SEWAGE PUMPING STATION CODE

(Including Pressure Mains)

Revision 2
Issue Date: August 2010
SEWAGE PUMPING STATION CODE of Australia (Including Pressure Mains)

South East Water Supplementary Manual

Scope:
Pumping Capacity of up to 200L/s and Pressure Mains up to and including DN 375 (DN 450 for PE)

Revision: 2

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Acknowledgements, Disclaimer and Information

ACKNOWLEDGMENTS
South East Water Limited acknowledges that the following source documents in the preparation of this standard:


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Further, the specification South East Water Supplementary manual to the Sewage Pumping Code of Australia WSA04-2001 may be periodically updated.

INFORMATION
For information and advice and to advise of possible errors, omissions and changes required for future revisions, please contact Mr Colin Paxman on 03 9552 3651.
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PREFACE

Where the word Developer is used this can be substituted with Designer or Consultant.

1.1.1 SCOPE AND OBJECTIVES - Scope

Additional Paragraph
This Code of Practice does not apply to low pressure pumping systems

1.1.4 SCOPE AND OBJECTIVES - Objectives of design

Additional dot point
(k) Provide unobtrusively designed, below ground structures without a super structure to house pump sets and to store sewage until pumped.

1.4 ABBREVIATIONS

Additional Abbreviations
ABS Acrylonitrile Butadiene Styrene
FLC Full Load Current
HRC High Rupture Capacity
PSTN Public Switch Telephone Network
SEWL South East Water Limited
SS316 Grade 316 stainless steel

2.3 DUE DILIGENCE REQUIREMENTS

Contingency plan Replace first dot point with “As a pre-requisite to design, develop and document a contingency plan for station failure based on an environmental risk assessment and the normal operating and maintenance practices of the relevant water agency.”

2.4 MATERIALS DESIGN

Additional paragraphs
The use of dissimilar metals within the pumping station pump well is to be avoided. If use of dissimilar metals is unavoidable, measures shall be taken to negate the effects of galvanic corrosion of equipment. Options include insulation between dissimilar metals or the use of sacrificial anodes at strategic point within the pump well. However these options are to be implemented only after consultation with an expert in the field of galvanic corrosion.

Pipeline products shall be approved for use and the appropriate pipeline designation shall apply. Refer to WSAA Polyethylene code WSA 01 for PE materials.

2.5 ODOUR CONTROL

Additional notes:

5. Odour emissions shall be minimised by ensuring that floating sewage debris, including fats and oils, doesn’t accumulate on the surface of sewage in the wet well and that heavy debris doesn’t accumulate in still-water areas of the wet well. The accumulation of floating debris can be lessened with a wet well washer to clean the oils off the well walls, by minimising the wet well control volume and perhaps by using an electric mixer in the wet well to turn the sewage over. The accumulation of heavy debris can be lessened by using wet well benching to minimise still water areas and with good pump selection and set-up.
6. Turbulent septic sewage will emit odours; this can be lessened by the careful design of the inlet and discharge structures to streamline the sewage flow path.

7. South East Water requires a partially submerged inlet drop pipe to minimise release of hydrogen sulphide gas from the turbulence of inflows. Where there is no drop structure, because space at an existing station is limited, then turbulence is to be addressed in the design of a pump inlet structure.

8. When the calculated detention time is excessive the designer shall carry out and provide documentation on a predictive analysis of hydrogen sulphide generation at both the pump station and point of discharge. This will require analysis of sewage entering from the reticulation system. The designer will need to liaise closely with South East Water on proposed ventilation and odour control.

2.6 SEPTICITY CONTROL
Additional paragraphs.
If all possible design parameters have been addressed to minimise the septicity of the sewage in the pump station and pressure main, and still a problem of septicity remains, it may be necessary to chemically dose the pressure main, pump well, and / or the reticulation lines leading to the pumping station. Where chemical dosing is considered necessary to control septicity then the designer is to detail dosing options, available impacts, advantages and disadvantages, capital / operating costs associated with the dosing.
South East Water has successfully used:
• Oxygen injection to maintain the sewage in an aerobic state.
• Ferox to lock the sulphides into solution and prevent release of hydrogen sulphide.
• Calcium Nitrate to lock sulphides into solution and prevent release of hydrogen sulphide.
• Magnesium hydroxide

2.9 COMMISSIONING PLAN
South East Water commissioning requirements are detailed in clause 5.

FIGURE 2.1 SPS OVERFLOW RISK REDUCTION DECISION DIAGRAM
In the OPERATIONAL SECTION Additional Note:
In the case of a relift pumping station the pressure main shall be kept to a minimum length to allow the station to overflow into the receiving sewer system, thereby minimising the risk of a spill.

3.1.1 PUMPING SYSTEM - General
Pump Equipment shall be consistent with existing SOUTH EAST WATER pumping equipment, such as ITT Flygt, KSB Ajax (including Forrers), Grundfos Pumps (including Sarlin) and ABS pumps or approved equivalent where necessary.

3.1.2 PUMPING SYSTEM - Hydraulic Design
Additional dot point for System hydraulics
• Water Hammer analysis

Amend final dot point to read
• Calculate the pump capacity requirements for slimed pipe at both the pump cut-out level and the emergency spill level. The clean pipe situation may also need to be
considered for a new rising main if this requires the pump to operate at the right hand side of its pump curve.

3.1.3 PUMPING SYSTEM - Pump Selection
Where WSA 101 is specified in this clause replace with South East Water specification 02-155-0 “Submersible Pumps” Refer Appendix C

3.1.4 PUMPING SYSTEMS - Pump Starters and Variable Speed Drives
Clause replaced with following:
Pump Starters and VSD’s – Pump stater shall be electronic soft starter incorporating line and bypass contactors. It shall also include an isolation switch (for insulation resistance testing) on the dead side of the soft starter, used to isolate to megger pumps. A label is to be fitted to warn not to “megger” the pump sets before disconnecting them via the isolating switch.

South East Waster endeavours to minimise its energy usage. For this reason VSD’s shall be considered on pumps above 15kW when the friction energy loss associated with the design flow rate is significant as indicated by the life cycle cost. The preferred practise is to program the system to batch pump at a low speed for most of the time and then to operate at the rising main scouring velocity periodically, and as required by the incoming flow rate. The timing and duration of the higher speed operation will be determined by the Designer in the original instance (generally an hour a day) and may be customised by South East Water in the longer term. South East Water doesn’t use VSD’s on smaller pumps because the potential pump energy savings are offset by the energy consumed by the VSD itself and the system’s reliability is affected by the extra complexity.

3.4.1 INPUT SYSTEM - Inlet MH
Factors – Specific Design Provisions
South East Water does not require a sump or screens because the intent of the sewage network is to get all of the sewage debris to the sewage treatment plants. Isolation of the wet well within the inlet manhole is NOT required. Refer to standard drawing SEWL_STD_000 for details isolating penstock mounted within wet well. Refer Appendix A

3.4.2 INPUT SYSTEM - Wet-well Design
Factors – Design
South East Water does not require sumps in the wet well.
Factors – Safety
Replace Wet-well to be a minimum of 1.8m diameter with 2.1m.

3.5.1 OUTPUT SYSTEM - Discharge Pipework
Factors – Special Inclusion
Additional dot point
- Pressure main scour valve back to wet well.

3.5.2 OUTPUT SYSTEM - Valve Chamber
Replace clause (e) with “valve chamber floor sloped to a drain pipe with a duck-bill check valve back to the wet well. Drain pipe shall ideally be straight so that it can be manually cleared of debris with a rod if required. South East Water doesn’t use a P-trap in this instance because the water seal is lost once the water has evaporated, which allows sewage gases to escape.”
Amend final sentence to “The valve chamber shall ideally be integral with the wet-well. If an integral structure is not possible the valve chamber shall be adjacent to the wet-well and shall have an ability to shift relative to the wet well with ground movement.”

**FIGURE 3.3 TYPICAL DISCHARGE VALVE ARRANGEMENT**
Refer to Standard Drawing SEWL_STD_090 &091. Refer to Appendix A.

### 3.5.3 OUTPUT SYSTEM - Pressure Main
Factors – Hydraulic Design
First dot point add, minimum of 100mm diameter for maintenance reasons.
Additional dot points
- If possible, the highest point of a rising main shall be at the discharge to minimise odour and operational issues
- Locate isolation valves in long, large diameter rising mains so that entire rising main doesn’t need to be drained for maintenance activities

Factor – Gas release valves.
Additional dot point
- Locate at high points on pressure main.

### 3.5.4.1 OUTPUT SYSTEM - Hydraulic Design - Selection of Pressure Main Sizes
Additional Note
Note 2. No reduction in pipe diameter is acceptable on the pressure main.

### 3.5.4.2 OUTPUT SYSTEM - Hydraulic Design – Velocity in Pressure Main
In second sentence change minimum velocity for pressure mains from 0.7 m/s to **0.9 m/s**
Third sentence replaced with
The maximum velocity before discharge to the receiving sewer shall be 2m/sec

### 3.5.4.3 OUTPUT SYSTEM - Total Headlosses
Add clarification to clause (b) “(This method is useful for quick preliminary system calculations but shall not be used for final pump sizing because of the inaccuracy of the associated assumptions.)”

### 3.5.5 OUTPUT SYSTEM - Receiving System
The following words from the first paragraph second sentence are deleted “ensuring that the ultimate flows in receiving system are accommodated within 2/3 of its diameter.” And replaced with “discharge to be online and grade.”

Additional Paragraph
The receiving structure including the cover shall have a protection system to minimise corrosion and shall be vented to minimise loss of water seals.

### 3.6.2 SITE INFRASTRUCTURE - Site Selection
Factor Site / Location
Amend second dot point so it reads
- Provide all-weather access to the facility for all routine and emergency, operation and maintenance activities taking adjacent road conditions / rules into consideration, e.g. access doesn’t require a right hand turn over double lines, etc

Additional dot points:
• Located clear of overhead power lines, in accordance with the “No Go Zones” requirement of Work Cover as per http://www.esv.vic.gov.au/Portals/0/Electricity%20Professionals/Files/Cranesrules.pdf
• Sufficient clearance from power lines for crane operation as directed by the Chief Electrical Inspector.
• Proximity to houses (odour and noise issues)
• With sufficient space to locate a temporary generator next to the switchboard in an emergency situation

Factor: Developer’s responsibilities

Additional dot point
• If the subdivision development does not proceed as expected and the pumping station is in an area as yet undeveloped. The developer is responsible for providing an all weather access track, hard standing area and water supply taking into consideration stage development

3.7 SUPPORTING SYSTEMS

Additional supporting systems
(h) Alternative power sources (eg Generator)
(i) Dosing and Odour services.
(j) Site drainage

4.1.1 FACILITY - General
Second Paragraph, first sentence rewritten to:
“The designer shall be responsible for all aspects of the pumping station and odour control aspects of the design”

4.1.2 FACILITY - Materials Design
South East Water requirements for the coating of exposed concrete are;
• All interior surfaces of the wet well, valve chamber, detention tank & inlet MH including the underside of the access covers shall be coated with a Epoxy Lining system
• The coating system shall be in accordance with specification “03.01 Coating systems for concrete in contact with sewage” as per http://www.southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Coating_systems_for_concrete_in_contact_with_sewage.pdf
The colour is white. Application shall be in accordance with the supplier’s recommendations.

Metal work within all pumping station structures shall be grade 316 stainless steel (grade 316L for fabricated items), provided no galvanic corrosion is likely as a result of the stainless steel installation.

4.2 PUMPING SYSTEM
Where WSA 101 is specified in this clause replace with South East Water specification 02-155-0 “Submersible Pumps” Refer Appendix C

4.2.2 PUMPING SYSTEM - Pump Discharge Pipework
Replace last sentence of Note 1 so that it reads “Calculate pump capacity requirements for slimed pipe at both the pump cut-out level and the emergency spill level. The clean pipe situation may also need to be considered for a new rising main if this requires the pump to operate at the right hand side of its pump curve.”
4.2.2  PUMPING SYSTEM - Pump Discharge Pipework
Amend clause (a) to read “vertical pipe work in the well noting that the velocity required to transport grit, e.g. sand, through vertical pipe work is higher than for the rest of the rising main, being around 2m/s. Note also that proprietary pump discharge pedestal mounts often require the use of an eccentric (not concentric) reducer to allow sufficient distance between the pump guide rails and the vertical riser pipes for a pump’s mounting claw to pass.”

Additional dot points:
(e) Vertical Pipework shall be supported at maximum 3m interval using supports as shown on standard drawing SEWL_STD_002. Refer to Appendix A
(f) It shall be possible to dismantle pipe work for maintenance activities. For straight line pipe assemblies between two parallel wall penetrations this may require a dismantling joint. All flange pairs shall be sufficient distance from the walls and floor to allow a person access with a spanner, generally 150mm clearance.

4.2.3  PUMPING SYSTEM - Pump Selection
Note 2 Replace drawing SPS-020 with standard drawing SEWL_STD_090 & 091. Refer Appendix A
Note 3 The pump selection shall be from ITT Flygt, KSB Ajax (including Forrers), Grundfos Pumps (including Sarlin) and ABS pumps or South East Water approved equivalent for unusual situations. Refer: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf

4.2.3.1  PUMPING SYSTEM - Submersible Pumps
Additional to Note 1.
Any proposal to install pumps in series shall require the written approval of South East Water.

4.2.3.5  PUMPING SYSTEMS - Guide-rails
Additional requirements:
- Guide rails are to be supported as shown on standard drawing SEWL_STD_001 and be provided in one continuous length. Refer Appendix A
- The lifting chain offered for pump removal must comply with Statutory Authorities requirements for industrial lifting.
- The pump lifting chain shall be PWB Anchor Grade “L” lifting chain, or approved equivalent, hot dipped galvanised finish, manufactured to AS 2321 “Short-link chain for lifting purposes” (for compliance reasons it shall NOT be stainless steel). The chain shall be sized to carry the weight of the pump, taking into account load carrying reductions for angled two leg slings. The minimum chain size shall be 10mm for small pumps, but larger pumps will require a minimum of 12mm or 16mm depending on whether a lower bridle is used to attach to two eyebolts. The DEE shackles used shall be PWB Anchor Grade “S”, or South East Water approved equivalent, hot dipped galvanised finish, and manufactured to comply with AS 2741 “Shackles”. Eyebolts provide by manufacturers, as part of the lifting equipment shall be manufactured to comply with AS 2317 “Collared eyebolts”. The lifting chain shall be supported and retained as shown on standard drawing SEWL_STD_008 by a small diameter stainless steel cable static line between the top of the chain and the top of the well adjacent to ground level, to retrieve the chain if dropped. Refer Appendix A
- Alternatively shackles may be proof loaded, tested and stamped stainless steel as supplied to South East Water by B & I Supplies in sizes 10mm, 12mm, and 16mm or South East Water approved equivalent.
4.2.4 **PUMPING SYSTEM - Ancillary Equipment**
Note 1 Replace with:
Wet well washers are required as per clause 4.5.11.

4.2.5.1 **PUMPING SYSTEM - Starters and Variable Speed Drives – Single and Double Speed Starters.**
Correction for part (c).
Replace 10 starts per hour with 12 starts per hour.

4.2.6 **PUMPING SYSTEM - Emergency Stop**
Delete clause.

4.2.7 **PUMPING SYSTEM - Staging**
Replace fourth paragraph with:
“If staging requires a change of pumps, or if the catchment is anticipated to grow beyond the current design parameters, then the access covers shall be sized to accommodate the maximum size pump that the well can accommodate.”

4.3.4.5 **PUMPING SYSTEM - Power Supply – On-site Generator**
delete clause and replace with;
The Emergency On–site Generator shall comply with South East Water Specification 02-159.0 “Emergency Generators” Refer Appendix B

4.3.4.6 **PUMPING SYSTEM - Power Supply – Mobile generator**
delete Note 1 and replace with;
The generator cables shall be terminated in the generator terminal compartment inside the switchboard.

4.3.5.1 **PUMPING SYSTEM - Power and Control Cubicle – Design**
delete Paragraph 2 and replace with:
South East Water Specification 07-01 ‘Electrical Performance Specification’ Refer Appendix O

4.4.6 **CONTROL AND TELEMETRY SYSTEM - Operating Levels and Default Settings**
Amend Table 4.3 as follows:
- South East Water does NOT use a low-level alarm (because it would use the same level measuring instrument as the normal pump cut-out in any case).
- The cut-out level is the minimum submergence level of the pump PLUS 100mm to provide some margin for calibration drift of the level measuring instrument
- South East Water’s Spill Alarm is the same as the WSA04 High-High level alarm.
  (South East Water do NOT use the WSA04 Overflow Alarm because there’s a risk that the calibration of the level measuring instrument may drift higher than this significant physical invert level)

4.5.1.2 **PUMPING STATION WET-WELL ISOLATING VALVE**
delete paragraph 2 and replace with:
The incoming sewer-isolating valve shall be a knife gate valve housed on the inside of the pump well. This valve shall have a non-rising spindle, a properly supported extension spindle and a valve key piece that allows the valve to be operated by an operator with a valve key from the top of the pumping station.
The knife gate valve shall have a grade 316 stainless steel (SS316) body with SS316 blade and a resilient seat as per South East Water approved products list or approved equivalent, refer: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrast ructure/Approved_Products-Sewer_Pumping_Station_System.pdf

The valve shall be mounted to a flange end on the inlet sewer pipe in the well. If an existing station is being refurbished, and the inlet sewer pipe in the well has corroded, then the pipe shall be cut back to the well wall and a mounting flange fabrication used instead. The mounting flange shall be ductile iron or fabricated from SS316L and attached to the pump well with SS316 studs using chemical anchors. A mounting flange fabrication is NOT required for new pumps stations. Standard Drawing SEWL_STD_000 shows examples of the valve mounting flanges. Refer Appendix A

A 25mm diameter valve spindle shall be used for DN150 to DN300 valves. A 38mm diameter valve spindle shall be used for DN375 valves. If the spindle length is greater than 6 metres, an intermediate spindle shall also be used.

The extension spindle shall be adequately supported from the pump well wall. Standard Drawings SEWL_STD_003 and SEWL_STD_004 show the arrangement for the extension spindle guide assembly and details for manufacture. Bolts or anchors of SS316 shall be used to secure the spindle guide assembly to the pump well wall. Refer Appendix A

The valve spindle shall be accessible without the need to remove any covers and shall be housed at ground level within a gas tight valve-winding box as shown on Standard Drawing SEWL_STD_006. Refer Appendix A

All valves to be clockwise closing.

The discharge of the drop pipe shall be 150mm above the cut-out control level so that the pipe is generally submerged throughout most of the pump operating cycle (thereby keeping sewage gases in the incoming sewer for most of the pump cycle) but allowing floating debris to fall out of the drop pipe at the end of the pump cycle. The top of the drop pipe shall have a 100mm diameter screw top cap so that top of the drop pipe can be manually accessed with a rod should debris get caught there. The bottom of the drop pipe shall be kinked so that the sewage doesn’t fall directly on the well floor. The drop pipe discharge shall be angled away from the pumps so that the inflow doesn’t adversely affect the hydraulics into the pump suction.

**4.5.2.1 WET-WELL DESIGN - Design**

Delete Paragraph one and replace with:

For small pumping stations (<80L/s), the designer shall provide a single wet-well to retain the sewage inflow and house the pumping system. The inlet MH shall be connected to the wet-well by a single pipeline. The isolating valve shall be located within the wet-well.

Delete Paragraph two and replace with:

For medium to large stations (80-200L/s) the designer shall determine how the station can be taken off-line, i.e. how sewage will be diverted around the station, if maintenance access is required to work on, say, a pump pedestal seal. On lift stations this can sometimes be done by installing a high level by-pass line from the inlet manhole to the discharge manhole. On stations with larger rising mains this may require a wet well with a dividing wall to a height above the high level alarm level and a bifurcated inlet manhole. With such an arrangement one half of the station can be isolated to take it off line whilst the sewage is handled normally in the other half of the well.
4.5.2.2 **WET-WELL DESIGN - Wet –Well Sizing**

Delete item (a) and replace with:

(a) The volume between the cut-in and the cut-out shall be determined by pump capacity and shall be set to limit the frequency of pump starts to a maximum of 12 starts per hour at peak wet weather flow for pumps 15kW or smaller or 8 starts per hour for pumps larger than 15kW. The minimum size of the wet-well diameter is 2.1m. Start levels shall take into account the need to prime pumps.

Item (c) additional words “sufficient room to work safely adjacent to pumps, drop pipe and inlet pipework and valves and evacuate personnel if necessary”

Add item (d):

(d) South East Water prefer wet-wells that are less than eight (8) metres deep to minimise the operations and maintenance issues that are experienced with deeper wells. South East Water will only consider a very deep well if it can be demonstrated that there aren't any options available for a well of the preferred depth.

4.5.2.4 **WET-WELL DESIGN - Soil Investigation**

Delete paragraph one and replace with:

The designer shall commission a soil investigation to identify:

4.5.2.5 **WET-WELL DESIGN - Control Levels**

Replace clause with:

The designer shall adopt control levels for the wet well in accordance with Table 4.3 (NOT Table 4.4)

4.5.2.6 **WET WELL DESIGN - Detention Time**

Additional Paragraph:

In addition to the H$_2$S generation due the wet well and pressure main, the designer will need to consider the septicity of the inlet sewerage and the impact this will have on the final product at the end of the pressure main. Any treatment proposal shall be referred to South East Water representative for approval.

4.5.3.2 **STRUCTURAL DESIGN - Design Loads and Forces**

Replace clause (c) with:

Areas accessible to trucks-AS 5000

Replace clauses (i) and (ii) respectively with:

(i): The provision of permanent ground anchors, designed in accordance with AS/NZS 1170.0 and AS 4678. The design shall incorporate an allowance for possible long-term corrosion of the anchors. All permanent ground anchors shall be fully grouted and encapsulated.

(ii): The provision of sufficient dead load to resist the flotation forces in accordance with AS/NZS 1170.0.

4.5.3.2 **STRUCTURAL DESIGN - Reinforced Concrete Structures.**

Additional sentence.

Structure shall be designed with a minimum concrete strength of 30MPa.

4.5.3.9 **STRUCTURAL DESIGN - Top Slab**

Additional paragraph:

Concrete slab to be all one level and incorporate well covers, storage area for removed covers, electrical cabinet and valve pit.
The cover opening in the top of the well shall be large enough to allow for future pump upgrades associated with later stages of catchment development. The slab shall not present a trip hazard to personnel working on the installation or to the general public. Landscaping is required to blend the finished surface of the slab into the surrounding terrain. The slab is not to be located in an area that would be subject to local flooding. All water from surrounding area is to drain away from roof slab.

4.5.3.10 STRUCTURAL DESIGN - Wet Well Benching
Additional sentence
The maximum allowable grade of the benching is 30° to horizontal.

4.5.4 WET-WELL VENTILATION
New paragraph:
South East Water applies Note 2 in Clause 4.5.4.1 to pump stations receiving fresh domestic sewage provided that the pump station has been fitted out with fittings, fixtures and concrete coatings that resist corrosion.

Odour modelling is required for pump stations that receive industrial sewage and those that handle aged sewage (e.g. from upstream pump stations) to ensure that these odours don’t cause an issue with nearby neighbours. The dispersal of gaseous emissions shall be modelled using AUSPLUME, which is the EPA approved air dispersion model that’s used to model emissions of wastes to air, e.g. gaseous plumes from vent stacks. EPA Victoria requires that AUSPLUME is used in accordance with the requirements set out in the State Environment Protection Policy (Air Quality Management) S240 Schedule C.

As AUSPLUME requires a minimum exit velocity from a vent stack it generally necessitates a mechanical ventilation system, because the flow rate from a natural ventilation system is variable depending on the local climate.

4.5.4.2 FORCED VENTILATION
New sentence:
All pumping stations with forced ventilation shall have AUSPLUME modelling carried out.

4.5.5.1 OVERFLOW Emergency Storage
Delete paragraph one and replace with;
The emergency storage provides time for South East Water to implement its operational contingency plan in an emergency situation, e.g. a power outage. The emergency storage shall be capable of retaining the peak dry weather sewage inflow, from the ultimate development to be serviced, for a nominal minimum of two (2) hours. South East Water may however require more than 2 hours storage for stations that are located in areas that are remote or have accessibility issues e.g. traffic congestion. South East Water needs to be consulted during the station’s planning stage to make this determination in relation to an increased storage requirement.

When an emergency storage tank is available South East Water will also this tank to facilitate maintenance activities in the bottom of the wet well, i.e. the sewer network will back up into the emergency storage when the wet well is off-line. For this reason the inlet pipe for the emergency storage shall take the inflows from the inlet manhole (rather than the wet well).

Should an additional storage tank be the option the following will need to be considered and discussed with South East Water:
• The manner in which the emergency storage will start to fill when the pump station’s high alarm level is reached in and the manner it will fully empty when the station returns to normal operation (including sloped floor to discharge)
• The installation of wet well washer(s) in a manner similar to clause 4.5.11 but will wash at a higher level
• The installation of a water tap for South East Water’s cleaning crew to connect their equipment to. If the emergency storage is directly adjacent to the wet well this tap may be the one in the cubicle used to wash down the wet well. If the emergency storage is some distance away a separate tap shall be installed; this tap shall have a secure closure so that the public can’t readily access it and leave it flowing.
• Accessibility for confined space entry for cleaning and maintenance activities e.g. number of covers required (minimum of two covers), facilities to meet fall-from-heights regulations similar to clause 4.5.7, positive isolation valves on the storage tank’s inlet and discharge pipes
• Ventilation requirements during confined space entry and for normal operation
• Concrete protection requirements
• Level monitoring requirements

4.5.5.3.1 EMERGENCY RELIEF STRUCTURE - General
Additional sentence:
The emergency relief structure shall comply with the requirements of the memorandum of understanding (MOU) with the EPA. Refer Appendix K.
Note The Consultant shall supply all documentation to South East Water who will obtain approval from the EPA.

4.5.5.3.3 EMERGENCY RELIEF STRUCTURE - Emergency Relief Weir Point
Additional sentence;
The flap gate shall be as per South East Water approved products list or approved equivalent, refer: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf
Flap gate to be installed to ensure that positive and effective gas seal is achieved.

4.5.5.3.4 EMERGENCY RELIEF STRUCTURE - Overflow Pipe
Additional paragraph:
Where an emergency overflow relief pipe is installed into an unformed drain, creek or water course then the designer will be required to indicate impact of 1:10, 1:20, 1:100 storm events on emergency overflow relief pipe operation.

4.5.6 LADDERS AND PLATFORMS
Clause replaced with:
The designer shall minimise the requirement for person entry. Ladders and platforms for safe entry are required for both the wet-well and the valve chamber, noting that any platforms or ladders provided shall NOT impede rescue from the wet-well, which is a confined space and so requires a person to wear a harness. The ladders and platforms shall be designed to comply with AS1657. The ladders shall be fitted with extendable stanchions in accordance with standard drawing SEWL_STP_005. The ladders shall be fabricated from annealed stainless steel grade 316L Refer Appendix A
4.5.7 WET-WELL ACCESS COVERS
The following shall also apply to 4.5.7:

- Covers shall comply with AS 3996 “metal access covers, road grates and frames”
- The cover shall generally be solid ductile iron Class B. (Concrete infill covers are not permitted) as per South East Water approved products list (or approved equivalent). Refer: [http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf](http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf)
- Class C or D covers shall only be specified when the layout of the pumping station allows vehicles to be driven on the covers.
- Correctly fitted multipart covers shall be gas tight, water tight and interchangeable or the location of each part clearly identified with an approved method.
- The maximum weight for a single cover in a multipart set up shall be selected with the intention of reducing the risk of injury to operators lifting the cover (Indicative weight 30kg-70kg).
- Covers with an approved spring loaded hinge shall be used for access points where only one cover is required.
- Alternative material covers will require the written approval of South East Water prior to incorporating into design. Alternative cover systems will be considered by South East Water only if they comply with the functional requirements of this clause.
- Aluminium covers are NOT permitted.
- Bollards to be placed to prevent vehicle loading on the wet well and valve chamber covers.
- It must be possible to lift only one cover to safely access a ladder into a pit or well. It shall not be necessary to remove any cross supports to gain access to a ladder.
- The class of covers shall be specified on the design drawings.
- The top slab design shall include a concrete cover roll off area so that the station can be used in all-weather. The covers shall not be a trip hazard in a trafficable area when the covers are off. The cover roll off area shall be delineated and labelled as such on the drawing.
- A fall arrestor system is required if a person can fall more than two metres when a cover is open. South East Water prefers the use of hinged bar grates under the covers to prevent falls. These allow the well or valve chamber to be inspected, ventilated, etc with the covers off, whilst protecting against possible falls. The grates shall be strong enough to stop the momentum of a falling person. Attachment points shall be installed so that people wearing fall-from-height harnesses can tether the harness when the covers and grates are open.

4.5.8 GRIT COLLECTION
Delete Clause, current policy does not require grit chambers.

4.5.9 SCREENS
Delete Clause, current policy does not require installation of screens.

4.5.10 MIXERS
Replace notes 1 and 2 with:
1. An electric mixer may need to be installed in the pump well when the sewage is expected to be heavily laden with debris or the well diameter is large in comparison with the pumping capacity. Mixers shall be as per South East Water’s approved products list or an approved equivalent, refer: [http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf](http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf)
2. Placement and orientation of mixers is critical to ensure efficient mixing of the well contents.
3. Mixers shall be sized to ensure that they draw only 85% of full load current under the most adverse well conditions. This gives some provision for the mixer to shed a rag if required, instead of the rag causing the motor to trip out on over-current.

4. The mixer is to be configured to commence just prior to pump start and to run a minimum of 2 minutes during pump operation to enable sufficient mixing for solids to be placed in suspension.

5. The mixer is to be controlled by the PLC to run at appropriate intervals to achieve sufficient mixing to enable all suspended and floating solids to be pumped out of the wet well. This will be dependent on station activity and the quality of the sewage inflow. South East Water may later alter the frequency and duration of operation as a consequence of local field experience at the station.

4.5.11 WET-WELL WASHERS

Replace sentence one with:
South East Water requires that all pump wells be fitted with an approved wet well washer such as per South East Water approved products list or approved equivalent:

The designer shall consider the following when designing wet-well washers:

1. Wet-well washers clean by water volume; they're not intended to be high pressure cleaners. The best results are achieved with a slow rotation speed - one nozzle directed at the wall and the other at the pumps / guide rails / floats etc;

2. Wet-well washers don't need to operate every pump down. The wet-well washer is to be controlled by the PLC to run at appropriate intervals. Trials have shown that a “fatty” well can be kept clean with a program of a 1 minute wash every 6 hours using around 100 litres of water per day.

3. The wet-well washer unit should be installed just above the cut-in level (say 1 metre) so that the spray can be directed at the cut-in level and below, where most of the fats build up. (Note that the washers don’t mind being submerged once in a while if the level gets above the cut-in level.)

Add Note 3;
3 Install a backflow prevention device to the water supply for the wet-well washer.

4.6.1.1 OUTPUT SYSTEM PUMP DISCHARGE PIPE WORK - Sizing

Additional paragraph:
All penetrations of pipe work through concrete walls of the wet-well and valve chamber shall incorporate an approved puddle flange (thrust ring) or other such thrust device to provide adequate thrust restraint for all pressure surges and vibrations created by the pump. Grouting of penetrations through block outs shall be carried out using high quality non-shrink grout with at least the same strength as the parent concrete.

The pressure main shall be fitted with a scour line to enable the main to be drained back to the pump-well or into an adjoining sewer reticulation system. The valve to operate this scour shall be accessible from the surface via a gas tight winding box adjacent to the access cover within the valve chamber.

The pipe shall be as per South East Water approved products list or approved equivalent. Refer:
All flanged joints shall be provided with a 3mm thick full-face neoprene gasket, hardness of Durometer Shore ‘A’ 50±5.

All buried pipe work in vicinity of the valve chamber and the wet-well is to have sand embedment to a depth of 200mm above the pipe.

4.6.2 VALVES
Clause replaced with:
South East Water requires;
a) Resilient seated valves.
b) Clockwise closing.
c) Minimum pressure class shall be PN16
d) All valves, be they isolation valves, non-return valves, air valves, etc shall be as per the South East Water approved products list on: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf or an approved equivalent

4.6.2.2 VALVES - Pressure Main Isolating Valve
Additional sentences:
An isolation valve shall be located downstream of each non-return valve. The isolation valve shall have a non-rising stem, cast iron body and bronze wedge and fusion bonded protective coating. Operation of the isolation valves for each pump from the surface is not required, but is to be handwheel operated, clockwise closing. However surface operation (via a winding box) of the pressure main scour valve is required without removing any valve chamber access covers. All valve-winding boxes are to be gas tight to prevent odours escaping from the installation. Refer standard drawing SEWL_STD_006 for details. Refer Appendix A

4.6.3.1 VALVE CHAMBERS - Design
Additional sentences:
The wet-well roof slab shall incorporate the covers of the valve chamber unless otherwise approved. The valve chamber covers shall be large enough to enable crane access to remove valves for maintenance purposes. For valves greater than DN150, removal must be able to be carried out as a “direct lift” operation.

The valve chamber drain back to the pump-well shall be fitted with a duck bill valve or approved equivalent. A water seal is not required.

4.6.3.2 VALVE CHAMBER - Dismantling Joints
Additional Notes:
South East Water requires uniflanges to be provided in the valve chamber. Uniflanges shall be as per the South East Water approved products list on: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf or approved equivalent are to be used and installed according to the manufacturer’s instructions, using only stainless steel grade AISI 4100 set screws. The setscrew torque shall be tightened to the recommended level as shown below;
- DN50-100  95NM
- DN150-375  125NM
- DN400—600  160NM
In vertical pipe work the uniflanges joint shall be at the top of the pipe.
4.6.3.4 **VALVE CHAMBER - Pressure Main Tappings**
Additional item:
(g) to be fitted with down turned copper tails to prevent accidental discharge into the face of maintenance personnel.

4.6.3.6 **VALVE CHAMBER - By-pass Pumping Arrangements**
Replace sentence one with:
Facilities for emergency bypass pumping shall be provided on the scour line.
PRESSURE MAIN

4.6.4.2 PRESSURE MAINS - Route Location and Easements
Replace clause with:
Pressure mains are not permitted in private property. Pressure mains shall be located in road reserves. Any other location is to be agreed with South East Water prior to completing the final design.

Pressure main location is to be identified with relevant posted signs. Signs are to be erected at

- Change of direction.
- At fittings along the pipeline.
- Minimum 500m.
- Posts are to be coloured green and comply with standard drawing SEWL_STD_060. Refer Appendix A
- South East Water will provide the signage to be installed at the developer’s / contractor’s cost. The sign to be provided is detailed in Figure 1 below

![Fig 1](image)

- The sign is to be connected to the post using self-tapping stainless steel screws.

4.6.4.8.2 PRESSURE MAIN SELECTION
Additional sentence:
The pipe shall be as per South East Water approved products list or approved equivalent. Refer:
4.6.5.1 PRESSURE MAIN VALVES - Valves in the valve chamber
Additional to Note 2:
The scour valve on the pressure main is to be designed in accordance with Standard Drawing SEWL_STD_090 & 091. Refer Appendix A and also:

a) Provide suitable access and hard standing area for an 18,000litre tanker (semi-trailer with double bogey trailer) to park and comply with any relevant standards and clause 4.7.3.
b) Scour outlet to be fitted with a 75mm female camlock fitting complete with lock-down cap to Australian Standards.
c) Scour valves are to be capable of operation from the surface level.
d) All valves to be clockwise closing.
e) Scour valves or eduction points shall be provided on the pressure main when the system volume exceeds 10m³.

4.6.5.2 PRESSURE MAIN VALVES - Valves on the pressure main
Additional paragraph:
The designer shall submit plans of proposed valve location for approval from South East Water prior to completing design plans. The air release valve shall comply with WSAA standard WSA112-2002 “Sewage Air Release and Vacuum Break Valves”
In determining the location of the air release valve the following factors are to be considered:
- Proximity to properties.
- Venting requirements and subsequent odour issues.
- Aesthetics of vent.
Standard Drawing SEWL_STD_060 details a typical Air Release / Scour Pit details. Refer Appendix A

4.6.7 ODOUR AND SEPTICITY CONTROL
Additional note:
4 Where it is considered necessary to dose to control odour / septicity then an odour assessment is required from the designer detailing chemical dosing options, impacts, advantages / disadvantages, operating / capital costs of all dosing options.

4.6.8 RECEIVING STRUCTURE
Additional paragraph:
The internal concrete surfaces of the receiving Maintenance Hole structure must have a protective coating in accordance with specification 03.01 – Coating systems for concrete in contact with sewage on http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Coating_systems_for_concrete_in_contact_with_sewage.pdf

4.7.1 SITE INFRASTRUCTURE - Site Selection
Second Paragraph comments:
South East Water will require the designer to consult with them if other than options (i) or (ii) are proposed.

4.7.2 SITE INFRASTRUCTURE - Location and Layout
In second paragraph replace 100mm with 300mm, i.e. “…300mm above the 1 in 100 year flood level”
4.7.3 SITE INFRASTRUCTURE - External Layout and Access

Additional comments:
The nominated vehicle for the site is an 18,000litre eduction tanker (semi trailer with double bogey trailer). The designer shall also consider the safe access into and out of the site from the existing carriageway, with respect to safe turning circles / roadways for three point turns, lines of sight, road rules, etc. The access road shall be constructed from compacted gravel unless otherwise specified.

South East Water use truck mounted cranes to lift the pumps. The lifting capacity of these cranes depends on the required crane span to the pump. As pumps can become encumbered with sewage debris, so may weigh more than usual, the preference is to park maintenance trucks directly adjacent to the pump station to maximise the lifting capacity. A non-preferred alternative is to reverse the crane truck back over the valve chamber. If this is the only alternative available the top slab and the access covers shall be designed to carry the weight of this non-articulated vehicle.

Bollards shall be placed to prevent vehicle loading on wet well and valve chamber covers that aren’t designed for such loading and to prevent the vehicle from accidentally backing into fixtures such as the electrical cabinet, light tower, fences, etc...

The pumping station shall be located such that cranes operating on site are clear of overhead electrical cables as per the supplementary clause 3.6.2.

4.7.6 SITE INFRASTRUCTURE - Site Security

Additional sentence:
South East Water will nominate if security fencing is required. Security fencing shall be in accordance with specification 03-02, and shall be large enough that the fences do not impede access to pump station equipment. Refer Appendix D.

4.7.8 SITE INFRASTRUCTURE - Power and Control Cubicle

Replace sentence one with:
The electrical cubicle shall be installed on a concrete plinth that is an integral part of the wet-well top slab. The cubicle shall be located to provide a safe working area adjacent to covers, noting that electrical rules require an emergency egress clearance of at least 600mm between the cubicle doors in any position and obstructions such as the fence, top slab openings, etc.

Additional comments:
- As future maintenance access may be required to excavate the incoming sewer and rising main in the event that they develop a leak, it’s preferred that the cabinet is not located directly over these pipes, but there is a horizontal clearance of at least 600mm.
- As the visibility of the Operator Interface Panel (OIP) may be compromised in bright light it shall be protected by orienting the cubicle to shade the OIP in harsh sunlight or by providing an awning.
4.7.9 SITE INFRASTRUCTURE - Signage

Additional paragraph:
If the pump station is a fenced site South East Water will provide a station identification sign to be installed on the fence near the gate. The contractor shall supply and install a sign on the cubicle.
Sign 1 Cubicle sign is detailed below.
A stainless steel external nameplate (230mm x 80mm) engraved with the following detail example. Note – For externally mounted switchboards only.

Sign No 2 details
• Made from Stainless Steel plate 230mm X 80mm, holes in 4 corners for attachment.
• Sample shown below:

4.8.1.1 SUPPORT SYSTEM - Water

Replace clause with
A metered water property service of minimum DN20 and a static pressure of at least 20m head shall be provided to ensure the wet-well can be cleaned manually. The designer shall detail the installation of backflow prevention devices in accordance with AS/NZS 3500.1 “Plumbing and drainage – Water services”. The device and the fire hose reel are to be housed within a separate section of the control cubicle. The hose reel shall be as per South East Water approved products list or approved equivalent. Refer: http://southeastwater.com.au/SiteCollectionDocuments/Business/Managing_Water_Infrastructure/Approved_Products-Sewer_Pumping_Station_System.pdf

It shall have at least 18m of 19mm diameter PVC fire fighting hose complete with a brass jet type grip operation nozzle.

The cubicle size is to be large enough to allow maintenance of the back flow prevention device.

The contractor shall purchase and install a water meter and a remote reading device for each pumping station from South East Water. As of 20 March 2007 the indicative costs of a 20mm meter was $126 and a remote reading device was $205. These prices are subject to change and contractors are advised to confirm prices prior to works proceeding.
4.8.1.2 **SUPPORT SYSTEMS - Telephone / Telemetry Lines**
Delete clause.

4.8.1.4.1 **SUPPORT SYSTEMS MATERIALS HANDLING - Lifting Equipment**
Replace sentence one with:
Refer to South East Water supplementary clause 4.2.3.5 for lifting chain requirements.

4.8.1.6 **SUPPORT SYSTEMS - Fire Control**
Delete Clause.

4.9.2 **DOCUMENTATION - Operation and Maintenance Requirements.**
Replace Appendix D of WSA101 with **South East Water specification 02-155-0 “Submersible Pumps” Refer Appendix C**

4.9.3 **DOCUMENTATION - Contingency Plans**
Additional paragraph:
The contingency plan shall incorporate the following;
1. Functional requirements for ERS (Provided at functional design stage).
2. A plan of the drainage system that the ERS is discharging into. In detail the plan is to show the location of drainage pits, size of drains and flow paths until the drainage system discharges into an open creek, river or waterway. The plan shall detail locations where access may be gained to carry containment activities, such as sandbagging and shall nominate other containment options.

4.9.4 **DOCUMENTATION - Contingency Plans**
Additional sentence:
Submission of the final design shall also include the completed design checklist. Refer to **Appendix E**

4.11.2 **DRAFTING STANDARDS - Recording of as-constructed information**
Additional paragraph:
All as-constructed drawings shall be in AutoCAD format. The SPS, ERS and pressure main as constructed location must be read in conjunction with Chapter 7 of Vol 3 Survey manual.

5 **COMMISSIONING**
Additional Paragraph:
Prior to commissioning all documentation outlined in preceding paragraph must be forwarded to South East Water’s officer. In addition the precommissioning checklist **Appendix F** shall be completed and lodged 5 working days prior to the planned commissioning date. Notification of the upcoming commissioning must be made to the Telemetry Manager 14 days in advance, to ensure that telemetry points are set up, and, the telemetry must be pre-commissioned in consultation with him to ensure that all alarms are being received at South East Water’s Communications Centre.
The pump station will not be commissioned / deemed operational until all documentation has been provided together with; Refer Appendices G, J, L, M & N

1. Plant data sheets. (2 hard copies, 1 digital copy)
2. As constructed drawings for Civil, Mechanical & Electrical (SPS & RM). (2 hard copies, 1 digital)
3. PLC program on CD or DVD. (1 digital)
4. Job Safety analysis for all routine maintenance tasks to be performed at the SPS.
5. Two copies of the operational and Maintenance manuals inclusive of pump system curves.
6. Copy of concrete compressive strength and slump test results.
7. Contingency Plan.
8. Factory or type test pump test results
9. Switchboard factory & site acceptance test certificates completed and signed.

Digital drawings shall be in AutoCAD format.

NOTE: South East Water will NOT commission pump stations on a temporary power supply, e.g. a generator, or before the water supply is connected.
# APPENDIX A – STANDARD DRAWINGS

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SEWAGE PUMPING STATION
STANDARD DESIGN REQUIREMENTS
LATERAL SUPPORT BRACKETS

NOTE:
1. CARBON STEEL SHALL BE GRADE 250
   TO ANSI 367-1988. STRUCTURAL STEEL -
   HOT-ROLLED BAR S AND SECTIONS.
2. ALL WELDING TO BE 6MM CONTINUOUS FILLET
   AND CONFORM TO ANSI 10.4.1.250C: STRUCTURAL STEEL WELDING.
3. STAINLESS STEEL TO AS 2387-1986: WROUGHT ALLOY STEELS -
   STAINLESS STEEL BARS AND SECTIONS PRODUCTS GRADE 316
   (316 1.4404) UNLESS OTHERWISE NOTED.
4. ALL CARBON STEEL SHALL BE HOT-DIP GALVANIZED TO AB 1660
5. DRW'T TO BE MEASURED AND CONFRMG ON SITE.
6. CARBON STEEL ITEMS NOT GALVANIZED ARE TO BE PROTECTED
   WITH ZINC SILICATE TO ANSI 370-1991.
   PAINTS FOR STEEL STRUCTURES - INSURANCE ZINC SILICATE PAINT

A3

DRAWING NUMBER
SEWL-STD-002

ISSUED AS STANDARD
30MB03
A.P.W.

REV DESCRIPTION DATE APPD

SCALE: N.T.S.

SEWAGE PUMPING STATION
STANDARD DESIGN REQUIREMENTS
LATERAL SUPPORT BRACKETS

NOTE:
1. CARBON STEEL SHALL BE GRADE 250
   TO ANSI 367-1988. STRUCTURAL STEEL -
   HOT-ROLLED BAR S AND SECTIONS.
2. ALL WELDING TO BE 6MM CONTINUOUS FILLET
   AND CONFORM TO ANSI 10.4.1.250C: STRUCTURAL STEEL WELDING.
3. STAINLESS STEEL TO AS 2387-1986: WROUGHT ALLOY STEELS -
   STAINLESS STEEL BARS AND SECTIONS PRODUCTS GRADE 316
   (316 1.4404) UNLESS OTHERWISE NOTED.
4. ALL CARBON STEEL SHALL BE HOT-DIP GALVANIZED TO AB 1660
5. DRW'T TO BE MEASURED AND CONFRMG ON SITE.
6. CARBON STEEL ITEMS NOT GALVANIZED ARE TO BE PROTECTED
   WITH ZINC SILICATE TO ANSI 370-1991.
   PAINTS FOR STEEL STRUCTURES - INSURANCE ZINC SILICATE PAINT

A3

DRAWING NUMBER
SEWL-STD-002

ISSUED AS STANDARD
30MB03
A.P.W.

REV DESCRIPTION DATE APPD
SEWAGE PUMPING STATION
STANDARD DESIGN REQUIREMENTS
SPINDLE GUIDE ASSEMBLY

NOTE:
1. CARBON STEEL SHALL BE GRADE 250 TO ASME S172.1998 STRUCTURAL STEEL - HOT-ROLLED BARS AND SECTIONS
AND ZINC SILICATE COATED TO ASME S70.1/1998.
PINTS FOR STEEL STRUCTURES - INORGANIC ZINC SILICATE PAINT
2. ALL WELDING TO BE 6TH CONTINUOUS FILLET
AND CONFORM TO ANSI 18.4/1990 STRUCTURAL STEEL WELDING
WELDING OF STEEL STRUCTURES
3. STAINLESS STEEL TO AS 2867/1998 - WROUGHT ALLOY STEELS - STAINLESS STEEL BAR AND SEAM-Finished PRODUCTS
4. DIMENSIONS SHOWN ON MECHANICAL ARRANGEMENT DRAWING.
5. CARBON STEEL ITEMS TO BE PROTECTED
WITH ZINC SILICATE TO ASME S70.1/1998.
PINTS FOR STEEL STRUCTURES - INORGANIC ZINC SILICATE PAINT

SCALE: 1/2 INCHES = 1 FOOT
MATERIAL: CARBON STEEL

SPINDLE GUIDE ASSEMBLY

SCALE: 1/8 INCHES = 1 FOOT
MATERIAL: CARBON STEEL

Bore when clamped together.

DRAWING NUMBER
SEWL-STD-004

D.I.

DRAWING SHEET 1 OF 1

A5
NOTES:
1. SUITABLE FOR A MINIMUM DEPTH OF 2000mm. DISCUSS ALTERNATIVE SOLUTIONS WITH SEWL IF PIT IS SHALLOWER.
2. FABRICATION AND INSTALLATION OF LADDERS SHALL CONFORM TO AS-1457.
3. ALL WELDS SHALL BE 6mm COMPLETE FILLT WELDS UNLESS NOTED OTHERWISE.
4. LADDER TO BE FABRICATED FROM GRADE 316L S/STEEL.
5. EQUIPMENT TO BE MOUNTED TO ENABLE EASY REMOVAL / REPLACEMENT.
200 US SUPPORT SHOWN

FIT BRACKET TO THIS SIDE AT THE END OF BEAM. FIT TO OPPOSITE SIDE OF BEAM AT THE OTHER END TO BALANCE THE LOAD. TIGHTEN BOLT SUFICIENTLY TO BE A SNUG FIT AGAINST BEAM WEB AND THEN FASTEN LOCKNUT. ENSURE THAT ROTATION IS POSSIBLE.

DRILL HOLE 2 PLACES.

LIFTING LUGS: 2 OFF REGD PER SUPPORT BEAM.
MATL IS S008 FLAT.
HOT DIPPED GALVANISED FINISH
ONCE ALL MACHINING IS COMPLETE.
**SEWAGE PUMPING STATION**

**STANDARD DESIGN REQUIREMENTS**

**PUMP PEDESTAL AND CHAIN BRACKET DETAILS**

**NOTES:**

1. THE LIFTING CHAIN OFFERED MUST COMPLY WITH STATUTORY AUTHORITIES REQUIREMENTS FOR INDUSTRIAL LIFTING.

2. THE PUMP LIFTING CHAIN SHALL BE PWB ANCHOR GRADE "B" LIFTING CHAIN, OR APPROVED EQUIVALENT, HOT DIPPED GALVANIZED FINISH, MANUFACTURED TO AS 2321-1979.

3. THE CHAIN SHALL BE SIZED TO CARRY THE WEIGHT OF THE PUMP, TAKING INTO ACCOUNT LOAD CARRYING REDUCTIONS FOR ANGLED TWO LEG SLEDS. THE MINIMUM CHAIN SIZE SHALL BE 15MM FOR SMALL PUMPS, BUT LARGER PUMPS WILL REQUIRE 16MM OR 18MM. PARTICULARLY WHERE A LOWER BRIDGE IS USED TO ATTACH TO TWO EYEBOLTS.

4. THE DEE SHACKLES USED SHALL BE PWB ANCHOR GRADE "B", OR APPROVED EQUIVALENT, HOT DIPPED GALVANIZED FINISH, MANUFACTURED TO COMPLY WITH AS 2744-1992 - SHACKLES.

5. EYEBOLTS PROVIDED BY MANUFACTURERS AS PART OF THE LIFTING ARRANGEMENT TO EQUIPMENT SHALL BE MANUFACTURED TO COMPLY WITH AS 2317 - COLOURED EYEBOLTS,

---

**TABLE:**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>MATERIAL</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EYEBOLT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DEE SHACKLES</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>CHEVRON &quot;C&quot;/W SHACKLE</td>
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**SOUTH EAST WATER**

**SEWL-STD-008**
SEWAGE PUMP STATION STANDARDS

NET WELL FLOAT / MOTOR CABLE
JUNCTION BOX SUPPORT AND ASSEMBLY

<table>
<thead>
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<th>NO.</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SUPPORT HEEL</td>
<td>STAINLESS STEEL (30%</td>
</tr>
<tr>
<td>2</td>
<td>TELLTALE CABLE</td>
<td>STAINLESS STEEL (HIGH POLY): DRAWN</td>
</tr>
<tr>
<td>3</td>
<td>SUPPORT NUT AND ELBOW</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>4</td>
<td>PLASTIC CABLE SUPPORT BUSH</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>5</td>
<td>PLASTIC SUPPORT CLAMP</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>6</td>
<td>FIBER OPTIC LEVEL PROBE</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>7</td>
<td>FLOAT PROBE</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>8</td>
<td>FLAT BUSH</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>9</td>
<td>CABLE TIE</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>10</td>
<td>SMALL DESCENDING HOLE</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>11</td>
<td>3/8 OD AUXILIARY CONDUCTOR</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>12</td>
<td>TERMINATION</td>
<td>THERMOCOUPLE (12)</td>
</tr>
<tr>
<td>13</td>
<td>FIBER OPTIC CABLE CLAMP</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>14</td>
<td>JUNCTION BOX FOR METER CABLE</td>
<td>INCONEL/STAINLESS STEEL</td>
</tr>
<tr>
<td>15</td>
<td>SUPPORT BRACKET</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>16</td>
<td>SUPPORT FLANGE</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>17</td>
<td>SUPPORT BRACKET</td>
<td>STAINLESS STEEL</td>
</tr>
</tbody>
</table>

DO NOT SCALE
TELEMETRY MAST TO REACH DVG 6.0m TBD OR SOUTH EAST WATER APPROVED EQUIVALENT.

GENERAL SITE LIGHTING 5.3 METERS ABOVE G.L. LIMIT TO BE ERECTED AT WORK AREA AND TO HAVE MINIMUM RADIATE ON SUNSHINE.

TYPICAL TELEMETRY AERIAL YAGI 6 ELEMENT

60/66

BASE PLATE

20 x 350 x 350 PCD FOUNDATION BOLT

STANDARD COSO TO EACH END ALL BARS

6 NO Y16 BARS (75 C/W)

RB 500C/C CORED CONCRETE

540 HEAVY DUTY RWP CONDUIT

INDICATIVE FOOTING DETAIL

-NOTES-
1. THE ACTUAL CONFIGURATION OF THE TELEMETRY AERIAL WILL BE DEPENDENT ON THE RESULTS OF THE SITE SPECIFIC FOUND SURVEY.
2. MAST TO BE STRAIGHT WITH DATA LINE.
3. MAST,WELDS TO COMPLY WITH DATA LINE.
4. MAST GALVANISED TO COMPLY WITH AS4400.
5. JIGS CONNECTION - C TYPE COUPLING END CONNECTION.
6. FOOTING DETAIL BASED ON TERRAIN CAT2 AND AN ALLOWABLE LATERAL SOIL BENDING STRENETH OF 70kPa PER METRE DEPTH. FOOTING SIZES WILL VARY TO SUIT THE, CONDITIIONS, WHATundying, AND TERRAIN CATGORIES.

SOUTHEAST WATER

SEWAGE PUMPING STATION
STANDARD DESIGN REQUIREMENTS
TELEMETRY MAST
DETAILS

DO NOT SCALE
SCHEDE: N.T.P.
DRAWING NUMBER
SEWL-STD-031
0
11
11
12
12
SEWAGE PUMPING STATION
STANDARD DESIGN REQUIREMENTS
ELECTRICAL CONTROL CUBICLE DETAILS

NOTES:
1. CONTRACTOR TO PROVIDE PVC COATED DRAW STRING FOR INSTALLATION OF CABLES TO ALL CONDUITS UNDER PLINTH, ALL UNUSED CONDUITS TO BE CAPPED AT BOTH ENDS.
2. MAXIMUM RADIUS BENDS IN ELECTRICAL CONDUITS UNLESS NOTED OTHERWISE.
3. CONDUITS TO BE SEALED USING A WATERPROOF EXPANDING FOAM, SILICATE OR NON SETTING SEALER.
MULTI PART INTERCHANGEABLE SOLID DUCTILE IRON COVER CLASS NOMINATED IN PROJECT SPECIFICATION

SUPPORT BEAM
REFER SEWL-STD-007

TELEMETRY MAST
REF SEWL-STD-031

Ø32 WATER SUPPLY CONDUIT

CONTROL CUBICLE
REFER SEWL-STD-032 TO 037

Ø63 ORANGE HEAVY DUTY PVC CONDUIT TO POWER SUPPLY PIT

300MIN.

GAS TIGHT WINDING BOX
REFER SEWL-STD-006

RETRACTABLE HANDGRIP
STANCHION LADDER
REF: SEWL-STD-000

PRESSURE MAIN

PUMP GUIDE RAIL SUPPORT
REFER SEWL-STD-000

SLAB PLAN

300MIN.

WELL PLAN

BENCHING PLAN

NOTES
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH WSA 04-2001 SEWAGE PUMPING STATION CODE OF AUSTRALIA
2. THE DETAIL SHOWN ON THIS DRAWING IS TYPICAL ONLY
3. ALL VALVE TO BE CLOCKWISE CLOSING
4. ALL DIMENSIONS IN MILLIMETRES
NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH WSA 04-2001 SEWAGE PUMPING STATION CODE OF AUSTRALIA

2 THE DETAIL SHOWN ON THIS DRAWING IS TYPICAL ONLY

3 LANDSCAPING AND FENCING MAY BE REQUIRED DEPENDENT UPON SITE LOCATION

4 AREA AROUND PUMP STATION SHALL BE GRADED TO PREVENT SURFACE WATER FLOWING ONTO OR OVER PUMP STATION SLAB

5 CONCRETE GROUND SLAB COLOUR TO BE NOMINATED IN PROJECT SPECIFICATION.
APPENDIX B - GENERATOR SPECIFICATION

PREFACE

This specification was prepared by South East Water.
The objective of the specification is to provide design, manufacturing, performance and testing requirements for manufacturers/suppliers of emergency generator sets and ancillary equipment.

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SCOPE OF DOCUMENT
This specification covers the design, supply, installation, testing and commissioning of Automatic Standby Generator Sets as specified in the Technical Data Sheet.

SCOPE OF SUPPLY
The Contractor shall include within the scope of supply;
- an automatic start generator set, including all integral equipment (generator enclosure, electronic governing systems, voltage regulators, batteries, battery chargers, instrumentation) required for the operation in its intended service,
- labour, materials and instruments required for the setting to work and commissioning of the generator set,
- spare parts and tools (refer Section 7),
- operation and maintenance manuals (refer Section 8).

The emergency generator unit shall be supplied completely assembled, with the other ancillary equipment supplied separately. Installation and commissioning of the emergency generator and ancillary equipment shall be part of supply.

The stand-by diesel control and switchgear shall be installed such that upon failure of the Supply Authority supply the pump station switchboard main contactor will open after a preset time, the engine will then start and run up to speed. When rated voltage is achieved and an engine warm up period has elapsed, the generator contactor will close, energising the load. After the Supply Authority supply has been restored for a preset time the generator contactor opens automatically and on delay the main contactor closes. The set will continue to run for a preset time on no load to facilitate cooling down.

The workmanship, equipment, accessories and materials provided in accordance with this specification shall comply in design, construction, installation and performance with the latest relevant Australian Standards or in their absence the latest relevant British Standards.

The Contractor shall ensure all equipment and materials supplied are in accordance with requirements of all relevant authorities and that all required approvals are obtained.

REFERENCED DOCUMENTS

Codes and Standards
The following Australian Standards are referenced within this document:

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1359.0:1998</td>
<td>Rotating Electrical Machines - General Requirements - Introduction and list of Parts.</td>
</tr>
<tr>
<td>AS1939:1990</td>
<td>Degrees of protection provided by enclosures for electrical equipment (IP Code).</td>
</tr>
<tr>
<td>AS2074:1982</td>
<td>Steel Castings.</td>
</tr>
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</table>
AS3000:2000 Electrical Installations (known as the Australian/New Zealand Wiring Rules).
AS3439.1:1993 Low-voltage Switchgear and Control Gear assemblies - Type-tested and partially type-tested assemblies.
AS3679.1:1996 Structural Steel - Hot-rolled bars and sections.
AS3947.4.1:2001 Low-voltage Switchgear and Control Gear - Contactors and motor-starters - Electromechanical contactors and motor-starters.
AS3947.5.1:2000 Low-voltage Switchgear and Control Gear - Control circuit devices and switching elements - Electromechanical control circuit devices

TECHNICAL REQUIREMENTS

Engine

Engine Cooling
The engine cooling system shall be sized to allow continuous operation with ambient temperatures of 45ºC in the shade.

Engine Speed Control
The engine shall be fitted with an electronic speed governor so that alternator frequency does not drop more than 3% on application of load.

Engine Over Speed
The generator set shall be so constructed such that in an emergency it can withstand an over speed of 25% without mechanical damage. Governing of the generator speed shall be controlled electronically.

Alternator

Alternator Rating
The output power from the alternator shall be sufficient to supply the load specified in the Technical Data Sheets at a power factor of 0.8 for standby service in accordance with ISO3046.1.

Alternator Tolerance
Tolerance to alternator parameters shall be in accordance with AS1359, Table 69.1.

Alternator Voltage Variations
The alternator shall be capable of supplying its rated output at rated speed and power factor at any voltage in the range 95% to 105% of its rated voltage continuously, in accordance with AS1359, Clause 31.5.

Alternator Short Circuit
The alternator shall be capable of withstanding without damage a 30-second, 3 phase, short circuit at its terminals when operating at rated kVA and power factor, at 105% rated voltage with fixed excitation.

Alternator Overload Current
The alternator shall be capable of supplying an overload current of 50% of rated current for one minute with the field set at rated excitation, and shall be capable of supplying an overload current of 10% for periods of one hour in any twelve hour period.
Alternator Excitation

The rated exciter capacity shall be equal to that required to supply the field excitation when the alternator is operating at 110% of rated kVA at rated power factor and voltage.

Alternator Voltage

The alternator shall be equipped with a Class A1 (1 % tolerance) automatic voltage regulator suitable for auto/manual operation.

Alternator reactance and voltage regulator performance shall be in accordance with AS1359.101. On application of loads under stand-by power the initial voltage drop shall not exceed 15% of rated voltage. Voltage regulation grade shall be VR 1 or better.

The generator shall be capable of carrying a continuous unbalanced load of 15% without damage provided the rated current is not exceeded in any phase.

General

Vibration

The generator and excitor shall be statically and dynamically balanced such that when operating, the vibration of the generator set shall not exceed the limits of vibration amplitude given in AS1359.114.

Noise

The engine and generator unit shall be housed within a weatherproof, acoustic enclosure designed such that the maximum noise level shall be the lesser of:

- 60dBA maximum at a distance of 6 metres from the unit or
- 42dBA maximum at the nearest window of the nearest residence.

DESIGN REQUIREMENTS

Generator set including diesel engine running at 1500 RPM direct coupled to a 4 pole brushless alternator. Switchgear and controls to enable automatic start up of the generator and bringing on line the stand-by power supply in the event of Supply Authority supply failure. This will include:

- generator isolating switch,
- mechanically and electrically interlocked changeover contactors and
- changeover controls.

The generator shall be rated for stand-by use in accordance with ISO 3046/1 and shall be rate for the load as described.

The diesel generator set and all other equipment supplied with this contract shall be designed in such a way that it can be operated and serviced with safety to personnel.

Emergency pushbuttons on the generator control panel and the pump station switchboard shall be provided to disable generator operation and open both the generator supply and mains contactor

Alternator

The alternator shall be of brush less, self-ventilating, revolving field type suitable for coupling to the diesel engine specified within this document.

Insulation

Winding insulation temperature rating shall not be less than Class F to AS2768. Temperature rise shall be in accordance with AS1359.101, for the insulation class used.

All insulation, bushings and terminal supports shall be made of non-hygroscopic, anti tracking, flame retardant materials.
Cooling

The method of cooling shall be IC01 to AS1359.106. Subject to South East Water approval, other categories of cooling may be accepted.

Terminal Boxes

The generator shall have both ends of each winding brought out to line and neutral terminal boxes. Terminal boxes shall be suitable for air terminations of cables and shall be fitted with removable non-ferrous gland plates.

- Voltage Waveform Deviation
- Generator voltage waveform deviation and telephone harmonic factor shall be in accordance with AS1359.101.

Excitation

The generator shall be provided with an air-cooled brushless exciter direct coupled to the generator shaft, excitation voltage being selected by the manufacturer. The stator winding of the exciter shall be brought onto a terminal box mounted on the side of the exciter.

The exciter enclosure shall be of a degree of protection equal to that of the generator.

The exciter insulation class shall be to AS2768, Class B as a minimum.

Anti-Condensation Heaters

The generator shall be provided with a 240V anti-condensation heater. Wiring for the heater shall be brought out in a terminal box separate from the main terminal box. The terminal box shall be fitted with removable gland plate.

Each cubicle shall be provided with anti-condensation heaters located at the base of the cubicle. Heaters shall be thermostatically controlled, and shall be shrouded.

Alternator IP Rating

The alternator casing shall be dust, moisture and vermin proof. Housings shall provide minimum degree of protection IP23 to AS1939. Required protection, if different, shall be detailed in the Technical Data Sheets.

Automatic Transfer Switch

The automatic transfer switch shall be a suitably sized, mechanical and electrical interlocked Sprecher and Schuh contactor set.

A Deep Sea Model 509 electronic manager shall preferably control the generator management and supply change over. The contractor shall provide an alternate cost and the Deep Sea option if an equivalent device of similar functionality is available.

Transfer configurations shall comply with AS 3010.1

Switchboard indications shall display mains and generator supply on load.

Current Transformers

Current transformers shall be fully encapsulated and shall comply with AS 1675.

Overload Protection

Generators shall be provided with bi-metal thermal overload units or programmable type protection relays.

Thermal overload relays shall be triple pole, bi-metallic, ambient compensated type with single phasing protection complying with AS3947.4.1. All relays shall include an adjustable, calibrated current setting.
The relays shall be fitted with one normally closed contact and be supplied with a door mounted reset pushbutton.

**Control Devices**

The generator control panel, degree of protection IP51 to AS1939, shall be located in a lockable steel cabinet, mounted on the generator or the generator enclosure wall, and shall include the following equipment as a minimum:

- 3 phase voltage indication,
- generator current indication for each phase,
- engine/generator system diagnostics including:
  - coolant temperature,
  - engine speed,
  - engine oil pressure and
  - DC system volts,
- generator kW indication,
- generator frequency indication,
- hours run indication,
- automatic/manual stop start controls,
- engine start and stop buttons,
- automatic shutdown for engine/generator faults,
- engine available to start indication and
- emergency generator stop button.

All control devices including indicating lamps, push buttons and selector switches shall comply with AS 3947.5.1 and the following requirements:

- all control devices shall be oil-tight and dust tight.
- all indicating lamps shall have a minimum rated life of 3,000 hours at the rated voltage.
- all indicating lamps shall include a press-to-test function.

Volt free contacts shall be supplied for remote indication purposes, to indicate:

- generator set available (also to incorporated emergency push button and generator isolator operation),
- generator set running,
- generator set fault,
- generator batteries low and
- fuel level low - to operate 1 hour prior to fuel level low engine shutdown.

The existing Mains Power Failure alarm to the telemetry system must signal Supply Authority supply loss whilst the generator is supplying stand-by power.

Cabling for remote telemetry purposes shall be run from generator set to the existing telemetry cubicle inside the building/control cubicle. Terminal allocations shall be supplied by SE Water.

Hour run meters shall be similar in appearance to the ammeters/voltmeters used and shall register operating hours with five (5) digit cyclometer dial, the lowest digit showing 1/10 hours.

The engine shall automatically shut-down in the case of:

- engine oil pressure low,
- engine fuel level low,
- engine coolant temperature high or
- engine over speed

Protection for the generator shall include but not be limited to the following:

- alternator over current,
- alternator over/under voltage,
- alternator earth fault, or
- alternator over temperature.
**Internal Wiring**

The switchgear and control assemblies shall be completely factory wired, in accordance with AS3439.1, AS 3000 and the following requirements:

- All wiring shall be carried out in flexible copper cables, 0.6/1 kV, V 75 grade PVC and terminated with insulated compression type lugs or connectors.
- The minimum size of flexible cable shall be as follows:
  - Control wiring: 1.5mm² (30/0.25mm)
  - Protection: 2.5mm² (50/0.25mm)
  - Metering: 2.5mm² (50/0.25mm)
- Cable colour shall comply with the following requirements:
  - Phases: Red, White, Blue
  - Neutral: Black
  - AC Control Active: Grey
  - AC Control Neutral: Black
  - ELV Active: Violet
  - ELV Neutral: Violet
  - DC Control Positive: Pink
  - DC Control Negative: Brown
  - Earth: Green with Yellow trace

All wiring shall be identified at each end by fully interlocking Z-type numbered ferrules. All such identification shall be in accordance with Schematic and Connection Drawings as approved by the Purchaser.

**Earthing Provisions**

Earthing requirements shall conform in all respects with the requirements of the S.A.A. Wiring rules AS 3000, AS 3010 and Electrical Supply Authority of Victoria Wiring Regulations.

Where mounted on a hinged metallic door, equipment shall be earthed with a flexible conductor connected to the earth bar or stud, in which case the door shall also be earthed by the same conductor.

**Rating Plates**

The generator shall be fitted with permanently affixed rating plate containing all the information specified in AS 1359.

**Drive**

**Engine**

The engine shall be installed complete with exhaust system including muffler and in the case of non-turbocharged engines, a spark arrester conforming to AS1019. A dry type air cleaner (cyclopac or equivalent) with restriction indicator shall be fitted.

**Cooling System**

The engine cooling system shall include a closed cycle water filled radiator with electric fan to provide air flow around the radiator core.

**Fuel Supply**

The generator set shall incorporate a fabricated steel fuel tank of sufficient capacity for at least eight (8) hours continuous operation at 75% load. The fuel tank shall be fitted with a sight gauge or calibrated dipstick.

The fuel system shall incorporate primary and secondary filters plus a water and sedimentation trap.

The fuel tank shall be supplied full of fuel and topped up after commissioning is complete.
A low level fuel switch shall be installed to shut the engine down when less than ½ an hour fuel supply remains.

**Starting System**

The generator set shall include a 24V DC starter motor and sufficient battery capacity for at least ten (10) cranking cycles. The cranking cycle shall consist of ten (10) seconds cranking then ten (10) seconds rest and shall preferably be adjustable.

**Batteries**

The batteries shall be of the sealed maintenance free lead-acid type and suitable for continuous trickle charging by a constant voltage charger.

The generator supply batteries shall be Exide N70EX, 620A cc, 150A rc, 80 A/hr or equivalent.

**Battery Charger**

Battery charger shall be floating charge type located on the frame of the generator set. The battery charger shall be a YK1212 9 (12v 12A) or YK0824 (24V 8A) as supplied by McFarlane Generators or equivalent.

**Ancillary Equipment**

**Weatherproof Sound Attenuated Enclosure**

The generator enclosure shall be constructed of marine grade aluminium or stainless steel, grade 316 sheeting not less than 3-mm thickness and be securely mounted to the concrete slab and removable to allow major overhaul of the unit.

The enclosure shall be fitted with sufficient access doors to enable easy access for regular maintenance purposes.

Doors shall be fitted with latches to hold them in the fully open position whilst work is being carried out. Door locks shall be heavy duty prestige pad bolt type clasps fitted with Lockwood padlocks keyed with South East Water’s restricted MKA1 system as supplied by A.F. Stewart Locksmiths, Normanby Rd, South Melbourne.

Cubicles shall be painted Rain forest Green AS2700 to colour G15 with white inside compartments and panel doors.

**Generator Base**

The generator set shall be mounted on a fabricated galvanised steel base with a lifting eye at each corner. The steel base shall be fixed to the concrete foundations with approved vibration damping supports.

**Holding Down Bolts and Anchor Bolts**

Holding down bolts shall be supplied and shall be designed to withstand the full shear force, over turning moment and resulting fatigue associated with the equipment supplied.
**Nameplates and Switch Labels**

All enclosures and equipment shall be identified with white tri-laminated phenolic nameplates and labels engraved with black lettering and complying with the following:

- lettering shall be of a minimum size of 5mm,
- labels shall be detachable and interchangeable,
- fixing holes shall be slotted to allow for expansion and contraction,
- minor labels within compartments may only be affixed by adhesive, to the approval of the Purchaser and
- push buttons and pilot lights shall be supplied with standard metal engraved labels.

**MANUFACTURING**

**Materials**

**General**

Where a specific material for a component has not been stated in this document, materials for manufacture shall be as listed in the Data Sheet.

**Castings**

Castings shall be close and uniform in grain, homogeneous and free from blowholes, porosity, shrinkage, cracks and other injurious defects. Filling of holes with any substance shall not be permitted. Castings shall be properly cleaned and fettled and all lumps and rough areas smoothed.

**Stainless Steel**

Stainless steel plate and bar subjected to welding during the manufacture of any component shall be a low carbon, and stabilized grade such as AS1449, grades 316L.

Stainless steel casings shall be a stabilized grade in accordance with AS2074, grade H6C.

Stainless steel in shafts, spindles or similar shall comply with AS1449, grade 420.

Graphite greases, graphite packing and graphite compounds shall not be used in contact with stainless steel.

**Mild Steel**

Mild steel shall conform to AS3679.1, grade 250.

**Machining**

Machining shall be concentric, square to line and true. All sharp edges and burrs shall be removed. Bolt holes shall be drilled and spot faced for bolt head and nut. Mating parts shall be match marked.

All components and the assembled rotating element shall be interchangeable for pumps of the same type, designation and size.

Bosses shall be provided for all tappings. The use of setscrews in castings shall be avoided. Dowels shall be provided between components requiring accurate locating in position.
INSPECTION AND TESTING

Type Tests
The Contractor shall provide ‘Type Test Certificates’ for type and size of generator supplied. Where ‘Type Test Certificates’ are not available the Contractor shall perform and document type tests at the Contractors works on the first generator of each design. Type tests shall include the following minimum requirements;

- measurement of cold resistance of windings,
- measurement of no-load losses,
- temperature rise test,
- measurement of efficiency,
- momentary overload test,
- high voltage test,
- insulation resistance test,
- vibration test and
- noise level test.

Workshop Performance Tests
The generator to be supplied shall be submitted to routine tests at the Contractors works prior to delivery to South East Water. Routine tests shall include the following as minimum;

- measurement of cold resistance of generator windings,
- measurement of generator no-load losses,
- measurement of generator controls/switchgear insulation resistance,
- generator high voltage test,
- generator Vibration test,
- testing of all control and interlock circuits to ensure satisfactory operation,
- check of wiring and terminations and
- load test at rated output for 1 hour.

All tests performed on the generator may be witnessed by a South East Water representative and shall be in accordance with AS 1359.60. The Contractor shall give a minimum of three (3) working days notice of commencement of tests.

Site Commissioning & Performance Tests
The generator set and associated equipment is to be commissioned on site within a time to be nominated by the contractor at the time of tendering.

All tests performed on the generator may be witnessed by a South East Water representative and shall be in accordance with AS 1359.60. The Contractor shall give a minimum of three (3) working days notice of commencement of tests.

The generator set and changeover controls commissioning tests shall include;

- testing of all control and interlock circuits for correct operation,
- insulation resistance tests,
- check of wiring and terminations,
- load tests including a minimum of five (5) pump starts and
- noise level test.

Unless stated otherwise in the Technical Data Sheet, the Contractor shall provide all test instruments, excepting flow meters. All instruments shall be calibrated by a NATA certified testing authority within three (3) months prior to the tests.
Analysis & Presentation of Test Results
Comparisons between test results and guaranteed performance will be made in accordance with AS1359.101.

Rejection of Generator Set
South East Water may reject the generator set should the performance during performance tests:
- fall outside the specified guarantee limits,
- fail to meet the guarantees for noise,
- fail to meet the guarantees for vibration or
- indicate poor mechanical or electrical design or manufacture.

South East Water may reject the motor should the Contractor not satisfy South East Water during workshop or commissioning tests, that the motor meets the specified service requirements.

Warranty Period
Any defects developed within a period of twelve (12) months from the date of commissioning, other than fair wear and tear, shall be rectified by the Contractor on receipt of notice from the South East Water, and at no cost to South East Water.

PACKING, TRANSPORTATION & DELIVERY

Labels & Markings
All items shall be individually labelled prior to packing. Labels shall include the following information;
- Property of South East Water Limited
- Contact Number
- Item / Part Number
Where items are manufactured for specific mating component parts, they shall all bear individual identification numbers and reference to the mating part identification numbers.

Packing
All items shall be individually packaged for long-term storage in a tropical environment, with external labelling duplicating the information specified in Section 6.1.

Crating of items for transportation shall be designed and constructed to withstand the loads imposed during transportation. Goods received in damaged packaging or crating may be returned to the Contractor for re-manufacture and/or re-inspection and testing.

Crates shall be clearly marked in black-stencilled lettering with the following information;
- Consignee’s name and delivery address as given in the Contract,
- Consignor’s name and contact point and contact number.

SPARE PARTS & TOOLS
The Contractor shall supply and deliver one (1) complete set of any special tools required for the dismantling, service and re-assembly of the motor.
The Contractor shall prepare and supply, minimum two sets, drawings, installation, operation and maintenance documentation.

The manuals and technical data sheets shall fully describe all specified equipment and clearly show its mode of operation and, as a minimum, contain the following information:

- A concise description of each motor type and ancillary equipment, together with a complete performance specification,
- A concise description of the mode of operation of each part or sub-system,
- Procedures for installation and commissioning of each part or sub-system,
- Procedures to be followed for testing, maintenance and fault finding. The fault finding table shall list fault indication, possible causes and remedies.
- Special precautions to be taken in replacement and/or adjustment of each item,
- A comprehensive routine maintenance and testing program based on that recommended by the manufacturer,
- A spare parts list for all items plus component assembly drawings of the motor and ancillary equipment,
- A list of supplier’s names and addresses to enable any parts to be ordered correctly and
- Any other information or instructions necessary to fully operate and maintain the equipment in a complete and satisfactory manner.
APPENDIX C PUMP SPECIFICATION

SPECIFICATION: 02-155.0

Submersible Centrifugal Sewage Pump

PREFACE
This specification was prepared by South East Water Limited and is based directly on the Water Services Association of Australia (WSAA) Sewage Pumping Code Woking Group ‘Draft’ Standard for Submersible Sewage Pumps.

The objective of the specification is to provide design, manufacturing and performance requirements for manufacturers of submersible electric pumps and ancillary equipment.
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SCOPE OF DOCUMENT

This specification covers the design, manufacture, inspection, works testing, supply, delivery and pre-commissioning of submersible type pumps as may be specified in the Technical Data Sheet.

(Submersible type pumps are those that are designed to be immersed in the liquid when operating, but may operate non-submerged.)

SCOPE OF SUPPLY

The Contractor shall include within the scope of supply:

- the pump unit, including all integral equipment required for the operation of the pump in the intended service including drive motor and instruments,
- for a pump specified for wet well service, a discharge support bend complete with coupling device and guide rail brackets
- for a pump specified for dry well service, a suction bend and mounting stool
- labour materials and instruments required for the setting to work and commissioning of the pump (as required in the Technical Data Sheets),
- spare parts and tools and
- operation and maintenance manuals.

The pump unit shall be supplied completely assembled, with the other ancillary equipment supplied separately. Installation of the pump and ancillary equipment may be required (refer to the Technical Data Sheet).

The workmanship, equipment, accessories and materials provided in accordance with this specification shall comply in design, construction, installation and performance with the latest relevant Australian Standards or in their absence the latest relevant British Standards or international ISO Standards.

The Contractor shall ensure all equipment and materials supplied are in accordance with requirements of all relevant authorities and that all required approvals are obtained.

REFERENCED DOCUMENTS

Codes and Standards

The following Australian Standards are referenced within this document:

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1111</td>
<td>ISO Metric Hexagon Commercial Bolts &amp; Screws.</td>
</tr>
<tr>
<td>AS1112</td>
<td>ISO Metric Hexagon Nuts, including thin nuts &amp; castle nuts.</td>
</tr>
<tr>
<td>AS1217</td>
<td>Acoustics – Determination of sound power levels of noise sources.</td>
</tr>
<tr>
<td>AS1359.102</td>
<td>Rotating Electric Machines – Methods For Determining Losses &amp;</td>
</tr>
<tr>
<td></td>
<td>Efficiency.</td>
</tr>
<tr>
<td>AS1359.109</td>
<td>Rotating Electric Machines – Noise Limits.</td>
</tr>
<tr>
<td>AS1359.114</td>
<td>Rotating Electric Machines – Vibration Measurements &amp; Limits.</td>
</tr>
<tr>
<td>AS1444</td>
<td>Wrought Alloy Steels – Standard &amp; Hardenability (H) Series.</td>
</tr>
<tr>
<td>AS1449</td>
<td>Wrought Alloy Steels – Stainless &amp; Heat Resisting Steel Plate, Sheet &amp; Strip.</td>
</tr>
<tr>
<td>AS1646</td>
<td>Elastomeric Seals For Waterworks Purposes.</td>
</tr>
<tr>
<td>AS1833</td>
<td>Iron Castings – Austenitic Cast Iron.</td>
</tr>
<tr>
<td>AS1939</td>
<td>Degrees Of Protection Provided By Enclosures For Electrical Equipment.</td>
</tr>
<tr>
<td>AS2074</td>
<td>Steel Castings</td>
</tr>
</tbody>
</table>
TECHNICAL REQUIREMENTS

Performance

System Characteristics
The system characteristics are as stated in the Technical Data Sheet. The required Guarantee Point is given for the purpose of performance testing under AS 2417-2001 Roto dynamic Pumps - Hydraulic performance acceptance tests – Grade 1 and 2, and is subject to the tolerances stated therein for the Class of test (1 or 2) stated in the Technical Data Sheet.

Secondary duty points, if stated, are given for the purpose of defining the required shape of the pump head-quantity characteristic curve. Allowable deviation from these secondary points, for guarantee, shall be to the following extent:

<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>+/- 3%</td>
</tr>
<tr>
<td>Pump Speed</td>
<td>+/- 1%</td>
</tr>
</tbody>
</table>

Pump Selection
The pump selected shall have a specific speed range \( N_q = 20 \) to 80 with a stable head-quantity characteristic curve (i.e. negative gradient from zero flow to end-of-curve).

The pump shall be selected to:
- meet all of the duty points within the range of 55% to 110% of the pump’s optimum flow rate (i.e. Best Efficiency Point), with the Guarantee Point as close to the optimum flow rate as possible,
- attain a maximum achievable flow, for continuous operation, not less than 20% greater than the highest flow duty point.

The Contractor shall adjust the duty point flow rates, specified in the Technical Data Sheet, as follows to accommodate reduction in performance with time:

- Pumps with fully shrouded impellers: 0%
- Pumps with semi-open impellers: 5%
- Pumps with screw-type impellers: 10%
The pump supplied shall be fitted with an impeller diameter no greater than 95% of the maximum size impeller for that casing.

**Operating Speed**

The pump’s operating speed shall not be greater than that specified in the Technical Data Sheet. If the pump is required to operate at various speeds, driven by a variable speed drive unit, the pump shall be selected such that the maximum supply frequency to the motor is less than 50 Hz and the minimum frequency preferably less than 80% of the maximum.

Under no circumstances shall the minimum operating frequency be less than 20 Hz.

**Efficiency and Power Consumption**

Normally the pump shall be selected to maximise operating efficiencies without modification. Polishing or coating of the impeller may be undertaken in special cases where aggressive or abrasive materials are being pumped.

Power consumption of the pump shall not exceed 95% of the motor rated power output:
- at zero flow,
- at any point within the operating range, or
- at any point corresponding to flows 20% beyond the maximum operating range.

Referring to the installation sketches, the pump shall not draw more than:
- 85% of full load name plate current at duty point (ultimate duty point in the case of a staged development), or
- 90% of nameplate full load current with the water level at spill level in the well.

The motor output shall be rated for as when operating in air (i.e. allowance is not to be made for additional cooling effect due to immersion in liquid)

If the Technical Data Sheet to this Appendix requires an additional allowance to be made for a future increase in performance output (either by fitting a larger impeller or increase in speed), the rated motor shall be sized for the increased performance requirement

**Net Positive Suction Head (NPSH)**

The pump shall be selected to have a Net Positive Suction Head Required (NPSHR) not in excess of 10 meters head at any point between zero flow and 120% of the maximum operating range flow.

The NPSHR of the pump shall be based on actual 3% head drop method test results, adjusted by calculation to represent a 1% head drop.

**Minimum Submergence**

The pump shall be guaranteed to operate continuously at the manufacturers’ minimum submergence level stated in the Technical Data Sheet, without:
- formation of vortices, or
- over heating of the motor

**Noise**

If specified for dry well service or operating at minimum submergence, the Sound Pressure Level (SPL) of the pump unit shall not exceed 85dB(A) measured on a one metre radius and in accordance with AS1359.109.

**Vibration**

When operating at minimum submergence level and at a submergence of 20m head, the vibration of the pump unit shall not exceed the limits specified in AS1359.114, Grade N.
DESIGN

General Arrangement

The pump unit shall be a composite of the drive motor and the pump wetted end. The latter shall be joined to the former by means of an oil chamber housing containing the shaft sealing devices. The impeller shall be mounted on the one-piece motor shaft.

The whole unit shall be orientated shaft vertical with the motor above the pump.

If specified in the Technical Data Sheet for wet well service, the pump unit shall be supported on a separate discharge bend manufactured with integral mounting feet.

If specified in the Technical Data Sheet for dry well service, a mounting stool designed to accommodate a separate suction bend shall support the pump unit.

PUMP

Solids Handling Capacity

Unless otherwise stated in the Technical Data Sheet, the pump will be required to pump unscreened sewage. Unscreed sewage shall be deemed to include:

- frangible solids
- hard solids (e.g. grit, sand and stones)
- fibrous solids (e.g. rags, rope, and sanitary napkins)
- mineral and other oils.

The pump (impeller and casing ports) shall be non-clogging and non-ragging, designed to pass a sphere of the following minimum diameters:

<table>
<thead>
<tr>
<th>Discharge Port Diameter</th>
<th>Minimum Sphere Passing Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 100 mm</td>
<td>75 mm</td>
</tr>
<tr>
<td>150 – 300 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>350 mm and over</td>
<td>150 mm</td>
</tr>
</tbody>
</table>

Alternative sphere clearances to those stipulated above will be considered, provided evidence of reliable operation over time, in a similar environment, can be produced by the supplier, and endorsed by the end user.

Grinder type pumps are considered to not comply with the requirements of this Specification and are therefore a special case. Grinder type pumps will only be considered after consultation with South East Water Limited representatives.

Impeller

The impeller type shall be designed to pump raw un-macerated sewage and be of a proven design to provide non-ragging and non-clogging performance throughout its life.

In particular the impeller shall:

- be of an approved grade of cast iron (AS1830, Grade T220 or superior), and shall be accurately finished to reduce friction, leakage loss, and recirculation, to a minimum. Alternative materials having the same or better wear characteristics will be considered as an alternative.
- be dynamically balanced prior to assembly in accordance with AS3709, grade G6.3.
- have streamlined vanes designed to smoothly pass all solids noted in 4.2.2.1 above.
- have adjustable components or replaceable seal rings (refer Section 0) to enable the efficiency and capacity of the pump to be re-established at minimal cost and maximum intervals.
Casing
The pump casing shall comprise of a volute separate to the motor casing. The volute shall be manufactured to be easily removed for impeller inspection and cleaning.

The pump casing components shall be of an approved grade of flake-graphite grey cast iron (AS1830, Grade T250 or superior) or wear resisting high-chrome iron. Spheroidal graphite irons and carbon steels are not acceptable.

The volute wall thickness shall be sufficient to accommodate pressures up to 1.5 times the design head, after loss of 25% of the wall thickness due to erosion, etc.

If specified in the Technical Data Sheet for wet well service, a pump shall have a volute shaped so that the discharge nozzle aligns with the centreline of the pump, such that the pump induces a single plane moment only on the discharge support bend.

If specified in the Technical Data Sheet for dry well service, a pump shall have the volute incorporate in-built hand-holes to enable the operator access for impeller inspection (discharge ports DN250 and larger).

Wear Rings / Plates
Renewable sealing rings and wears shall be fitted to pumps with shrouded impellers.

Wear ring (s) shall: -

- be of dissimilar corrosion and erosion resistant materials and
- have a minimum hardness 50 Brinnell higher than the impeller sealing ring(s), to prevent galling during operation.

Pump / Motor Shaft
The shaft shall be machined from solid one-piece bar stock of stainless steel in accordance with AS1444, Grade 316 (or South East Water Limited approved equivalent) and have a ground finish over its entire length.

Other shaft materials with a proven history of reliable performance will be considered as an alternative to the grade of shaft stated above.

The shaft shall be designed such that:

- for fixed speed pumps, the first lateral critical speed is not less than 150% higher than the maximum operating speed of the pump,
- for pumps required to operate at varying speeds, the first lateral critical speed is not less than 300% higher than the maximum operating speed of the pump.

The first lateral critical speed shall be calculated for the maximum diameter impellers able to be fitted to the pump, without any support from wear ring (s) or neck ring (s).

The maximum lateral deflection of the shaft shall be determined to establish permissible internal clearances, taking into account all lateral hydraulic reactions on the impeller and any external loads.

Shaft Seal & Seal Chamber
Sealing of the shaft between the pump and motor shall be by independent hard faced mechanical seals contained within an oil bath or lubricated chamber providing sufficient cooling and lubrication of the seal faces to ensure optimum performance.

Each mechanical seal shall be: -

- of robust construction, designed to withstand the adverse operating conditions associated with sewage pumping and be
- guaranteed for a minimum life of 5000 hours under normal sewage pumping conditions. (i.e. 50% to 110% of BEP flow)

Seal face materials shall be: -

Top Seal Silicon Carbide / Graphite
Bottom Seal Silicon Carbide / Tungsten Carbide
Alternate configurations of seal materials utilising silicone carbide, tungsten carbide, and cemented carbide, will be considered provided the supplier guarantees in writing, the wear resistance (life) and sealing capacity of the configuration offered.

The seal chamber shall incorporate:
- oil fill and drain points and
- a leak detection device in pump units 7.5 kW and over, enabling water leakage past the lower mechanical seal to be detected, and an alarm signal generated.

Seals located in the pumped medium above the impeller do not comply with this requirement.

**Reverse Rotation**
All pump components shall withstand, without damage, the effects of reverse rotation due to reverse flow through the pump up to 120% of normal direction rated speed.

**MOTOR**

**General**
Generally, the motor shall be in accordance with the requirements of AS1359 and be of type tested design. Motors shall be capable of sustaining a minimum number of starts per hour in accordance with the following table:

<table>
<thead>
<tr>
<th>Limiting Motor Rating (kW)</th>
<th>Maximum Starts Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 15</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 15</td>
<td>8</td>
</tr>
</tbody>
</table>

It is assumed for the figures stated above, that the starts occur generally evenly spaced over the hour. i.e. 12 starts per hour occurring approximately every 5 minutes.

The motor shall be:
- 415V, 50Hz, 3 phase, 4 pole or greater (6 or 8 pole) induction type with a maximum synchronous speed of 1500 rpm, unless otherwise stated in the Data Sheet.
- rated IP68 for submerged operation, in accordance with AS1939,
- resistant to corrosive gases such as may be found in municipal sewers (e.g. methane, hydrogen sulphide),
- suitable for direct-on-line and reduced-voltage starting, using either star delta, auto transformer, electronic soft starter/soft stop or VSD types and
- have an earthing terminal provided within the power supply terminal box.

The motor manufacturer shall be informed if the motor is to be used in conjunction with a VSD of PWM type so that the manufacturer can take into account the increased level of harmonic currents and the increased voltage stress on the insulation. Motor windings shall have an impulse withstand voltage rating and a dV/dt rating engineered to the characteristic output of the VSD and the length of cable between the motor and VSD. Furthermore, the motor manufacturer and remedial measures taken to offset any detrimental effects shall take the effects of common mode currents flowing through the bearings into account.

The locked rotor current shall not exceed a maximum of 7 times the rated full-load current.

Although submersible pumps are not subject to the new legislation relating to high efficiency motors, South East Water Limited selects pumps based on “Whole Of Life Costs”, and therefore urges all suppliers of submersible equipment to embrace the legislation and supply high efficiency submersible motors.

**Housing**
The motor housing shall be designed to withstand submergence to a depth of 20 metres head without leakage.
The motor casing shall incorporate lifting brackets or lifting eyes to AS2317 for ease of installation. The pump unit when suspended shall hang vertically at an attitude enabling easy engagement / disengagement of the pump onto the pump pedestal mounting claw and sealing face.

**Cooling**
The motor shall be designed and adequately rated to operate in air with convective cooling, i.e. without additional cooling effect due to immersion in the fluid.

Motors shall be rated to not overheat during continuous operation under any hydraulic conditions, including non-submerged conditions.

**Protection**
The motor shall be protected from overheating by either:
- a minimum of one (1) positive temperature coefficient (PTC) thermistor, embedded in each of the three (3) stator windings. Each thermistor to be connected in series to terminals adjacent to the stator terminals and encapsulated and compatible with the motor selected or
- resistance temperature detector (RTD) elements (100 Ω).

Alternative protection devices will be considered provided anecdotal evidence is available from 3rd party users as to their suitability.

A moisture detection device shall be fitted in the motor stator housing, and the cable termination housing if fitted.

**Insulation**
Winding insulation temperature rating shall be not less than that specified as Class F to AS2768.

**Cables & Motor Entry Glands**
Cables shall be flexible, multi-core, insulated, sheathed and suitable for immersion in industrial as well as domestic sewage. Cables shall comply with AS5000.1.

The contractor shall ensure that cables are configured to support the starting method referred to in the Technical Data Sheets.

Cables incorporating additional cores for RTD / thermistor protection and moisture detection shall have the additional cores provided with secondary sheaths.

All cables entering the motor are to be glanded to a single demountable flange.

The length of electrical cable required for each motor shall be 15 meters unless stated differently in the Technical Data Sheet.

Motors specified for VSD operations shall have screened cables with no less than 85% optical screening.

**Bearings**
The motor bearings shall be:
- of metric dimensions,
- fully sealed and pre-greased,
- designed for a $L_{10}$ Rating Fatigue Life of at least 70,000 hours at the maximum operating speed and
- be stocked in Melbourne by specialist bearing suppliers.

Bearing mountings shall be designed to allow for variations in shaft temperature.

Thrust bearings shall be fitted to take all axial loads due to hydraulic thrust.

**Protective Coatings & Surface Treatments**
The pump design shall be such that the corrosion protection is fully effective for all surfaces exposed to sewage or sewer gases. All surfaces that cannot be coated and tested shall be of corrosion resistant material.
The design of all components shall be such that a polymer coating can be applied and tested fully for conformity with AS4158. The coating shall be continuous across the full width of all joints, gaskets and seals.

Surface coatings shall be applied after all hydrostatic testing has been completed.

Auxiliary items, unless they are manufactured from corrosion resistant materials, shall be hot-dip galvanized to AS4680 or coated with a protective coating to AS4158.

**ANCILLARY ITEMS**

**Discharge Support**
If specified in the Technical Data Sheets, each pump intended for wet well service shall be supplied with a discharge support designed with the following features:

- a support foot suitable for bolting to the pump well floor, capable of resisting all static and dynamic loads induced by the pump and discharge pipe work.
- a de-coupling ‘duck-foot’ joint able to be manipulated from the top of the pump well by lifting or lowering the pump, without the need of special devices, and able to maintain a leakage free seal between pump and pipe work during all operational conditions.
- an anchor point for mounting of vertical guide rail, located to ensure that the pump can be raised and lowered in the pump well without lateral deviation and
- a vertical flanged discharge port

**Guide Rails**
As specified in the Technical Data Sheets the pump shall also be supplied with guide rails to suit the standard dimensions for the pump pedestal. The guide rails shall be designed to permit the pump to slide freely and seat correctly when lowered into the working position.

**Brackets**
If specified in the Technical Data Sheets brackets shall be provided to support and attach the guide rails to the wet well wall. Each pump shall be supplied complete with:

- a top mounting guide rail brackets and
- intermediate mounting guide rail brackets suitable for connection to discharge pipe work flanges. The brackets shall be sufficient in number to ensure excessive loads are not placed on the guide rails, but not less than required for 3.0 metre centres.

**Suction Bend & Mounting Stool**
The suction bend shall be manufactured from the same material as the pump.

The mounting stool shall be manufactured from cast iron (grade as per the pump volute) or stainless steel in accordance with AS1444, grade 316L.

**Bolts, Screws & Dowels**
All bolts, nuts, studs and screws shall be manufactured from materials that are electrolytically compatible with the components being secured and shall be designed to comply with AS1111 and AS1112. Stud bolts shall not be used unless required for tapped holes.

**Flanges**
Suction and discharge branches shall have a pressure rating not less than the pressure rating of the casing.

Discharge flanges shall be drilled to AS 2129 Table ‘E’.

Pipe flanges shall comply with the requirements of AS4087, for sizes within the range covered by the appropriate table, and shall be machined full face or include an ‘O’ Ring groove or a raised face as listed in the Technical Data Sheet.
Pipe flanges sizes and rating outside the scope of AS4087, or flanges requiring special dimensions and drilling to match existing pipe work, shall have:

- Flange dimensions, face sealing and drilling as detailed in the Technical Data Sheet.
- Flange thickness determined by the Contractor in accordance with AS1210. In other respects AS4087 shall apply.

The backs of flanges shall be machined or spot faced for the seating of bolts and nuts.

**Nameplates**

A nameplate manufactured from stainless steel to AS1449, grade 316 and shall be affixed to the body of the pump unit by means of suitable stainless steel screws. The nameplate shall be stamped or engraved with the following information:

- Model / Type Descriptor
- Serial Number
- Rated Speed & Direction Of Rotation
- Duty Point
- Impeller Diameter (fitted)
- kW Rating
- Voltage
- Locked Rotor & Full Load Current
- Power Factor
- Class Of Insulation
- Degree Of Protection
- Total Weight
- Date Of Manufacture

A second identical nameplate shall be supplied loose.

Motors with thermistors or RTD’s fitted shall be supplied with (loose) warning labels;

**WARNING: THERMISTORS OR RESISTANCE TEMPERATURE DETECTORS INSTALLED, DO NOT MEGGER.**

**MANUFACTURING**

**Materials**

**General**

Where a specific material for a component has not been stated in this document, materials for manufacture shall be as listed in the Technical Data Sheet.

**Preferred Material Grades – Castings**

Preferred grades for cast materials stated in the Data Sheet are:

1. Grey Cast Iron  
   - AS1830, grade T220 or better.
2. Austenitic Iron  
   - AS1833, grade S-Ni Cr 20 2.
3. Stainless Steel  
   - AS2074, grade H6C.
4. Carbon Steel  
   - Not a preferred material.
5. Spheroidal Graphite Iron  
   - Not a preferred material.

Alternative materials with a proven history of reliable service to those stated in 1 to 3 above will be considered as an alternative to those specified.

The responsibility lies with the supplier to prove to South East Water Limited that the materials offered, will provide the same or better reliability than the materials specified.

Castings shall be close and uniform in grain, homogeneous and free from blowholes, porosity, shrinkage, cracks and other injurious defects. Filling of holes shall not be permitted unless allowable under Australian Standards. Castings shall be properly cleaned and fettled and all lumps and rough areas smoothed.
Stainless Steel
Stainless steel plate and bar subjected to welding during the manufacture of any component shall be a low carbon and stabilized grade such as AS1449, grade 316L. All welding shall have passive treatments carried out once the fabrication is completed.

Stainless steel casings shall be a stabilized grade in accordance with AS2074, grade H6C.

Stainless steel in shafts, spindles or similar shall comply with AS1449, grade 316 or better.

Graphite greases, graphite packing and graphite compounds shall not be used in contact with stainless steel.

Mild Steel
Mild steel shall conform to AS3679.1, grade 250.

Seals
Material for seals, other than mechanical seals, shall be natural rubber, synthetic polyisoprene or a mixture of natural rubber and nitrile rubber. The rubber hardness shall be as required by the seal design for the pressure specified and, if required, shall be reinforced with Kevlar fabric.

Subject to the approval of South East Water Limited, other elastomers with durability and mechanical properties at least equivalent to the materials specified may be substituted.

‘O’ Rings
‘O’ Rings for flanges shall comply with AS4087. ‘O’ Ring sealing components shall comply with the relevant sections of AS1646 and AS2842.

Machining
Machining shall be concentric, square to line and true. All sharp edges and burrs shall be removed.

Bolt holes shall be drilled and spot faced for bolt head and nut. Mating parts shall be match marked.

All components and the assembled rotating element shall be interchangeable for pumps of the same type, designation and size.

Bosses shall be provided for all tapings. The use of setscrews in castings shall be avoided. Dowels shall be provided between components requiring accurate locating in position.

INSPECTION AND TESTING

MATERIALS
The Contractor shall carry out material testing as required in the Technical Data Sheet.

All materials testing shall be carried out by a testing laboratory accredited by the National Association of Testing Authorities (NATA) for the class of test being undertaken, and, if required, shall be witnessed by a representative of South East Water Limited.

Materials and/or components specified as requiring testing shall not be used in the work without prior approval of South East Water Limited.

WORKSHOP ASSEMBLY
If specified in the Technical Data Sheets that works inspection(s) is/are required to be carried out by South East Water Limited, the pump unit shall be progressively assembled in the Contractor’s works in such a way that the fitting of all parts and all essential movements can be checked.
TYPE TESTS
The Contractor, if requested to do so, shall provide ‘Type Test Certificates’ for type and size of submersible pump supplied. Where ‘Type Test Certificates’ are not available the Contractor shall perform and document type tests at the Contractor’s works on the first submersible pump of each design. Type tests shall include the following minimum requirements:
- temperature rise,
- momentary overload,
- high voltage,
- efficiency,
- power factor,
- DOL locked rotor starting current and
- DOL locked rotor torque.

Flow, head, power, vibration (if feasible), and other required parameter measurements shall be taken at several flow rates to provide definable smooth curves for Head, Efficiency, Pump Absorbed Power and Motor Electrical Power (all versus Flow Rate) extending from zero flow to the maximum achievable flow required. The test flow rates shall include:
- zero flow,
- the guarantee point,
- any secondary duty points,
- maximum achievable flow.

If required by the Technical Data Sheet, tests to determine the pump’s NPSHR shall be conducted. NPSHR testing shall be carried out at a minimum of five (5) flow rates, equi-spaced between zero flow and the maximum achievable flow (one point to include the latter flow).

The performance of each pump shall be tested using the motor to be supplied under the contract. All tests shall be conducted in accordance with AS2417, AS1359.109 and AS1359.114 as applicable and may be witnessed by a South East Water Limited representative. The Contractor shall give a minimum of three (3) working days notice of commencement of tests. An interim copy of the test sheets shall be submitted to South East Water Limited immediately following the tests.

SITE PERFORMANCE/COMMISSIONING TESTS
Test Requirements
The Contractor shall, if requested in the Technical Data Sheets, carry out site based performance/commissioning tests to demonstrate the suitable of the pump unit for the intended service. The tests shall include:
- checks for mechanical damage to the pump unit, including corrosion protection systems,
- demonstration of the mechanical operation of raising and lowering apparatus,
- electrical integrity of cabling and motor,
- measurements of flow, head and power at flows approximating those used for the works tests,
- checks for formation of vortices at minimum submergence,
- checks for excessive vibration at minimum submergence, and
- checks for excessive noise.

An interim copy of the test sheets shall be submitted to South East Water Limited immediately following the tests.

Test Officer
The Contractor shall nominate a test officer for the duration of the tests, who shall be responsible for:
- the submission of the Test Plan, Procedures & Method Statements,
- the conduct of the tests,
- recording / analysis of results and
- the submission of the Contractor's Test Report to South East Water Limited for acceptance.
Unless stated otherwise in the Technical Data Sheets the Contractor shall provide all test instruments, excepting flow meters. All instruments shall be calibrated by a NATA certified testing authority as required by the Australian Standards.

**ANALYSIS & PRESENTATION OF TEST RESULTS**
Comparisons between test results and guaranteed performance will be made in accordance with AS2174 and AS1359.33.

**REJECTION OF PUMP UNITS**
South East Water Limited may reject the pump unit should the performance during works tests:

- fall outside the specified limits for the guarantee point or secondary duty points,
- fail to operate at the maximum achievable flow,
- fail to meet the guarantees for NPSHR or vibration and
- indicate poor mechanical or electrical design or manufacture.

South East Water Limited may reject the pump unit should the Contractor not satisfy South East Water Limited during pre-commissioning, that the pump unit meets the specified service requirements.

**WARRANTY PERIOD**
Any defects developed within a period of twelve (12) months from the date of commissioning, or 18 months from delivery whichever the sooner, other than fair wear and tear, shall be rectified by the Contractor on receipt of notice from South East Water Limited and at no cost to South East Water Limited.

**PACKING, TRANSPORTATION & DELIVERY**

**LABELS & MARKINGS**
All items shall be individually labelled prior to packing. Labels shall include the following information:

- Property of South East Water Limited
- Contact Number
- Item / Part Number

Where items are manufactured for specific mating component parts, they shall all bear individual identification numbers and reference to the mating part identification numbers.

**PACKING**
All items shall be individually packaged for long-term storage in a tropical environment, with external labelling

Crating of items for transportation shall be designed and constructed to withstand the loads imposed during transportation. Goods received in damaged packaging or crating may be returned to the Contractor for re-manufacture and/or re-inspection and testing.

Crates shall be clearly marked in black-stencilled lettering with the following information:

- Consignee's name and delivery address as given in the Contract,
- Consignor's name and contact point and contact number.

**SPARE PARTS & TOOLS**
The Contractor shall supply and deliver one (1) complete set of any special tools required for the dismantling, service and re-assembly of the pump unit.
DOCUMENTATION

The Contractor shall prepare and supply drawings, installation, operation and maintenance documentation.

The manuals and technical data sheets shall fully describe all specified equipment and clearly show its mode of operation and, as a minimum, contain the following information:
- a concise description of each pump type and ancillary equipment, together with a complete performance specification,
- a concise description of the mode of operation of each part or sub-system,
- procedures for installation and commissioning of each part or sub-system,
- procedures to be followed for testing, maintenance and faultfinding. The faultfinding table shall list fault indication, possible causes and remedies.
- special precautions to be taken in replacement and/or adjustment of each item,
- a comprehensive routine maintenance and testing program based on that recommended by the manufacturer,
- a spare parts list for all items plus component assembly drawings of the pump and ancillary equipment,
- a list of supplier’s names and addresses to enable any parts to be ordered correctly,
- any other information or instructions necessary to fully operate and maintain the equipment in a complete and satisfactory manner and
- a set of pump assembly drawings on CD format.

APPENDICES

TECHNICAL DATA SHEETS

NOTE:
If the pumps being quoted are fully described in a catalogue that the consultant has previously handed to a mechanical engineer at South East Water / 'us' – Utility Services you only need to specify the complete model number; there is no need to also fill in the Technical Data Sheets attached to this Appendix unless the information is not described in the pump catalogue.
## Project Title

### Pump Descriptor

#### Section 1 - General

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<table>
<thead>
<tr>
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#### Section 2 – Pump Hydraulic Design

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<td>Suction Eye Area</td>
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<td>2.3</td>
<td>Impeller Free Passage</td>
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<td>2.4</td>
<td>Impeller Diameter</td>
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#### Section 3 – Pump Mechanical Design

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<td>Clearing Vanes Fitted?</td>
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<td>Fixing Method/Material</td>
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<td>Stationary Face Material</td>
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<td>Spring(s) Material</td>
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### Section 4 – Motor Electrical Design

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<td>Power Factors</td>
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### Section 5 – Motor Mechanical Design

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<td>Temperature Rise At Full Load</td>
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### Section 5 – Components

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### Section 6 – Inspection & Testing

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**Section 8 - Documentation**

| 8.1 | Certified Drawings |  |
| 8.1.1 | General Arrangement | Within 2 Weeks of Placement of Order |
| 8.1.2 | Sectional Arrangement | Within 2 Weeks of Placement of Order |
| 8.2 | Certificates |  |
| 8.2.1 | Materials | Prior To Delivery |
| 8.2.2 | Hydrostatic | Prior To Delivery |
| 8.2.3 | Performance | Prior To Delivery |
| 8.3 | Operation & Maintenance Manuals | Prior To Delivery |

**Section 9 – Spare Parts & Tools**

| 9.1 | Spare Parts & Tools | Tenderer To List Items Included in the Tender |
## Performance Sheet

### Project Title

### Pump Descriptor

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<tr>
<th></th>
<th>Guarantee Point</th>
<th>Secondary Duty 1</th>
<th>Secondary Duty 2</th>
<th>Secondary Duty 3</th>
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<td>Offered</td>
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<td>Head (m)</td>
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<td>NPSHR (m)</td>
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<td>KWh/1000litres</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed (RPM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Pump Submission Sheet**

### 9.3 Pump Submission Sheet

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Option A</th>
<th>Option B</th>
<th>Option C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pumps</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impeller Dia Short Term 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impeller Dia Ultimate 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throughput size (Sphere Clearance) Impeller 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throughput size (Sphere Clearance) Impeller 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Efficiency Short Term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Efficiency Ultimate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rating (shaft power)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current – full load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current - start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Efficiency at full load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Efficiency at 3/4 load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Efficiency at 1/2 load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Permissible Starts per hour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight of complete unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lifting equipment (Chain and Shackels grade etc.)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discharge pipework dia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pump width</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pump length</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Pump Separation Recommended</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Well diameter required</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recommended minimum access opening for pumps</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Supply Cost (excl GST)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short Term – 2 pumps c/w disch bend, guide rail brackets etc.</strong></td>
</tr>
<tr>
<td><strong>Ultimate – 2 new impellers</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Operation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Duty Point</strong></td>
</tr>
<tr>
<td><strong>Running current at duty point - Amps</strong></td>
</tr>
<tr>
<td><strong>Shaft KW at duty point</strong></td>
</tr>
<tr>
<td><strong>% of Motor Rated Power at Duty Point</strong></td>
</tr>
<tr>
<td><strong>Overall Efficiency at Duty Point</strong></td>
</tr>
<tr>
<td><strong>BEP flow at Duty Point</strong></td>
</tr>
<tr>
<td><strong>% of BEP flow at duty point (must be between 55% and 110%)</strong></td>
</tr>
<tr>
<td><strong>Expected pump life at BEP in hrs</strong></td>
</tr>
<tr>
<td><strong>Expected pump life at This Duty Point in hrs</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Final Duty Point</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Running current at duty point - Amps</strong></td>
</tr>
<tr>
<td><strong>Shaft KW at duty point</strong></td>
</tr>
<tr>
<td><strong>% of Motor Rated Power at Duty Point</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Overall Efficiency at Duty Point</td>
</tr>
<tr>
<td>BEP flow at Final Duty Point</td>
</tr>
<tr>
<td>% of BEP flow at duty point</td>
</tr>
<tr>
<td>Expected pump life at BEP in hrs</td>
</tr>
<tr>
<td>Expected pump life at This Duty Point in hrs</td>
</tr>
<tr>
<td>Cost of Major repair from seal failure</td>
</tr>
<tr>
<td>Minimum Submergence for pump offered</td>
</tr>
<tr>
<td>Starts per hour (max)</td>
</tr>
<tr>
<td>Estimated Maintenance and Repair Costs Based on 25% run time p.a. (3 hrs per day for each pump)</td>
</tr>
<tr>
<td>1100 hrs per year</td>
</tr>
<tr>
<td>Analysis by South East Water</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>SEWL</td>
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<td>SEWL</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>SEWL</td>
</tr>
</tbody>
</table>

*Items thus marked are to be completed by the supplier*

Power Cost  per KWhr  0.18
APPENDIX D - SECURITY

SPECIFICATION NAME:  Security Fencing

SPECIFICATION NO:  03-02.
Issue Date: March 2003

Endorsed by:
South East Water ABN 89066902547

ACKNOWLEDGEMENTS
South East Water acknowledges the following source documents in the preparation of the specification:

- Australian Standard AS1725-1995 – Galvanised rail-less chainwire security fences and gates

DISCLAIMER
"South East Water excludes all liability to all persons and all conditions and warranties, which are express or implied at law (including under statute). Where liability and conditions and warranties cannot be excluded at law, the liability of South East Water is limited at their choice, to resupplying the Specification 03-02 or paying the cost of resupplying the Specification 03-02.

Please note that the Specification 03-02 or information contained within the Specification must only be used in conjunction with the Australian Standard AS1725-1995.

Further, the Specification may be periodically updated.

INFORMATION
For information and advice and to advise of possible errors, omissions and changes required for future revisions please contact Mr Alan Watts on 03 9552 3641

Scope
This specification details specific requirements for weldmesh and galvanised chainwire security fences and gates. This specification is to be read in conjunction with AS1725-1995 – Galvanised rail-less chainwire security fences and gates.

Application
This specification is applicable to the manufacture and erection of security fences and gates at sewer and water asset sites, where restricted access is desirable.

Definitions
Refer to Australian Standard AS 1725-1995 Clause 1.3 for details.
Materials

Weldmesh fence type
Materials used in the construction of the fence shall comply with the following requirements:
- Weldmesh to be WG523, in 2400mm high panels, which is bolted or riveted to post. All bolts to be buried to stop removal.
- Fence to be topped with 2 strands of high tensile barbed wire. An optional requirement is top with 470mm flat loop short barbed tiger tape.
- Materials to be black powder coated, including tiger tape, but excluding the barbed wire.
- Posts shall be min 50mm dia at maximum 3000mm centres.
- Rail top and bottom shall be minimum 32mm dia.
- Post foundations shall be 750mm deep and 250mm dia.
- All concrete foundations shall finish 50mm below ground level.
- Where fence is located on a batter, infill panels are required where the gap below the bottom rail exceeds 50mm.
- Where stepping of panels is required, additional tiger tape shall be placed at the posts, to prevent unauthorised entry.
- Weldmesh to be buried a minimum of 100mm below ground level.
- The site shall be left clean and tidy.
- All disturbed areas shall be topsoiled and regressed.

Chainwire fence type
Materials used in the construction of the fence shall comply with the following requirements:
- Fence to be topped with 2 strands of high tensile barbed wire. An optional requirement is top with 470mm flat loop short barbed tiger tape.
- Materials to be black powder coated, including tiger tape, but excluding the barbed wire.
- Posts shall be min 50mm dia at maximum 3000mm centres.
- Post extension shall be cranked.
- Rail top and bottom shall be minimum 32mm dia.
- Post foundations shall be 750mm deep and 250mm dia.
- All concrete foundations shall finish 50mm below ground level
- The site shall be left clean and tidy.
- All disturbed areas shall be topsoiled and regressed.

Restraining and Locking of Gates
Materials used in the construction of the gate shall comply with the following requirements:
- Single gates to be 1000mm wide.
- Double gates to be 4000mm wide.
- Gates to be provided with a 16mm dia locking drop bolt, which is secured into the ground via a 25mm dia long sleeve, encased in concrete minimum dia 300mm.
- Gates to be provided with galvanised high tensile chain and padlock to South East Water master key.
### APPENDIX E - DESIGN CHECKLIST

**Design Audit for Sewerage Pumping Station and Pressure Main.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Complete</th>
<th>Date / Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WET WELL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Design Capacity minimum 2hr @ PDWF provided. Clause 4.5.5.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Computations for flotation confirm minimum FS of 1.1. Clause 4.4.3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Coating of concrete surfaces specified Clause 4.1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Top slab to incorporate all below ground structures. Clause 4.5.3.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Wet well shall be self draining. Clause 4.5.3.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Covers in accordance with Clause 4.5.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Minimum wet well diameter complies. Clause 4.5.2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cut in Cut out volumes comply. Clause 4.5.2.2</td>
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<tr>
<td>9. Wet well washers comply. Clause 4.5.11</td>
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<tr>
<td>10. Concrete strength specified. Clause 4.5.3.2</td>
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</tr>
<tr>
<td>11. Clearance from overhead power lines. Clause 4.7.3</td>
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</tr>
<tr>
<td>12. Ladders comply with standard Drawing SEWL_STD_005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Penstock complies. Clause 4.5.1.2 and Standard Drawing SEWL_STD_000</td>
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<td></td>
</tr>
<tr>
<td>14. Pipe work complies. Clause 4.6.1.1</td>
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<tr>
<td>15. Pipe supports comply with standard drawing SEWL_STD_002 and clause 4.6.3.3</td>
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</tr>
<tr>
<td>16. Pump well inlet pipe complies with clause 4.5.2.1(h)</td>
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<td></td>
</tr>
<tr>
<td>17. Computations for pump selection inclusive of NPV. Clause 4.2.3</td>
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</tr>
<tr>
<td>18. Approved pumps. Clause 4.2.3</td>
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<tr>
<td><strong>EMERGENCY RELIEF STRUCTURE</strong></td>
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<tr>
<td></td>
<td>Complies with Standard drawing SEWL_STD_061 and clause 4.5.5.3.2</td>
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</tr>
<tr>
<td><strong>VALVE CHAMBER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pit Accessible. Clause 4.6.3.1</td>
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<td></td>
</tr>
<tr>
<td>2. Pipe supports comply with. Clause 4.6.3.3</td>
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</tr>
<tr>
<td>3. Pressure main tapping’s in accordance with Clause 4.6.3.4</td>
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<td></td>
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<tr>
<td>4. Ladders comply with standard drawing SEWL_STD_005</td>
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</tr>
<tr>
<td>5. Operation of valves without need to remove cover. Clause 4.6.3.1</td>
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<td></td>
</tr>
<tr>
<td>6. Chamber is self-draining. Clause 4.6.3.1</td>
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<tr>
<td>7. Valves Clockwise closing. Clause 4.6.2</td>
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</tr>
<tr>
<td>8. Pipework and fittings comply with Clause 4.6.4.8.1</td>
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</tr>
<tr>
<td>INFRASTRUCTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>1. Water supply in accordance with clause 4.8.1.1</td>
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<td></td>
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<tr>
<td>2. Lighting in accordance with clause 4.8.1.3</td>
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</tr>
<tr>
<td>3. Access Road in accordance with clause 4.7.3</td>
<td></td>
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</tr>
<tr>
<td>4. Bollards in accordance with clause 4.5.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Switchboard location complies with clause 4.7.8</td>
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</tr>
<tr>
<td>6. Termination of generator connectors comply with clause 4.3.4.6</td>
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<tr>
<td>7. Telemetry mast complies with clause 4.4.5</td>
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<tr>
<td>8. Site drainage complies with clause 4.8.1.5</td>
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<table>
<thead>
<tr>
<th>PRESSURE MAIN</th>
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</thead>
<tbody>
<tr>
<td>1. Minimum pipe class as per clause 4.6.4.8.2</td>
<td></td>
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<tr>
<td>2. Computations verifying velocity complies with clause 3.5.3</td>
<td></td>
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<tr>
<td>3. Discharge MH copies with clause 4.6.8</td>
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<tr>
<td>4. Air valve complies with clause 4.6.2 &amp; 4.6.5.2 and standard drawing SEW_STD_060</td>
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<tr>
<td>5. Scour Valve assembly complies with standard drawing SEW_STD_060</td>
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</table>
APPENDIX F - SUBMISSION OF PRECOMMISSIONING DOCUMENTATION

SOUTH EAST WATER PRE-COMMISSIONING CHECKLIST FOR NEW ASSETS

WASTE WATER SITES

REQUIREMENTS BY CONTRACTOR
The following checklist is required to be fully completed, signed and returned to South East Water before a joint commissioning is considered.

Please note: in the event of a commissioning being abandoned due to works not completed or operational, South East Water will recover costs incurred.

STATION NAME:_________________________  STATION NO:___________

- Supply Authority Power available  Yes □ No □
- Provision of sufficient water for all testing purposes  Yes □ No □
- Fresh water discharge flushing system operating as per design  Yes □ No □
- Ancillaries (GPO’s, lighting etc) tested and working correctly  Yes □ No □
- Telemetry radio survey completed satisfactorily  Yes □ No □
- Station telemetry points list supplied  Yes □ No □
- Established telemetry communications and verified inputs locally  Yes □ No □
**VERIFICATION OF AS CONSTRUCTED LEVELS AND OPERATION.**

Note: Levels taken from well cover down

<table>
<thead>
<tr>
<th>Setting/Alarm</th>
<th>Measurement</th>
<th>Operational function (contractor to verify correct operation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spill alarm</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>H/L back up pump 2 start</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>H/L back up pump 1 start</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>High level alarm</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>H/L pump cut out/ Transfer</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Duty pump cut-in</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Duty pump cut out</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Low level alarm (indication only)</td>
<td>M</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Wet well level indicator</td>
<td></td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Level controller span</td>
<td>0-……… M</td>
<td></td>
</tr>
<tr>
<td>Level controller datum</td>
<td>MAHD</td>
<td></td>
</tr>
</tbody>
</table>

Level settings according to design  Yes ☐ No ☐ NA ☐
PROCEDURE FOR PERFORMANCE TESTING OF PUMPS

Contractor to complete for all pumps :-

Gauge RDG  Date of test  ____/____/____

H  Pump No ___________.
D

Pump make/model:

Electric motor kw _________SPEED_________

Serial no: _________

Measure inside diameter of well: -D = _______m

Kilowatt hour meter constant: K = ____m

(A) QUICK CHECK OF GENERAL CONDITION
Run pump for one minute with the delivery valve closed and record :-
Delivery Gauge reading H_D = ____________ m, Height Correction H_C = ____________ m

Time for disc on kilowatt hour meter to do 2 revs = __________ secs

(B) NORMAL EFFICIENCY TEST
1. CALCULATE PUMP TOTAL HEAD (T_H)  Delivery Gauge Reading H_D = ____________ m
   Gauge Height Correction H_C = ____________ m
   Total Head = H_D + H_C  T_H = ____________ m

2. KILOWATT INPUT TO PUMP/MOTOR (Pa)
   With only the test pump running, time say 10 revs of the Kilowatt-hour Meter disc then determine average time per rev.
   Kilowatt Input = 3600  PA = _________ kw
   K x Time per rev

3. PUMP FLOW RATE (Q)
   If flow meter installed measure flow over an accurate time on most sites a volumetric drawdown test will be required.

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Measure water level in well before start  \( L_1 = \) ________________ m

After pump has stopped measure again  \( L_2 = \) ________________ m

Drawdown = \( L_2 - L_1 \) over a measured time of  \( T = \) ______ secs  Drawdown  \( L = \) ________________ m

Volume pumped = \( \frac{\pi \times (D/2)^2 \times L \times 1000 \text{ litre}}{V} \) litre

Pump Flow Rate (\( Q \)) = volume/Time run (\( V/T \))  \( Q = \) ________________ litre/sec

4. **THEORETICAL POWER INPUT (\( P_T \))**

\[
= 9.8 \times Q \times \frac{T}{\text{KW}}
\]

\( PT = \) ________________ kw

5. **OVERALL EFFICIENCY OF PUMP/MOTOR**

\[
\text{EFF'Y} = \frac{\text{THEORETICAL Power} \times 100\%}{\text{ACTUAL}}
\]

\( PT \times 100\% \) EFF'Y = ________________%

Should be: ________________%

Pressure gauges calibrated according to QA requirements:-  Yes □ No □

Pump performance satisfactory:-  Yes □ No □

Test performed by :-______________________________

Pump performance results as compared to tender offer- satisfactory- Yes □ No □

General Contractor Comments:

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

All information has been supplied and verified ready for Commissioning

_/ /
Signed (Contractor)  Date

______________________________
Print name

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**Note:** The telemetry is to be fully ready for commissioning day (refer South East Water supplementary manual for requirements)

-----------------------------------------------------------------------------------------------------------------

**South East Water use only**

<table>
<thead>
<tr>
<th>Description</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level information and Operational function satisfactory</td>
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<td></td>
</tr>
<tr>
<td>Pump performance results as compared to tender offer satisfactory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump motor information readings satisfactory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telemetry commissioned satisfactorily</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General South East Water Comments:

-----------------------------------------------------------------------------------------------------------------

-----------------------------------------------------------------------------------------------------------------

-----------------------------------------------------------------------------------------------------------------

All information has been supplied and verified at Contractor Pre-commissioning

/ /

Signed (South East Water) Date

----------------------------------------------
Print name
### APPENDIX G - COMMISSIONING CHECKLIST

#### Commissioning of Civil Works

<table>
<thead>
<tr>
<th>Item</th>
<th>Complete</th>
<th>Date / Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Management

1. Verify that consultant has provided all documentation. (as constructed details, operating manuals, test results etc)  
   - If NO then close audit.

#### Concrete

1. Verify that the concrete slab is flush with the finished surface level.
2. Verify that there is no damage to any exposed concrete surface.
3. Verify that the top slab does not affect the drainage of the site.
4. Verify that the surface dimensions of the top slab are in accordance with the design drawings.
5. Verify that the below ground concrete structures are dimensionally correct and in accordance with the design drawings.
6. Verify no leakage through the concrete structure.
7. Verify the verticality of the structure is within tolerance in accordance with SOUTH EAST WATER specifications.
8. Verify that all chamfers are provided in accordance with the design drawings.
9. Verify that the pump well benching has been provided in accordance with design drawings.
10. Verify that the specified coating to the walls has been applied in accordance with the design drawings.(extent/coverage)

#### OH&S

1. Verify that ladder access to wet well meets OH&S requirements.
2. Verify that ladder access to valve chamber meets OH&S requirements.
3. Verify that all ladders are provided with the extension above the FSL.
4. Verify that the ladders have non-slip treads.
5. Have safety cages been specified
6. Verify that safety cages have been installed in accordance with the design drawings.
7. Verify that adequate distance between wet well opening and switchboard is in accordance with OH&S requirements.
8. Verify that adequate set down areas for the covers has been provided in accordance with OH&S requirements.
9. Verify that no overhead cables restrict access via crane trucks.
### Products & Materials

1. Verify that all products incorporated on the project are approved by South East Water

2. Verify that all markings as required by South East Water specification are visible on the covers

3. Verify that the covers and frames are greased in accordance with the manufacturer's requirements.

4. Verify that the interchangeable multi part covers have lifting lugs on the beams for removal and covers have clockwise lifting key holes.

5. Verify that South East Water approved penstock stuffing box is installed.

### Pipes and Fittings

1. Verify that the valves are clockwise closing

2. Verify that adequate supports have been provided for the valves.

3. Are valve extension spindles required. (includes penstock) / NA

4. Are adequate supports provided in accordance with South East Water standard drawings. / NA

5. Verify that DICL pipe work has been provided to correct DN.

6. Verify that adequate supports for vertical pipe work has been provided. (i.e. vibration not noticeable when pumps operating)

7. Verify that all gate valves operate through the full range and are left in the open position.

8. Verify that a flap valve has been installed on the valve chamber drain.

9. Verify that bleeders have been installed on the NRV's

10. Verify that the specified pressure gauges have been installed in the valve chamber.

11. Verify that the South East Water specified coating for all valves has been applied.

12. Verify that the South East Water specified coating for the pipe work has been applied.

13. Verify that the pipe work for the incoming sewer is in accordance with the design drawings.

14. Verify that the specified bolting system on the flanges has been used.

15. Verify that all valves can be removed through the available cover opening.

16. Verify that uni-flanges have been provided to allow ease of removal of valves in accordance with standard drawings.

17. Verify penstock installed as standard drawings.

### Other Services

1. Verify that the water service has been fitted with an approved back flow prevention device and hose reel in cabinet.

2. Verify that all conduits through the top slab have been sealed to prevent odour escaping.

3. Verify that electricity is below ground, not above.
4. Verify that the access track is in accordance with the design drawings.

5. Verify that adequate site drainage has been provided.

6. Verify that wet well washers have gate valves and regulators fitted.

### Restoration

Verify that the site restoration has been completed.

### Testing

1. Verify that pump well infiltration test passed.

2. Verify that pump draw down tests passed.

### Mechanical Equipment.

1. Verify that the guide rails comply with the standard drawings.

2. Verify that the lifting chain complies with South East Water specification.

3. Verify that the Pump footstool has been secured to wet well floor with appropriate chemical anchors.

4. Are wet well washers specified on design drawings?

5. Verify that they meet the South East Water specified requirement.

### Electrical Equipment.

1. Verify that the Station Identification plaque has been fitted to the electrical cabinet.

2. Verify that the telemetry aerial has adequate protection in accordance with South East Water specification.

3. Verify that external lighting over the switchboard has been provided.

4. Verify that the South East Water locks fitted to switchboard and operational.

5. Verify that quick link generator connectors provided

### Security.

1. Verify that the security fencing has been installed in accordance with the design drawings.

2. Verify that South East Water keyed locks installed.

### Have all NCR items been resolved (including any raised as a result of this audit)

If YES Issue Acceptance of Works., and close audit

Would outstanding NCR items impact on the ability to operate the pump

If YES then close audit (wait for NCRs to be resolved)

Has Operations authorized the pumps to remain on

If YES record the name of the person who authorized this.

NAME………………………………….
## Commissioning of Electrical Works

<table>
<thead>
<tr>
<th>Item</th>
<th>Complete</th>
<th>Rectified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ELECTRICAL/TELEMETRY EQUIPMENT</td>
<td>N/A</td>
<td>Rectified</td>
</tr>
<tr>
<td>Refer to Electrical Specification 07-01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX H - APPROVED PRODUCTS / SUPPLIERS

Appendix has been removed from document and product/supplier list can now be found at the following hyperlink:

APPENDIX J - SCHEDULE OF TECHNICAL DATA

TECHNICAL DATA SHEET FOR EMERGENCY GENERATORS

Project Title

Pump Descriptor

<table>
<thead>
<tr>
<th>Section 1 - General</th>
<th>Required</th>
<th>Tendered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Manufacture’s Name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Manufacture’s Address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Generator Model Nr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 2 - Diesel Engine</th>
<th>Required</th>
<th>Tendered</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Make</td>
<td>Not Specified</td>
<td></td>
</tr>
<tr>
<td>2.2 Model</td>
<td>Not Specified</td>
<td></td>
</tr>
<tr>
<td>2.3 Fuel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3.1 Type</td>
<td>Diesel</td>
<td></td>
</tr>
<tr>
<td>2.3.2 Storage Volume</td>
<td>Not Specified</td>
<td></td>
</tr>
<tr>
<td>2.4 Cooling</td>
<td>Water/Fan</td>
<td></td>
</tr>
<tr>
<td>2.5 Air Filter</td>
<td>Dry Paper Type</td>
<td></td>
</tr>
<tr>
<td>2.6 Noise Level</td>
<td>60dBA @ 6m</td>
<td></td>
</tr>
<tr>
<td>2.7 Coupling</td>
<td>Direct</td>
<td></td>
</tr>
</tbody>
</table>
### Section 3 – Alternator

<table>
<thead>
<tr>
<th>3.1</th>
<th>Make</th>
<th>Not Specified</th>
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</thead>
<tbody>
<tr>
<td>3.2</td>
<td>Model</td>
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</tr>
<tr>
<td>3.3</td>
<td>Rating</td>
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</tr>
<tr>
<td>3.3.1</td>
<td>Output (kVA)</td>
<td>211</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Frequency (Hz)</td>
<td>50</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Voltage (Volts)</td>
<td>415</td>
</tr>
<tr>
<td>3.4</td>
<td>Protection</td>
<td>IP23 to AS1939</td>
</tr>
<tr>
<td>3.5</td>
<td>Insulation</td>
<td>Class F to AS2768</td>
</tr>
<tr>
<td>3.6</td>
<td>Cooling</td>
<td>IC01 to AS1359.106</td>
</tr>
<tr>
<td>3.7</td>
<td>Vibration</td>
<td>AS1359.114</td>
</tr>
<tr>
<td>3.8</td>
<td>Electronic Governor</td>
<td>Yes</td>
</tr>
<tr>
<td>3.9</td>
<td>Battery Charger</td>
<td>Floating Charge Type</td>
</tr>
<tr>
<td>3.10</td>
<td>Controller</td>
<td>Deep Sea 509</td>
</tr>
<tr>
<td>3.11</td>
<td>Changeover Switch</td>
<td>Not Specified</td>
</tr>
</tbody>
</table>

### Section 4 - Documentation

<table>
<thead>
<tr>
<th>4.1</th>
<th>Certified Drawings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.1</td>
<td>General Arrangement</td>
<td>Within 2 Weeks of Placement of Order</td>
</tr>
<tr>
<td>4.1.2</td>
<td>Sectional Arrangement</td>
<td>Within 2 Weeks of Placement of Order</td>
</tr>
<tr>
<td>4.2</td>
<td>Certificates</td>
<td></td>
</tr>
<tr>
<td>4.2.1</td>
<td>Materials</td>
<td>Not Required</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Performance</td>
<td>Prior To Delivery</td>
</tr>
<tr>
<td>4.3</td>
<td>Operation &amp; Maintenance Manuals</td>
<td>Prior To Delivery</td>
</tr>
</tbody>
</table>

### Section 5 – Spare Parts & Tools

<table>
<thead>
<tr>
<th>5.1</th>
<th>Spare Parts &amp; Tools</th>
<th>Tenderer To List Items Included in the Tender</th>
</tr>
</thead>
</table>
APPENDIX K - EPA PROTOCOL

EMERGENCY RELIEF STRUCTURE PROTOCOL

SOUTH EAST WATER LIMITED AND ENVIRONMENT PROTECTION AUTHORITY

BACKGROUND

As a continuation of the Memorandum of Understanding (MoU) signed between Melbourne Water (MW) and Environment Protection Authority (EPA) in 1994, a new MoU has been executed between the South East Water Limited (SEWL) on 1 February 1996. This demonstrates SEWL’s commitment to Best Practice Environmental Management.

SEWL and EPA acknowledged that -

(a) in order to -

(i) ensure the occupational health and safety of SEWL staff and contractors;

(ii) safeguard public health and safety;

(iii) protect sewers and sewerage treatment plants from damage.

SEWL is obliged to construct and maintain Emergency Relief Structures (ERS’s) at appropriate points in its sewerage system and to allow emergency releases from sewers through such Structures from time to time;

(b) SEWL is not required to apply for work approvals or waste discharge licences under the Environment Protection Act 1970 for ERS’s designed only to operate in an emergency.

Section 4.2 of the MoU sets out the actions to be followed by the SEWL before it decides to construct any ERS.

PURPOSE

The purpose of this Protocol is

- provide guidelines to internal SEWL Design Engineers and Consulting Engineers employed by SEWL or Developers to design sewerage systems to enable them to take all necessary steps needed to comply with Section 4.2 of the MoU in designing sewerage systems;
- establish appropriate consultative mechanisms and procedures and agreed principles to avoid delays; and,
- reflect a commitment to the Quality Assurance Principles in achieving efficient work practices.

GUIDELINES

Investigate Whether an ERS is required

The designer/consultant should show evidence that an exhaustive investigation has been carried out to determine whether an ERS is required to ensure that occupational health and safety, public health and safety, or the safety of the sewerage system is maintained.
Such evidence should include -

- design computations to demonstrate that uncontrolled spillage would take place in the system without the construction of an ERS;
- Longitudinal Section plans of the sewers and hydraulic grade lines showing the location/s of such uncontrolled spillage;
- plans showing alternative locations for the ERS;
- all relevant data used and any assumptions made in the design computations; and,
- any other information the designer/consultant deem relevant.

**Investigate Alternative Means to Avert or Reduce the Risk of the Sewer Overflowing**

The designer/consultant should show evidence that complete investigation has been carried out to consider all possible alternative means to avert or reduce the risk of the sewer overflowing. The designer/consultant should provide a complete description of all the options considered. Brief description of the methodology adopted in evaluating the options should also be provided together with the ranking of the options. The preferred option is to be selected and reasons for its selection should also be submitted.

**Assess the Likely Impact upon the environment of any release from the ERS**

In assessing the impact upon the environment of any release via the ERS, the designer/consultant should provide:

- a list of possible causes of spillage (pump failure, power failure, rising main burst, blockages etc) in the particular circumstance and the methods of overcoming them;
- computations for the estimated rates, duration and frequency of spillage via the proposed ERS;
- information regarding the type of overflow arrangement provided in the ERS and whether the pipe work has the effect of providing grease and solid retention facility and if so for what duration;
- a statement regarding the quality of the sewage in terms of its BOD and septicity;
- a statement whether the spillage can be prevented from spreading and contained for easy clean up;
- an assessment of the impact on the receiving waters of the spillage in terms of the expected dilution;
- an assessment of the impact on other properties; and,
- an assessment of the impact on the fauna and flora of the area.

**Assess the Need to Incorporate Detention Facilities to Delay Spillage**

The designer/consultant should assess the need to install a detention facility to delay discharges to the environment via the ERS.

Some of the situations for such a requirement would be:

- dry streams being used as receiving waters;
- very little dilution in the receiving waters;
- highly sensitive area just downstream of the ERS;
- spreading of the spillage cannot be contained for easy clean up;
- very septic sewage;
- pump station failure due to pump or power failure; and,
- Rising Main Burst.

Detention facilities that are considered appropriate to the situation are:

- purpose built holding tanks/emergency storage facilities;
- storage capacity available within the sewer system upstream of the ERS; and,
- “control volume” within a pump well.
The designer/consultant should list the possible causes of spillage in the given situation and estimate:

- the rate and duration of spillage via the proposed ERS; and,
- the response time required to stop the spillage.

The designer/consultant should then consider alternative detention facilities appropriate for the particular situation and select the preferred facility and give reasons for such selection and provide:

- the volume of a holding tank/emergency storage facility to detain the spill for the duration of the estimated response time, if a holding tank is selected as the preferred detention facility;
- computations and plans used to estimate the available storage capacity within the upstream sewerage system, if the latter is selected as the preferred detention facility.

Where the “control volume” of the pump well is selected as the preferred detention facility, the pumping stations are to be designed in accordance with the SEWL’s design criteria. They are:

- no dry weather spills; and,
- the ability to transfer the flow generated from a 1 in 5 year storm event.

In order to achieve the above level of service the pumping stations shall:

- be connected to a telemetry system, to notify a central location of fault conditions;
- have competent and current documentation for operating and maintenance procedures and systems;
- have a stand by pump installed in the wet well to provide backup should the duty pump fail; and,
- have at least a two hour storage capacity of Peak Dry Weather Flow (in the sewer system upstream and/or the wet well between high level alarm and the pumping station spill (ERS) level); OR
- have a by-pass pipe line.

In addition to the above requirements, for specific pumping stations of high criticality as nominated by SEWL, the installation of a stand by/back-up electricity supply is mandatory. The provision of an additional electric feeder from a different bus in the electricity supply authority sub-station or an “on site” Diesel Alternator set would satisfy this requirement.

The designer/consultant should provide copies of design computations and plans for the pumping station.

**Assess the Capacity of Sewers in the Catchment is Sufficient to Handle Likely Flows**

The designer/consultant should assess whether the capacity of the sewers in the relevant catchment is sufficient to handle likely flows.

**Existing sewers** will be deemed to have sufficient capacity where flows resulting from a 1 in 5 year rainfall event are contained. Contained means:

- flows in sewers greater than or equal to 300 mm diameter will be contained within the surcharge capacity; and,
- flows in sewers less than 300 mm diameter will be contained within the on grade capacity.

**New and Rehabilitated Sewers** must be able to contain flows resulting from a 1 in 5 year rainfall event for the design life of the system. Design must allow for increase in sewage flows from catchment development and upstream sewer system deterioration. Capacity must be determined:

- using hydraulic modelling for sewers greater than or equal to 300 mm diameter; and,
- using *Water Industry Technical Services Manual* (WITS Manual) for sewers less than 300 mm diameter.
The designer/consultant should provide copies of design computations and/or hydraulic models used for the purpose.

**Discuss the Design and Location of the Proposed ERS with EPA**

After completing all relevant steps appropriate for the particular situation from 3.1 to 3.5 above, the designer/consultant should forward to the Responsible Person (see Section 4 below) of SEWL a complete set of computations, drawings and all other relevant materials together with a *one page summary* document detailing the investigations and findings. This summary document shall be forwarded by SEWL to the Responsible Person of the EPA for information and comments, if appropriate.

The designer/consultant will allow a minimum of twenty one working days from the lodgement of the summary document with SEWL before finalising the detail designs. The EPA may choose to make any comment/recommendations to SEWL within ten working days of receiving the summary document. SEWL will forward such comment/recommendations to the designer/consultant for consideration in the final detail designs.

A standard design component of all ERS’s is the installation of an electronic level recorder to monitor surcharge levels. Alarms from the recorder are directed via SEWL’s telemetry system to alert the communications centre of any spillage via the structure.

**Responsibility**

The designer/consultant shall be responsible to carry out and complete all works in compliance with the SEWL’s Quality System, ISO 9001, WITS Manuals and all other conditions as stipulated in the “offer” made to the developer related to the particular development. Forwarding copies of the summary document, design computations, drawings, other relevant materials and the summary document as referred to in Section 3.6 shall in no way exonerate the designer/consultant from his obligations to carry out the work correctly and accurately and in compliance with the SEWL’s Quality System, ISO 9001 and WITS Manuals.

The Responsible Persons for the purpose of this ERS Protocol for its duration are:

**Organisation:** South East Water Limited  
**Name:** Mr Rex Dusting, Manager Sewerage Asset Planning  
**Location:** 20 Corporate Drive, Moorabbin 3189  
**Telephone:** 9 552 3739  
**Fax:** 9 552 3625

**Organisation:** EPA  
**Name:** Mr Andrew Dunn  
**Location:** 45 Princes Highway, Dandenong  
**Telephone:** 8710 5579  
**Fax:** 9794 5188

**Duration of the Protocol**

This protocol is operative for the duration of the SEWL/EPA Memorandum of Understanding.

**Date of Issue**

19 July 2002.

This version of the ERS Protocol supersedes all previous versions.
EXAMPLE

Emergency Relief Structure Protocol

IS AN ERS REQUIRED?

An ERS is required at the pumping station location for the following reasons:

- It is the lowest point on the sewage collection system;
- Possible spillages are a public health and safety hazard;
- To provide a controlled overflow for the system during extreme emergency situations;
- Detention storage is provided so that an overflow will only occur if no corrective action is performed.

Relevant ERS levels are as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Relevant levels within Catchment (m AHD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invert level of lowest incoming sewer</td>
<td>31.6</td>
</tr>
<tr>
<td>Invert level of pump sump</td>
<td>30.3</td>
</tr>
<tr>
<td>Overflow level of ERS</td>
<td>37.25</td>
</tr>
<tr>
<td>Lowest manhole top level within catchment (Located next to pumping station)</td>
<td>38.3</td>
</tr>
</tbody>
</table>

FACTORS THAT REDUCE THE RISK OF WASTEWATER OVERFLOWING

The following facilities have been included in the design of the scheme to reduce the risk of wastewater overflows:

- The pumping station well has been sized to provide detention storage.
- Standby pump for use during duty pump failure.
- Alarm facilities to warn operators of high wastewater levels.
- Rising main diameter no smaller than pump discharge.

IMPACT ON THE ENVIRONMENT

Possible causes of spillage are tabulated below:

<table>
<thead>
<tr>
<th>Types of Failure</th>
<th>Overcoming Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Failure</td>
<td>Standby pump available</td>
</tr>
<tr>
<td>Power Failure</td>
<td>Detention storage</td>
</tr>
<tr>
<td>Rising main Blockage</td>
<td>Detention storage</td>
</tr>
</tbody>
</table>

The peak dry weather flow (PDWF) for Stage 1 of the pumping station is estimated at 20L/s. The total detention storage required to provide 2 hours storage at PDWF is 144m$^3$. *(VERIFY WITH SOUTH EAST WATER MINIMUM STORAGE REQUIRED, CAN BE GREATER THAN 2HRS)*

Additional detention storage will be added to the system as part of the future upgrades planned for this station.
The ERS for this station connects to the main pump well and overflows to the adjacent drain as shown on the attached plan. The effluent will have undergone the following treatment prior to discharge:

- Trapping of floatables and grease in the pump well and manholes.
- Detention in the pump well and manholes to enable settling of suspended solids.
- Trapping of solids in a 5mm mesh screen.

**The partially treated sewage will then discharge to the floodway to the east of the pump station.**

There are no alternative locations for the ERS which will provide the same level of public health and safety protection.

The pumping station will be monitored 24 hours a day via South East Water’s telemetry system. In the event of a spill, South East Water will take pre-planned action in accordance with an emergency plan which incorporates the following actions:

- Control any spill using eduction tankers;
- Contain the spill and initiate clean-up using appropriate labour and equipment;
- Monitor the effect of any spill;
- Report the spill to EPA within the criteria of South East Water’s sewer spillage checklist (SFS-SFG-146).

**DETENTION FACILITIES**

The design brief for the station requires a 2 hour detention storage volume at Peak Dry Weather Flow (PDWF).

The 2 hour storage volume has been established as the maximum time required for an operator to arrive at the pump station with mobile pump out facilities and to carry out repairs if necessary.

The storage system has not been designed for Peak Wet Weather Flows (PWWF). South East Water intend to provide Excess Storm Flow Facilities (ESFLOW) at a later date to detain the wet weather flows if the system becomes overloaded.

The detention storage exceeds the 2 hour PDWF requirement for Stage 1 as shown in the table below

<table>
<thead>
<tr>
<th>Volume</th>
<th>Initial PDWF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manholes 2Nos. 1800mm</td>
<td>28</td>
</tr>
<tr>
<td>Manholes 6Nos. 1500mm</td>
<td>57</td>
</tr>
<tr>
<td>Pump well</td>
<td>217</td>
</tr>
<tr>
<td>In line 533m of 600dia</td>
<td>151</td>
</tr>
<tr>
<td><strong>Total Storage</strong></td>
<td><strong>453</strong></td>
</tr>
</tbody>
</table>

**CAPACITY OF SEWERS**

All sewers within this scheme will be designed to accommodate the peak wet weather flows as determined using the Water Services Association of Australia Sewerage Code.
Example Calculation for Emergency Storage.

<table>
<thead>
<tr>
<th>Manholes</th>
<th>HGL level @ MH</th>
<th>MH base level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>37.50</td>
<td>31.9</td>
</tr>
<tr>
<td></td>
<td>37.60</td>
<td>32.1</td>
</tr>
<tr>
<td></td>
<td>37.75</td>
<td>32.33</td>
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<tr>
<td></td>
<td>37.90</td>
<td>32.55</td>
</tr>
<tr>
<td></td>
<td>38.00</td>
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<tr>
<td></td>
<td>38.15</td>
<td>33</td>
</tr>
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<td></td>
<td>226.90</td>
<td>194.64</td>
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</table>

<table>
<thead>
<tr>
<th>m dia</th>
<th>area</th>
<th>m³</th>
<th>6 manholes</th>
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</thead>
<tbody>
<tr>
<td>1.5</td>
<td>1.77</td>
<td>57.10</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sewers</th>
<th>20.5 m</th>
<th>4.5 m</th>
<th>52 m</th>
<th>82 m</th>
<th>96 m</th>
<th>87 m</th>
<th>87 m</th>
<th>104 m</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>28.50 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>533 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wet well</th>
<th>Spill</th>
<th>alarm</th>
<th>37.25</th>
<th>31.6</th>
<th>5.65 m above alarm level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td>217.44 m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wet well</th>
<th>Sewers</th>
<th>217.44</th>
<th>150.70</th>
<th>28.50</th>
<th>2 manholes 1800mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>57.10</td>
<td>6 manholes 1500mm</td>
</tr>
</tbody>
</table>

| Total volume | 453.74 m³ |

<table>
<thead>
<tr>
<th>Total time</th>
<th>378 minutes at 20l/s PDWF.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 hours 18 mins</td>
</tr>
</tbody>
</table>

Revision 2
Page 110 of 195
August 2010
EXAMPLE PLAN
APPENDIX L - WATERSHED DATA SHEET

Watershed Data Collection-Sewer Pump Station

DATE:   /   /   

STATION NAME ________________   NO ________
### Electrical Supply Distribution (SYS)

#### Generator

| Detail |  |  
|--------|--|--|
| Engine Make |  |  
| Engine Model |  |  
| Engine Serial Number |  |  
| Engine Rating (kW) |  |  
| Fuel Tank Capacity (litres) |  |  
| Maximum Runtime (hrs) |  |  
| Panel Type |  |  
| Alternator Make |  |  
| Alternator Model |  |  
| Alternator Serial Number |  |  
| Alternator Rating (kVA) |  |  
| Notes |  |  

#### Generator

<table>
<thead>
<tr>
<th>Generator Connection Point</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator changeover details</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Make</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Model</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Serial Number</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Coil (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Gen Contactor Make</td>
<td></td>
</tr>
<tr>
<td>Gen Contactor Model</td>
<td></td>
</tr>
<tr>
<td>Gen Contactor Serial Number</td>
<td></td>
</tr>
<tr>
<td>Gen Contactor Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Gen Contactor Coil (AC volts)</td>
<td></td>
</tr>
</tbody>
</table>

#### Surge Diverters

| Make |  |  
| Model |  |  
| No of diverters |  |  

## Main Isolator

<table>
<thead>
<tr>
<th>Detail</th>
<th>Type</th>
<th>Make</th>
<th>Model</th>
<th>Serial Number</th>
<th>Current Rating (Amps)</th>
<th>Current Setting (Amps)</th>
<th>Fault rating (kA)</th>
</tr>
</thead>
</table>

## Motor 1 Starter Isolator

<table>
<thead>
<tr>
<th>Detail</th>
<th>Type</th>
<th>Make</th>
<th>Model</th>
<th>Serial Number</th>
<th>Voltage Rating (AC volts)</th>
<th>Current Rating (Amps)</th>
<th>Current Setting (Amps)</th>
<th>Fault Rating (kA)</th>
</tr>
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</table>

## Motor 2 Starter Isolator

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<thead>
<tr>
<th>Detail</th>
<th>Type</th>
<th>Make</th>
<th>Model</th>
<th>Serial Number</th>
<th>Voltage Rating (AC volts)</th>
<th>Current Rating (Amps)</th>
<th>Current Setting (Amps)</th>
<th>Fault Rating (kA)</th>
</tr>
</thead>
</table>

## Motor Starter 1

<table>
<thead>
<tr>
<th>Detail</th>
<th>Type</th>
<th>Make</th>
<th>Model</th>
<th>Serial Number</th>
<th>Voltage Rating (AC volts)</th>
<th>Current Rating (Amps)</th>
<th>kW Rating</th>
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</table>
## Motor starter 1 Technical

<table>
<thead>
<tr>
<th>Line Contactor Make</th>
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<tbody>
<tr>
<td>Line Contactor Model</td>
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</tr>
<tr>
<td>Line Contactor Serial Number</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Line Contactor Coil (AC volts)</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Contactor Model</td>
<td></td>
</tr>
<tr>
<td>Start Contactor Serial Number</td>
<td></td>
</tr>
<tr>
<td>Start Contactor Current Rating (amps)</td>
<td></td>
</tr>
<tr>
<td>Start Contactor Coil (AC volt)</td>
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</tr>
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<table>
<thead>
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</tr>
<tr>
<td>Run Contactor Current Rating (amps)</td>
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</tr>
<tr>
<td>Run Contactor Coil (AC volts)</td>
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<table>
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<tr>
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</tr>
<tr>
<td>By-pass Contactor Serial No</td>
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<td>By-pass Contactor Coil Voltage</td>
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<tr>
<th>Overload Make</th>
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<td></td>
</tr>
<tr>
<td>Overload Serial Number</td>
<td></td>
</tr>
<tr>
<td>Overload Current Range (amps)</td>
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</tr>
<tr>
<td>Overload Current Setting (amps)</td>
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<tr>
<td>Protection Relay Current Rating (amps)</td>
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</tr>
<tr>
<td>Protection Relay Current Setting (amps)</td>
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## Motor Starter 2

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</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Voltage Rating (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Current Rating (Amps)</td>
<td></td>
</tr>
<tr>
<td>kW Rating</td>
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## Motor starter 2 Technical

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<tbody>
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<td></td>
</tr>
<tr>
<td>Line Contactor Current (Amps)</td>
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</tr>
<tr>
<td>Line Contactor Coil (AC volts)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Contactor Model</td>
<td></td>
</tr>
<tr>
<td>Start Contactor Serial Number</td>
<td></td>
</tr>
<tr>
<td>Start Contactor Current Rating (amps)</td>
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</tr>
<tr>
<td>Start Contactor Coil (AC volt)</td>
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<table>
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<tbody>
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<td></td>
</tr>
<tr>
<td>Run Contactor Current Rating (amps)</td>
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</tr>
<tr>
<td>Run Contactor Coil (AC volts)</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<tbody>
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<tr>
<td>By-pass Contactor Coil Voltage</td>
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</table>

<table>
<thead>
<tr>
<th>Overload Make</th>
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</thead>
<tbody>
<tr>
<td>Overload Model</td>
<td></td>
</tr>
<tr>
<td>Overload Serial Number</td>
<td></td>
</tr>
<tr>
<td>Overload Current Range (amps)</td>
<td></td>
</tr>
<tr>
<td>Overload Current Setting (amps)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection Relay Make</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Protection Relay Model</td>
<td></td>
</tr>
<tr>
<td>Protection Relay Serial Number</td>
<td></td>
</tr>
<tr>
<td>Protection Relay Current Rating (amps)</td>
<td></td>
</tr>
<tr>
<td>Protection Relay Current Setting (amps)</td>
<td></td>
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## SWITCHBOARD

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<td>Make</td>
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</tr>
<tr>
<td>Construction Material</td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
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### Instrumentation (Sys)

#### LEVEL MONITOR

<table>
<thead>
<tr>
<th>Detail</th>
<th>Control</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Type</td>
<td></td>
<td>Hydrostatic Pressure</td>
</tr>
<tr>
<td>Make</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage Rating</td>
<td>24 VDC</td>
<td></td>
</tr>
<tr>
<td>Output Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Units</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Calibration Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument Span</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Wet Well</td>
<td>Wet Well</td>
</tr>
</tbody>
</table>
## Odour Control (SYS)

**SOIL BED FILTER, OZONATOR OR OTHER SYSTEM**

<table>
<thead>
<tr>
<th>Detail</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Odour Control Type</td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td></td>
</tr>
<tr>
<td>Specific Surface Area (m²/m³)</td>
<td></td>
</tr>
<tr>
<td>Length (m)</td>
<td></td>
</tr>
<tr>
<td>Width (m)</td>
<td></td>
</tr>
<tr>
<td>Height (m)</td>
<td></td>
</tr>
<tr>
<td>Flow Capacity (m³/min)</td>
<td></td>
</tr>
<tr>
<td>Irrigation Rate (L/s)</td>
<td></td>
</tr>
</tbody>
</table>

### Odour control ventilation fan

<table>
<thead>
<tr>
<th>Make</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Impellor Diameter (mm)</td>
<td></td>
</tr>
<tr>
<td>Flow Capacity (cubic m/hr)</td>
<td></td>
</tr>
<tr>
<td>Speed (RPM)</td>
<td></td>
</tr>
<tr>
<td>kW Rating</td>
<td></td>
</tr>
<tr>
<td>Full Load Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Voltage Rating (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Fan Operation (details of running times etc)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Starter Present</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter Type</td>
<td></td>
</tr>
<tr>
<td>Starter Make</td>
<td></td>
</tr>
<tr>
<td>Starter Model</td>
<td></td>
</tr>
<tr>
<td>Coil Voltage (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Current Range (Amps)</td>
<td></td>
</tr>
<tr>
<td>Current Setting (Amps)</td>
<td></td>
</tr>
</tbody>
</table>
## Pumping System 1 (SYS)

### PUMP 1

#### Pump Detail

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Well Mounted</td>
<td>Submersible</td>
</tr>
<tr>
<td>Integrated Pump/Motor</td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Design Capacity (l/s)</td>
<td></td>
</tr>
<tr>
<td>Head (m AHD)</td>
<td></td>
</tr>
<tr>
<td>Pump Type</td>
<td></td>
</tr>
<tr>
<td>Impellor Type</td>
<td></td>
</tr>
<tr>
<td>Impellor Manufacturer</td>
<td>Code</td>
</tr>
<tr>
<td>Impellor Diameter (mm)</td>
<td></td>
</tr>
<tr>
<td>Oil Type</td>
<td></td>
</tr>
<tr>
<td>Outlet Connection (mm)</td>
<td></td>
</tr>
<tr>
<td>Flushing Valve Present</td>
<td></td>
</tr>
<tr>
<td>Pump Efficiency Test Result</td>
<td></td>
</tr>
<tr>
<td>Pump Efficiency Test Date</td>
<td></td>
</tr>
<tr>
<td>Date Installed</td>
<td></td>
</tr>
</tbody>
</table>

#### Motor Detail

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>kW Rating</td>
<td></td>
</tr>
<tr>
<td>Voltage Rating (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Motor Speed (RPM)</td>
<td></td>
</tr>
<tr>
<td>Full Load Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Running Load Current (Amps)</td>
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</tr>
</tbody>
</table>
## Pumping System 2 (SYS)

### PUMP 2

#### Pump Detail

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<tbody>
<tr>
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</tr>
<tr>
<td>Integrated Pump/Motor</td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Design Capacity (l/s)</td>
<td></td>
</tr>
<tr>
<td>Head (m AHD)</td>
<td></td>
</tr>
<tr>
<td>Pump Type</td>
<td></td>
</tr>
<tr>
<td>Impellor Type</td>
<td></td>
</tr>
<tr>
<td>Impellor Manufacturer Code</td>
<td></td>
</tr>
<tr>
<td>Impellor Diameter (mm)</td>
<td></td>
</tr>
<tr>
<td>Oil Type</td>
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</tr>
<tr>
<td>Outlet Connection (mm)</td>
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<tr>
<td>Flushing Valve Present</td>
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<tr>
<td>Pump Efficiency Test Result</td>
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<tr>
<td>Pump Efficiency Test Date</td>
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<tr>
<td>Date Installed</td>
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#### Motor Detail

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Note</td>
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<tr>
<td>kW Rating</td>
<td></td>
</tr>
<tr>
<td>Voltage Rating (AC volts)</td>
<td></td>
</tr>
<tr>
<td>Motor Speed (RPM)</td>
<td></td>
</tr>
<tr>
<td>Full Load Current (Amps)</td>
<td></td>
</tr>
<tr>
<td>Running Load Current (Amps)</td>
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</table>
**Station Control (SYS)**

High Level Pump Operate Control. If relay, enter type as relay only

<table>
<thead>
<tr>
<th>Detail</th>
<th>Type</th>
<th>PLC</th>
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<th>Model</th>
<th>Serial Number</th>
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</table>

**Phase Failure Relay (PFR001)**

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**Operator Interface**

<table>
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<tr>
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<th>Serial Number</th>
<th>Voltage Rating (DC volts)</th>
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**Control Power Supply** (fill out only if separate power supply to telemetry)

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<th>Detail</th>
<th>Make</th>
<th>Model</th>
<th>Rating (amps)</th>
<th>Voltage (volts DC)</th>
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</table>
PLC (FILL OUT IF SEPARATE PLC FROM RTU. IF COMBINED PLC/RTU USE RTU FORM)

<table>
<thead>
<tr>
<th>Type</th>
<th>PLC</th>
<th>Rack position number</th>
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<tbody>
<tr>
<td>Remote Operation</td>
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<tr>
<td>Make</td>
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<tr>
<td>Base Unit Model</td>
<td></td>
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</tr>
<tr>
<td>Base Unit Voltage (Volts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU Module Model</td>
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<td></td>
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<tr>
<td>Digital Input Module 1 Model</td>
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<td>Digital Input Module 1 Voltage spacer 2</td>
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<tr>
<td>Digital Input Module 2 Model</td>
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<td></td>
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<td>Analogue Input Module Model spacer 4</td>
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</tr>
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<td>Digital Output Module 2 Model spacer 6</td>
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## Structure (SYS)

### Building

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<td>Lighting Description</td>
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<td>Vent Description</td>
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Skylight on-site: false

### Dry Well

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<tr>
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<td>Cover Details</td>
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### Dry Well Sump Pump

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<td>Head (m AHD)</td>
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<td>Motor Speed (RPM)</td>
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<td>Full Load Current (Amps)</td>
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### Equipment Access

- **Use Yes, No or N/A**

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### Lifting Equipment

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<td>Capacity (kg) Trolley</td>
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Station Ventilation Fan (do not include soil bed fan refer odour control)

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Wet Well Mixer

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<td>Impellor Size (mm)</td>
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## Washers

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# Telemetry (SYS)

## Antenna

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## Radio

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- Make: Trio
- Model: 900DC
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<td>Model</td>
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<tr>
<td>Internal Diameter (mm)</td>
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<td>Flange to Flange size (mm)</td>
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<td>No of Bolt holes</td>
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<tr>
<td>No of Uniflanges</td>
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| **Non Return Valve** | | | | |
| Valve Type (ball/flap) | | | | |
| Make                | | | | |
| Model               | | | | |
| Internal Diameter (mm) | | | | |
| Flange to Flange size (mm) | | | | |
| No of Bolt holes    | | | | |

| **Pump** | | | |
| PSS Number | | | |
| Make | | | |
| Model | | | |
| Serial No | | | |
| KW | | | |
| FLC (amps) | | | |
| RLC (amps) | | | |
| Impellar size (mm) | | | |
| Impellar code | | | |
| Weight (kg) | | | |
| Duty (l/sec@mH) | | | |

| **Penstock details** | |

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August 2010
### Operations

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<td>Rising Main Pipe Length (m)</td>
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<td>Rising Main Discharge Point</td>
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### Emergency

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<td>Generator Capacity (Kva)</td>
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<td>Catchment</td>
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<td>Upstream Feed (3)</td>
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<td>Hold Time Detail</td>
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### SCADA Level

| Cover Level (m AHD) |  |
| Spill Level (m AHD) |  |
| High Level (m AHD) |  |
| Duty Pump Transfer Level |  |
| Duty Pump Start Level |  |
| Duty Pump Stop Level |  |
| Level of Base (m AHD) |  |
| Number of Pumps |  |
| Extended Pump Down Level |  |
### OH&S

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<tr>
<td>Dry Well Class - Inspection</td>
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<td>Valve Pit Class - Maintenance</td>
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### General

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### Location

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### Site Detail

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### TELEMETRY DATA SHEET

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<th>Item</th>
<th>Response</th>
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<tr>
<td>1. Where does the SPS pump too?</td>
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<tr>
<td>2. What SPS are located immediately downstream</td>
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<tr>
<td>3. Pump delivery capacity at operating head</td>
<td></td>
</tr>
<tr>
<td>4. Levels for pumps and discharge point</td>
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</tr>
<tr>
<td>5. Friction loss</td>
<td></td>
</tr>
<tr>
<td>6. A full list of all points connected to the telemetry system (with their PLC reference numbers or where hardwired, their RTU terminal numbers, as applicable)</td>
<td></td>
</tr>
<tr>
<td>7. Pressure Main Nominal dia and actual ID.</td>
<td></td>
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</tbody>
</table>
8. The span and distance from the bottom of the well of the Vega probe.

9. The as constructed (or configured) levels for all operating and alarm points.

10. The as constructed level (m AHD) of:
   a) The face of the Vega Probe;
   b) Top of wet well.
   c) Overflow
   d) Pressure main Invert Level
   e) Landing platform (if applicable)
   f) Inlet sewer inverts level.
   g) Bottom of wet well.
   h) The capacity of each pump in normal operation from results of the mechanical / electrical commissioning tests.
   i) The span of power / current transducers and flow meters installed (if applicable)
   j) The capacity in cubic metres of the installed incoming sewer MH and the wet well itself from the high level alarm point up to the overflow level.
APPENDIX N - SCHEDULE OF DOCUMENTS TO SUBMIT

SCHEDULE OF DOCUMENTS TO SUBMIT

DESIGN

1. Design Checklist.
2. Pump Selection System curves & NPV
5. Water Hammer Analysis
6. Odour Analysis.
7. Structural Computations.
8. H\textsubscript{2}S Analysis of Pressure Main.
10. ERS requirements.

PRECOMMISSIONING

1. Pre-commissioning Checklist.
2. Radio Survey Results.
3. Factory pump test results.
4. Concrete compressive strength and slump test results

COMMISSIONING

1. Telemetry Data Sheet.
2. Watershed Data Sheet.
4. As Constructed of SPS and Pressure Main –2 copies on disc.
5. Plant Data Sheets – 2 copies.
6. PLC Program – 2 copies on disc.
APPENDIX O - ELECTRICAL DESIGN & CONSTRUCTION SPECIFICATION

Document Control

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<td>J.Myyrlainen</td>
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<td>13/8/08</td>
<td>Instrumentation added</td>
<td>J Myyrlainen</td>
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**Table of Contents**

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General Requirements

General
Details included in this specification outline South East Waters minimum standard to achieve, manufacture, testing, delivery, installation and commissioning of electrical works. The specification does not include functional or operational descriptions relating to the intended scope of work. The document does not outline civil, mechanical arrangements, pump selection, pump performance or hydraulic assessment.

Standards
All works implemented must be in accordance to AS/NZS 3000, Australian/New Zealand wiring rules, Electricity Safety Act 1998 Act No. 25/1998 incorporating amendments, regulations and codes of practice, Victorian Service & Installation Rules, relevant Australian Standards, requirements of the Electricity Distribution Company, manufactures guidelines and other relevant statutory regulations.

The following Australian Standards shall be complied with, (but not limited to).

- **AS 3013**: Electrical installations – classification of the fire and mechanical performance of wiring systems.
- **AS1023.1-1985**: Low voltage switchgear and control gear - Protection of electric motors - Built-in thermal detectors and associated control units.
- **AS 1025.2-1989**: High-voltage a.c. switchgear and control gear - Switches and switch-disconnectors - For rated voltages of 52 kV and above.
- **AS/NZS 1102.107:1997**: Graphical symbols for electrotechnical documentation - Switchgear, control gear and protective devices.
- **AS 2086-1995**: A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 72.5 kV.
- **AS 2184-1985**: Low voltage switchgear and control gear - Moulded-case circuit breakers for rated voltages up to and including 600 V a.c. and 250 V d.c.
- **AS 2700S-1996**: Colour Standards for general purposes.
- **AS/NZS 3947.4.1:2001**: Low-voltage switchgear and control gear - Contactors and motor-starters - Electromechanical contactors and motor-starters.
- **AS/NZS 3947.4.2:2000**: Low-voltage switchgear and control gear - Contactors and motor-starters - A.C. semiconductor motor controllers and starters.
- **AS/NZS 60269.1:2000**: Low-voltage fuses - General requirements.
Electromagnetic Compatibility
Comply with Australian Communications Authority requirements for electrical and electronics products to limit electromagnetic interference (EMI).
AS61800.3-2005: Adjustable speed electrical power drive systems - EMC requirements and specific test methods.

Emissions
Provide products with C-tick or Regulatory Compliance Mark (RCM) to AS 4417:3, Marking of electrical products to indicate compliance with regulations – specific requirements for electromagnetic compatibility regulatory applications.

Immunity
Electrical and electronic apparatus: To AS/NZS 4252.1, Electromagnetic compatibility - Generic immunity standard - residential, commercial and light industry (EN 50082-1), or EN 50082-2, Electromagnetic compatibility – generic immunity standard – industrial environment.

Harmonics and Voltage Surges
Level of emissions to be acceptable to the electricity network, refer Essential Services Commission, Electricity Distribution Code.

Related Codes
The Sewage Pumping Station Code of Australia WSA 04-2001 shall be used as a reference where this specification declines to provide related information.
Design

General: If part or all of an installation is to be designed by the contractor or by agreed amendments to the design, submit documents showing relevant schematics, arrangements, layouts and calculations supporting the design.

Design by Contractor

Performance Requirements

General: Provide efficient and effective facilities in line with good commercial practice for delivering and controlling the plant.

Reliability: Provide reliable equipment with multiple units and standby or redundant equipment to maintain availability in accordance with good commercial practice. Refer Section 8 - Approved Equipment Schedule.

Energy usage and running costs: Give due regard to equipment selections and system design to minimise energy usage and operating and maintenance costs.

Isolation facilities: Provide suitable isolation facilities to allow partial shutdown for operation and maintenance.

Shop drawings

General: Prepare and submit drawings showing schematics, dimensional details of the fabrication, layout and installation of all plant and equipment, including relationship to building structure and other services.

Standards:


AS1101.6-1989 : Graphical symbols for general engineering - Process measurement control functions and instrumentation.

Format: AutoCAD 2000 or later version, with standard metric scale and dimensioned scale line for drawing reduction.

Drawings

Typical but not limited to.

- Process and Instrumentation Diagrams (P & ID).
- Single line diagrams for all Control Assemblies and Distribution Boards.
- All Electrical schematics employing graphical symbols to AS/NZS 1102.
- PLC I/O module connection/wiring diagrams.
- PLC network topology.
- Instrument loop diagrams.
- Instrument schedules.
- RTU connection diagrams.
- Plant room layout plans identifying all electrical equipment.
- Switchboard and control panel general arrangement.
- Cable type, size and marking details.
- Electrical equipment schedules.
- Label schedules.
- Embedded Conduit arrangement drawings
- Earthing Arrangement Diagrams
- Power, Lighting and Communications Plans
- Cable route drawings.

Drawings shall be checked and signed by a responsible person to verify conformity with the requirements of the contract.

**Pre-Construction Submissions**

**Procedure**

**General**
Submit for review electrical schematics, schedules of equipment, calculations and shop drawings.

**Timing**
General: Make submissions in a timely manner, to suit the construction program. Coordinate submissions of related items. Allow time for review and possible amendment and re-submission. Delays: Avoid delays by making early and adequate submissions. Notice: Give notice before commencing work affected by contractor’s submissions, unless the submissions have been reviewed with no exception taken. Hold points: Where hold points are specified, do not commence work affected by contractor’s submissions until the submissions have been reviewed with no exception taken.

**Submissions Schedule**
Maintain and submit monthly a schedule of submissions to identify all proposed submissions designated with the following information:
- Submission number, description, date and revision number.
- Status
  - Accepted
  - Submitted awaiting acceptance
  - Not yet submitted
  - To be corrected and re-submitted

**Authorities and Utilities**
Correspondence: Submit copies of correspondence and notes of meetings with authorities and utilities.

Authorities and utilities approvals: Submit documents showing approval of the authorities and utilities whose requirements apply to the work.

**Tests**
Test program: Submit a testing and commissioning program which is consistent with the construction program. Include particulars of test stages and procedures. Test records: For designated tests, including pre-delivery tests, record results and submit reports or certificates in a form suitable for inclusion in operation and maintenance manuals.
Materials, Equipment and Components

General

Quality
All electrical components and materials shall be selected and installed to ensure reliable and satisfactory operation in which safety is the first consideration, and to facilitate inspection, cleaning and repairs. Materials shall be of the best quality and class and shall withstand the variations of temperature and atmospheric conditions without distortion or without affecting the strength and suitability of the various parts for which they have to perform.

Selection
Equipment shall be selected from established manufacturers regularly engaged in the manufacture of such equipment, who issue comprehensive rating data and certified test data on their products. To maintain standards between sites the preferred South East Water equipment schedule shall be followed, refer Section 8. If alternative equipment is proposed the contractor shall provide supporting documentation indicating equipment is of equal or better quality.

Consistency
For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Do not provide without approval products that are obsolete, discontinued or about to be discontinued.

Safety
Provide all necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including effective earthing of electrical components, electrical interlocks, warning lights, and signs, alarms and local lighting.

Special Tools
Supply special tools necessary to dismantle equipment requiring periodic maintenance or replacement. The tools shall not be used for the erection of equipment during construction.

Quality

Inspections

Notice
Inspection witness points: Give notice for inspection in respect of relevant parts of the works, and advise if and when those parts are to be concealed.

Minimum notice for inspections to be made: otherwise 2 working days for on-site inspections, and 5 working days for local pre-delivery inspections.

Tests
• Pre-completion tests: Tests carried out before completion tests including factor acceptance test.
• Site tests: Tests carried out on site on static plant and systems before commissioning (eg. electrical insulation resistance testing, instrument calibration).
Completion tests: Tests carried out before the date for practical completion on installations or systems which have been completed and commissioned, to demonstrate that the installations or systems, including components, controls and equipment, operate correctly, safely and efficiently, and meet performance and other requirements and are integrated with connecting systems.

Notice
Witness tests: Give sufficient notice for designated tests to be witnessed.
Minimum notice:
- 2 working days for site tests; and
- 5 working days for local pre-delivery tests.

Reports
General: Submit copies of test reports, showing the observations and results of tests, and highlighted to show compliance or deviation from requirements.

Facilitation of Tests
If tests are to be carried out on parts of the works, do not conceal those parts until the tests have been satisfactorily completed and compliance verified.

Failed Tests
If plant or part thereof fails under test, make good the plant and repeat the tests. Costs incurred by the Superintendent or Proprietor associated with witness tests which must be repeated will be deducted from the Contract Sum.

Installation

General Requirements

Responsibility
Installation of all electrical equipment and materials supplied. Supply all labour, tools, materials, and equipment necessary to complete the electrical installation, including all terminations and connections.

Standards
All work performed and equipment supplied must conform in design, material, construction, installation, workmanship and performance to AS/NZS 3000 and other relevant Australian Standards, Victorian Services and Installation Rules and other statutory requirements.

Requirements
Provide all stands, cabinet fixing components, supports, brackets, plates etc. for the mounting and positioning of all electrical, instrumentation equipment and systems. Unless specifically stated otherwise all supports, brackets and fixings must be 316 stainless steel.
All equipment unless stated otherwise must be installed in accordance with the manufacturer’s requirements.
Mount equipment on fixed structures. Where no fixed structure exists, supply and install an approved structure for the mounting of the equipment.
Protect equipment from weather and the ingress of dirt, moisture, vandalism and tampering.
Provide access to all components requiring entry, inspection or maintenance.
The installation work must include but must not be limited to the following:

- Connection of cables
- Setting out of runs
- Penetrations
- Earthing
- Conduits, fittings and joints
- Cable tray, ladder and troughing
- Fixings
- Installation of switchboards
- Installation of all instrumentation, junction boxes and other field mounted equipment
- Installation of all lighting and general power equipment
- Telemetry antennae and communications.
- Installation of Instrumentation

System Integration

General
Interconnect system elements so that the installations perform their designated functions.

Building Penetrations

Non-fire-resisting Building Elements
Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is weather proof, acoustic rated or subject to pressure, maintain the rating. Acoustically seal penetrations through plant room walls and floors.

Limitations
General: Do not penetrate, or chase the following without approval:

- Structural building elements including external walls, core walls, fire walls, floor slabs, beams and columns.
- Acoustic barriers
- Other building services.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings.

Flashing
Provide overflashing for ducts, piping, conduits, cabling and supports passing through roofs, external walls, and floors and walls of wet areas.

Piping, cabling: Similar material to the service, sealed and secured to ensure durability and water tightness.
Fixing

**General**
Fix all plant directly to structure in approved manner. Submit details of types of fixings, locations and loads for approval.

Fix only lightweight items to non-structural building elements.

Do not pierce waterproof roofs, floors or walls with fixings.

**Services Trenches**

**Witness Points**
Give notice of inspection of the following:
- Services trenches on completion of services installation and prior to back filling.

**Excavation**
If practicable, make trenches straight and at uniform grade between pits, personnel access ways, junctions and changes in route, with vertical sides and uniform grades.

Comply with construction safety regulations.

Supports: Sheet and brace open trenches.

If excavation is necessary below the level of adjacent footings, seek approval, and provide necessary support for the footings.

Spoil: If excavated material cannot be used for filling or backfilling remove it from the site.

**Trench Widths**
Keep trench widths to the minimum consistent with the laying and bedding of services, and the construction of personnel access ways and pits.

**Trench Depths**
For electrical services refer to AS 3000, SAA Wiring rules.

**Obstructions**
Clear trenches of sharp projections. Cut back roots to at least 600 mm clear of services. Remove other obstructions including stumps and boulders, which interfere with services or bedding. If rock or concrete is encountered, give notice. Also give notice if filled ground is encountered.

**Dewatering**
Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

**Excess Excavation**
If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or, AS 1379, Specification and supply of concrete, grade N20 concrete.
Backfilling
Backfill service trenches as soon as possible after the service has been laid, bedded and tested. Place the backfill in layers \( \leq 150 \text{ mm} \) thick and compact to the density applicable to the location of the trenches, to minimise settlement, and so that pipes are buttressed by the trench walls.

Remove shoring and temporary pipe supports.

Install underground marking tape: To AS/NZS 2648.1, *Underground marking tape, non-detectable*.

Backfill Material
General fill with no stones greater than 25mm occurring within 150mm of the service, or other materials as required for particular services or locations. Well graded, inorganic, non-perishable material, maximum size 75mm, plasticity index \( \leq 55\% \).

Under roads and paved areas and within 4m of buildings: salt free coarse sand, controlled low strength material or fine crushed rock.

In topsoil areas: Complete the backfilling with topsoil for at least the top 150 mm.

In reactive clay: In sites classified M, H or E to AS 2870, *Residential slabs and footings*. Provide an impervious material where trenches fall towards footings.

Reinstatement of Surfaces
General: Reinstate existing surfaces removed or disturbed by trench excavations to match existing and adjacent work.

Noise and Vibration

Noise Control
General
Minimise the generation and transmission of noise from plant.

*Noise Levels for Occupied Spaces*
Select and install plant and equipment and provide acoustic control measures so that the noise levels arising from simultaneous operation of all services do not exceed the maximum sound levels in Table 1 of AS 2107 when measured in accordance with Appendix B of AS 2107, *Acoustics - recommended design sound levels and reverberation times for building interiors*.

*External Noise Levels*
Comply with statutory requirements regarding noise to the external environment emanating from plant. Victorian installations shall comply with SEPP-N1.

Vibration Control
*Performance and Selection*
Object: Minimise the transmission of vibration and noise from rotating, reciprocating or vibrating equipment to building elements.
Criteria: Provide vibration control comprising vibration isolators and inertia bases where necessary to limit building vibrations in occupied areas as follows:

\[
\begin{align*}
& \text{\geq 8Hz} & \text{-} & <0.20\text{mm/s rms velocity.} \\
& \text{<8Hz} & \text{-} & \text{product of frequency and velocity <1.6mm/s rms.}
\end{align*}
\]

Vibration mounts: Support rotating, reciprocating or vibrating equipment on vibration isolating mounts.

Isolator selection: Select mounts with static deflections to limit building vibration allowing for span, stiffness and mass of supporting structure, and mass, imbalance, and operating speed range of equipment. Provide neoprene pads, neoprene mounts, or spring mounts as necessary.

Balancing: Balance all equipment to minimise vibrations. Rotating and reciprocating machinery - at least *"satisfactory" to AS 2625.3, Measurement and evaluation of vibration severity of large machines in situ or AS 2625.4, Measurement and evaluation of vibration severity of small rotating machines.

Installation
Install mounts allowing adequate clearance for free movement between stationary and moving parts.

Ensure that mounting bolts and the like do not bridge between vibrating and static objects.

Install vibration isolating mounts or flexible connections in all piping, ductwork, electrical and other connections to vibration isolated equipment.

Completion
Check freedom of movement of equipment and mountings.

Metalwork

General
General: Use metalwork capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces. Construct to prevent rattle and resonance.

Metal separation: Prevent contact between electrolytically dissimilar metals, by using concealed dissimilar metals.

Fabrication
Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges.

Welding and Brazing

Safety Precautions
Fire and electrical: To AS 1674.1 and AS 1674.2, Safety in welding and allied processes, fire precautions and electrical.

Welding
Steel: To AS/NZS 1554.1, Welding of steel structures.
Stainless steel: To AS 1554.6, Welding stainless steels for structural purposes.
Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not use butt joints relying on the filler metal fillet only.

**Filler Metal**

- To AS 1167.1, Filler metal for brazing and braze welding as follows:
- Copper-to-copper: Minimum 15% silver content.
- Copper-to-brass: Minimum 34% silver content.
- Potable water supply: Do not use alloys containing cadmium.

Painting

**Standards**

Painting
AS/NZS 2312 Guide to the protection of iron and steel against exterior atmospheric corrosion.
AS/NZS 2310, Glossary of paint and painting terms
AS 3715-2002 Metal finishing - Thermoset powder coating for architectural applications of aluminium and aluminium alloys

**Scope**

Paint all unprotected metallic surfaces. Exception to factory finished equipment, prefinished surfaces and services concealed in risers or ceiling spaces (unless otherwise specified).

**Equipment and fittings**

- Repair factory finishes if damaged.
- Finish paint factory primed surfaces.

Inclusions: Paint supports, brackets and hangers. Prime uncoated steel in all locations.

**Corrosion Protection**

Protect metallic components from corrosion by factory applied pre finishes or site finishes and by electrical separation of dissimilar metals.

**Colours**

Colours: To AS 2700, Colour standards for general purposes.

Electrical panels and control panels:
- Indoor assemblies: Storm Grey N42
- Outdoor assemblies: Rivergum Green G62
- Internal surfaces: White N14
- Instrumentation panels: White N14

Flues, exhausts and hot surfaces: Aluminium.

**Application**

Standards
General: To AS 2311 Sections 3, 6 and 7.

Protection of steelwork: To AS/NZS 2312 Sections 5, 8 and 10.
Repair of galvanizing: For galvanised surfaces which have been subsequently cut or welded, prime the affected area.

Paint Application
Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint is uniform in colour, gloss, thickness and texture, and free of runs, sags, blisters, or other discontinuities.

Methods: Do not employ spray painting on site.

Completion
Cleaning
After painting, clean plant and adjacent building surfaces. Remove paint marks, oil and the like.

Clean and polish bright metal parts, nameplates and identification markers.

Identification
Mark equipment, electrical wiring, piping conduits and ducts to provide a ready means of identification.

Pipes, Conduits and Ducts
Standard: To AS 1345, Identification of the contents of pipes, conduits and ducts.

Wiring and Terminal Strips
Identify wiring with numbered ferrules at both ends.

Number each terminal of terminal strips.
Numbering system: To match electrical and control shop drawings.

Equipment Identification
Extent: Identify each item by name and identification number.

Contents: Match terminology and numbering system of the contract documents. Number multiple items individually.
Automatic controls, electrical equipment and instruments: Control valves, control dampers, input/output panels, thermostats, pressure switches, temperature and pressure sensors, motor starters, circuit breakers, power isolators, pilot lights, switches, thermometers, pressure gauges and the like.

Components inside electrical enclosures: Starters, relays, timers and the like.

Labels
Terminology and numbering: Match contract drawings and shop drawings.
Select from the following types:

General labels:
- Stencil with black or white lettering contrasting with background.
- For indoor applications only, engraved two-colour laminated plastic, black lettering on white background.
- Exposed areas, engraved and black filled lettering on stainless steel, minimum thickness 1mm.
Main switch and caution labels: Red lettering on white background.

Warning labels and markings:
Danger and warning labels, fire and safety equipment labels: White lettering on red background.

Label edges: If labels exceed 1.5mm thickness, use radiused or bevelled edges.

Minimum lettering heights:
- Major equipment nameplates: 40mm
- Minor equipment nameplates: 20mm
- Main switches: 10mm
- Outgoing electrical functional units: 8mm
- Danger, warning and caution notices: 10mm for heading, 5mm for text.
- Warning notices: 7mm.
- Automatic controls electrical equipment and instruments: 5mm
- Components inside electrical enclosures and control panels: 3.5mm.
- Minor lettering: 3mm

Lettering style: Helvetica medium.

Location: Locate labels so that they are easily seen from normal access adjacent to the item being marked. Do not install labels on components normally removed or replaced.

Exposed locations: Provide durable materials.

Fixing: Use mechanical fixings, at least two pins or screws per 80 mm of label length shall mount all labels. Self-adhesive shall not be permitted. Do not penetrate insulation vapour barriers.

**Completion and Commissioning**

**Pre-completion Submissions**
Prior to practical completion, submit designated documents.

Include warranties, as-built drawings, operation and maintenance manuals, spare parts schedule, commissioning reports, authorities and utilities approvals and electrical safety certificates and the like.

**Warranties**
General: Name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement and duration: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion. Warranty periods to end at expiry of defects liability period unless specified otherwise. 52 weeks warranty and defects liability period.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.
On completion submit a Certificate of Electrical Safety.

As-built Drawings

General
- Maintain current sets of contract drawings and shop drawings on site.
- Progressively record changes to form a record of work as installed.
- Prepare and submit for approval as-built drawings covering all aspects of the work.
- Show dimensions, types and locations of equipment, cables, piping, ductwork pits and markers in relation to permanent site features and other underground services.
- Control documentation to include setpoints and settings of all controls.

Format
- Prints: One bound set A3 size with coversheet and drawings index.
- CAD Files: CD in AutoCAD with drawing index.

Operation and Maintenance Manuals

General
General: Submit operation and maintenance manuals for installations.

Aim: To provide a detailed understanding of the plant and its operation, an aid for training of operators, a reference for fault diagnosis and a framework for preventive and breakdown maintenance.

Authors and compilers: Use personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Subdivision: By installation or system, depending on project size.

Warning and Cautions: Include to emphasise conditions hazardous to personnel or equipment, giving instructions to avoid the hazard. Format to be:

| WARNING: | An examining or testing procedure or practice which must be observed or risk loss of life or injury to personnel. |
| CAUTION: | An examining or testing procedure which must be followed or risk damage to equipment. |

Referenced documents: If referenced documents or technical sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Timing and Quality
Submission: Submit 2 hard copies of manuals and 2 CDs 2 weeks before the date for practical completion for review and to enable the principal's staff to familiarise themselves with the installation. Include provisional record drawings and preliminary performance data.
Final copies: Submit commissioning test reports after practical completion. Provide loose leaf amendments additional or revised data.

**Format**

*Hard copies*
A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled.

*Electronic copies*
- Digitised manual material: Provide all text, tables and diagrams, in Microsoft Word, or jpg or pdf and AutoCAD on CD.

**Training**

**Operation and Maintenance**
Prior to practical completion, explain and demonstrate to the principal's staff the purpose, function, operation and maintenance of the installation.

**Technical Assistance**
During the warranty period, provide technical assistance and advice to the Principal's staff regarding the operation and maintenance of the plant.

**Spare Parts Schedule**

**General**
At least 4 weeks before the date for practical completion, submit a schedule of spare parts necessary for maintenance of the installation. State against each item the recommended quantity, and the manufacturer's current price, including for
- packaging and delivery to site;
- checking receipt, marking and numbering in accordance with the spare parts schedule;
- referencing equipment schedules in the operation and maintenance manuals; and
- painting, greasing and packing to prevent deterioration during storage.

**Commissioning**

**General**
Mechanical and electrical items to be tested to ensure operation in accordance with the drawings and specifications.

**Reports**
Submit reports indicating observations and results of tests and compliance or non-compliance with requirements. Include commissioning data, test results, protection settings, instrument range, instrument relative offsets in AHD (pressure / level measurements) for all equipment and systems, with completed checklists. Include all software.

**Equipment**
Proprietary test equipment calibrated within the last 12 months and labelled shall be used.
Notice
Give notice for witnessing of commissioning tests after commissioning of each system is completed.

Testing
Provide checks and tests including but not limited to
- Complete circuit tests (including control gear and switchgear) of each cable termination, equipment rating, cable rating, protection ratings (fuse/MCB), protection settings of all devices and circuit components.
- Mechanical soundness of all terminations.
- Earth continuity and loop impedance tests.
- Earth resistance tests of earthing electrodes.
- Insulation tests with 1000V megger on all 415V, 500V on all 240V mains, submains, and sub circuit cables, busbars and equipment. Ensure electronic equipment, meters, thermistor relays, VSDs, soft starters and any equipment likely to be damaged under such tests are disconnected from the circuit under test.
- All cables numbered correctly and conforming to the cable numbers on drawings.
- Instrumentation equipment at 0, 25, 50, 75 and 100% of calibrated measurement range.

Starting Up
General: Coordinate programs for starting up of various systems and equipment.

Checks: Before starting, verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, circuit protection or for other conditions which may cause damage.

Tests: Verify that tests, meter readings, and specified electrical characteristics agree with those required by the manufacturer.

Load tests: Carry out simulated and on-line load tests for any standby generators or UPS’s.

Wiring: Verify wiring and support components for equipment are complete and tested.

Starting up: Execute starting up under supervision of manufacturers’ representative in accordance with manufacturers' instructions.

Electrical load balance: Measure phase currents and balance electrical loads.

Electrical insulation resistance: Check that the insulation resistance values are within limits.

Report: Submit a report demonstrating that equipment has been properly installed and checked and is functioning correctly.

Circuit Protection
Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Controls
Calibrate, set and adjust control instruments, control systems and safety controls.

Thermographic Scan
Criteria: Main switchboards and sub assemblies rated >400A.
Notify South East Water superintendent to organise thermographic scan main switchboard of motor control centres, submain cables, distribution boards, final sub-circuits, line isolation transformers to verify normal temperatures during full live load operation.

**Telemetry**

Test site telemetry digital and analog channel inputs to the South East Water SCADA host. Notify the South East Water’s SCADA representative to organise the relevant point listings and confirm the commissioning date.

Documentation: Submit documents to South East Water’s SCADA representative indicating:
- A full list of all digital points as transmitted to the telemetry system.
- The span of analog inputs and applicable ‘0’ datum in metres AHD.

Demonstrate the correct operation of the equipment and wiring, by exercising each plant item input from its source through to the remote SCADA host.

**Vibration**

Notify South East Water superintendent to organise vibration analysis of rotating machinery and associated supports.

**Cleaning**

**General**

At practical completion, clean the following:
- Switch rooms.
- Luminaries.
- Insides of switchboard, switchgear and control gear assemblies, contactors and the like.
  Adjust as necessary.
- Control escutcheons.
- Face plates of services outlets and panels.
Electricity Supply

General

To AS 3000 Wiring Regulations, Victorian Service and Installation Rules - Code of Practice for the connection of Electrical Installations to Supply Mains.

Definitions
Ipsc: The Prospective Short Circuit current that would flow at point in the installation where a connection of negligible impedance is provided across all phases, without a change in supply.

Imsc calculation: The maximum Ipsc for the installation at any time is subject to the supply transformer impedance, cable impedance and voltage drop. The maximum Ipsc determines rms kA rating of protection devices.

Electricity Supply
The electricity supply is 415/240 Volt, three phase, four wire 50Hz with a Multiple Earth Neutral earthing system.

Consumers Mains
Liaise with the Distribution Company for the installation and connection of the consumers mains between the point of supply and the consumers’ main switchboard.

Capacity
Calculate the supply cables size to support the required and nominated future load with a minimum 15% spare capacity.

Services Connections

Utility Requirements
If the utility provider elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed by the utility provider.

Electricity Distribution Company

Distribution Company
Pay for all Distribution Company costs and charges associated with the provision of the permanent electricity supply and connection of the consumer mains.

Distribution Contribution
Ascertain the supply contribution charge required by the Distribution Company.

Distribution Company’s Requirements
If the Distribution Company elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the Distribution Company.
Metering

Electricity Retailer

Pay for all Electricity Retailer costs and charges associated with the provision of tariff meters and metering C.T.’s.

Retailer’s Requirements

If the Retailer elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the Electricity Retailer.

Preferred Retailer

Contact South East Water current electricity retailer to initiate supply connection and metering requirements.

Sites consuming > 160Mwhr / Annum

Energy Australia - Contract ending 31 December 2007

Suite 2, Level 12 Como Office Tower
644 Chapel St
South Yarra
Victoria 3141

1300 856 848
Fax 13 88 58

Sites consuming < 160Mwhr / Annum

Powerdirect - Contract ending 30 June 2008

Complex 1
303BurwoodHwy
East Burwood
Victoria 3151

1300 307 966
Fax 880 566 99
Customer CRN 94285

Unmetered Sites – Within distribution zones

TRU Energy (SP Ausnet zone, formally TXU) 8 628 1001
AGL (Alinta zone, formally United Energy) 1800 655 013
Origin Energy (Citpower zone) 13 21 14
LV Switchboards

General

Cross References

General
Comply with the General Requirements section.

Standards

General
To AS 3439.1 Low voltage switchgear and control gear assemblies - type tested and partially type-tested assemblies.

Interpretations

Definitions
Custom-built assemblies: Low voltage switchgear and control gear assemblies manufactured to order.

Proprietary assemblies: Low voltage switchgear and control gear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.

Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions. Amperages shown on drawings and schedules are rated currents.

Electricity Distribution Company and Retailer

Distribution Company and/or Retailer Equipment
General: Install equipment supplied by the Distribution Company and/or Retailer and provide wiring to complete the installation.

Tariff meter compartment: Install the Retailer's tariff metering equipment in a separated, sealed meter compartment or separate meter panel.
Quality

Inspection

Witness Points
Give notice so that inspection may be made at the following stages:

- Factory assembly completed, with busbars exposed and functional units assembled.
- Assembly ready for factory tests.
- Assembly installed and connected, prior to site tests.
- Commissioned and complete.

Pre-Completion Tests

Production Tests
Carry out the following tests and checks:

- Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment. Operate and functionally test mechanical devices, relays, programmable logic controllers and logic controls, protection, interlocking, metering, indicating and alarm equipment.
- Check C.T. for polarity and connection.
- Conductance testing: Millivolt drop tests on busbar joints.
- Protect solid state devices during testing.
- Check termination and gland provisions to ensure that they are suitable for cables to be installed on site. Mechanically check clamps, fixings and terminations.

Site Tests
Carry out insulation resistance tests on the switchboard assembly after installation and before energisation, to verify the IR readings. Demonstrate ≥1 mega Ohm resistance using 1kV megger, with all submains connected.

Repeat millivolt drop tests on busbar joints where required by the Superintendent.

Protect solid state devices during testing.
Set settings of protection devices.

Contractor’s Submissions

Product Data for Proprietary Assemblies
Submit shop drawings showing:

- Switchboard form.
- Types and model numbers of items of equipment.
- Overall dimensions.
Switchboard general arrangements, plan view, front elevations and cross-section of each compartment and clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.

- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- Locking systems.
- External and internal paint colours and paint systems.
- Construction and plinth details, ventilation openings and gland plate details.
- Terminal block layouts and control circuit identification.
- Busbar arrangements, links and supports, spacing between busbar phases, and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed to AS/NZS 3008.1, Cables for alternating voltages up to and including 0.6/1kV, AS 3768, Guide to the effects of temperature on electrical equipment and AS 3865, Calculation of the effects of short circuit currents.
- Internal separation and form of separation and details of shrouding of terminals
- Labels and engraving schedules.
- Paint colours and finishes.
- Access details.

Switchboard Assemblies

Construction
Provide rigid, ventilated, consisting of panels, doors, or both, giving the designated enclosure separation and degree of protection.

Materials
Internal - Constructed from 2 mm (minimum) Cold Rolled Commercial Quality (CRCQ) mild steel folded and welded construction, powder coated finish.

External – constructed from 3.0 mm 5005 H34 grade aluminium folded and welded construction, powder coated finish.

Degree of Protection
Assemblies for indoor: Minimum IP 52 to AS 1939, Degrees of protection provided by enclosures for electrical equipment (IP Code).

Assemblies for outdoor: IP56 for exterior surfaces and IP41 for interior operating escutcheon.

Fault Levels
Rated short-circuit current: Maximum prospective symmetrical r.m.s. current at rated operational voltage, at assembly incoming supply terminal, excluding effects of current limiting devices. (Imsc).

Separation
Required form: Form of separation and degree of protection subject to application.

Form 3a: Use form of separation meeting Form 3a construction requirements.

Lower forms of separation are acceptable where a number of functional units are contained within separated compartments of the assembly, as follows:
• Moulded case circuit breakers ≤ 200A: Mount ≤ 4 functional units within a common separated compartment.
• Moulded case of miniature circuit breakers rated up to 100 A, connected to circuits for lighting, general purpose outlets and small single or multi-phase electrical accessories: Mount any number of circuit breakers within a Form 1 separated compartment, provided the circuit breakers are mounted on an approved multi-pole busbar chassis assembly, concealed with an escutcheon panel and removable door.

Spare Facilities
Provide space for a minimum of additional circuits and equivalent spare capacity as follows:

Main switchboard: 20%
Sub-switchboards: 25%
Distribution boards: 30%

Mounting
Floor mounted: Assemblies generally.
Wall mounted: Front access assemblies with frontal areas <1m² where space permits.

Connection
Indoor cable entries: Top and bottom, to suit location.
Outdoor cable entries: Bottom only.

Layout
Position equipment to provide safe and easy access for operation and maintenance with adequate clearances at front, rear, sides and overhead.
Optimise functional relationships between items of equipment in laying out the assembly.
Section sizes: Limit dimensions to facilitate transport to final position.
Withdrawable switchgear: Provide for withdrawal without opening adjacent doors.
Locate equipment to permit dismantling or removal without disturbing other equipment or wiring.
Allow space for cable entry and termination.

Form 1 enclosures: Separate into compartments using partitions at 1.8m maximum centres.
Locate cable zones and vertical busbar compartments to provide separate access to the zones and compartments.
Equipment mounting heights above floor to the centre line of the equipment:

- Toggles and handles of circuit breakers, fused switch units and isolators:
  - Wall mounted assemblies: 500-1900mm.
  - Floor mounted assemblies: 200 - 1900mm

- Control switches, indicating lights, meters and instruments on doors:
  - Wall mounted assemblies: 1000 - 1700mm.
  - Floor mounted assemblies: 200 - 1800 mm.

- Push button emergency switching devices: 800 - 1600mm.

Equipment on doors: Set out in a logical manner in functional unit groups, so it is accessible without the use of tools or keys.

Common control equipment: Group common control relays, timers and fuses in a common panel or compartment.

Mounting rails: To AS 2756, *Low voltage switchgear and control gear - mounting rails for mechanical support of electrical equipment.*

**Ventilation**

Provide adequate low level inlet and high level outlet vents at top, sides or rear of switchboards.

Provide mechanical forced ventilations were required air refresh rates exceed natural ventilation.

Cover ventilation openings using non-combustible and non-corroding 1mm mesh complete with replaceable dust filters (where specified) of adequate area.

**Equipment Mounting Trays**

General: Strong enough to support the weight of mounted equipment. Construct using 3mm mild steel plate, 15mm fold on all edges, bolted to switchboard studs.

**Equipment Fixing**

Spacing: Provide sufficient thermal, mechanical and electrical clearance between busbars and equipment to ensure proper functioning.

Mounting: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning.

Installation: For lightweight equipment, use combination rails and proprietary clips.

**Earth Continuity**

Effectively bond equipment and assembly cabinet metal frame to the protective earth conductor. Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

**Lifting Provisions**

For assemblies with shipping dimensions exceeding 1.8 m high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.
Supporting Structure
Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

Wall-mounting
Reinforce at bolt holes. For flush or semi-flush assemblies, provide angle trims of the same material and finish as the enclosure.

Floor-mounting
Provide mild steel channel plinth, galvanized to class Z600, nominal 75 mm high x 40 mm wide x 6 mm thick, complete with fixing tabs to enable vertical drilling. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes using zinc rich organic binder. Bolt channels to structural floor. Provide shimming for levelling. Backfill air gaps with epoxy.

Factory Finishes
Refer to General Services Requirements section.

Cable Entries
Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated without undue bunching and sharp bends.

Group together terminals for each circuit.

Gland Plates
Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Doors
Application: For access to equipment cubicles.

Width: 900 mm maximum.

Door swing: At least 120° - with positive retainer in open position. Door retainer fixed and must not be removable without the use of tools.

Adjacent doors: Space adjacent doors to allow both to open to 90 at the same time.

Construction: Provide single right angle return on all sides and fit resilient neoprene seal to provide the degree of protection and prevent damage to paintwork. All doors exceeding 500 mm in width or 750 mm in height must be provided with internal channel section stiffener. Hanging: Provide corrosion-resistant pintle hinges or integrally constructed hinges to support doors. For removable doors, provide staggered pin lengths to achieve progressive engagement. Provide 3 hinges for doors higher than 1m. Provide restraining devices and opposed hinges for non lift-off doors.
Door hardware: Internal switchboards.

- Doors > 1.5m high - Corrosion-resistant lever-type handles, operating a three point latching system with latching bar.
- Doors <1.5m high - Dual, edge mounted, corrosion-resistant "L" handles.
- Escutcheon doors - Captive, corrosion-resistant knurled thumb screws. Thumb screws secured by 'nutserts' within cubicle body.

Door hardware: External switchboards.

- Doors > 1.4m high – Recessed handles, dual locking, top lock 100 night latch, bottom lock 213 deadbolt.
- Doors <1.4m high - Recessed handles, single lock, 100 night latch.
- Escutcheon doors - Captive, corrosion-resistant knurled thumb screws. Thumb screws secured by 'nutserts' within cubicle body.

Locking: Incorporate Abloy 201 cylinder locks, 5AP100 locking system, keyed alike, Stewarts Locksmiths.

Door mounted equipment: Protect or shroud door mounted equipment and terminals to prevent inadvertent contact with live terminals, wiring, or both.

Drawing pockets: Provide internal pockets for wiring diagrams and circuit schedules.

Earthing: Maintain earth continuity to door mounted indicating or control equipment using multi-stranded, flexible earth wire, or braid of equal cross-sectional area, bonded to the door.

Covers
Application: For access to busbars and directly connected conductors. Maximum dimensions: 900mm wide and 1.5m² surface area.

Fixing: Fix to frames using at least 4 fixings. Provide corrosion-resistant acorn nuts if the cover exceeds 600mm in width. Rest cover edges on the cubicle body or on mullions. Fit resilient neoprene seals to provide the degree of protection required. Do not use interlocked covers.

Handles: Provide corrosion-resistant "D" type handles.

Main Switches

**Switch-Isolator and Combination Fuse-Switch Units**

**Standard**
To AS 3947.3, Switches, disconnectors, switch-disconnectors and fuse-combination units.

**Type**
Poles: 3.

Rated current: To suit unit installed in enclosure.

**Rated Fault Capacity**
Short circuit making capacity: At least the fault level at assembly incoming terminals.
Breaking capacity: At least the rated full load current.

**Utilization Category**
- Circuits consisting of motors or other highly inductive loads: At least AC-23A.
- Other circuits: At least AC-22A.

**Rated Duty**
Uninterrupted in non-ventilated enclosure.

**Operation**
Independent manual operation including positive "ON/OFF" indicator.

**Locking**
Provide for padlocking in the "OFF" position.

**Handles**
Removable only when switch is in open position.

**Construction**
- General: Either
  - totally enclosed; or
  - with full and direct shrouding to fixed live parts of switches and fuses, so that insertion of a screwdriver does not cause faults between phases.
- Shrouding: Effective over range of air break switch positions.

  Incorporate the following:
  - Earthing terminal.
  - Neutral link mounted within unit.
  - Contact position clearly indicated whether cover is in place or not. For fuses mounted in withdrawing carriage ensuring isolation from supply before access to fuses is possible, secondary indication may be omitted.

**Fuse-switch Units**
- General: Provide an extended operating handle, at least 100 mm above the floor, which remains clear of other equipment over the range of positions.

  Fuse links: Isolated when switch contacts are open. Provide 3 phase sets of high rupturing capacity (HRC) fuse links.

**Auto-Transfer Switches**

**Standard**
To AS 3947.6.1, Automatic transfer switching equipment.

**Type**
3 pole automatic type with microprocessing supervisory circuits which initiate and restore the changeover transfer operation.

**Load Side Connections**
Segregate from incoming side.
Circuit Breakers
Comply with Moulded case and miniature circuit breakers, in the Circuit breakers subsection.
Provide automatic circuit breakers.

Contactors
Comply with Contactors, in the Controlgear subsection.

Interlocks
Provide electrical and mechanical interlocks between circuit breakers.

Indication
Provide voltage metering, phase – phase and phase – neutral selection for both incoming supplies.

Manual Operation
Provide control switches to enable manual override and testing of the changeover transfer operation.

External Control Connections
Provide external control connections to mains sensing, generator control, remote alarm annunciator and for remote operation.

Moulded Case and Miniature Circuit Breakers

Type
Fault capacity > 10kA: To AS 3947.2, Circuit Breakers.
Fault capacity <10kA, current rating <100 A: Miniature overcurrent circuit breakers to AS 2184
Moulded-case circuit-breakers for rated voltages up to and including 600V a.c. 250 V d.c. or for
BCA Class 1a single dwellings or Class 2 sole-occupancy units only, AS/NZS 4898, Circuit
breakers for overcurrent protection for household and similar installations.

Mounting
Mount circuit breakers so that the "ON/OFF" and current rating indications are clearly visible with
covers or escutcheons in position. Align operating toggles of all circuit breakers in the same plane.

Utilization Category
Partial or full discrimination required: Type B.

Adjustable Current Settings
General: Provide accessible trip current adjustment.

Labels: Provide labels indicating trip settings.

Trip Settings
Adjustable short circuit trip settings: Set to discriminate with upstream devices using lpsc.

Trip Units
Circuit breakers with interchangeable and integral trip units: Connect so that trip units are not live
when circuit breaker contacts are open.
≥ 250A. Provide solid state protection relay.
≤ 100A. Thermal magnetic fixed setting acceptable.

Trip Unit: Manual reset.
Locking
Provide for locking circuit breakers in the open position.

Clip Tray Chassis
For miniature circuit breakers provide clip tray assemblies capable of accepting single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for unused portions.

Accessories
Rotary handle: Provide "ON/OFF" indication, and override release to open door padlocking facility.

Motor operators: Provide selector switches, controls and indicators.

Auxiliary contacts: Minimum rating 5 A.

Links

Neutral and Earth Links

Terminals
Provide terminals for future circuits.

Links
Configuration: One [1] neutral and one [1] earth terminal must be provided for each spare circuit breaker pole.
Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral and earth links.

Labels: Provide labels for neutral and earth terminals.

Cables > 10mm2
Provide bolts or studs.

Wiring

Wiring
General
For the main circuit supply, provide cable interconnections as follows:

- Minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1, Cables for alternating voltages up to and including 0.6/1kV.
- Use cables with current ratings suitable for the ambient air temperature and for temperature rise limits of equipment within the installation.
- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
- Run cables neatly. Provide slotted PVC trunking with covers sized for future cables or tie at 150 mm maximum intervals using ties strong enough to withstand magnetic stresses created at the specified fault current. Do not use adhesive supports.
To minimise eddy current effects metal cable saddles must not be fitted over single core cables.

- Run cables clear of busbars and metal edges. Fit bushes to all cut outs in sheet metal through which wiring passes.
- Ensure wiring for future equipment can be installed without removal of existing equipment.
- Terminate control cables and motor control circuits in tunnel terminals, use suitable palm type lugs and correct crimp tool.
- All spare cores of the control and instrument cables must be terminated. In addition, 20% spare terminals must be provided for future use.
- Where mixed voltages exist on common terminal rails provide screw down covers on terminals above 32V AC or 115V DC on which a warning notice is displayed to prevent accidental contact by persons during service.
- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables using spiral wrap PVC.
- If recommended by device manufacturers, provide shielded wiring.
- Identify power and control cables at both ends using neat fitting ring type ferrules agreeing with work-as-executed circuit diagrams.

**Recommended wiring sizes where not specified the following shall be observed.**

<table>
<thead>
<tr>
<th>Wiring Type</th>
<th>Recommended Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Wiring</td>
<td>0.50 mm$^2$ stranded (minimum).</td>
</tr>
<tr>
<td>PLC I/O</td>
<td>0.50 mm$^2$ stranded.</td>
</tr>
<tr>
<td>Instrumentation Wiring</td>
<td>0.50 mm$^2$ stranded (twisted pair, individual &amp; overall screen).</td>
</tr>
<tr>
<td>Instrumentation power</td>
<td>Flexible cord to AS 3191.</td>
</tr>
<tr>
<td>CT Secondary Wiring</td>
<td>2.50 mm$^2$ stranded.</td>
</tr>
<tr>
<td>General Power Wiring</td>
<td>2.50 mm$^2$ stranded.</td>
</tr>
</tbody>
</table>

**Cable Colours**

- A phase: Red
- B phase: White
- C phase: Blue
- Neutral: Black
- Earthing: Green-yellow
- Control, LV VAC: Grey
- Control Neutral, LV VAC: Black
- Control ELV: Violet
- Control Neutral ELV: Violet
- Instrumentation (Screened) Positive: White
- Instrumentation (Screened) Negative: Black

**Cable Number Identification**
**Terminations**

**Types**

Connection to circuits ≤ 16 mm²: Provide DIN-type tunnel terminal blocks.

Connection to circuits > 16 mm²: Provide stud-type terminals > 5mm diameter, sized to continuously carry the load.

Cables > 70 mm²: Stud type terminals, fixed to a DIN-type or G rail.

Tunnel terminals: Provide insulated sleeve ferrules to flexible cables terminated in tunnel terminals.

Type: Screw-tightened, clip-on, 35 mm DIN-type, flexible, non-flammable and, as a minimum, suitable for the insertion of a screwdriver blade.

Shrouded terminations:

- Form 4 separation (where specified) : Polycarbonate solid sheet rigidly fixed into position, with cable cut-outs to underside.
- Degree of protection: IP2X minimum.

Location: Locate terminals to provide access for connections to outgoing terminations.
Mounting rails: Screw or rivet mounting rails to assembly ≤ 500 mm centres. Provide sufficient length to accept a further 20% terminals.

Arrangement: Terminate internal wiring to one side of the terminal block, leaving the other side for outgoing circuits.

Grouping: Provide separate terminal groups for final sub circuit, control and instrumentation wiring. Provide oversized barriers between each group of terminals having different voltages and terminal size.

- Terminals for power wiring: 3 phases or single phase and neutral.
- Control terminals: In alphabetical or numerical order of wire identification, with the lowest number or letter next to the power terminals.

Marking: Number terminals individually to match as-built drawings.

Identification: Identify cables at both ends using neat ring-type ferrules.

Switchgear Accessories

Circuit Breaker Integral Protective Relays

General
Provide integral protective relays which provide for tripping in the event of relay operation, and for manually resetting. Provide operation indicators with a set of change over voltage free alarm contacts, for connection to an alarm circuit.

Mounting
- Integral type: Readily accessible for viewing and adjustment with doors and covers in position.
- External type: Flush.

Residual Current Devices

Integral Type
Standard: To AS 3190 Approval and test specification – residual current devices (current-operated earth leakage devices)

General: Where shown incorporate earth leakage in circuit breaker protection operation.

Mounting: Comply with Moulded case and miniature circuit breakers, in the Circuit breakers subsection.

Tripping
Residual current classification: Type II.

Maximum tripping current: 30 mA.
Fuses With Enclosed Fuse Links

Standards
To AS 2005, Low voltage fuses - fuses with enclosed fuse-links.

- Part 10 - General requirements.
- Part 20 - Supplementary requirements for fuses for use by authorised persons (Fuses mainly for industrial application) - common requirements.
- Part 21.1 - Fuses with fuse-links with blade contacts.
- Part 21.2 - Fuses with fuse links for bolted connections.
- Part 29 - Supplementary requirements for fuses for use by authorised persons (Fuses mainly for industrial applications) - Standardised fuses with compact dimensions.
- Part 40 - Supplementary requirements for fuse - links for the protection of semi-conductor devices.

General
General: Provide fuses suitable for the fault level at the assembly, and which discriminate with other protective equipment.

Let-through energy and peak cut-off current: To suit protected equipment.

Fuse-holders
Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Unenclosed Fuses
Not permitted.

Fuse Links
Type: Enclosed, high rupturing capacity type mounted in a fuse carrier. If necessary for safe removal and insertion of the fuse carrier, provide extraction handles. Mount on clips within the spares cabinet.

Identification: Clearly indicate Australian manufacturer or distributor.

Busbar Mounted Fuse Holders
Provide fuse carriers with retaining clips, minimum fuse holder 32 A.

Spares
Provide 3 spare fuse links for each rating of fuse link on each assembly. Mount spares on clips within the spares cabinet.
Control Gear

Contactors

Standard
A.c. and d.c. contactors: To AS 3947.4.1, Contactors and motor-starters electro mechanical contactors and motor starters.

Type
Block type, air break, electro-magnetic.

Poles
Number: 3.

Minimum Rated Values
Rated operational current: Full load current of the load controlled.

Rated duty:
- Motors: Intermittent class 12 per hour.
- Heater banks: Intermittent class 12 per hour.

Mechanical durability: 10 million.

Utilization category:
- Motors: AC-3.
- Heater banks: AC-1.

Contacts life: 1 million operations at AC-3.

Co-ordination with short-circuit protective devices: Type 2.

Interconnection: Do not connect contactors in series or parallel to achieve ratings.

Auxiliary Contacts
General: Provide auxiliary contacts with at least one normally-open and one normally-closed pair of contacts with rating of 6 A at 240 V a.c.

Utilization category: AC-3.

Slave relays: If the number of auxiliary contact required exceeds the number which can be accommodated, provide separate slave relays.
Mounting
Mount with sufficient clearance to allow access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Alternating Current Motor Starters
Selection
Provide direct-on-line starters for constant speed drives unless regulatory, standby generator limitations, hydraulic, process or starting currents preclude their use.

Select motor starters in accordance with AS/NZS 3000 and Victorian Service and Installation Rules clause 2.7.

Characteristics
Rated operational current: The full load current of the motor nameplate.

Rated duty: Intermittent class: 12 per hour.

Utilization category: AC-3.

Mechanical durability: 3 million.

Control
Provide an individual circuit breaker, fuse combination unit or fuses for each starter, rated to carry the greater of the locked rotor current or maximum permissible current of the equipment.

Direct-on-line Starters
Standard: To AS3947.4.1 Contactors and motor starters - electromechanical contactors and motor-starters.

Type: Direct - switching electromagnetic contactor.

Overload protection: Thermal overload unit giving overload protection in each phase of supply.

Variable Speed Drive Controllers
Power Supply
Where required by controller manufacturer for drives >55kW, provide high speed semi conductor fuses.

Motor Protection
General
Provide over-current protection as part of the equipment assembly for each motor starter.

Short-circuit co-ordination: Type 2 to AS 3947.4.1.
**Single Phase Motor Protection**
Comply with *Thermal overload protection relays* and provide overload units matching the motor heating curve characteristics.

**3 Phase Motor Protection**
All motors: Thermal overload protection and phase failure protection for each motor.

Standard: To AS 3947.4.1, *Contactors and motor-starters - electromechanical contactors and motor-starters*.

Constant speed motors $\geq 22$ kW and variable speed motors $\geq 0.55$ kW: thermistor protection relays.

Motors $\geq 55$ kW: programmable electronic motor protection relays or protection incorporated within electronic motor starter.

**Thermistor Control Units**

Thermistor control unit: Compatible with thermistors installed in each phase winding of the motor.

Contractor submission: Provide evidence of compatibility of thermistors and protection units.

Contacts: Provide at least one normally-open and one normally-closed set of contacts rated at the starter control circuit voltage and minimum 4A. Connect contacts to open the starter at the setting temperature.

Protection type classification: TP2

Utilization category: AC-11.

- Arrange the circuit so that thermistor failure, failure of other control systems components, or excessive winding temperature, causes the motor circuit to trip.

Indication: Provide Light emitting diode on the thermistor control unit, to indicate that circuit is in normal operating mode, warning of impending trip, and tripped.

**Control and Test Switches**

**Standards**
To AS 3947.5.1, Electro mechanical control circuit devices, and AS 3947.1, Low voltage switchgear and control gear - general rules.

**Rated Operational Current**
Utilization category: AC-22 to AS 3947.1.

**Degree of Protection**
At least the degree of protection for the assembly.

**Push-buttons**
Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm.
Rated operational current: At least 4 A at 240 V A.C. inductive.

Emergency stop push buttons: Mushroom head latching type.

Marking: Identify functions of each push-button. For latched "STOP" or "EMERGENCY STOP" push-buttons, state instructions for releasing latches.

Colour code: To AS 3947.5.1, Electromechanical control circuit devices.

Illuminated push-buttons: Comply with Indicator lights, in the Measurement accessories subsection.

**Rotary Switches**

General: Cam operated type with switch positions arranged with displacement of 60°.

Off position: Locate at the 12 o'clock position. Test positions must spring return to off position.

Rated operational current: At least 6 A inductive at 240 V A.C.

Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

**Proximity Switches**

To AS 3947.5.2, Proximity switches.

**Indications and Meters**

**Ammeters**

Type: Analogue or digital.

Overscale: For ammeters subject to motor starting currents, overscale to at least 5 x full load current.

Selector switches: 4-position type with positions designated "R/W/B/OFF". Mount under or next to relevant ammeters.

**Voltmeters**

Type: Analogue or digital.

Selector switches: 7-position voltage transfer type for measurement of phase-to-phase and phase-to-neutral voltages with off. Mount beneath relevant voltmeters.

**Hours-run Meters**

6 digit (minimum) dial with last digit read-out in 0.1 hour increments.

Scale: Horizontal linear digits.
Indicator Lights

Standard
  To AS 3947.5.1, Electromechanical control circuit devices.

Degree of Protection
  At least that of the assembly/operating face.

Type
  Domed glass or heat resistant plastic lens and black bezel.

Performance
  – Rated lamp life 20,000 hours.
  – Indication clearly visible from side or front at 15 metres in normally illuminated plantroom.
  – All colours to have equal brightness.

Neon Indicators
  240V, 12mm diameter with in-built resistor.

LED Indicators
  12 or 24V, nominal 12 mm diameter.
  Clustered LED's: Encapsulated with current limiting resistors and voltage regulators.

Lamp Test Facility
  Provide individual push-to-test or common test circuit.

Spares
  Provide 3 spare lamps and one lamp extractor. Mount on clips in spares cabinet.

Control Relays

Standards
  To AS 3947.5.1 Electro mechanical control circuit devices and AS 2481, All or nothing electrical relays (instantaneous and timing relays).

Auxiliary Relays
  Selection: Suitable for continuous operation.
  Mechanical life: 10 million operations.
  Type: Plug-in interchangeable.

Construction
  Latch plug-in types to receptacle bases using captive clips which can be applied and released without using tools.
  Contact elements
  Type: Electrically separate, double break, silver alloy, non-welding contacts.
Utilisation category:
- Alternating current: AC – 15
- Direct current: DC - 13

Configuration: For standard relays, provide assemblies with at least 2 sets of contacts. Provide at least one normally-open and one normally-closed contact, circuit dependant.

Incorporate light emitting diodes indicating energisation states of relays.

**Time Delay Relays**
Characteristics: As for auxiliary relays.

Timer range: Adjustable over the full timing range with timing repeatability within ±12.5% of nominal setting.

Timers: Preferably electronic.

**Phase Failure Relays**
General: Provide separate solid-state phase failure relays which release at
- 85% of normal voltage; adjustable hysteresis
- single phase failure; or
- reverse phase sequence after an appropriate time delay.

Sensing circuit: Rejects induced voltage spikes, and disturbances with frequencies other than 50Hz.

Back-up protection: Provide high rupturing capacity fuses to each phase.

**Extra-Low Voltage Transformers**

**Selection**
- Primary and secondary windings wired out on opposite sides of transformer case.
- Primary and secondary windings separated by means of an earthed screen wired out to an insulated terminal.
- Output loading 80% of transformer continuous rating, taking account of degree of ventilation and ambient temperature within assembly, and supplied load.

**Installation**
One side of the secondary winding and the metal screen shall be connected to earth.
Anti-Condensation Heaters

General
Rating: Provide heaters rated at not less than 20 W/m$^2$ of total external area including top of weatherproof enclosure.

Type: Black heat type which may be touched without injury, mechanically protected and thermostatically controlled.

Transient Protection

Standards
ANSI/IEEE C62.41, C62.45

Primary Protection
Provide surge protection unit utilizing dual redundant shunt connected metal oxide varistors at incoming supply terminals.

- Maximum surge current 200kA
- Lines protected L-L, L-N, L-G, N-G
- LED indication representing protection status and surge event
- Remote contact output representing surge event.

Cables
- Maximum length between main circuit supply active and associated fuse, isolator, arrester, neutral and earth conductor connections: 1 m.
- Maximum length between earth conductor and earth grid/electrode system: 5 m.
- Minimum cable size: 6 mm$^2$, stranded, green/yellow PVC insulated cable installed such that it is segregated from all other cables.

Tools and Spares Cabinet

General
General: Provide a spares cabinet with nameplate, labelled shelves and non-lockable door. To accommodate racking handles, special tools, spare lamps, spare fuse links and other equipment necessary for operation of the assembly.

Location: Either
- incorporated into assembly enclosure; or
- wall mounted in main switchroom.
Finish: To match assembly.
**Danger, Warning and Caution Notices**

Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch, and on rear covers, indicating that busbars are not insulated. “Danger-Live Bars Behind”.

Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match as-installed fuse link ratings, make and characteristics. Provide separate label stating fault current limiting fuse ratings.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti-condensation heaters.

Custom-built assemblies: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units, and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.
Wiring and Accessories

General

Comply with General services requirements section.

Quality

Pre-Completion Reports

Site tests

Insulation resistance tests to AS/NZS 3000: Australia/New Zealand wiring rules

Cable systems: before energisation, or for equipment with electronic components – before connection.

Submissions

Cable routes

Submit details of the following:

- Sub-main cable routes including dimensions.
- Spacings of cast in insitu conduits near switchboards and in congregated areas.
- Structural penetrations for cabling and ducting.
- Underground conduit routes and cable marker positions.
- Earthing positions a cable routes.

Electrical Cable Sizing

Calculate cable rating and voltage drops based upon actual cable lengths and selected make of cables. Allow for standby plant and future demand as indicated within the Electrical Scope of Works Specification. Take into consideration installation conditions and external influences, short circuit fault levels and ratings of protection equipment.

Standard: To AS/NZS 3008.1 Cables for alternating voltages up to and including 0.6/1kV.

Amend cable sizes or installation to suit. Submit amended selections for review.

Cable Sizing calculations

General: If cable sizes are not given, submit calculations of current ratings and voltage drop.

Standard: To AS/NZS 3008:1 Cables for alternating voltages up to and including 0.6/1kV.

Wiring Systems

Selection

Provide the following main and submain systems:

- Main and submain cables in electrical switchrooms and plantrooms on cable ladders.
- Submain cables on cable trays or ladders.
Provide the following systems for final sub-circuits:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Plant rooms: Unsheathed cable in heavy duty UPVC conduit, on spacer blocks.
- Buried in ground: PVC cables in heavy duty UPVC conduit.

**Installation**

**Standard**
Fire or mechanical damage: Classifications to AS 3013.

**Configuration**
Laid single core cables in trefoil.

**Straight-through joints**
Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

**Cable joints**
Locate in accessible positions in suitable junction boxes.

**Extra-low voltage circuits**
Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

**Conductor colours**
General: For fixed wiring, use coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Sheath for small power subcircuits: Black

Sheath for lighting subcircuits: White

**Tagging**
Identify multicore cables and trefoil groups at each end using stamped non-ferrous tags clipped around each cable or trefoil group.
Identify each cable as per South East Water standard drawing SEWL-STD-037, destinations.
Earthing

General
Provide earthing system incompliance to AS/NZS 3000 Wiring Rules and Victorian Services and Installation Rules.

Main Earth
A main earth bar, which maybe included in the switchboard, shall be provided for the installation. All cables connecting to the main earth bar shall be labelled according to their function. Where connection points to the floor slab reinforcement are made available, these shall be connected to the main earth bar of the installation. In situations where metallic pipework is accessible, both the suction and delivery pipework shall be individually connected to the installation main earth bar.

Earth Rods
Each earthing rod must be a minimum 16 mm stainless steel copper clad rod with a minimum length of 3.0 m. Each earthing cable must be provided with a PVC sleeve. Bare earthing conductors must not be used. All earthing cable connections to earthing rods must be by means of approved earthing clamps. Provide earth inspection pits at each rod. Each pit must be marked for easy identification.

VSD Earthing
Where variable speed drive fed motor cables are installed, the VSD manufacturers’ installation recommendations shall be followed. This will typically include grounding of the cable at both ends, the use of braided earth straps between the VSD and the earth bars, the use of screened cable with appropriate earthing rings and metallic glands.

Power Cables

Selection
Conductor material
Provide cables with high conductivity multi-stranded copper. Do no provide aluminium cables.

Standards
- Building wires and double insulated PVC/PVC cables: To AS 3147 Electric cables – thermoplastic insulated – for working voltages up to and including 0.6/1kV.
- Double insulated XLPE/PVC cables: To AS 3198 Electric cables – XLPE insulated – for working voltages up to and including 0.6/1kV.
- Flexible cords: To AS 3191 Electric flexible cords.
- Control and protection cables: To AS 2373:1 Electric cables for control and protection circuits – multi-core control cables.
- AS 2373:2 Electric cables for control and protection circuits – twisted pair control cables.
- Appendix E, and AS 3013, Classification of the fire and mechanical performance of wiring systems.
Cable sizes
Sub-mains: 6mm² minimum.

Cables supplying motors: Rated as follows:

- Motors ≤150kW: 150% of motor full-load current; minimum size of 2.5 mm² for building wires and PVC/PVC, or MIMS cables.
- Motors > 150kW: 125% of motor full-load currents.
- Control and protection circuits to AS 2373:1: 1.5mm² minimum.

Sub-circuit cables: Increase size where necessary for reasons of voltage drop or de-rating to AS 3008.1 and AS 3000.

- Lighting sub-circuits: 2.5 mm²
- General purpose power sub-circuits: 2.5 mm²
- Emergency and exit lighting sub-circuits: 2.5 mm²
- Instrumentation: 0.5 mm² individually and overall-screened cable
- Control circuits including alarms etc: 1.5 mm² multicore
- Flexible cords: 30/0.25 mm²

Terminations

Copper Conductors

General
Provide suitably sized lug unless the equipment (circuit breaker, contactor or thermal overload or field device) has tunnel type terminals and the conductor size is larger than 2.5mm². Compress using the correct tool or use soldering.

Within assemblies and equipment
General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

- Alternative: run cables in UPVC cable duct with fitted cover.

Identification ferrules: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.
Wiring Enclosures and Cable Supports

Conduits

General
Conduit may be either steel or PVC subject to the following requirements:

- Conduit on a surface exposed to mechanical damage: Galvanised steel conduit
- Exposed external conduit: Galvanised steel or UV stabilised PVC.
- Conduit cast into concrete, run in chases or concealed areas: PVC conduit may be used. Light duty rigid PVC conduit may be used in areas where not subject to the risk of mechanical damage.
- Conduit buried in ground: Heavy duty UPVC conduit.
- Plant areas: Provide spacer blocks, minimum heavy-duty uPVC, galvanised steel where exposed to mechanical damage.

Minimum sizes
Metallic and non-metallic conduits: 20mm.

Rigid conduits
Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings. Remove sharp edges prior to drawing-in wires.

Flexible conduits
Run fixed wiring to motors and appliances requiring flexible connections in rigid conduit to a junction box adjacent to the item of equipment, and from there in flexible conduit to the equipment. Provide flexible conduit connections <600mm in length.

Galvanising
If installed in damp locations, galvanise mild steel wiring enclosures and support systems.

Set out
If exposed to view, install conduits truly vertical or horizontal and in parallel runs with right angle changes of direction.

Inspection fittings
Provide in accessible locations.

Draw cords
General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.
Material: Polypropylene cord, or insulated stranded earth wire, 2.5mm² minimum size.

Draw-in boxes
General: Provide draw-in boxes in accessible positions and at intervals not exceeding 30m in straight runs, and at changes of level or direction. Provide draw-in boxes no greater than 7.5 m apart for vertical lengths of conduit runs.
Underground draw-in boxes: Provide gasketted covers and seal against moisture.
Bends and elbows

Bends: Make with easy sweeps. Provide bends of 90° with a radius of not less than three times the external diameter of the conduit, without mechanical stress sufficient to cause deformation. Limit the number of 90° bends between boxes in any conduit run to 2. Solid elbows not permitted.

Conduit saddles and brackets

Space conduit saddles a maximum of 1200 mm apart for metallic conduit and 1000 mm apart for non-metallic conduit. In areas subject to high ambient temperatures or other severe duty, maximum saddle spacing for non-metallic conduit 500 mm.

Where two or more conduits are run in parallel they may be grouped. Provide suitable surface brackets where conduits cannot be fixed.

Metallic Conduits and Fittings

Standards
Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.
Galvanised water pipe: Medium or heavy, to AS 1074.

Type
Screwed steel.

Corrosion protection
For steel conduits, paint ends and joint threads with zinc rich organic binder to GPC-C-29/16.

Expansion joints
General: Provide flexible couplings consisting of flexible conduit and fittings, at

- structural expansion joints; and
- in long straight runs if the ambient temperature varies by more than 40°C.

Conductivity: Maintain electrical conductivity between the two ends of rigid metallic conduit.
Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

Sets and bends
Make sets and bends cold with bending machines in such a manner that there is no damage to or distortion of the conduit. In locations where it is not practicable to use sets for changes in direction, make such changes by the use of screwed fittings.

Non-Metallic Conduits and Fittings

Standards
Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Conduits in roof spaces
Locate below roof insulation. In accessible roof spaces, provide mechanical protection for light-duty conduits.
Conduits in slabs
High compression corrugated conduit, restrain at regular intervals to achieve a nominally straight run.

Category A conduit
Direct buried installations: Category A conduit, use protective cover strips and corrugated conduit.

Sets and bends
Form with a spring or other device inserted in the conduit to prevent distortion of the walls. The forming of conduit bends using heat from a naked flame or similar method which may damage or deform the conduit will not be accepted.

Associated fittings
Type: The same type and material as the conduit. Provide standard manufactured bends for all PVC conduits of larger than 25 mm diameter.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

Inspection fittings
Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints
Type: Cemented or snap on joints.

Expansion couplings: If encased in concrete, do not provide bellows type.

Cable Supports
System
Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories. Fabricate brackets, racks and hangers from structural steel sections or other materials in sections of equivalent strength. Maintain earth continuity of the entire cable support system.

Manufacture
Use proprietary trays, ladders and accessories from a single manufacturer in the same application.

Cable trays
Materials:

- Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
- Exterior: Hot dip galvanised steel.

Minimum steel thickness:

- Trays < 150mm wide: 1 mm.
- Trays > 150mm, < 300 mm wide: 1.2 mm.
- Trays > 300mm wide: 1.6 mm.
- Folded edge > 19mm deep and radiused.
Perforations: To Admiralty pattern, reverse stamping.

Accessories: Use fish plates or splines for tees, crosses and joints.

**Cable Ladders**
General: Use 2 folded steel or extruded structural grade aluminium side rails minimum 75 mm deep with cable support rungs between the rails and complete with requisite bends, risers, tees, reducers, splicers fixing brackets, supports, hangers and the like.

Steel ladders: Galvanised.

Rung spacing: 300mm maximum.

Small cables: Run cables less than 13mm diameter in cable trays or ducts.

Structural sections:
- Angles and bars: 6.5mm minimum thickness.
- Rods: 10mm minimum diameter.

**Single Spine Cable Trays or Ladders**
Provide cable trays with central supports and twin cantilevered trays to facilitate side loadings of cables.

Maximum width: 400mm each side.

Central support: Resistant to asymmetrical loadings.

**Fixing to building structure**
General: Install parallel to walls, floors and ceiling lines. Fix supports to the building structure or fabric by means of direct fixing, hangers or brackets.

Spacing: Space supports at maximum intervals of 1.5 m for trays and 3 m for ladders.

**Access**
Provide a minimum of 150 mm free space above and 600 mm free space on one side of trays and ladders.

**Cable fixing**
Provide slats or rails suitable for fixing cable ties, strapping or saddles.

**Bend radius**
Provide bends with a minimum inside radius of 12 times the outside diameter of the largest diameter cable carried.

**Cable protection**
Provide rounded support surfaces under cables where they leave trays or ladders.

**Cable strapping**
Provide steel straps on MIMS cables.

**Minimum clearances**
Hot water pipes: 200mm.
Boilers or furnaces: 500mm.

**Penetrations**
Where trays or ladders pass through ceilings, walls and floors, provide neat, close fitting apertures.

Where these penetrate fire rated structures, terminate the ladders either side of the opening.

**Expansion joints**
Building expansion joints: Install not to resist relative movements of building sections.

**Underground Services**

**General**

**Standards and rules**
To AS 3000 and all other relevant Australian Standards and to the requirements of the Electricity Distribution Company, Victorian Services and Installation Rules and other relevant local authorities.

**Cables and Conduits in Trenches**

**Sand bed and surround**
Provide clean sand under and around cables and conduits installed underground. Clear the bottom of the trench of all rocks, stones and other hard and sharp materials. Fill the trench to a depth of 50mm with a layer of selected filling prior to cable placement.

**Sealing ducts and conduits**
Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation. Seal the ends of conduits entering the building with expanding foam to prevent moisture and vermin entry. Seal the joints of all conduits or pipes enclosing PVC/PVC and XLPE/PVC wiring with approved PVC jointing compound.

Water proofing: Provide puddle flanges around conduits where they pass into cable pits. Install bell mouth accessory on end of conduit located within wall of pits and flush with inside surface of pits on conduits > 100mm dia.

**Pipe ducts and conduits**
Bedding: 50 mm compacted depth, compacted fill and extending the full width of the trench.

Layout: Avoid sharp bends and locate drawing in points above ground.

Cleaning: Swab clean before installing any cables.

Marking: Provide PVC marker tape 200 mm above wiring system.

**Protection**
Provide additional mechanical protection where cable leaves the ground to a height of 500mm above the finished ground surface.
Cable Pits

General
Sizes: Minimum 600 x 600mm. Allow for turning of cables at above the minimum acceptable bending radius.
Location: Provided at every major change in direction of a pipe duct and conduit, or at 100 m minimum intervals on long straight duct and conduit routes.
Cable support: Use galvanised iron brackets to separate layers of cables in the pit.
Slack cables: Leave maximum length of slack cables in pits to cater for future alteration.

Proprietary cable pits
For pits < 1.2 x 1.2 m, provide proprietary concrete or polymer moulded pits.

In situ construction
For pits ≥ 1.2 x 1.2 m, select from the following:
- Proprietary cable pits.
- Construct walls and bottoms from rendered brickwork or 75 mm thick reinforced concrete.
  Incorporate a waterproofing agent in the render or concrete. Minimum wall thickness as follows:
  - 100 mm for double boxed reinforced pit
  - 123 mm for double boxed un-reinforced pit
  - 150 mm for single boxed un-reinforced pit

Pit covers
General: Provide pit covers to suit expected loads of pedestrian or vehicular traffic in the location in which it is installed. Fit flush with the top of the pit. Use reinforced concrete or load carrying "Gatic" type or similar.
Standard: To AS 3996.
Maximum weight: 40 kg for any section of the cover.

Drainage
General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system.
Absorption trenches: Minimum size 300 x 300 x 2000 mm.

Underground Cable Routes

General
Provide all changes in grade or direction in easy stages, and bends with a radius of not less than fifteen times the conduits overall diameter.

Survey
Accurately record the routes of underground cables before backfilling. Accurately plot conduit routes, pits, junction boxes, etc., and note levels of ducts at the following points:

- Changes in direction.
- Entry and exit from structures.
- Changes in depth.
Lighting and Socket Outlets

**Lighting and Socket Outlets**

**General**
Supply and install all lighting, socket outlets and connections complete with fixings and fastenings.

**Standards**
- General: To AS 3137.
- Ventilation: To AS 3137 Category A
- Road lighting luminaires: To AS 3771.
- Radio interference limits: To AS/NZS 4051.
- Quality assurance: To AS 2990 Category B.

**Lighting and Socket Outlet Switches**

**General**
Use switches of the rocker type designed for inductive and fluorescent lighting loads generally flush wall mounted.

- Multi switch: Ganged under one cover plate.
- Location: On the latch side of doors and door swings.
- Minimum rating: 15 A, 240V A/C.
- Indicators: to be visible with switches “on”.

**Construction**
- Face plates: High impact polycarbonate construction or metal.
- Protected and weatherproof: Non-corroding metal or polycarbonate enclosures.

**Location**
- Mounting heights: To the centre of the equipment.

**General Purpose Outlets**

**General**
Use power outlets of the same manufacture as the switches.

- Outlets: Combination rocker switch/socket type flush wall mounted.
- Socket outlets: Mount outlets with the earth pins in the 6 o'clock position.
Double outlets: Under one flush plate.

Plugs: Provide with outlets of greater rating than 10 A 250 V.

3 Phase Outlets

Minimum rating
20 A, 500 V A/C.

Pin arrangement
Five round pins mounted with earth pins at the 6 o'clock position, neutral pins in the centre, and the red, white and blue phases in a clockwise sequence when viewed from the front of the outlet.

Construction
Surface mounted type of high-impact resistant plastic, with flap lid on the outlet.

Luminaires

General
Mount luminaires on proprietary supports using battens, trims, noggings, roses and packing material, as necessary.

Levelling
Adjust the length of suspension rods or chains so that the lighting system is level and even. Tolerance: ± 3mm.

Suspension
Chains: Electroplated welded link chain.

Surface mounted luminaires
General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Use 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

Emergency and Exit Lighting

Standards
Accordance with the requirements of the Building Code of Australia with applicable State or Territory amendments.

Emergency and exit lighting where required shall be designed and installed in compliance with Australian/New Zealand Standard AS/NZS 2293 – Emergency Evacuation Lighting for Buildings.
Construction

Luminaires shall be manufactured and fully tested to AS/NZS 2293 and be self contained, single point type complete with nickel cadmium batteries with dual rate battery charge, test button and battery charging LED. Battery capacity to deliver code lighting for 90 minutes.

Unless otherwise specified emergency luminaires shall be of the maintained type and exit luminaires shall be of the two lamp sustained type. Luminaires subject to water, dust or insect penetration shall be rated at IP65.
Instrumentation

General

Comply with General services requirements section

Installation

Equipment arrangement: Instruments to be arranged so that adjustments can be readily made in the field. Permanent access must be provided for all field indicators, transmitters and analysers.

Field: Mount instruments within enclosures providing the following degree of protection.
- IP 56 minimum for all equipment above the ground
- IP 67 minimum for all equipment in the pits, e.g. valve pits,
- IP 68 for the equipment subject to submergence.

Mount instruments collectively on common instrument gear tray. Tray to be constructed from 3mm mild steel, Powder coated White N14, 15mm folded edges on all sides.

Plant room: Mount instruments collectively on common instrument gear tray. Tray to be constructed from 3mm mild steel, Powder coated White N14, 15mm folded edges on all sides.

Piping

Provide pipe unions, isolation valves, test and drain points to enable removal or in situ calibration of in line instruments with screwed connections such as pressure transmitters switches, and gauges, rotameters etc.

- All small bore fittings shall be Swagelok gaugeable fitting.
- All threaded joints shall be BSP threads. NTP threading, BSB tapered and BSP parallel threading may be required for connection of some components.
- All cock valves shall be Swagelok quarter turn ball valves. All needle valves shall be Swagelok screwed bonnet needle valves.
- All piping and tubing shall be done in hard drawn copper or flexible nylon tubing. Flexible nylon tubing shall be rated to 1.5 times the maximum measurement value and be fitted with Swagelok gaugeable fittings

Identification

All equipment and instruments must be identified by means of corrosion resistant tags permanently affixed adjacent to the instrument by means of stainless steel screws or rivets.

Transmission

All transmitters shall be capable of transmitting the output signal by loop powered 4-20mA analogue current loop. The output signal shall be linear with a proportional increase in measured variable. Transmitter shall be HART protocol compatibility.

Each transmitter shall be fitted with a configurable local indicator. The indicator shall be integral with the transmitter assembly. It shall be possible to configure the local indicator to display the measured value in engineering units.

Surge Protection

Provide lighting surge protection to instrument loops > 5m installed in field locations.

Direct mount the protection device on the instrument or install modular protection
enclosed in a cubicle within 1m of the instrument. Provide modular protection at the PLC, RTU, receiving device loop.

Protection: Multi stage, line to line, each line to screen/ground, 10kA max discharge surge current.

Measurement Guidelines
If not specified by the Principal, the Contractor shall select the most appropriate instrument to be installed having due regard to the process environment and conditions. All instruments to be installed shall be in accordance with the Principal’s standards and shall be subject to the approval of the Superintendent.

Accuracy
Unless otherwise specified, all instruments shall have a measuring accuracy of ± 0.5% of range.

Calibration
Conduct calibration of instruments against a reference instrument, test pressure or standard. Calibrate instrument at 0, 25, 50, 75 and 100% of nominated range. Provide a calibration report for each function indicating instrument uncertainty, error and adjustment. Calibrated measurements are to be compared against the manufacturer’s specification. Provide manufactures calibration certificates stating the instrument compliance against the instrument specification.

Ranges
Unless otherwise specified the proportional 4-20ma range of the instrument shall be form zero (0) to 1.5 times the expected maximum measurement value.

Instrument Zero Reading
Provide instrument zero readings referenced to a known relative level. Relative levels include cover level, bottom level, pipe centre line or invert level.
Telemetry

General

Comply with General services requirements section

Arrangement

South East Water adopts a either 450 or 850MHz frequency radio networks to communicated alarm, status and variable data from remote sites to its telemetry and SCADA host.

Telemetry Software

The site telemetry system utilises software for both telemetry and control routines specific to South East Waters telemetry network. Intimate knowledge of network protocols and concepts are required to program and configure the telemetry system.

South East Waters primary preference is to nominate a software specialist to load and configure the site software outside the installation contract. Alternatively, depending on contract arrangements the contractor shall forward the credentials of a specialist conversant with the system configuration to undertake the works.

Installation

Telemetry Radio Survey

South East Water undertakes radio surveys to determine site to branch station communications. Information concluded from the radio survey determines configuration and type of telemetry equipment. Upon request, equipment specifications shall be provided to the contractor prior to switchboard construction.

Telemetry Aerial

The telemetry aerial shall be Yagi 6 element or whip aerial (of the appropriate frequency), 9 dB gain mounted on top of a 6 meter ground mounted taper pole mast, to AS 1798-1992 Lighting poles and bracket arms, RG213 aerial cable and surge diverter, refer standard drawing SEWL_STD_031. (This arrangement is to be confirmed dependent on the results of a radio survey).

Battery Backup

The telemetry power supply shall be battery backed-up. The battery charger shall be capable of supplying the 150% of the DC load without batteries connected and shall have sufficient capacity to charge fully discharged batteries at a minimum of 5A at 12VDC with a adjusted output of 13.8 VDC.

The battery storage capacity shall be suitably sized to provide 150% of the connected load for a minimum of 6 hours on mains power failure.
Approved Equipment Schedule

Refer to Sewer Pump Station Approved Products List located at:

South East Water – Managing Water Infrastructure