruments, meters and accessories must be supplied and connected as indicated on the Single Line Diagram or as specified.

Instruments and meters must be flush mounting types. Voltmeters and voltage operated instruments must be protected by potential fuses. All indicating lights must be LED types.

3.8 Corrosion Protection

Equipment must be protected from the effects of corrosion using systems detailed in WSA 201 - Manual for Selection and Application of Protective Coatings and the guidelines below:

1. Fixings, brackets, nuts, bolts etc. for equipment, pipework, cable trays or similar must be galvanised. All other fixings must be stainless steel.
2. Where dissimilar materials are used they must be insulated from each other to prevent galvanic corrosion.
3. Anchor bolts for mounting pump unit to the concrete slab must be stainless steel.
4. The engine manufacturer's standard finish is acceptable.
5. Electrical power isolation and control panels must be powder coated.
6. The acoustic / weatherproof enclosure must be powder coated in the specified colour.

Surface preparation and coatings must comply with WSA-201.

All of the above systems to be applied must be approved by Sydney Water.

3.9 Earthing

The engine mounting frame must be bonded to earth by flexible conductors. Any component not in effective electrical contact with these components must be appropriately earthed.

The control panel, battery charger and gas and oil systems must be earthed to the mounting frame.

3.10 Installation, Operation and Maintenance Manuals

One hard copy of an installation, operation and maintenance manual must be provided for use with the gas pump set.

A copy of the manual in electronic form must be provided. The media and data must not be password protected so that it can be transposed into the Sydney Water's database for common usage.

The manuals must be specific only to the equipment specified. They must be complete and include all information necessary for engineers, supervisors and tradesman to install, operate and maintain the unit satisfactorily whether they are electrical or mechanical by discipline.

Electronic versions must contain a table of contents with hyperlinks to the reference sub-sections and drawings, and PLC code if applicable.

As part of the manual, a list of recommended spare parts must be included to cover such items as:

- Filters
- Injector components
- Recommended lubricants and coolants
- All consumables
- Critical spares
- Bearings
- Seals

4. Inspection and tests

The complete gas pump unit must be factory tested in the Supplier's works when manufacturing is complete. The Supplier must ensure that there is sufficient gas supply to the factory to enable pump testing at maximum capacity and to the maximum speed. A factory inspection of the completed gas pumping unit and witnessing of factory testing may be undertaken by Sydney Water. At least two weeks' notice must be given of a proposed factory testing.

Before commencing tests, the Supplier must provide Sydney Water with details of name, rating, type, manufacturer and serial number for the:

- engine,
- pump,
- priming system,
- ancillary equipment,
- control panel,
- battery chargers, and
- batteries.

The Supplier must then perform the tests listed in the presence of Sydney Water. All checks and tests of the unit must be recorded on Sydney Water approved ITP and Check Lists that must be submitted for approval prior to testing. The ITP must include as a minimum the following items:

- Check complete unit and control panel for compliance with the Technical Specification, drawings and Data Sheet.
- Full run test the unit for a period of 1 hour, or until the temperature of the bearings and coolant settle, at the specified pump duty point loading and record readings of all meters and gauges at intervals of 10 min maximum.

- Check operation of manual start, manual stop, emergency stop, simulated faults and other specified operating functions.
- Speed governor settings.
- Alarm, trip and engine shut down settings (e.g. actual temperature setting that shuts down the engine).
- Battery charging systems functioning.
- Priming system and time required for priming.
- Insulation resistance tests on all equipment and wiring.
- Load test on complete battery/charger unit.
- Operational test of the engine.
- Pump hydrostatic test.
- Pump performance tests.
- Check instrumentation panel for correct display - voltage, speed, pressure, temperature, etc.

The complete gas pump assembly with enclosure must also be factory tested for noise and vibration compliance.

The Supplier must provide all facilities including certified calibrated test equipment and instrumentation for the testing. The instrumentation used for testing must have current certification by NATA, or equivalent.

Readings must be recorded for the following:

1. All temperatures monitored on engine control panel.
2. All pressures monitored on engine control panel.
3. Engine air inlet temperature.
4. Pump performance test results.
5. Simulated functional tests to prove correct operation of the controls and alarms.
6. Noise ratings.
7. Paint thickness.

Hydrostatic pressure test of the pump casing and covers must be at least 1.5 times the design working pressure rating as per the Technical; Specification - Mechanical.

The pump H/Q, η /Q and NPSHr/Q performance tests must be carried out in accordance with the requirements of Technical Specification - Mechanical.

Pump unit priming tests must also be conducted to demonstrate the performance of the vacuum priming system.

The gas pump vibration levels must be factory tested in accordance with the requirements of Technical Specification – Mechanical.

Ownership

Ownership

Role	Title
Group	Engineering and Technical Support
Owner	Manager, Engineering
Author	Milan Rubcic, Technical Director – Mechanical Engineering

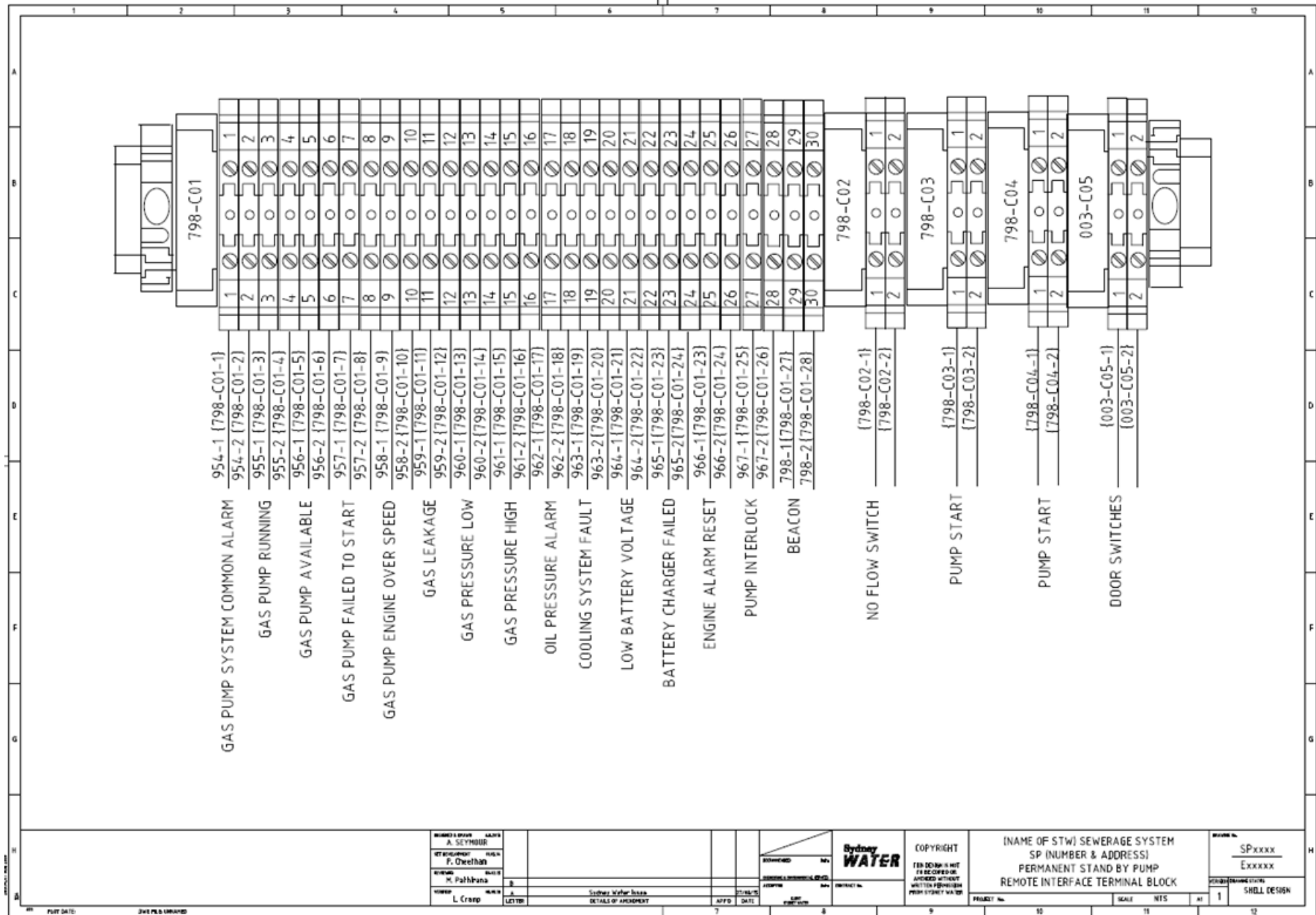
Change history

Version No.	Prepared by	Date	Reviewed by	Approved by	Issue date
1	Milan Rubcic	10/05/2023	L. Gupta, W. Legg, R. Madhok, M. Mordini, M. Pathirana, V. Perakis, S. Spedding, P. Zhou	Norbert Schaeper	10/05/2023
0	Warren Legg	15/2/2017	B. Maunder, M. Pathirana		15/2/2017

Appendices

Appendix	Title
1	Gas Pump Remote Interface Terminal Block
2	Gas Pump Data Sheet
3	Gas Pump System Curves

Appendix 1 Gas Pump Remote Interface Terminal Block



Appendix 2 Gas Pump Data Sheet

Project Number	
Site	
Description	
Tag number(s)	
Quantity required	

SPECIFICATIONS & REFERENCE INFORMATION	
<ul style="list-style-type: none"> Sydney Water Technical Specification – Permanent Gas Engine Driven Pump 	

SCOPE OF SUPPLY	
<ul style="list-style-type: none"> The design, fabrication, supply, assembly, factory testing and delivery to site of a gas pump. The unit must be provided with the necessary electrical control panel and acoustic enclosure, as per the Technical Specification. Supply of test documentation, drawings and O&M manuals in accordance with the Technical Specifications. 	
<p>Note: Civil works, installation, connection of services, site testing and commissioning are excluded from the scope.</p>	

Item	Units	Requirement*	Suppliers offer
*To be reviewed and completed by the Designer.			
VENDOR INFORMATION			
Function	-	To provide standby pumping during mechanical or electrical failures.	
Engine type	-	Gas	
Supplier	-	Supplier to advise	
Manufacturer	-	Supplier to advise	
Model	-	Supplier to advise	
Engine make & model	-	Supplier to advise	
Pump make & model	-	Supplier to advise	
Control panel make	-	Supplier to advise	
AMBIENT CONDITIONS			
Location	-	Outdoor	
Ambient environment	-	Inland / Coastal	
Ambient temperature range	°C	-6 to +55	
Maximum 24 hours average ambient temperature	°C	+35	
Ambient humidity range	% RH	30 to 90	
Elevation	mAHD		
OPERATING CONDITIONS			
Operation	-	Constant speed (with level control)	
Fluid	-	Raw unscreened sewage	
Suspended solids	mg/L	100-200 (typical)	
Corrosion/Erosion	-	Erosion due to grit particles present in sewage	
Fluid temperature (sewage)	°C	15-25, typically 20	
Density	kg/m ³	1000	
Viscosity	Pa.s	0.01	
Vapour pressure	kPa	2.340	
Maximum suction lift at pump horizontal centreline	m		

Technical Specification – Permanent Gas Engine Driven Pump

NPSHa	m		
Flow rate	L/s		
Head	m		
Operating speed	rpm	Supplier to advise	
Operating range	-	Refer to Appendix 3 – Gas Pump System Curves	
Overall dimensions	mm	Supplier to advise	
Weatherproof enclosure required	-	Yes	
Acoustic enclosure required	-	Yes	
Control panel installation	-	Separate from the main pump compartment	
Weight (wet)	kg	Supplier to advise	
Weight (dry)	kg	Supplier to advise	
ACOUSTIC ENCLOSURE			
Type	-	Supplier to advise	
Noise level limit – sound pressure level @ 7m	dB(A)	The noise level limit is required for any position 7m from the perimeter of the enclosure with the pump operating at the duty point and control panel door in open position.	
Manufacturer	-	Supplier to advise	
Height	mm	Supplier to advise	
Width	mm	Supplier to advise	
Length	mm	Supplier to advise	
Materials	-	Supplier to advise	
Thickness	mm	Supplier to advise	
Removable panels	-	Supplier to advise	
Mass of each panel	kg	Supplier to advise	
Method of removal	-	Supplier to advise	
Access doors	-	Supplier to advise	
Intake louvres:			
- Type	-	Supplier to advise	
- Material	-	Supplier to advise	
- L X W X H	-	Supplier to advise	
Locks to Sydney Water standards	-	Supplier to advise	
IP rating	IP	22 (min)	
Design life	Years	Minimum 25 years Supplier to advise	
GAS ENGINE - GENERAL			
Rated power	kW	Supplier to advise	
Rated speed	rpm	Supplier to advise	
Rated torque	Nm	Supplier to advise	
Cycles	-	Supplier to advise	
Engine type	-	Supplier to advise	
Rated BMEP	kPa	Supplier to advise	
Minimum speed	rpm	Supplier to advise	
Over speed trip	rpm	Supplier to advise	
Moment of inertia	kg.m ²	Supplier to advise	
Turbocharger speed	rpm	Supplier to advise	

Technical Specification – Permanent Gas Engine Driven Pump

No. of cylinders	No.	Supplier to advise	
Bore	-	Supplier to advise	
Stroke	-	Supplier to advise	
Configuration	-	Standard/V Supplier to advise	
Min. gas consumption	MJ/h	Supplier to advise	
Max. gas consumption	MJ/h	Supplier to advise	
Gas consumption at duty point	MJ/h	Supplier to advise	
Min. gas supply pressure	kPa	Supplier to advise	
Max. gas supply pressure	kPa	Supplier to advise	
Cylinder liner type	-	Wet/Dry	
No. of piston rings	-	Supplier to advise	
Size of compression	-	Supplier to advise	
Main bearings	-	Size, Type, Material Supplier to advise	
Flywheel bearing	-	Size, Type, Material Supplier to advise	
Thrust bearing	-	Size, Type, Material Supplier to advise	
Connection rod bearing	-	Size, Type, Material Supplier to advise	
Wristpin bearing	-	Size, Type, Material Supplier to advise	
Exhaust valve	-	No., Size, Facing, Seat Supplier to advise	
Inlet valve	-	No., Size, Facing, Seat Supplier to advise	
Exhaust manifold	-	Wet, Dry, Insulated, Shielded, Cooled Supplier to advise	
Exhaust manifold material	-	Supplier to advise	
Exhaust pipe and muffler	-	Supplier to nominate	
Vibration dampers	-	Size, Type Supplier to advise	
Torsional calculations	-	Supplier to advise	
Weight (Net)	kg	Supplier to advise	
Flywheel weight	kg	Supplier to advise	
Overall dimensions	mm	Supplier to advise	
Exhaust connection	-	No., Size, Rating Supplier to Advise	
Air inlet connection	-	No., Size, Rating Supplier to advise	
Starting air connection	-	No., Size, Rating Supplier to advise	
Jacket water inlet	-	No., Size, Rating Supplier to advise	
Jacket water outlet	-	No., Size, Rating Supplier to advise	
Oil inlet	-	No., Size, Rating Supplier to advise	
Oil outlet	-	No., Size, Rating Supplier to advise	
Mass of gas engine	kg	Supplier to advise	

Technical Specification – Permanent Gas Engine Driven Pump

GAS ENGINE – COOLING SYSTEMS			
Jacket water pump	-	Yes/No	
Jacket water pump manufacturer	-	Supplier to advise	
Jacket water pump drive	-	Supplier to advise	
Jacket water pump head	m	Supplier to advise	
Jacket water pump speed	rpm	Supplier to advise	
Jacket water pump impeller material	-	Supplier to advise	
Jacket water pump case material	-	Supplier to advise	
Jacket water capacity	L	Supplier to advise	
Jacket water flow	m ³ /h	Supplier to advise	
Jacket water pressure	kPa	Supplier to advise	
Jacket water inlet temperature	°C	Supplier to advise	
Lube oil cooler type	-	Supplier to advise	
Lube oil cooler manufacturer	-	Supplier to advise	
Lube oil cooler duty	kJ/h	Supplier to advise	
Lube oil cooler surface	m ²	Supplier to advise	
Lube oil cooler code	-	Supplier to advise	
Lube oil cooler shell OD	mm	Supplier to advise	
Lube oil cooler thickness	mm	Supplier to advise	
Lube oil cooler design pressure	kPa	Supplier to advise	
Lube oil cooler tubes OD	mm	Supplier to advise	
Lube oil cooler length	mm	Supplier to advise	
Lube oil cooler BWG	-	Supplier to advise	
Lube oil cooler water flow	m ³ /h	Supplier to advise	
Lube oil cooler inlet temperature	°C	Supplier to advise	
Lube oil cooler shell material	-	Supplier to advise	
Lube oil cooler tube material	-	Supplier to advise	
Lube oil cooler channel material	-	Supplier to advise	
Lube oil cooler baffle material	-	Supplier to advise	
Air cooler type	-	Electric Fan/Engine Driven Fan Supplier to advise	
GAS ENGINE – LUBRICATION SYSTEM			
Lube oil pump type	-	Integral/Separate Supplier to advise	
Lube oil pump manufacturer	-	Supplier to advise	
Lube oil pump model	-	Supplier to advise	
Lube oil pump drive	-	Supplier to advise	
Lube oil pump capacity	m ³ /h	Supplier to advise	
Lube oil pump pressure	kPa	Supplier to advise	
Lube oil pump speed	rpm	Supplier to advise	
Lube oil pump impeller/ gear material	-	Supplier to advise	
Lube oil pump case material	-	Supplier to advise	
Pre-lube pump type	-	Supplier to advise	
Pre-lube pump drive	-	Supplier to advise	
Pre-lube pump capacity	m ³ /h	Supplier to advise	

Technical Specification – Permanent Gas Engine Driven Pump

Pre-lube pump minimum pressure	kPa	Supplier to advise	
Lube oil filter type	-	Supplier to advise	
Lube oil filter aperture	µm	Supplier to advise	
Lube oil filter manufacturer	-	Supplier to advise	
Lube oil filter model	-	Supplier to advise	
Lube oil level controller - lubricator	-	Yes/No Supplier to advise	
Lube oil level controller - crankcase	-	Yes/No Supplier to advise	
Lube oil level controller manufacturer	-	Supplier to advise	
Lube oil level controller model	-	Supplier to advise	
Lube oil dipstick	-	Yes/No Supplier to advise	
Lube oil dipstick – magnetic filter	-	Yes/No Supplier to advise	
Slow flow oil meter	-	Yes/No Supplier to advise	
Slow flow oil meter manufacturer	-	Supplier to advise	
Slow flow oil meter model	-	Supplier to advise	
GAS ENGINE – STARTING SYSTEM			
Type	-	Electric	
Make	-	Supplier to advise	
Model	-	Supplier to advise	
No. of starts	-	Supplier to advise	
Voltage	V	Supplier to advise	
Battery capacity	Ah	Supplier to advise	
Mains battery charger	Ah	Supplier to advise	
Glow plug start	-	Yes/No Supplier to advise	
GAS ENGINE – FUEL SYSTEM			
Fuel type	-	Gas	
Gas filters type	L	Supplier to advise	
Gas pressure regulators type	-	Supplier to advise	
Gas pressure switches type	-	Supplier to advise	
Gas leakage detectors model	-	Supplier to advise	
Gas shut off valves type	-	Pre-chamber/Direct injection/Gas pressure regulator Supplier to advise	
GAS ENGINE – GOVERNOR			
Type	-	Constant Speed/Variable Speed Supplier to advise	
Make	-	Supplier to advise	
Model	-	Supplier to advise	
Reset by	-	Manual/Pneumatic Signal/Electric Signal/Other Supplier to advise	
Speed range	rpm	Maximum & Minimum Supplier to advise	

Technical Specification – Permanent Gas Engine Driven Pump

Regulation	%	Supplier to advise	
Signal range	-	Supplier to advise	
Tachometer	-	Mechanical/Electrical/Other Supplier to advise	
Tachometer make	-	Supplier to advise	
Tachometer model	-	Supplier to advise	
Pyrometer required	-	Supplier to advise	
Pyrometer make	-	Supplier to advise	
Pyrometer model	-	Supplier to advise	
Engine gauge board instruments	-	Pyrometer/Tachometer/Oil Pressure Gauge/Oil Temperature Gauge/Jacket Water Temperature Gauge/Gas Pressure Gauge/Air Pressure Gauge/Hours Run Meter/Other Supplier to advise	
GAS ENGINE – AUXILIARY EQUIPMENT			
Jacket water heater voltage	V	Supplier to advise	
Jacket water heater power	W	Supplier to advise	
Jacket water heater phase	-	Supplier to advise	
Lube oil heater voltage	V	Supplier to advise	
Lube oil heater power	W	Supplier to advise	
Lube oil heater phase	-	Supplier to advise	
Exhaust silencer type	-	Spark Arrestor/Standard/Hospital Supplier to advise	
Exhaust silencer manufacturer	-	Supplier to advise	
Exhaust silencer model	-	Supplier to advise	
Exhaust silencer mounting	-	Horizontal/Vertical/Saddle/Trunnions/ Other Supplier to advise	
Air filter type	-	Dry/Oil Bath Supplier to advise	
Air filter manufacturer	-	Supplier to advise	
Air filter model	-	Supplier to advise	
Air filter connection	-	Side/Top/Bottom Supplier to advise	
Air filter max. allowable differential pressure	mbar	Supplier to advise	
Flywheel bearing type	-	Manual/Air Jack Supplier to advise	
Flywheel guard	-	Yes/No Supplier to advise	
GAS ENGINE – ALARM AND SAFETY SHUT DOWN			
Over Speed	-	Alarm Set, Shut Down Set Supplier to advise	
Low Oil Pressure	-	Alarm Set, Shut Down Set Supplier to advise	
High Oil Pressure	-	Alarm Set, Shut Down Set Supplier to advise	
High Jacket Water Temperature	-	Alarm Set, Shut Down Set Supplier to advise	
Low Jacket Water Level	-	Alarm Set, Shut Down Set Supplier to advise	
High Fan Vibration	-	Alarm Set, Shut Down Set	

Technical Specification – Permanent Gas Engine Driven Pump

		Supplier to advise	
Gas Over Pressure	-	Alarm Set, Shut Down Set Supplier to advise	
Gas Low Pressure	-	Alarm Set, Shut Down Set Supplier to advise	
Gas Leakage	-	Alarm Set, Shut Down Set, Shut Off Gas Supply, Electrical Supply Disabled, Sparking Mechanism Disabled Supplier to advise	
GAS ENGINE – ATMOSPHERIC EMISSIONS			
Content O ₂ in combustion	%	Supplier to advise	
Guaranteed level NO _x	g/kWh	Supplier to advise	
Guaranteed level NO _x	ppm	Supplier to advise	
Unburnt hydrocarbons (VOC)	ppm	Supplier to advise	
Guaranteed level CO ₂	g/kWh	Supplier to advise	
Guaranteed level CO ₂	ppm	Supplier to advise	
PUMP - DATA			
Manufacturer	-	Supplier to advise	
Pump type and model	-	Supplier to advise	
Performance curve number	-	Supplier to advise	
Number of stages	-	1	
Impeller type	-	Supplier to advise	
Impeller diameter	mm	Supplier to advise	
Maximum impeller diameter	mm	Supplier to advise	
Moment of inertia (pump and water)	kg.m ²	Supplier to advise	
Maximum sound pressure level pump & engine at 7 metres (with enclosure)	dB(A)	Supplier to advise	
Maximum sound pressure level pump & engine at 7 metres (with enclosure doors fully open)	dB(A)	Supplier to advise	
Critical speed	rpm	Supplier to advise	
Direction of rotation	-	Supplier to advise	
PUMP - MATERIAL SPECIFICATION			
Casing	-	CI (BS1452:1990 Gr 220) or DI (AS1893)	
Impeller	-	Stainless Steel (ASTM A276M Gr 316)	
Balance disc wear plate	-	Stainless Steel (ASTM A276M Gr 316)	
Bearing temperature sensors	-	PT100 RTD	
Shaft	-	Stainless Steel (ASTM A276M Gr 431)	
Shaft sleeve	-	Supplier to advise	
Fasteners	-	Stainless Steel (ASTM A276M Gr 316)	
Bearing housings	-	Supplier to advise	
Casing wearing ring	-	Stainless Steel (AS2074 Gr H3C)	
Casing water piping	-	Stainless Steel (ASTM A279 Gr 316)	
Guards	-	Supplier to advise.	
Nozzles	-	Supplier to advise	
Miscellaneous lubrication & small bore piping & fittings	-	Stainless Steel (ASTM A279 Gr 316)	
Seals	-	Mechanical	
Seal Faces	-	Silicon carbide vs silicon carbide	

Technical Specification – Permanent Gas Engine Driven Pump

PUMP - CONSTRUCTION DATA			
Design Standard	-	Supplier to advise	
Type	-	Supplier to advise	
Casing:			
- Type	-	Supplier to advise	
- Suction flange	-	Front end	
- Discharge flange	-	Supplier to advise	
- Mounting	-	Horizontal	
- Tapped openings	-	Drain/Vent/Gauge Connections Supplier to advise	
Bearings:			
- Type & material	-	Axial/Radial/Ball/Roller/Plain/Other Supplier to advise	
- Thrust	-	Balance Disc/Balance Drum/Thrust Supplier to advise	
- Lubrication	-	Grease/Ring Oil/Forced Supplier to advise	
- Bearing life & standards	-	Supplier to advise	
Lubrication oil cooling			
- CW supply temp	°C	Supplier to advise	
- Flow rate	m ³ /h	Supplier to advise	
- Outlet temp	°C	Supplier to advise	
Seal			
- Type	-	Supplier to advise	
- Model/Size	-	Supplier to advise	
- Flush fluid	-	Supplier to advise	
Connections			
- Suction	-	*DNxx*, AS4087 PN16, Raised	
- Discharge	-	*DNxx*, AS4087 PN16, Raised	
Mass of pump	kg	Supplier to advise	
PUMP - PERFORMANCE CRITERIA			
Flow rate	L/s		
Head	m		
Efficiency	%	Supplier to advise	
Speed	rpm	Supplier to advise	
Power required at duty point (shaft)	kW	Supplier to advise	
Power required at 110% duty point flow (shaft)	kW	Supplier to advise	
Power required minimum head (shaft)	kW	Supplier to advise	
Flow rate at best efficiency point (BEP)	L/s	Supplier to advise	
NPSHr at minimum and maximum head	m	Supplier to advise	
Maximum shut-off head	m	Supplier to advise	
Guaranteed performance parameters	-	Supplier to confirm with performance curves at various operating speeds (refer to Appendix 3 – Gas Pump System Curves)	

GAS PUMP VIBRATION			
Vibration classification no.	-	Supplier to advise	
Max. vibration severity point	-	Supplier to advise	
Max. vibration power/speed	kW/rpm	Supplier to advise	
Vibration severity grade	-	Supplier to advise	
Measured max. acceleration	m/s ²	Supplier to advise	
Measured max. velocity	mm/s	Supplier to advise	
Measured max. displacement	µm	Supplier to advise	
ACCESSORIES			
Base plate			
- Type	-	Fabricated for pump/engine combination	
- Material	-	Steel (AS3678 Gr 300)	
- L x W x H	mm	Supplier to advise	
- Mass of base plate	kg	Supplier to advise	
Anti-vibration mounts	-	Supplier to advise	
Foundation bolts	-	Supplier to advise recommended size, grade and torque loads. Material SS316.	
Close coupled	-	Y/N	
Coupling (long coupled only)			
- Manufacturer	-	Supplier to advise	
- Type	-	Flexible	
- Balancing	-	Final Balancing of Coupling/Engine/Pump by the Supplier	
- Torque meter provision	-	Provision for spacer to enable torque meter installation for direct measurements of shaft torque and power absorbed	
- Guard		Required during maintenance	
Pump priming system			
- Type	-	Supplier to advise	
- Manufacturer	-	Supplier to advise	
- Model/Size	-	Supplier to advise	
- Capacity	L/s	Supplier to advise	
- Time to prime	s	≤ 180	
Instrumentation systems		Supplier to itemise requirements for gas pump	
Pump lubrication systems	-	Bearing lubrication systems & ancillary piping & valves required & determined by the supplier	
Condition monitoring	-	Provision of pump and engine bearings over temperature protection	
Gearbox			
- Required	-	Y/N	
- Rating	-	Supplier to advise	
- Ratio	-	Supplier to advise	
Electrical power supply isolation panel enclosure	-	Stainless Steel (ASTM A279 Gr 316)	
Other accessories supplied with skid		Supplier to advise	

Technical Specification – Permanent Gas Engine Driven Pump

INSTALLATION			
Foundation specifications	-	Supplier to advise	
Mounting details	-	Supplier to advise	
Total mass of gas pump	kg	Supplier to advise	
EQUIPMENT LABELLING			
Label material	-	Stainless Steel Grade 316	
Lettering	-	Engraved, black ink filled	
Information required	-	As per Sydney Water Technical Specifications – Mechanical	
Fixing method	-	Oval head stainless steel screws	
PROTECTIVE COATINGS			
Colour	-	Dulux Ocean Mist 96183250 or RAL9018 All Enclosures/Canopies	
Requirements	-	As Per WSA 201, System POW, PUR-A or PUR-B, as applicable	
SPARE PARTS			
Years (recommendation list)	Years	5	
Availability	-	Supplier to advise	
Warehouse location	-	Supplier to advise	
Pricing	-	Supplier to advise	
DOCUMENTATION & CERTIFICATION			
Drawings	-	As per Technical Specification	
Test documentation	-	As per Technical Specification	
Operation and maintenance Manuals	-	As per Sydney Water Specification Commissioning – transitioning assets into operation	
INSPECTION & TEST REQUIREMENTS			
Inspection and Test Plan	-	Required	
Pre-factory acceptance tests	-	Required	
Factory acceptance test	-	Required (witnessed)	
Pre-site acceptance test	-	NA	
Site acceptance test	-	NA	
FACTORY ACCEPTANCE TESTING			
<ol style="list-style-type: none"> 1) General construction checks against the Technical Specification 2) Electrical wiring checks against the Technical Specification 3) Pump hydrostatic test in accordance with Technical Specification - Mechanical 4) Gas pump performance testing to AS/ISO 9906 in accordance with Technical Specification - Mechanical 5) Gas pump noise level testing 6) Gas pump vibration testing 7) All other tests as per the Technical Specification 			
<p>The gas pump must not be shipped to site until all defects noted at the FAT have been rectified and accepted by Sydney Water.</p>			
SPECIFIC REQUIREMENTS			
<p>Tenderers must include the following information with their offers:</p> <ul style="list-style-type: none"> • Technical brochures • Control system details • Dimensional drawings showing the overall dimensions of the packaged gas pump 			

Technical Specification – Permanent Gas Engine Driven Pump

- Installation details including masses and dynamic loads for design of concrete plinth
- Gas engine details
- Pump details
- A statement regarding the availability of spare parts

NOISE DATA SHEET									
Measured Sound Pressure Levels	Octave Band Frequency Hz								8 Position Average
	65	125	250	500	1000	2000	4000	8000	
With Acoustic Enclosure Fitted									
Air Intake into Enclosure									
Air Exhaust from Enclosure									
<ul style="list-style-type: none"> • Tests performed on full load with radiator fitted. • Tests conducted as per AS/NZS 1269 or approved equivalent. 					<ul style="list-style-type: none"> • Reference sound pressure is 20µPa. • Sound measurement locations is to be 1m from the centre of the gas pump unit. • Tests to consider pump priming system. 				
Measured Sound Power Levels	Octave Band Frequency Hz								Sound Power Level
	65	125	250	500	1000	2000	4000	8000	
With Acoustic Enclosure Fitted									
Air Intake into Enclosure									
Air Exhaust from Enclosure									
<ul style="list-style-type: none"> • Tests performed on full load with radiator fitted. • Tests conducted as per AS/NZS 1269 or approved equivalent. 					<ul style="list-style-type: none"> • Reference sound power is 1pW. • Tests to consider pump priming system. 				

Date:					
Revision:					
Prepared by:					
Mechanical verified by:					
Electrical verified by:					
Process verified by:					
Approved by:					

Appendix 3 Gas Pump System Curves